CARRIAGE, HANDLING AND STORAGE OF

DANGEROUS GOODS

ALONG THE MEKONG RIVER

VOLUME I: RISK ANALYSIS

Mekong River Commission

Navigation Programme

Mekong River Commission

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NAVIGATION PROGRAMME

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PREFACE

Inland navigation can contribute to making transport more sustainable, particularly where it substitutes for road transport, but can also have considerable environmental impacts. Increasingly, petroleum products and other dangerous goods are being transported along the Mekong River. If not managed properly, these cargoes have the potential to cause significant pollution and even major incidents such as fires and explosions impacting on riparian communities.

Freedom of navigation is covered in Article 9 of the Mekong Agreement of 1995 which states that the river "*shall be kept free from obstructions, measures, conduct and actions that might directly or indirectly or indirectly impair navigability, interfere with this right or permanently make it more difficult*." While navigation does not have any priority over other uses of the river, the agreement stipulates that "*any mainstream project*" should take navigation uses into account.

The MRC Navigation Strategy formulated in 2002 calls for harmonising and enforcing common rules and regulations on environmental protection and safety measures. It also highlights a strong need for raising awareness of environmental protection and controlling navigation risks. To implement the strategy, the MRC Navigation Programme was formulated in 2003 in close cooperation with the four Member Countries and other regional stakeholders. The development objectives are to promote freedom of navigation and increase international trade opportunities for the mutual benefit of the four countries and to help develop effective and safe waterborne transport that is sustainable and protective of the waterway environment. The Navigation Programme's third component is devoted to traffic safety and environmental sustainability. Immediate objectives are promoting and realising environmental standards for "clean" river transport, balancing environmental consequences of projects against their economic and social significance and ensuring the ecological health of the river is not compromised by navigation developments.

In 2010, the Navigation Programme began a risk analysis on the carriage, handling and storage of dangerous goods along the Mekong. The project was a significant body of work involving local and international experts. National working groups were established to collect data and national staff were trained to identify and evaluate the association risks. Oil spills and industrial waste are emerging threats from storing, handling and carrying dangerous goods along the river. These need to be addressed through regional action plans as well as environmental management and monitoring systems.

Carriage, Handling and Storage of Dangerous Goods Along the Mekong River (Volume I: Risk Analysis) is designed to be an important reference for the MRC, national line agencies, development partners and the private sector. This comprehensive assessment covers risks related to ports and terminals, vessels and waterways as well as the legal framework and environmental factors. It complements the accompanying publication (*Volume II: Recommendations*) which provides a framework to ensure a balance between inland water transport and environmental protection in the Lower Mekong Basin.

Mr Hans Guttman
Chief Executive Officer
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ACRONYMS AND ABBREVIATIONS

ADN	Accord européen relatif au transport international des merchandises dangereuses par voie de navigation intérieure (European Agreement concerning the international carriage of dangerous goods by inland waterways)
ADNR	Accord Européen relatif au Transport International des Marchandises Dangereuses par voie de Navigation du Rhin European (Agreement concerning the international carriage of dangerous goods on the Rhine)
ADR	Accord européen relatif au transport international des marchandises Dangereuses par Route (European Agreement concerning the international carriage of dangerous goods by Road)
AFS	Anti-Fouling Systems on ships
AGN	European Agreement on Main Inland Waterways of International Importance
AIS	Automatic Identification System
ALARP	As low as reasonably practicable
ANSI	American National Standards Institute
API	American Petroleum Institute
AS/NZS	Australian Standard/New Zealand Standard
ASEAN	Association of Southeast Asian Nations
ASME	American Society for Mechanical Engineeers
ASTM	American Society for Testing and Materials
BK2	Bulk Containers
C	Severity of possible consequences
CCNR	Central Commission for the Navigation of the Rhine
CCTV	Closed Circuit Television
CEO	Chief Executive Officer
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMI	Cambodian Maritime Institute
CNI	Cambodia Naval Institute
CNMC	Cambodia National Mekong Committee
CTU	Cargo Transport Unit (container)
CWG	Country Working Group National Counterpart to the NWG at the Mekong River Commission Secretariat

DIN	German Institute for Standardisation
DOT	Department of Transport
DNV	Det Norske Veritas
DG	Dangerous Goods
DGPS	Differential Global Positioning Systems
DO	Diesel Oil
DWT	Deadweight Tonnage
EA	Executive Agency
EBIS	European Barge Inspection Scheme
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EN	European Norm
EP	Environment Programme (of MRC)
EPC	Environmental Protection Commitment
ESIA	Environmental Social Impact Assessment
EUR	Euro (official currency of the eurozone)
F	Frequency
FASRB	Framework Agreement on the Sava River Basin
FO	Fuel Oil
FRTs	Floating Roof Tanks
FSO	Facility Security Officer
FSP	Facility Security Plan
GIS	Geographic Information System
GL	Germanischer Lloyd
GMS	Greater Mekong Subregion
GRT	Gross Register Tonnage
GPS	Global Positioning System
HFO	Heavy Fuel Oil
HNS	Hazardous and Noxious Substances
HSE	Health, Safety and Environment
IBCs	Intermediate Bulk Containers
ICPDR	International Commission for the Protection of the Danube Ribvrt
ID	Identification
IEC	International Electrotechnical Commission
ILO	International Labor Organisation

IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organisation
INE	Inland Navigation Europe
ISGINTT	International Safety Guide for Inland Navigation Tank-barges and Terminals
ISO	International Organization for Standardisation
ISPS	International Ship and Port Facility Security
ISRBC	International Sava River Basin Commission
ISTEA	Industrial Safety Techniques and Environment Agency
IUCN	International Union for Conservation of Nature
IWD	Industrial Works Department
IWT	Inland Waterborne Transport
Km	Kilometre
KO	Kerosene Oil
LAD	Least Available Depth
LCB	Leam Chabang Port
LMB	Lower Mekong Basin
LMRB	Lower Mekong River Basin
LNMC	Lao National Mekong Committee
LOA	Length Over All
LR	Lloyds Register
LPG	Liquid Petroleum Gas
MAWP	Maximum Allowable Working Pressure
MARPOL	Marine Pollution
MDO	Marine Diesel Oil
MEGCs	Multiple-Element Gas Containers
MFO	Marine Fuel Oil
MMPS	Ministry of Military and Public Security
MNFC	Mekong Navigation Facilitation Committee
MSC	Maritime Safety Committee (IMO)
MOGAS	Motor Gasoline
MOIT	Ministry of Industry and Trade
MOSTE	Ministry of Science, Technology and Environment
MOT	Ministry of Tourism (Cambodia)
MOT	Ministry of Transport (Viet Nam)
MoWRAM	Ministry of Water Resources and Meteorology
MPWT	Ministry of Public Work and Transport

MRC	Mekong River Commission
MRCS	Mekong River Commission Secretariat
MRCS NPO	Mekong River Commission Secretariat Navigation Programme Office
MSDS	Material Safety Data Sheets
MTSA	Maritime Transportation Security Act
M/V	Motor Vessel
NACE	National Society of Corrosion Engineers (US)
NAP	Navigation Programme
NEG	Navigation Expert Groups
NFPA	National Fire Protection Association (US)
NNC	National Navigation Coordinator
NMC	National Mekong Committee
NOHSC	National Occupational Health and Safety Commission (Australia)
NWG	Navigation Working Group
OCIMF	Oil Companies International Marine Forum
ODA	Official Development Assistance
OISD	Oil Industry Safety Directorate (India)
ONEP	Office of Natural Resources and Environmental Policy and Planning
OSH	Occupational Safety and Health
OPRC	Oil Spill Preparedness and Response Cooperation
PACPLAN	Pacific Island Regional Marine Spill Contingency Plan
PACPOL	Pacific Ocean Pollution Prevention Program
PAH	Polycyclic Aromatic Hydrocarbons
PAT	Port Authority of Thailand
PCD	Pollution Control Department
PDR	Peoples' Democratic Republic
PEMSEA	Partnership in Environmental Management for the Seas of East Asia
PERC	Powered Emergency Release Coupling
PHSEMS	Port Health, Safety and Environmental Management System
PIANC	Permanent International Commission for Navigation Congresses. The International Navigation Association
POP	Persistent Organic Pollutants
PPAP	Phnom Penh Autonomous Port (Cambodia)
PPC	Provincial Peoples Committees
PPE	Personal Protective Equipment
PRC	Peoples Republic of China

PRF	Port Reception Facilities
PRP	Police River Patrol
PRSP	Poverty Reduction Strategy Papers
PSA	Port Security Assessment
PSC	Port State Control
PSHEMS	Port Safety and Health and Environmental Management System
PSN	Proper Shipping Name
QCDPS	Vietnamese Local Technical Regulation
QCVNs	Vietnamese national technical regulation
R	Risk Rating
RADAR	Radio Detection and Ranging
RGC	Royal Government of Cambodia
RA	Risk Analysis
RID	Règlement concernant le transport international ferroviaire des marchandises dangereuses (International rule for transport of dangerous substances by railway)
RWP	Rated Working Pressure
SEA	Strategic Environmental Assessment
SIA	Social Impact Assessment
SMS	Safety Management System
SOLAS	Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SWL	Safe Working Load
SWP	Safe Working Procedures
TEU	Twenty-Foot Equivalent Units (intermodal shipping container)
TCCSs	Organization’s Standards
TCVNs	Vietnamese National Standard
TG	Technical guidance
TMD	Thailand Marine Department
TNMC	Thailand National Mekong Committee
TWG	Technical Working Groups
UHA	Updating off the Hydrographic Atlas
UNCCD	United Nations Convention to Combat Desertification
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
USCG	United States Coast Guard
USD	US dollar

VEA	Vietnam Environment Administration
VHF	Very High Frequency
VINASARCOM	Vietnam's National Search and Rescue Committee
VIWA	Viet Nam Inland Waterway Administration
VND	Vietnamese Dong
VNMC	Viet Nam National Mekong Committee
VR	Viet Nam Register
VSQI	Viet Nam Standards and Quality Institute
VTS	Vessel Traffic System
WG	National Working Group
WREA	Water Resources and Environment Authority
WQ	Water Quality
WQI	Water Quality Index
WQM	Water Quality Monitoring
WQMN	Water Quality Monitoring Network

DEFINITIONS

Administration: means the government of the state whose flag the ship is entitled to fly.

Approved equipment: equipment has been tested and approved by an appropriate authority; national line agency or classification society. The authority should have certified the equipment as safe for use in a specified hazardous or dangerous area.

Auto-ignition: the ignition of a combustible material without initiation by a spark or flame, when the material has been raised to a temperature at which self-sustaining combustion occurs.

Barge: any vessel or ship used for inland navigation.

Berth: any dock, pier, jetty, quay, wharf, marine terminal or similar structure (whether floating or not) at which a ship may tie up. It includes any plant or premises, other than a ship, used for purposes ancillary or incidental to the loading or unloading of dangerous cargoes.

Bulk: cargoes which are intended to be carried without any intermediate form of containment in a cargo space which is a structural part of a ship or in a tank permanently fixed in or on a ship.

Cargo area: the part of the ship which contains the cargo containment system, cargo pumps and compressor rooms, and includes the deck area above the cargo containment system. Where fitted, cofferdams, ballast tanks and void spaces at the after end of the aftermost hold space or the forward end of the forward most hold space are excluded from the cargo area.

Company: the owner of a ship or any other organisation or person, such as the manager or the bareboat charterer, who has assumed the responsibility for the operation of the ship from the owner of the ship.

Dangerous area: an area on a tanker which, for the purposes of the installation and use of electrical equipment, is regarded as dangerous.

Dangerous cargoes: any of the following cargoes, whether packaged, carried in bulk packaging or in bulk within the scope of the following instruments:

- Oils covered by Annex I of MARPOL 73/78;
- Gases covered by the Codes for the Construction and Equipment of Ships Carrying
- Liquefied gases in bulk;
- Noxious liquid substances/chemicals, including wastes, covered by the Codes for the
- Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk and Annex II of MARPOL 73/78;
- Solid bulk materials possessing chemical hazards and solid bulk materials hazardous only in bulk (MHBs), including wastes, cove red by group B schedules in the Code of Safe Practice for Solid Bulk Cargoes (BC Code);
- Harmful substances in packaged form (covered by Annex III of MARPOL 73/78); and
- Dangerous goods, whether substances, materials or articles (covered by the IMDG Code).

The term dangerous cargoes includes any empty uncleaned packagings (such as tank-containers, receptacles, intermediate bulk containers (IBCs), bulk packagings, portable tanks or tank vehicles) which previously contained dangerous cargoes, unless the packaging have been sufficiently cleaned of residue of the dangerous cargoes and purged of vapours so as to nullify any hazard or has been filled with a substance not classified as being dangerous

Dangerous goods: means those substances and articles the carriage of which is prohibited by applicable legislation, or authorized only under the conditions prescribed therein.

Earthing (also referred to as "grounding"): the electrical connection of equipment to the main body of the 'earth' to ensure that it is at earth potential. On board ship, the connection is made to the main metallic structure of the ship, which is at earth potential because of the conductivity of the sea.

Enclosed space: a space that has limited openings for entry and exit, unfavourable natural ventilation, and that is not designed for continuous worker occupancy. This includes cargo spaces, double bottoms, fuel tanks, ballast tanks, pump rooms, cofferdams, void spaces, duct keels, inter-barrier spaces, engine crankcases and sewage tanks.

Explosion-proof (also referred to as "flame-proof"): An "explosion proof" classification of electrical equipment means that the housing has been engineered and constructed to contain a flash or explosion. Such housings are usually made of cast aluminium or stainless steel and are of sufficient mass and strength to safely contain an explosion should flammable gases or vapours penetrate the housing and the internal electronics or wiring cause an ignition. The design must prevent any surface temperatures that could exceed the ignition temperature of the gases or vapours covered by its group rating.

Flame arrester: A permeable matrix of metal, ceramic or other heat-resisting materials which can cool even an intense flame, and any following combustion products, below the temperature required for the ignition of the flammable gas on the other side of the arrester.

Flammable: capable of being ignited and of burning.

Foam: an aerated solution that is used for fire prevention and fire-fighting.

Handling: the operation of loading or unloading of a ship, railway wagon, vehicle, freight container or other means of transport, transfer to, from or within a warehouse or terminal area or within a ship or transhipment between ships or other modes of transport and includes intermediate keeping, i.e. the temporary storage of dangerous cargoes in the port area during their transport from the point of origin to their destination for the purpose of changing the modes or means of transport and movement within the port which is part of the transport supply chain for those cargoes.

Hazardous area: an area on shore which, for the purposes of the installation and use of electrical equipment, is regarded as dangerous. Such hazardous areas are graded into hazardous zones depending upon the probability of the presence of a flammable gas mixture. (For ships, see "Dangerous area")

Hazardous task: a task other than Hot Work which presents a hazard to the ship, terminal or personnel, the performance of which needs to be controlled by a risk assessment process such as a 'Permit to Work' system or a controlled procedure.

Hot work: work involving sources of ignition or temperatures sufficiently high to cause the ignition of a flammable gas mixture. This includes any work requiring the use of welding, burning or soldering equipment, blow torches, some power driven tools, portable electrical equipment which is not intrinsically safe or contained within an approved explosion-proof housing, and internal combustion engines.

International Safety Management (ISM) Code: international standard for the safe management and operation of ships and for pollution prevention. The Code establishes safety management objectives and requires a Safety Management System (SMS) to be established by the Company and audited and approved by the flag administration.

Intrinsically safe: The main objective of the Code is to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular to the marine environment and to property.

Loading arm: an articulated hard pipe system and its associated equipment, which may include;

quick release couplings, emergency release systems or hydraulic power pack, used for the purpose of transferring dangerous cargoes.

Loading rate: the volumetric measure of liquid loaded within a given period, usually expressed as cubic metres per hour (m3/h) or barrels per hour (bbl/h).

Master (also referred to as "captain"): the person having command of a ship.

Material Safety Data Sheet (MSDS): a document that contains information on the potential hazards (health, fire, reactivity and environmental) and how to work safely with a hazardous substance. It also contains information on the use, storage, handling and emergency procedures related to the hazards of the material. MSDS are prepared by the supplier or manufacturer of the substance and are intended to tell what the hazards of the product are, how to use the product safely, what to expect if the recommendations are not followed, what to do if accidents occur, how to recognize symptoms of overexposure, and what to do if such incidents occur.

Naked lights: open flames or fires, lighted cigarettes, cigars, pipes or similar smoking materials, any other unconfined sources of ignition, electrical and other equipment liable to cause sparking while in use, unprotected light bulbs or any surface with a temperature that is equal to or higher than the auto-ignition temperature of the products handled in the operation.

Non-volatile petroleum: petroleum having a flashpoint of 60ºC or above as determined by the close cup method of testing. These liquids produce, when at normal ambient temperature, equilibrium gas concentrations below the lower flammable limit. They include residual fuel oils, heavy gas oils and diesel oils.

Oxygen meter: an instrument for determining the percentage of oxygen in a sample of the atmosphere drawn from a tank, pipe or compartment.

Packing: the packing, loading or filling of dangerous cargoes into receptacles, intermediate bulk containers (IBCs), freight containers, tank containers, portable tanks, railway wagons, bulk containers, vehicles, ship borne barges or other cargo transport units.

Packaged cargo: petroleum or other cargo stored in drums, packages or other containers.

Permit (to work): a permit to work is a document which specifies the work to be done and the precautions to be taken. When effectively developed and implemented, it serves as a checklist to ensure that all hazards, control measures, work procedures and general safe work requirements are identified, documented, reviewed with and understood by the personnel who will be involved with the work activities. A permit to work provides a record of the authorisation and completion of hazardous work activities, controls and authorisation for the work. Examples are hot work permits, cold work permits, confined space entry work permits and electrical work permits.

Permit to work system: a formal written system used to control certain types of work which are identified as potentially hazardous.

Petroleum: crude oil and liquid hydrocarbon products derived from it.

Port authority: any person or body of persons empowered to exercise effective control in a port area.

Pressure surge: a sudden increase in the pressure of the liquid in a pipeline brought about by an abrupt change in flow rate. Pressure surges can be generated by anything that causes the liquid velocity in a line to change quickly (e.g., valve closure, pump trip, emergency shutdown closure) and subsequently packing pressure.

Pressure/vacuum relief valve: a device that provides for the flow of the small volumes of vapour, air or inert gas mixtures caused by thermal variations in a cargo tank.

Safety Management System (SMS): a formal, documented system required by the ISM Code. The system makes shipowners and operators responsible for the daily safe operation of their vessels. This ensures that the safety of a vessel and its crew, and the protection of the marine environment, is maintained throughout the year. Safety management systems cover construction, stability, equipment, operating limits, operating parameters, the qualifications of the crew, training of crew, vessel maintenance, emergency procedures and health and safety considerations.

Slops: any oily water mixture from cargo tank washing.

Spontaneous combustion: the ignition of material brought about by a heat producing (exothermic) chemical reaction within the material itself without exposure to an external source of ignition.

Static electricity: the electricity produced by movement between dissimilar materials through physical contact and separation.

Stowage: the positioning of packages, intermediate bulk containers (IBCs), freight containers, tank containers, portable tanks, bulk containers, vehicles, ship borne barges, other cargo transport units and bulk cargoes on board ships, in warehouses, sheds or other areas.

Surge Pressure: a phenomenon generated in a pipeline system when there is a change in the rate of flow of liquid in the line. Surge pressures can be dangerously high if the change of flow rate is too rapid and the resultant shock waves can damage pumping equipment and cause rupture of pipelines and associated equipment (see pressure surge).

Tank cleaning: the process of removing hydrocarbon vapours, liquid or residue from tanks. Tank cleaning is usually carried out so that tanks can be entered for inspection or hot work or to avoid contamination between grades.

Tanker: a ship designed to carry liquid petroleum, chemical or gas cargo in bulk.

Terminal: a place where tankers are berthed or moored for the purpose of loading or discharging petroleum cargo.

Torch (also referred to as "flashlight"): a battery operated hand lamp. An approved torch is one that is approved by a competent authority for use in a flammable atmosphere.

Toxicity: the degree to which a substance or mixture of substances can harm humans or animals. 'Acute toxicity' involves harmful effects to an organism through a single short term exposure. 'Chronic toxicity' is the ability of a substance or mixture of substances to cause harmful effects over an extended period, usually upon repeated or continuous exposure, sometimes lasting for the entire life of the exposed organism.

Ullage: the void space in a tank measured from the top of the tank to the upper surface of the liquid.

Volatile petroleum: petroleum having a flashpoint below 60ºC as determined by the closed cup method of test. Some petroleum liquids in this category are capable of producing equilibrium gas/air mixture within the flammable range when in some part of the normal ambient temperature range, while most of the rest give equilibrium gas/air mixture above the upper flammable limit at all normal ambient temperatures. Examples of the former are jet fuels and kerosenes and of the latter gasolines and most crude oils.

Water spray: a spray of water divided into coarse drops by delivery through a special nozzle for use in firefighting.

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EXECUTIVE SUMMARY

RISK ANALYSIS (VOLUME 1)

The MRC Navigation Programme (NAP) was formulated in 2003 in close cooperation with Member Countries and other regional stakeholders. Its five components share the objective of the MRC Navigation Strategy to "*promote Freedom of Navigation and increase the international trade opportunities for the MRC Member countries' mutual benefit, and to assist in coordination and co-operation in developing effective and safe waterborne transport in a sustainable and protective manner for the waterway environment*." The third component of the programme, Traffic Safety and Environmental Sustainability, aims to provide better facilities and capacity to increase safe and efficient Mekong navigation as a separate transport mode and as part of the regional multimodal transport network. It also aims to promote the concept of "clean" river transport, focusing on strategic prevention of environmental damage from waterway infrastructure or from shipping and port activities;

The Mekong River and its main tributaries are an important transport corridor for the trade of cargo, particularly the Upper Mekong between China and Thailand, and the Lower Mekong between Cambodia and Viet Nam. Cargo and fuel throughput and trips by vessels have increased significantly in the Mekong Delta with the development of a deep-sea port at Cai Mep, which allows exports from Cambodia and Viet Nam to be shipped directly to major world markets. At the same time, the construction of a new Mekong port in Chiang Saen in northern Thailand, scheduled for completion on 2012, is paving the way for a sharp increase in exports of fuel to China.

In 2009, the Navigation Programme consulted with port authorities, vessel associations, petroleum companies, transport operators and relevant ministries in Cambodia, Lao PDR, Thailand and Viet Nam to assess growing transport of dangerous goods along the Mekong.

Unfortunately, the design of vessels for transporting such goods is lagging in Member Countries and does not provide sufficient protection for the cargo in case of accidents. If not managed properly, the increased transport of dangerous goods along the Mekong could have considerable negative environmental impacts.

Within the Member Countries, specific legislation on managing navigation spills is limited. Only Thailand and Viet Nam have the necessary personnel and equipment to respond effectively to emergencies. In general, there is limited enforcement or legislative and regulatory guidance prescribing how to prevent navigation spills and what to do in case of an accidental or operational spill. With the need to develop adequate regulations, operational plans and procedures to ensure the risks of pollution can be controlled, the initial consultation was used to formulate the terms of reference for a Risk Analysis.

Conducted over a 12-month period with four National Working Groups and international experts, the Risk Analysis was an extensive assessment of selected ports, terminals, vessels and waterways as well as the environment and legal framework in place to govern the safe transport of dangerous goods in the Lower Mekong Basin. The potential impacts of oil spills and operational impacts of the transport of dangerous goods were carefully considered on both a regional and national basis.

The Risk Analysis included assessing the operational impacts of ports, terminals and vessels and also the waterway, environment and legal framework which governs international, cross-border and domestic transport. National working groups were selected in the Member Countries to undertake risks assessment activities at selected ports, terminals, ferry crossings and onboard vessels. The risks identified were compared against regional and international standards, causes of major incidents in the petroleum, maritime and the inland waterborne transport sector to identify priority areas for improving the transport of dangerous goods.

An assessment of the waterway was undertaken to determine the suitability for transporting dangerous goods along the Mekong River. The navigation conditions in the Upper Mekong (Lao PDR and Thailand) are categorized by rocky outcrops, strong currents and shoals which are hazardous for navigation. In Cambodia and Viet Nam, the waterway conditions allow for the operation of maritime and IWT vessels, the main hazards for navigation are high traffic density and man-made obstacles along the waterways.

CAMBODIA

The carriage, handling and storage of dangerous goods is significant in Cambodia. Gasoline, diesel, jet fuel and other petroleum products are imported from Viet Nam and primarily stored at 12 large petroleum terminals on the Mekong and Tonle Sap Rivers. The petroleum products are transported on inland barges from petroleum terminals in Viet Nam. Other dangerous goods including ammonium nitrate, fertilizers and toluene are imported through Phnom Penh Port by cross-border transport with Vietnamese and other foreign-flagged vessels. The transport of dangerous goods and all cargo has increased and is expected to rise further with the development of Phnom Penh Port II on the Mekong River downstream from Phnom Penh which will commence operations in 2012.

Domestic transport in Cambodia is still relatively limited, with passenger transport being the most prominent mode. There are only a few inland barges and petroleum tankers registered. However, tankers are still used in the high-water season to transport petroleum products from terminals on the Tonle Sap River to floating fuel stations on the Tonle Sap Lake. Domestic tankers are also used as feeders for fuel supply to industries along the Mekong River for power generation and other uses. The transport and storage of petroleum products on the Tonle Sap Lake was identified as an area of concern in relation to the waterway, water-quality threats, importance of wetlands and proximity to riparian populations. Domestic transport may increase in the future with a focus on the development of the agricultural sector, with rice exports expected to rise steadily.

LAO PDR

The transport of dangerous goods is relatively limited in Lao PDR and there are no large inland ports or petroleum terminals operating along the Mekong River. The most prominent navigation activity is the passenger transport between Huay Xay and Luang Prabang in the Upper Mekong. Vessels are used to transport general cargo mostly in the high-water season. One of the main reasons that navigation is limited is due to the dangerous conditions of the waterway.

Most dangerous goods are transported by ferry crossings and include gasoline, diesel, asphalt, fertilizers and construction materials. Tanker trucks containing dangerous goods load onto ferries and transport goods from Thailand to Lao PDR. Km 4 State Port Authority has fuel-storage capacity for refuelling trucks, cranes and equipment onsite. There are a number of small refuelling stations along the Mekong River for cargo, passenger and small fishing and other vessels. One of the main issues identified by the Risk Analysis was the management of solid and liquid wastes and limited awareness of the risks associated with transport and storage of dangerous goods.

THAILAND

The main navigation activity in Thailand is the import and export of general cargo to the People's Republic of China through Chiang Saen Port in the Upper Mekong. Cargo throughput and ship calls are increasing through Chiang Saen and the new Chiang Saen Port II will commence operations in 2012, with imports and exports set to increase even further. The transport of dangerous goods is also increasing in Thailand through the export of petroleum products through Keawalee Terminal in Chiang Saen, a privately-owned terminal used to transfer diesel and gasoline from tanker trucks to inland barges from the People's Republic of China and Myanmar.

Ferry crossings continue to transport tanker trucks containing gasoline, diesel and asphalt across the Mekong River to Lao PDR. General cargo, construction materials and consumables are also carried across the Mekong River at the ferry crossings.

VIET NAM

Inland waterborne transport is well advanced in Viet Nam where there are a number of inland and maritime ports helping to boost economic growth. The transport and storage of dangerous goods is extensive in Viet Nam. There are a number of petroleum terminals which use domestic tankers to supply refuelling stations and industry for power generation.

Tankers are used to export petroleum products to Cambodia from terminals in Ho Chi Minh City and large tankers are also used for domestic trade from Can Tho and My Tho to the west of the Mekong Delta. Due to the magnitude of the transport of dangerous goods in the Mekong Delta, the potential risks to wetlands, agricultural land, mangrove forests and riparian populations is high.

REGIONAL ISSUES

Navigation development varies greatly between the Upper and Lower Mekong. In the Upper Mekong, Thailand and Lao PDR have signed the Mekong-Lancang Agreement on Commercial Navigation. The Khone Falls in Lao PDR acts as a physical barrier to vessels in the Lower Mekong, where Cambodia and Viet Nam have signed the Agreement on Cross- Border Navigation. Maritime, cross-border and domestic transport is now developing significantly, particularly in Viet Nam.

Awareness of dangerous goods, environmental protection, impacts of oils spills and safety requirements are currently limited in all of the Member Countries. Public information and awareness programmes will need to be developed to raise the awareness of all waterway users.

Further investigation is required on the legal framework in Member Countries, specifically in relation to existing rules and regulations for inland waterborne transport, the transport of dangerous goods and environmental protection at the national level.

Consideration will need to be given to how national and regional rules can be harmonised in the Upper and Lower Mekong under the relevant legal agreements. Member Countries drafting rules and regulations for transporting dangerous goods should consider regional legal agreements and existing rules and regulations. Cambodia is drafting regulations for inland waterborne transport and the transport of dangerous goods. Existing rules and regulations in Viet Nam should be considered under the Cambodia-Vietnam Agreement on Cross-Border Transport.

The development and implementation of international instruments such as the ADN Code for the transport of dangerous goods should be evaluated taking into account the current technical capacity and socio-economic development of Member Countries. The implementation of the ADN Code should be undertaken in a feasible and practical manner.

Viet Nam has the most extensive legal instruments for inland waterborne transport. However, a full review needs to be undertaken to determine the effectiveness of the rules, decrees and circulars specifically for transport of dangerous goods. The review needs to include information on how the rules and regulations are implemented and who is responsible for monitoring and compliance.

National line agencies in Member Countries all have difficulties ensuring compliance with existing rules and regulations. This is often due to limited budgets, resources, institutional capacity and also a lack of technical guidance to complete necessary inspections. The line agencies also have difficulty accessing some private terminals and completing registrations and inspections for all vessels.

In all Member Countries, there are limited emergency-response mechanisms along the waterway to monitor inland and navigation activities and respond to security incidents, navigation accidents, oil spills and other major incidents. Early-warning, notification and emergency-response systems should be enhanced in respect to existing National Disaster Committees and ASEAN Disaster Response Preparedness.

To prevent navigation accidents and pollution, inland waterborne transport should be restricted in areas deemed not suitable for the transport of dangerous goods. Any future proposals to do so on these stretches of the river should be subject to full risk assessments taking into account ports/ terminal, vessels, waterways and the environment.

To improve waterway safety, minimum safety requirements for navigation equipment should be established for tankers and cargo vessels transporting dangerous goods in the Mekong River system. A feasibility study should be carried out on establishing a Vessel Traffic System (VTS) to monitor the movement of cross-border tankers and cargo vessels transporting dangerous goods.

A number of ports and petroleum terminals do not have effective emergency-response planning for fire, explosion and pollution incidents. The emergency-response plans should also involve consultation with location communities and emergency-response authorities.

The capacity of emergency-response authorities needs to be improved to respond effectively to major fire and explosion incidents in collaboration with the private operators of ports and petroleum terminals and local communities. Fire and emergency drills should be performed on a planned basis and reviewed to ensure continual improvement.

Not all ports visited had established safety, health and environment management systems. Cambodia, Thailand and Viet Nam have all signed up to the Ports Safety, Health and Safety Management (PHSEM) Code for Partnership in Environmental Management for the Seas of East Asia (PEMSEA). This presents a good opportunity to apply the code to major inland ports in the Member Countries.

Some of the petroleum terminals have also not established safety health and environment-management systems or emergency-response plans to governments to outline how they will prevent pollution and respond to emergency situations. Petroleum terminals can have significant impacts on the environment, people and public infrastructure in the event of a major incident and require further monitoring.

The petroleum industry and shipping companies should be encouraged to protect the environment under corporate social responsibility (CSR) programmes. The petroleum industry is a lucrative business and companies should invest in safety and environmental protection to ensure a sustainable future for Member Countries.

The potential for major oil spills is highest in Cambodia and Viet Nam due to the size of the petroleum terminals and tankers operating. Further assessment and modelling is required to determine the possible trans-boundary impacts and location of terminals to water intake (for drinking) and public infrastructure.

There are currently no programmes in the Member Countries to investigate soil contamination, surface-water quality and groundwater monitoring in the vicinity of ports, petroleum terminals and areas with high levels of inland waterborne transport.

Heavy metals and other industrial contaminants have been detected downstream from navigation activities. However, the source of such pollution cannot be confirmed. Impacts of navigation on water quality are difficult to determine under both the Water Quality Monitoring Network of the MRC and water quality monitoring by the Member Countries. Further investigation is required to monitor water quality in areas with high levels of transport of dangerous goods.

A number of facilities were built before the implementation of Environmental Impact Assessment (EIA) rules and regulations. They are therefore not required to submit Environmental Management Plan (EMP) reports to national line agencies to ensure compliance with standards for water quality, waste water and pollution prevention. In Viet Nam, it was reported that a number of operators do not comply with EIA requirements.

Cooperation at the inter-ministerial level needs to be enhanced between the Ministries of Environment, Water Resources, Transport and other sectors to ensure compliance with environmental rules and regulations. A joint statement should be prepared between key ministries in the Member Countries to promote inland waterborne transport and the protection of the environment, as recently done by the countries along the Danube River.

The conclusions of the Risk Analysis in this volume are being used to guide the Recommendations in Volume II to determine the regional priorities for improving the transport of dangerous goods on the Mekong River. Together, these two volumes provide a useful framework to ensure a balance between inland waterborne transport and environmental protection.


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1. INTRODUCTION AND PROJECT DESIGN

1.1 BACKGROUND

The Mekong River is one of the greatest river systems on Earth. It is ranked as the twelfth-longest river in the world and eighth in terms of annual discharge. The seasonal variation in the water level and the range of wetland habitats inundated by the Mekong River provide the source of the river system's productivity. The rich biodiversity within the Mekong River Basin, especially fisheries, is fundamental to the viability of natural resource-based rural livelihoods of the people living within the basin. These livelihoods are founded in the integrated use of a wide range of natural resources, and which are adapted to the seasonal changes of flooding and recession. Maintaining and improving the natural productivity of the river basin is essential to both the local populations and the national economies of those countries within the basin.

For thousands of years, the Mekong River has been an important conduit for people and goods between the many riparian communities situated along its banks. Traditional forms of trade in small boats linking communities continue today. However, the river is also becoming an important link in international trade routes connecting the six Mekong countries to each other and the rest of the world. The Mekong Basin comprises six countries. The four nations of the Lower Mekong Basin – Cambodia, Lao PDR, Thailand, and Viet Nam – are members of the Mekong River Commission (MRC). China and Myanmar, located in the Upper Basin, are dialogue partners of the MRC. The Mekong River Commission (MRC) was established in 1995 by an agreement between the governments of Cambodia, Lao PDR, Thailand and Viet Nam. Article 9 of the 1995 Agreement gives MRC a specific mandate to promote and co-ordinate water transportation and to encourage freedom of navigation in the Lower Mekong region. A common interest in increasing international trade was the reason that the MRC signatories opted for a separate article in the 1995 Agreement on Freedom of Navigation.

Economic growth, through trade, port developments and passenger services has increased significantly on the Mekong River, benefitting local communities and furthering the development of trade opportunities for Member Countries. It is important that development is balanced with the environmental impacts of increased navigation to ensure shipping on the Mekong River is safe and environmentally sustainable.

1.2 MRC NAVIGATION PROGRAMME

The MRC Navigation Programme (NAP) was formulated in May 2003 in close cooperation with MRC Member Countries and other regional stakeholders to ensure national and regional ownership of the suggested activities. The NAP is based directly on the MRC Navigation Strategy; all NAP components share the development objective of the strategy which is to:

> "*promote Freedom of Navigation and increase the international trade opportunities for the MRC Member countries' mutual benefit, and to assist in coordination and co-operation in developing effective and safe waterborne transport in a sustainable and protective manner for the waterway environment*."

The Navigation Programme is an integrated body of work consisting of the following five components:

Component 1 (Socio-Economic Analysis and Regional Transport Planning): Assess the socio-economic outcome of enhancing navigation on the Mekong River, and to examine and propose cost-effective and practical ways in which cargo and passenger transport on the Mekong waterway network can be increased as a separate transport mode and as a part of the regional multimodal transport network;

Component 2 (Legal Framework for Cross-Border Navigation): Establish an appropriate legal foundation and navigation regime for International Mekong Navigation, and to ensure its implementation and sustainability;

Component 3 (Traffic Safety and Environmental Sustainability): Provide better facilities and capacity to increase safe and efficient Mekong navigation as a separate transport mode and as part of the regional multimodal transport network. Promote the concept of "clean" river transportation, focussing on strategic prevention of environmental damage from waterway infrastructures or from shipping and port activities;

Component 4 (Information, Promotion, Coordination): Establish an integrated Mekong River Information System necessary for navigation development that covers operational data, traffic monitoring and information on navigation development and management throughout the Lower Mekong Basin. Demonstrate the advantages and potentials of the waterborne transport sector, and identify coordination and cooperation mechanisms that include national and regional initiatives and the private sector; and

Component 5 (Institutional Development): Establish the institutional structures on the regional level and to provide the necessary resources for the MRC Member Countries to establish the management structures on the national level for implementing NAP. The implementation of capacity building programmes for the waterborne transport sector in the Member Countries.

1.3 TRAFFIC SAFETY AND ENVIRONMENTAL SUSTAINABILITY

The MRC Navigation Strategy calls for harmonisation and enforcement of common rules and regulations on environmental protection and safety measures. The Strategy highlights a strong need for awareness-raising in environmental protection and risk control within the navigation sector. The NAP aims to promote and realise the concept of environmental standards for "green" river transportation, focussing on strategic prevention of environmental damage. The third component of the NAP is 'Traffic Safety and Environmental Sustainability' dealing with environmental prevention and protection. The immediate objectives of Component 3 are to:

1. promote and realise the concept of environmental standards for "clean" river transportation, focussing on strategic prevention of environmental damage;
2. balance the environmental consequences of projects against their economic and social significance; and
3. ensure that the ecological health of the river, which is the basis for food security and livelihoods, is not compromised by navigation developments.

Another reason for the MRC to engage in improving and promoting regional navigation is the reference to sustainable development is in Article 3 of the 1995 agreement:

> *"to protect the environment, natural resources, aquatic life and conditions, and ecological balance of the Mekong River Basin from pollution or other harmful effects resulting from any development plans and uses of water and related resources in the Basin."*
>
> The NAP has also been tasked to assist Member Countries in establishing efficient environmental management systems and contingency plans to deal with emergencies, pollution and accidents on the waterways and inland river ports and petroleum terminals.

1.4 OVERVIEW OF TRANSPORTATION OF DANGEROUS GOODS

The Mekong River and its main tributaries are an important transport corridor for the trade of cargo, particularly in the Upper Mekong between China and Thailand, and in the Lower Mekong between Cambodia and Viet Nam. Cargo and fuel throughput and boat trips have increased significantly in the Mekong Delta with the development of a deep sea port at Cai Mep, which allows exports from Cambodia and Viet Nam to be shipped directly to the US and Europe. Inland transportation along the Mekong River can be divided into two sections.

Upper Mekong Inland Water Transportation

Diesel and other petroleum products are also carried by vessels between the People's Republic of China (PRC), Myanmar and Thailand in the Upper Mekong. Trade and inland waterbone transport(IWT) is increasing in the Upper Mekong, particularly with the development of Chiang Saen Port II in Thailand which will include a tank farm for storing and handling petroleum products for export to the PRC. Ferry crossings continue to provide an important link for carrying tank trucks and gas tankers, mining products, fertilisers and pesticides across the Mekong River between Lao PDR and Thailand. There are no standard practices for loading and unloading these ferries and no environmental safeguards have been developed or implemented to prevent incidents, oil spills or loss of cargo.

Lower Mekong Inland Water Transportation

The trade of oil, gas and petroleum products between Viet Nam and Cambodia has increased significantly over the last few years. Petroleum terminals are located on the Mekong, Tonle Sap and Bassac Rivers in Cambodia and Viet Nam. Most of these terminals have developed standard operating procedures for bunkering, fuel transfer and other critical operations. The carriage, handling and storage of petroleum products are of major concern for the Mekong River. Most terminals have developed response plans for firefighting and other emergencies. But a number do not have contingency plans or sufficient equipment and resources to respond to oil spill emergencies and major accidents. Further investment is required for capacity building and resources to ensure petroleum terminals and ports can prevent and respond appropriately to such emergencies.

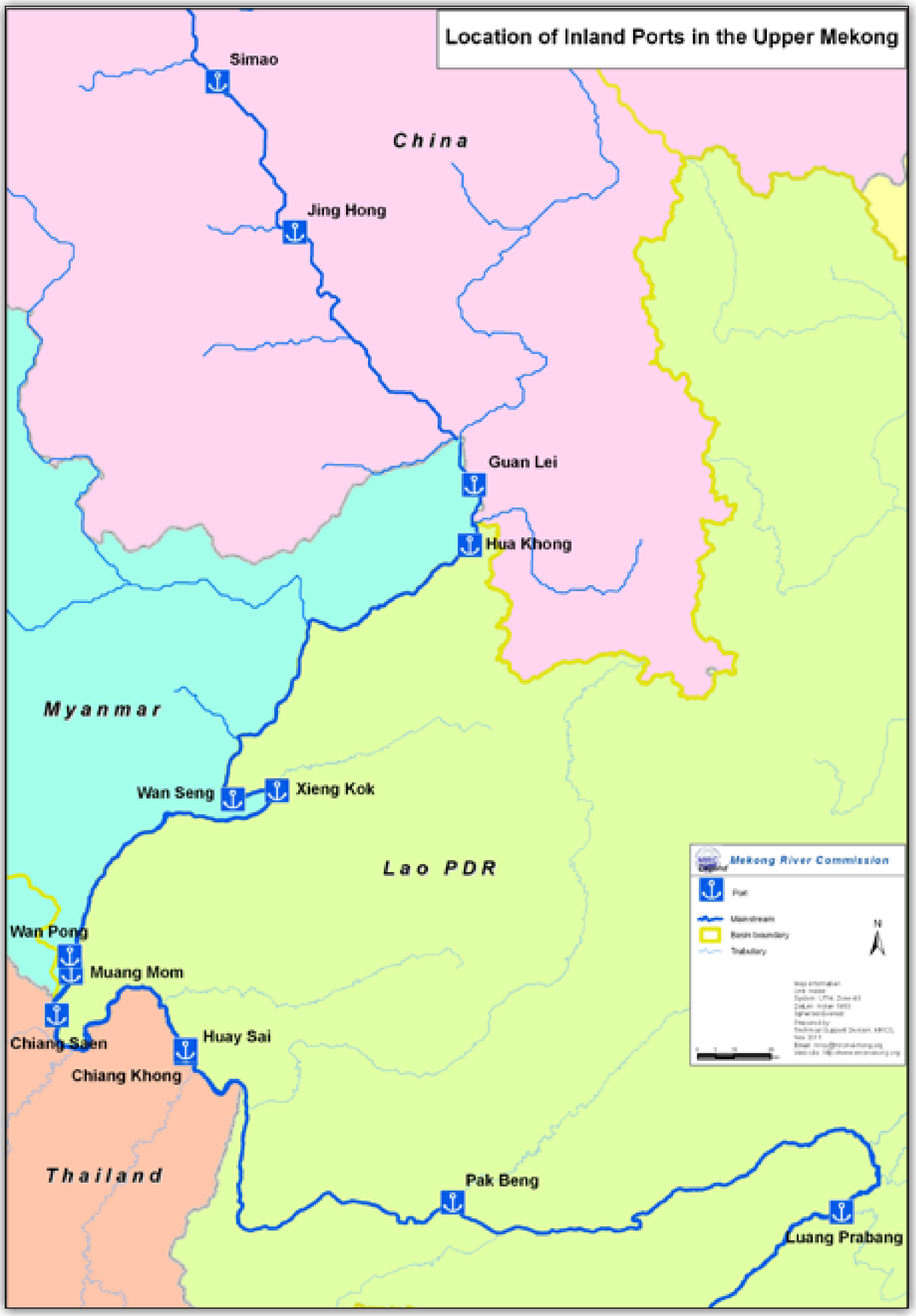


Figure 1: **Registered Ports in the Lancang-Mekong Agreement on Commercial Navigation**

1.5 ENVIRONMENTAL IMPACTS

The NAP is promoting a measured approach to navigation infrastructure development, operations and maintenance to ensure sustainable development.

The environmental impacts of the transportation of dangerous goods need to be carefully evaluated. Increased carriage, handling and storage of dangerous goods can lead to the following environmental impacts and risks:

- increased pollution from transportation of dangerous goods (e.g. cargo residues, spills and leakages, solid and liquid wastes);
- increased risk of spillages and pollution from shipping accidents as well as ports and terminal operations;
- atmospheric emissions from motorised vehicles such as diesel-powered vessels releasing particulates and gases;
- impacts on human health as a result of pollution, fire and explosion;
- loss or damage to habitats and species due to an increase in disturbance, reduced water quality and pollution; and
- health and safety risks for existing users of the river.

It is important that these risks are identified and mitigated to ensure the sustainable development of inland waterway transport. In 2009, the NAP conducted an initial consultation with relevant line agencies including port authorities, vessel associations, petroleum companies, transport operators and the relevant ministries in Cambodia, Lao PDR, Thailand and Viet Nam to determine the situation of navigation activities and the transport of dangerous goods along the Mekong River which is increasing.

Unfortunately, the design of vessels for transporting dangerous goods is lagging in the MRC Member Countries or does not provide sufficient protection for the cargo in case of accidents. If not managed properly, the increased transport of dangerous goods along the Mekong River could have considerable negative environmental impacts. Within the Member Countries, specific legislation on managing navigation spills is limited. Only Thailand and Viet Nam have the necessary personnel and equipment to respond effectively to emergencies. In general, there is limited enforcement or legislative and regulatory guidance prescribing how to prevent navigation spills and what to do in case of an accidental or operational spill. Hence, there is a need to develop adequate regulations, operational plans and procedures to ensure the risks of pollution can be controlled.

1.6 INITIAL CONSULTATION

The initial consultation enabled the NAP team to establish the level of existing controls and environmental safeguards and to further identify hazards related to the transport of dangerous cargo, port operations and petroleum terminals. Trade and cargo figures, statistics on boat traffic, passengers and ship calls were obtained to evaluate areas of economic growth and potential. A questionnaire was developed to determine:

- current port, vessel and navigation activities;
- rules and regulations applying to port and vessel operations;
- existing environmental safeguards and controls;
- management of wastes received from vessels and cargo operations;
- contingency plans and equipment to respond to oil spill and major accidents;

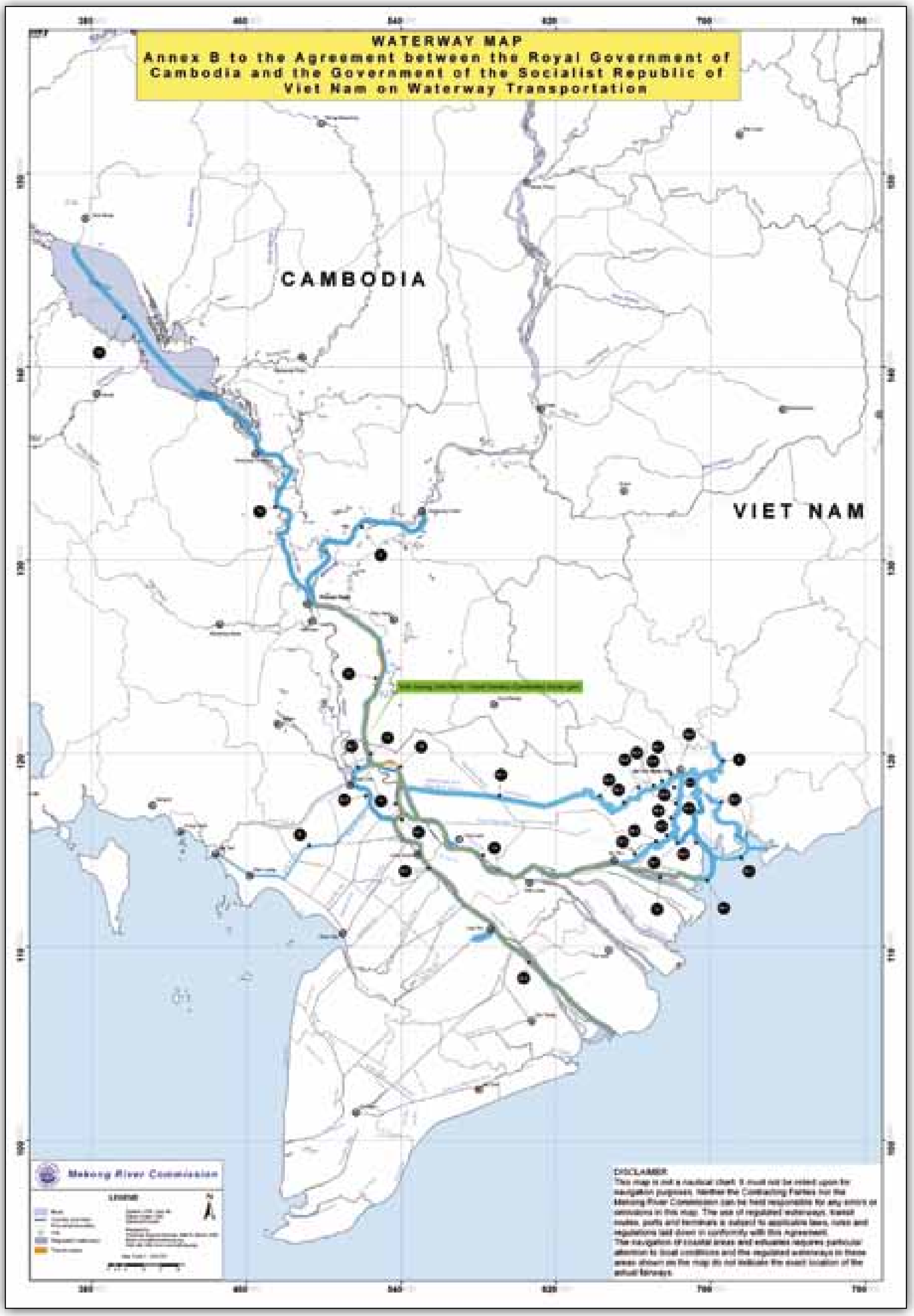


Figure 2: **Ports and Regulated Waterways in the Cambodia-Viet Nam Legal Agreement**

- incident reporting and investigation systems;
- priority issues and considerations in the port and surrounding areas; and
- future planning and developments of road and inland waterborne transport infrastructure.

The NAP in consultation with the MRC Member Countries selected a sample of the most important ports, petroleum terminals, ferry crossings, vessels and waterways for further risk analysis. To determine the most significant ports, terminals vessels and waterways the following factors were considered:

- possible environmental impacts identified from initial consultation;
- fuel storage capacity and operations;
- current environmental management and monitoring plans;
- future international and domestic trade opportunities involving the transport of dangerous goods; and
- future developments in road and waterway infrastructure.

The initial consultation was used to formulate the terms of reference (TOR) for a risk analysis.

1.7 JUSTIFICATION FOR THE RISK ANALYSIS

The project *"Phase 1: Risk Analysis of the Carriage, Handling and Storage of Dangerous Goods"* is an output under NAP Component 3 (Traffic Safety and Environmental Sustainability). The carriage of dangerous goods on the Mekong River and its tributaries has been identified as a high-risk activity and any incident would have severe impacts on the environment and safety of riparian populations. Yet environmental protection measures to ensure the safe handling and storage of dangerous goods are limited. Provisions for pollution prevention and contingency plans in case of oil spills and major accidents such are fires and explosions are also limited.

To estimate the efforts and tools needed to manage (prevent, control and combat) pollution associated with the carriage, handling and storage of dangerous goods it is necessary to determine the levels of risk. Such an assessment is important to evaluate which activities could harm the environment, people and local communities, enabling relevant line agencies to determine whether prevention and mitigation measures are sufficient to control risks and minimise impacts.

Under NAP Component 2 (Legal Framework for Cross-Border Navigation), new legal instruments have been established and are being implemented to ensure the standardisation and harmonisation of different rules and regulations for inland water transport. The Goal of the MRC Strategic Plan 2011-2015 is for Member Countries to *"implement basin-wide Integrated Water Resources Management (IWRM) approaches in national water and related sector frameworks and development programmes for sustainable and equitable development."* The implementation of Phase 1 (Risk Analysis) followed by *"Phase 2: Regional Master Plan for Sustainable Management of Dangerous Goods"* will achieve the Strategic Plan's Key Result Area 1, which is "application of IWRM-based navigation development and coordination." The results will be shared extensively to ensure exchange of information and dialogue between Member Countries, development partners, the private sector and all key stakeholders.

At the MRC level, there are no specific institutional arrangements for navigation spill control. There is no adequate legislation and no agreements on inland waterway transportation and pollution. The organisational and institutional framework to deal with navigation spill control is also limited.

There are also the trans-boundary aspects of pollution. The development of inland waterborne transport in the Mekong River Basin will inevitably increase the possibility of pollution from vessel operation, oil spills and increase risks of other incidents. As an international river, with stretches where the international border follows the river alignment and stretches where the river crosses international borders , pollution in the Mekong will often become a trans-boundary issue. It is therefore essential that effective trans-boundary measures for preventing pollution and mitigating impacts of accidents, oil spills and pollution incidents are developed, agreed upon by the countries and enforced.

1.8 OBJECTIVES OF THE RISK ANALYSIS

The objective of the risk analysis is to identify and determine the magnitude of risks associated with the carriage, handling and storage of dangerous cargo in ports, vessels and oil and gas terminals on the Mekong River, and determine feasible prevention and mitigation measures to manage the risks. When applied consistently and uniformly on a number of waterways, the process is expected to provide a basis for making best value decisions for risk mitigation and prevention measures at the regional, national and local level. The aim is to also clearly measure the legal framework and institutional capacity in the MRC Member Countries to develop, implement and monitor environmental prevention and mitigation measures. Table 1 below describes the objectives of Phase 1:

Table 1: **Development Objectives**

Development objective (of the design and implementation of the Risk Analysis)	The overall objective is to increase the efficiency of domestic and cross-border waterborne transport in the Lower Mekong Basin, by reducing the risks for accidents in ports, on vessels and on waterways so that the ecological health of the river, which is the basis for food security and livelihoods, is not compromised by shipping activities, operations and developments.
Immediate objectives (of the Risk Analysis)	The objectives of Phase 1 are to identify and quantify the risks associated with the transportation of dangerous goods along the Mekong River and determine the prevention and mitigation measures that need to be implemented.

Phase 1 must detail the likelihood and consequence of an incident occurring and investigate, the effectiveness of existing prevention and mitigation measures that have been implemented to reduce and control risks or minimise environmental impacts and determine further prevention and mitigation measures that need to be developed and implemented. Phase 2 will be to develop the regional master plan including an implementation strategy and project plans for the MRC Member Countries at the regional and national level.

1.9 IMPLEMENTATION ARRANGEMENTS

MRC Navigation Programme

The NAP, on behalf of the MRC, will serve as the Executing Agency (EA) of this project. In Phase 1, it was responsible overall project activities including the recruitment of consultants, financial and technical supervision and monitoring of project implementation. The data and results of the assessment will also be utilised during and after the project by the MRC.

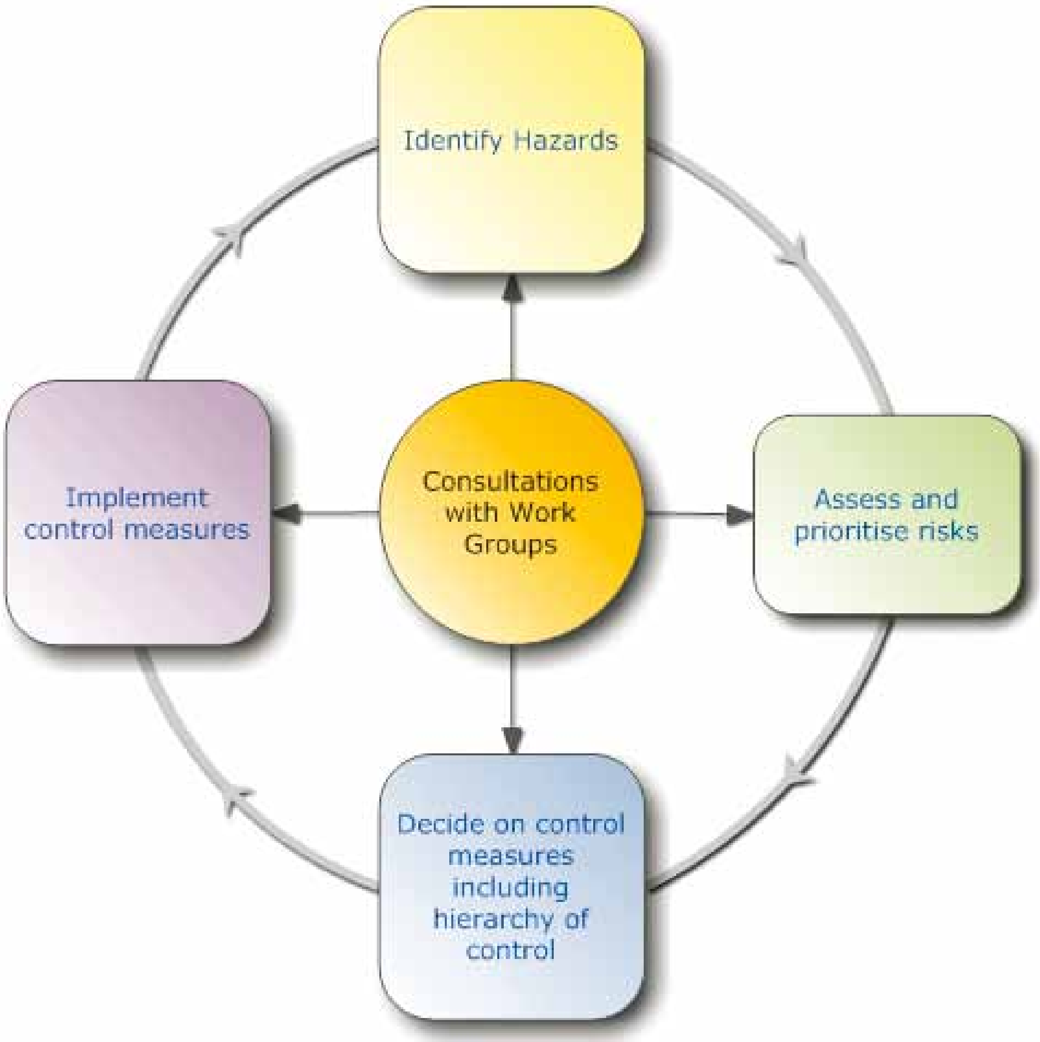
National Working Groups (WG)

National Working Groups (WG) were selected in each of the Member Countries to undertake data collection, risk assessments and be responsible for completing the outputs and overseeing the national component of the project. In Cambodia, Lao PDR and Viet Nam, three national working group members were appointed in each country for *ports*, *vessels* and the *environment*. In Thailand, the WG was established with representatives of the Thai National Mekong Committee (TNMC) and the Thailand Marine Department. The WG members were selected by National Mekong Committees in consultation with the NAP. They were supported by NAP and international experts engaged by the MRC to provide technical expertise to ensure the successful completion of specific outputs and activities of the risk analysis.

International Experts

Four consultants were engaged to develop risk analysis guidelines, project tools and to assist the NAP and national task forces to review and complete the final outputs of the Risk Analysis in the MRC Member Countries. The four international experts recruited were specialists is the fields of *port environmental risk, vessel environmental risk, waterways* and *law*.

Each consultant was responsible for completing the final outputs to their specific area of expertise and providing technical assistance to the NAP and national task forces as required.



National Mekong Committee

The National Mekong Committee (NMC) of each Member Country served as Coordinating Agency. Through the National Navigation Coordinator (NCC), the agencies assisted the MRC in liaising with the government to obtain any other additional information necessary and will assist the MRC to inform the related line agencies and key stakeholders about the progress and the results of the study.

1.10 THE GEOGRAPHICAL PROJECT AREA

Ports and Terminals

Following the initial consultation and the Regional Risk Assessment the following ports, terminals and ferry crossing were included in the Risk Analysis in the Member Countries:

Thailand:

- Chiang Saen Port;
- Keawalee Terminal;
- Chiang Khong/Huay Xay Ferry Crossing;
- Bungkhan/Pakxanh Ferry Crossing; and
- Nakhon Phanom Ferry Crossing.

Lao PDR:

- Huay Xay/Chiang Khong Ferry Crossing;
- Luang Prabang Ports;
- Km 4 State Port, Vientiane;
- Pakxanh/Bungkhan Ferry Crossing; and
- Bung Pung Cheng/Ban Tuay Ferry Crossing; and
- Nakasang Passenger Port.

Cambodia:

- Phnom Penh Port;
- 3 selected petroleum terminals along the Mekong and Tonle Sap River;
- Krakor Floating Terminal;
- Chnouk Trou Floating Terminal; and
- Chhong Kneas Vessel Fuel Station.

Viet Nam:

- Tay Nam Bo Petroleum Terminal;
- Binh Duc Petroleum Terminal;

- Quang Trung Petroleum Terminal; and
- Dong Thap Petroleum Terminal.

Figure 3 on the following page indicates the locations of the ports, terminals and ferry crossings included in the Risk Analysis of the Carriage, Handling and Storage of Dangerous Goods.

Vessels

The risk assessments were completed for a sample of different types of vessels in the MRC Member Countries:

Thailand

- Two Chinese tanker vessels

Lao PDR

- Two cargo vessels

Cambodia

- Two cargo vessels; and
- Two petroleum tankers

Viet Nam

- Two petroleum tankers; and
- Two liquid petroleum gas (LPG) tankers

Waterways

The risk assessment conducted by the National Working Group members focuses on the ports, terminals, ferry crossings and vessels. An international waterway expert was engaged to undertake a risk assessment of the waterways. A desktop analysis and consultation with waterway users was conducted to determine the hazards and risks along the waterways. A hazard classification was designed to determine the waterway stretches suitable for the transport of dangerous goods, those that are not suitable and stretches which require further prevention measures to improve safety. The waterway hazard classification was used to assign hazard levels to the waterways at low and high water levels as well as at day and night to determine risk levels for transporting dangerous goods

The waterway assessment was divided into a number of sections to allow a more detailed analysis of the waterway stretches suitable for the transport of dangerous goods. The waterway assessment was done from the Golden Triangle (Km 2,373) to Deep Sea Buoy (Km 0).

Figure 3: **Location of Ports, Terminals and Ferry Crossings included in Risk Analysis**

1.10.1 Lao PDR and Thailand

Section 1: Golden Triangle (Km 2,373) – Chiang Saen (Km 2,364): distance = 9 km

Section 2: Chiang Saen (Km 2,364) – Chiang Khong/Huay Xay (Km 2,314): distance = 50 km

Section 3: Chiang Khong/Huay Xay (Km 2,314) to Pak Beng (Km 2,172): distance = 142 km

Section 4: Pak Beng (Km 2,172) to Luang Prabang (Km 2,010): distance = 162 km

Section 5: Luang Prabang (Km 2,010) – Pak Lay (Km 1,800) – Vientiane (Km 1,585): distance = 425 km

Section 6: Vientiane (Km 1,585) – Savannakhet (Km 1,126): distance = 459 km

Section 7: Savannakhet (Km 1,126) – Pakse (Km 869): distance = 257 km

Section 8: Pakse (Km 869) – Khone Falls (Km 721): distance = 148 km

1.10.2 Cambodia

Mekong between the Lao Border (Khone Falls) and Kompong Cham

Section 1: Section Kompong Cham (Km 448) – Phnom Penh (Km 348): distance = 100 km

Section 2: Phnom Penh (Km 348) – border with Viet Nam (Km 251): distance = 97 km

The Tonle Sap between Phnom Penh Port and Chhong Kneas

Section 1: Phnom Penh (Km 0) – Kompong Chhnang (Km 99): distance = 99 km

Section 2: Kompong Chhnang (Km 99) – Chong Kneas (Km 149 + approx. 55 Km): distance = 104 km

1.10.3 Viet Nam

Mekong Mainstream

Section 1: Deep sea buoy (Km 0) – My Tho (Km 74): distance = 74 km

Section 2: My Tho (Km 74) – Tan Chau (Km 236): distance = 162 km

Section 3: Tan Chau (Km 236)- border with Cambodia (Km 251): distance = 15 km

Bassac River and the Vam Nao Pass

Section 1: River mouth of the Hau (Bassac Estuary: Km 0) to Can Tho (Km 109): distance = 109 km

Section 2: Can Tho (Km 129) - Long Xuyen (Km 162): distance = 33 km

Section 3: Long Xuyen (Km 162) to Vam Nao Pass and junction with the Mekong mainstream (Km 216 of the Mekong mainstream) = 54 km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2. RISK ANALYSIS METHODOLOGY

2.1 INTRODUCTION

To estimate prevention and mitigation measures needed to manage (prevent, control and combat) pollution and major accidents associated with the carriage, handling and storage of dangerous goods, it is necessary to determine the level of associated risks and environmental impacts. It will be important to assess the level of risk and which hazards could cause not only harm to the environment but also to people and local communities. This will enable relevant line agencies to determine whether the prevention and mitigation measures implemented are sufficient to control the risks and minimise impacts. The aim is to also to clearly measure the institutional capacity in the MRC Member Countries to develop, implement and monitor environmental prevention and mitigation measures.

2.2 RISK DEFINITIONS AND TERMINOLOGY

The National Working Group members in the Member Countries were required to undertake risk assessments at selected ports, terminals, ferry crossings and onboard vessels.

They attended a NAP Regional Risk Assessment Workshop in February 2011 before completing the risk assessments to understand the important definitions and terminology of the process. The following are important definitions derived from Australia/New Zealand Standard *AS/NZS 4360:2004- Risk Management*:

1. **Risk assessment** is the overall process of estimating the level of risk of a particular hazard (activity of process);
2. **Hazard** is a source or situation with a potential for harm in terms of damage to the environment, injury or illness, damage to property, or a combination of the above;
3. **Incident** is an unplanned event resulting in or having the potential to result in damage to the environment, health, property damage or other loss. An incident can be a single occurrence or a series of occurrences;

4. **Risk** is measured in terms of a combination of the consequences of an incident and their likelihood;
5. **Likelihood** is the probability of occurrence;
6. **Consequence** is the severity of an outcome or incident;
7. **Risk control** is measures that eliminate or reduce the risks, associated with the identified hazards, as far as practicable;
8. **Risk evaluation** is the process of comparing the level of risk against risk criteria; and
9. **Risk analysis** is the systematic process to understand the nature of and to reduce the level of risk. The risk analysis details the likelihood and consequence of an incident occurring and investigate the effectiveness of existing risk control measures th at have been implemented to reduce and control risks or minimise environmental impacts and determine further prevention and mitigation measures that need to be and implemented. Prevention and mitigation measures consider the physical and operational means by which the risks are mitigated.
10. **Prevention measures** *lower the probability of a scenario occurring.* Determines how well the environmental risk is currently being controlled and what further action is needed to improve risk reduction strategies; and
11. **Mitigation measures** *lower the severity of the consequences.* Assesses the effectiveness of the current emergency measures in place and what further action is needed to improve emergency planning and response strategies.

Risks were identified for all processes, activities, products and services associated with the carriage, handling and storage of dangerous goods in the MRC Member Countries. The following section explains the methodology used.

2.3 RISK ASSESSMENT PROCESS

The preparation of a risk assessment is a critical element in the risk analysis of dangerous goods. Figure 4 on the next page illustrates this process of identifying hazards, and evaluating and controlling risks.

Risks must be identified for all processes, activities, products and services associated with the carriage, handling and storage of dangerous goods. Unfortunately, in some of the MRC Member Countries, a risk assessment has not been completed before. There are limited operational, legal or regulatory frameworks available and records of accidents, to determine the cause and severity of incidents, are also limited. This Risk Assessment is therefore an important step to determine the baseline conditions of the transportation of dangerous and priorities areas for improvement.

The transport of dangerous goods chain encompasses a wide range of systems including storage of dangerous goods and hazardous substances, handling and transportation, and waste disposal. The transport and storage of dangerous goods involves many elements in complex, interdependent and dynamic relationships. The system consists of objects of transport (goods and people), technical means of vessel, port/terminal infrastructure and facilities, management and operations, documentation and human resources. Human factors are very important to evaluate in the system since they design, develop, build, operate, manage, regulate and interact with other elements of the system.

Dangerous goods in bulk and packaged dangerous goods are carried onboard different types of vessels including tankers, general cargo vessels and ferries. The common practice is that different regulations apply for different vessels. At this stage, however, the study tried to look at the most critical activities and operations onboard. A similar approach was taken for ports and terminals where petroleum terminals, ports and floating fuel stations are primarily used for the storing and handling dangerous goods for the domestic and international trade of petroleum products. This study prepared a comprehensive risk assessment that covered all the critical activities and operations, possible hazards, consequences to evaluate the risks for vessels, ports and terminals. The risk assessment specifically focussed on the activities and operations involved with the transport of dangerous goods in the MRC Member Countries. The following sections provide an overview of dangerous goods and the associated risks.

Figure 4: **Risk Management Process**

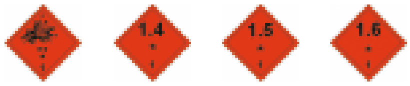
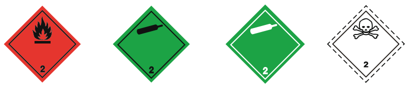
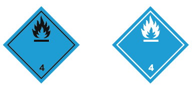
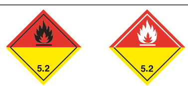
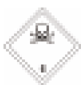
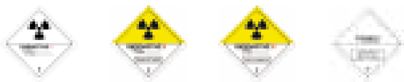
2.4 DANGEROUS GOODS

Dangerous goods may be explosive, flammable, combustible, spontaneously combustible, oxidising, water-reactive, toxic or corrosive (see Annex 1). They can be deadly and seriously damage property and the environment so it is important that they are stored and handled safely.

2.4.1 Definitions and Terminology

Dangerous goods are classified on the basis of immediate physical or chemical effects, such as fire, explosion, corrosion and poisoning affecting property, the environment or people. The International Maritime Dangerous Goods (IMDG) Code classifies dangerous goods in different classes, subdivides a number of these classes and defines and describes characteristics and properties of the substances, material and articles within each class or division. These classes or divisions are as listed below in Table 2.

Table 2: **IMDG Code Dangerous Goods Class or Divisions**

Class	Symbol	Description
1		Explosive substances and articles
2		Gases 2.1: Flammable gases 2.2: Non-flammable, non-toxic gases 2.3: Toxic gases
3		Flammable liquids
4.1		Flammable solids, self-reactive substances and desensitised explosives
4.2		Substances liable to spontaneous combustion
4.3		Substances which, in contact with water, emit flammable gases
5.1		Oxidising substances
5.2		Organic peroxides
6.1		Toxic substances
6.2		Infectious substances
7		Radioactive material
8		Corrosive substances
9		Miscellaneous dangerous substances and articles

Many of the substances assigned to Classes 1 to 9 are deemed as marine pollutants. Certain marine pollutants have an extreme pollution potential and are identified as severe marine pollutants. These pollutants will also have an impact on the Mekong River and have been included in the Risk Analysis. It is important to consider the physical and chemical properties of dangerous goods to determine the risk associated with storage and handling. Table 3 below shows the intrinsic properties of the dangerous goods classes.

Table 3: **Intrinsic Hazardous Properties of Dangerous Goods**

Hazard	Class/Division (including Sub-risks)											
	2.1	2.2	2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	8	9
Flammability	■			■	■	■	■		■			■
Chemical explosion	■			■	■							
Physical explosion	■	■	■									
Physical and chemical explosion	■											
Explosive atmosphere	■			■		■						
Toxic by inhalation			■							■		
Toxic by skin/eye contact										■	■	
Toxic by ingestion										■		
Temperature sensitivity						■			■			
Asphyxiation risk		■										
Corrosiveness											■	
High reactivity					■	■	■	■	■			
Chemical instability								■	■			
Hazardous decomposition						■	■	■		■	■	
Environmental pollutant										■		■

The IMDG Code is incorporated into rules and regulations for maritime, rail road and inland water transport. The following international standards have adopted the IMDG Code for inland navigation:

- ADN Regulations 2009: European Agreement concerning the carriage of dangerous goods;
- International Safety Guide for Inland Navigation Tanker Barges and Terminals; and
- Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas, IMO, 1995.

It is especially important in ports and terminals to ensure that different classes of dangerous goods are segregated to ensure that incompatible substances are not stored together.

2.4.2 Incompatible Goods

Two or more goods are incompatible provided their interaction gives rise to any of the following outcomes:

- harm to persons, property or the environment;
- fire, or explosion, generation of toxic, flammable or corrosive vapours/gases;
- accelerate the combustion of other goods/liquids in the event of fire;
- release of the contents results in the premature degradation/corrosion of other dangerous goods or combustible liquids' packaging/means of containment; and
- in the event of a fire/spill/release, the interaction of dangerous goods/combustible liquids with incompatible firefighting or dispersal media. Some materials are water reactive and should be stored away from other goods that are reliant on water or foam as a firefighting/ dispersal/suppression media).

A compatibility chart is used to ensure that incompatible dangerous goods are segregated and adequately stored according to class (Table 4).

Table 4: **Example of Compatibility Chart for Dangerous Goods**

Class of Goods	2.1	2.2	2.2	2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	8	9	Combustible Liquids
2.1	✓ A	✓ B	✗ S1	✗ S1	✗ S2	✗ S2	✗ S4	✗ S5	✗ S2	✗ S4	✗ S1	✗ S1	✓ C	✗ S2
2.2	✓ B	✓ A	✓ B	✗ S1	✗ S2	✗ S2	✗ S4	✗ S5	✓ B	✗ S4	✓ B	✗ S1	✓ C	✗ S2
2.2	✗ S1	✓ B	✓ B	✗ S1	✗ S2	✗ S2	✗ S4	✗ S5	✗ S2	✗ S4	✓ C	✗ S1	✓ C	✗ S2
SR 5.1	✗ S1	✓ S1	✗ S1	✓ I	✗ S2	✗ S2	✗ S4	✗ S5	✗ S2	✗ S4	✓ C	✗ S1	✓ C	✗ S2
2.3	✗ S2	✗ S2	✗ S2	✗ S2	✓ A	✗ S3	✗ S4	✗ S5	✗ S2	✗ S4	✗ S3	✓ B	✓ B	✓ B
3	✗ S2	✓ S2	✗ S2	✗ S2	✗ S2	✓ A	✗ S4	✗ S5	✗ S2	✗ S4	✗ S3	✓ B	✓ B	✗ S2
4.1	✗ S4	✗ S4	✗ S4	✗ S4	✗ S4	✗ S4	✓ A	✗ S5	✗ S4	✗ S4	✗ S4	✓ B	✓ B	✗ S4
4.2	✗ S5	✗ S5	✗ S5	✗ S5	✗ S5	✗ S5	✗ S5	✓ A	✗ S5	✗ S5	✗ S5	✗ S5	✓ G	✗ S5
4.3	✗ S2	✓ B	✗ S2	✗ S2	✗ S2	✗ S2	✗ S4	✗ S5	✓ D	✗ S4	✓ C	✗ S3	✓ C	✗ S3
5.1	✗ S4	✗ S4	✗ S4	✗ S4	✗ S4	✗ S4	✗ S4	✗ S5	✗ S4	✓ E	✓ CE	✗ S4	✓ CE	✗ S4
5.2	✗ S1	✓ B	✓ C	✓ C	✗ S3	✗ S3	✗ S4	✗ S5	✓ C	✓ CE	✓ A	✓ H	✓ B	✗ S3
6.1	✗ S1	✗ S1	✗ S1	✗ S1	✓ B	✓ B	✓ B	✗ S5	✗ S3	✗ S4	✓ H	✓ F	✓ C	✗ S3
8	✓ C	✓ C	✓ C	✓ C	✓ B	✓ B	✓ B	✓ G	✓ C	✓ CE	✓ B	✓ C	✓ A	✓ B
9 Combustible liquids	✗ S2	✗ S2	✗ S2	✗ S2	✓ B	✗ S2	✓ S4	✗ S5	✗ S3	✗ S4	✗ S3	✗ S3	✓ B	✓ A

✓	May be compatible in many cases with exceptions. Follow the alphabetical compatible goods guidance notes.
×	Likely to be incompatible. Segregation strongly recommended, follow the segregation of guidance notes for incompatible goods.
S1	Segregate these goods by 3 m or more in a well ventilated area. For liquid dangerous goods, the distance is measured from the edge of the spill catchment area. See supplementary notes 6 and 7.
S2	Segregate by 5 m or more. If one of the dangerous goods is a liquid, measure the distance from the edge of the spill catchment area. Liquid dangerous goods should be located within a separate spill catchment area. See supplementary notes 6 and 7.
S3	Segregate by 3 m or more for PG III goods and 5 m or more for PG II, PG I goods or where the goods may react dangerously. If both are solids then a minimum of 1 m separation may be used. Where one of the goods is a liquid, the distance is measured from the edge of the spill catchment area. See supplementary notes 6 and 7.
S4	Segregation preferred by the use of fire-rated partitioned areas. Consider use of separate detached buildings for organic peroxides and for highly pyrophoric class 4.2 goods.
S5	Segregation of Class 4.3 preferred by use of a separate, detached building without water based fire suppression system.

It is important to consider firstly the hazards intrinsic to the dangerous goods. The next step is to also identify hazards that are external to the goods. This includes all other substances, structures, plant, systems of work and activities used in the storage and handling of dangerous goods or not directly involved with dangerous goods but that could impinge on safety and protection of the environment.

2.4.3 Risk Assessment

When conducting risk assessment for dangerous goods it is important to consider the chemical and physical properties and the critical activities and operations associated with the storage, handling and transport.

Risk, in relation to dangerous goods to property or the environment, is the probability of dangerous goods causing unreasonable damage or harm to property or the environment. In relation to people, this is the probability of dangerous goods causing the death or injury to one or more individuals.

Risk assessment, in relation to the dangerous goods handled or stored at a port or terminal or transported by vessel, should be a detailed evaluation that:

- identifies all hazards relating to dangerous goods at the site;
- for each hazard, determines the likelihood of the hazard causing a dangerous goods incident;
- nature of the harm to people, property and the environment that would result from the occurrence of that incident; and
- for each hazard, identifies risk control measures;

When preparing a risk assessment for dangerous goods, the following key risk factors were considered in relation to ports, terminals and vessels:

- failure of containment leading to spillage or leakage of goods (e.g. failure of tank containing the goods, including cargo pipes, during transfer from terminal and vessels);
- fires and explosions resulting from the nature of the dangerous goods;

- storages of combustible liquids, other combustible materials and the compatibility of dangerous goods;
- mechanical and electrical equipment used with or near the dangerous goods (e.g. heat or ignition sources);
- location of tanks, sheds, warehouses and buildings near or in which the dangerous goods are stored or handled;
- unauthorised access to ports and terminals
- confined or enclosed spaces increasing risks;
- maintenance tasked performed by personnel;
- type and quantity of dangerous goods stored, quantity is a key risk factor.

Physical and human components have the potential to increase the risks of dangerous goods causing harm to property, people and the environment. The following was considered when preparing the risk assessment for ports, terminals and vessels:

- systems of work, safe operating procedures, emergency response measures and management;
- process for inspection of ports, terminals, vessels and associated equipment;
- authority control, rules, regulations and technical requirements;
- private sector cooperation with local emergency response and fire authorities;
- transfer of dangerous goods from vessels to ports terminals;
- proximity of operations to important wetlands, local communities and public infrastructure; and
- weather conditions such as wind, lightning or rainfall including the potential for flooding.

2.4.4 Consequences of Dangerous Goods Incidents

The consequences of a possible incident involving dangerous goods can have severe consequences, the risk assessment considered the potential for:

- water pollution and adverse effects on sensitive environments;
- harm to people at the port, terminal and onboard the vessels;
- "knock-on" effects involving increased risks to or from other dangerous goods or substances at the site from fire, explosion damaging critical public infrastructure;
- injury and illness to people outside the site (e.g. could public works and infrastructure be affected, including nearby facilities such as factories, schools, food processing or local communities);
- risks to other dangerous goods stores or handling areas in the vicinity of port, terminal and vessel operations; and
- trans-boundary pollution.

A standard risk assessment was developed to be used in the MRC Member Countries at selected ports, terminals and vessel operations, taking into account the critical operations and activities, possible hazards in relation to critical activities and operations related to dangerous goods storage and handling. The risk analysis methodology is described further in the following section.

2.5 RISK ANALYSIS METHODOLOGY

The NAP developed a risk analysis methodology for the National Working Group members to undertake risk assessments at ports, terminals, vessels and ferry crossings in the Member Countries.

2.5.1 Risk Register

The risk register was a standard risk assessment template developed for ports, terminals and ferry crossings to be used in all the MRC Member Countries. The risk register was based on international standards and leading industry practices. Risk registers or risk assessment tools are developed to:

- provide useful tools for managing and reducing the risks identified before and during projects;
- document risk mitigation strategies being pursued in response to the identified risks and their grading in terms of likelihood and consequence;
- provide management and relevant line agencies with a documented framework from which the status of risk can be reported;
- ensure the communication of risk management issues to key stakeholders;
- provide a mechanism for seeking participation and to encourage the involvement of the key stakeholders; and
- identify the mitigation actions required for implementation of risk management plan and feasibility studies.

The risk register in this study was used to identify hazards, evaluate risks and determine the existing prevention and mitigation measures. The risk register included:

- a unique numerical identifier for each risk;
- a description of specific activities and operations and the associated hazards;
- evaluation of risks (likelihood and possible consequence); and
- a risk matrix to determine the level of potential risks.

The risk register was specifically formulated following national consultations, site visits and taking into account risk assessment methodology for dangerous goods. An example of the blank risk register used is shown below (Table 5).

Table 5: **Blank Risk Register for Risk Analysis of Carriage, Handling and Storage of Dangerous Goods**

Number	Activity/ Operation	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measure	Risk Rating		Risk Level	Determine Prevention and Emergency Response Measures
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		

The risk register is a semi-quantitative technique; this means that the assessment has qualitative and quantitative components. If the same dangerous goods and similar work processes are used in a number of locations, it is possible to develop standard risk assessment templates applicable to ports/

terminals (see Annex 2) and vessels/ferry crossings (see Annex 3) in the Member Countries. All relevant factors and variables were taken into account. Three standard risk registers were developed for ports and terminals, vessels and ferry crossings. The following are the main components of each register:

1. activity/operations;
2. possible hazards;
3. possible consequences;
4. risk (environment, safety, property damage, stakeholders);
5. existing prevention and emergency response measures;
6. risk rating;
7. risk level; and
8. determine prevention and emergency response measures to be implemented.

The risk management process is illustrated below (Figure 5) and the following sections explain further the specific components of the risk registers and the risk management process.

2.5.2 Activity and Operations

All of the critical activities and operations related to dangerous goods at the selected ports, terminals and vessels. The critical activities and operations were developed by the NAP in consultation with Member Countries.

2.5.2.1 Possible Hazards

This component determines the possible hazards associated with the critical activities and operations: what can go wrong. Hazard identification is the most important step in the risk assessment process. This involves the identification of hazards, causes and contributing factors to incidents in the transportation of dangerous goods. The hazard identification technique used was a systematic examination of planned or existing processes in operations and activities to identify and evaluate problems that may represent risks to personnel, equipment, environment and local communities. In the risk register, the possible hazards and associated consequences were detailed by the NAP. All the possible hazards relating to dangerous goods at ports, terminals and vessels were identified at the selected sites. The risks associated with each hazard were then evaluated in terms of the likelihood of harm and the possible consequence of an incident.

2.5.2.2 Possible Consequences

The possible consequences were evaluated in relation to the severity and the likelihood of an incident occurring. The possible consequences of dangerous goods include oil spills, release of toxic gas, fire, explosion, injuries or fatalities and can pose risks to local communities. For dangerous goods, the possible consequences can range from minor to catastrophic. The severity depends on:

- type and quantity of dangerous goods stored;
- operating conditions of the ports, terminals and vessels; and
- external factors increasing the risks of possible incidents.

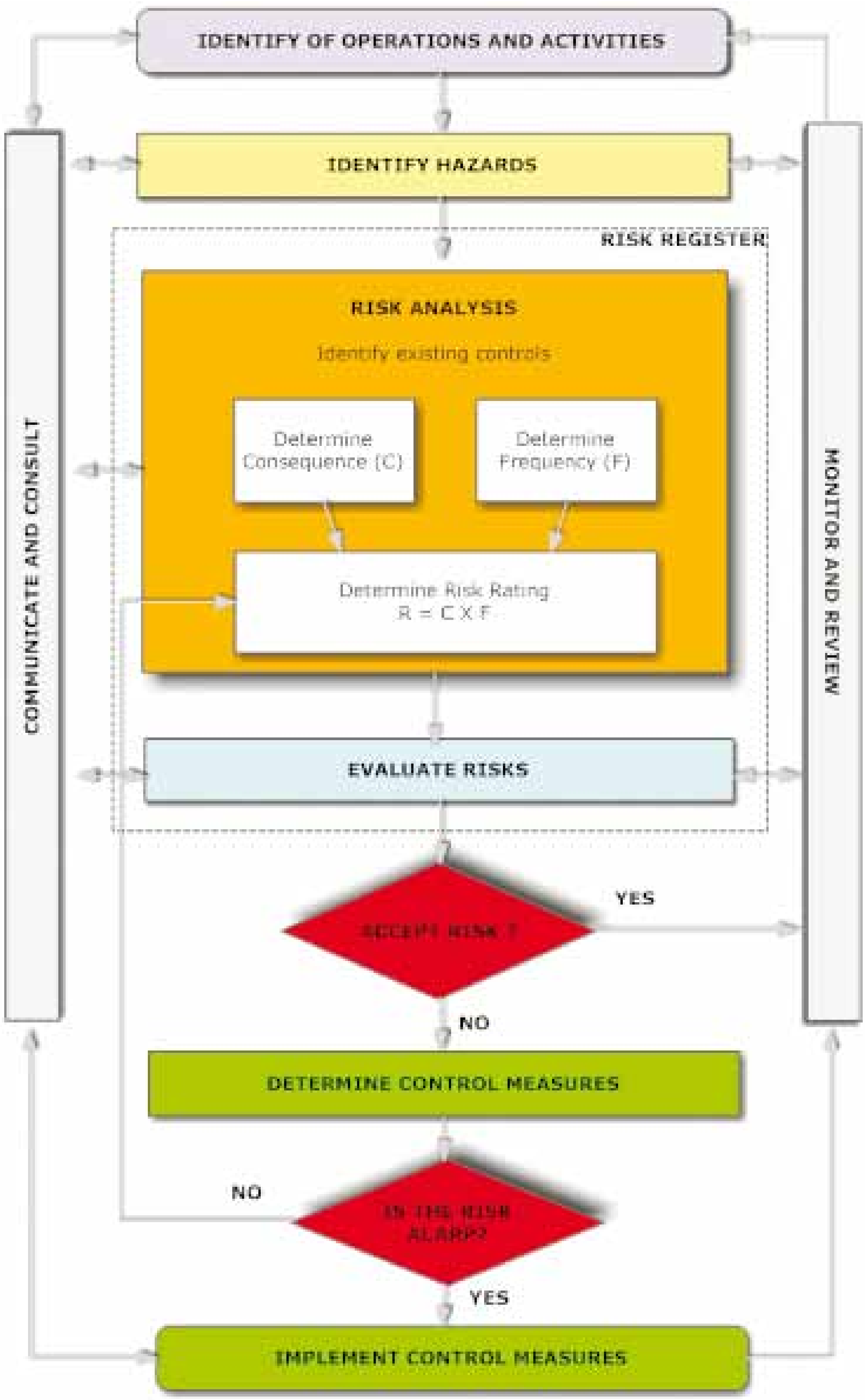


Figure 5: **Risk Management Process and Risk Register**

2.5.2.3 *Risks*

The possible consequences were grouped into the following four risk categories:

1. **Environment** risks of pollution to surface water, ground water, air, soil/land, natural resources, and flora and fauna;
2. **Safety** risks to the health, safety and security of personnel and community;
3. **Property** risks vessels, terminals, public infrastructure and other vessels and commercial operations; and
4. **Stakeholders** risks to the interests of public and private stakeholders, relevant line agencies, commercial operations, loss of trade and public relations.

2.5.2.4 *Existing Prevention and Emergency Response Measures*

Before the possible consequences of a hazard can be determined, the existing risk control measures were evaluated at the selected ports, terminals and vessels. Risk control measures include:

- **Procedural** such as checklists, safe work procedures, work processes, hazard analysis and emergency response plans;
- **Human resources** such as knowledge and skills, training, supervision, communication and emergency response drills;
- **Engineering design** such as construction and design of ports, terminals, vessels and systems of work;
- **Maintenance** such as the maintenance and use of proper equipment;
- **Safety equipment** such as firefighting, fire detection, alarms and personal protective equipment (PPE); and
- **Oil spill response equipment** such as absorbent pads and booms for oil spill response and bunding for the containment of spills.

2.5.2.5 *Risk Rating*

Evaluating risks is important for determining priorities for the implementation of risk control measures; prevention and mitigation The National Working Group measures evaluated the risks and determined a risk rating for each identified hazard. The risk rating is a combination of the frequency (F) and the likelihood of the incident occurring and the severity of the possible consequences (C). The severity of the possible consequences related to the risks to environment, safety, property and stakeholders is illustrated in Table 6 below.

Table 6: **Severity of Possible Consequences (C)**

C	Severity	Safety	Property	Environment	Stakeholders
4	Catastrophic	Multiple fatalities. Local communities and public affected.	Total loss. Extensive costs to replace.	Long-term environmental impairment of ecosystem functions. Trans-boundary pollution and major regional and national spill response.	International media. Port, terminal or vessel operations cease. Long- term loss of trade.
3	Severe	Single fatality or multiple severe injuries	Severe structural damage. High costs to repair and service.	Serious medium term environmental effects. National spill response required.	Bad national publicity. Port, terminal or vessel operations restricted temporarily. Medium-term loss of trade.
2	Significant	Multiple or severe injuries	Structural damage. Low costs.	Moderate short-term effects of pollution and minimal response required	Bad national and local publicity. Port, terminal or vessel operations restricted temporarily. Short-term loss of trade.
1	Minor	Minor injuries	Minor structural and equipment damage. Minimal costs.	Non-significant spill, minor pollution. Local response needed.	Bad local publicity or short-term loss of revenue

The severity of possible consequences is scored between one and four from minor to catastrophic. The score for possible consequences is used to determine the risk rating in combination with the frequency. A similar process is used to determine the frequency; the likelihood of an incident occurring. Frequency analysis is used to estimate how likely it is that various incidents or hazards will occur. In this risk assessment methodology the definitions are indicated in Table 7 below.

Table 7: **Frequency of Incidents Occurring (F)**

F	Frequency	Definition
4	Very likely possibility of repeated incidents	More often than every six months
3	Likely possibility of isolated incidents	Once per five years. The scenario has occurred in the past and/or could occur in the future
2	Unlikely, not likely to occur	Once per 10 years. The scenario is considered unlikely.
1	Very unlikely	Once per 30 years or more

Frequency is scored from one (very unlikely) to four (very likely). The scores for severity of possible consequences and frequency were obtained using the information in Table 3 and 4 to determine the risk rating. The process to determine the risk rating (R) is to multiply the scores for Severity (C) by Frequency (F):

R = C X F

Where:

- R = Risk rating;
- C = Severity of possible consequences; and
- F = Frequency.

For example, if a risk has a frequency of one and a severity of four this could be multiplied together to produce a risk factor of four. Another risk could have a frequency of three and a severity of four giving a risk factor of twelve. This means that the second risk is higher than the first and should be dealt with immediately or in the short term. Risk ratings are then used to determine the risk level to ensure risks are prioritised effectively.

2.5.2.6 Risk Level

Once the risk rating is determined, the risk matrix below in Table 8 is used to indicate the risk level and determine whether the risk is acceptable based on the risk ratings; potential severity (C) and the likelihood (F).

Table 8: **Risk Matrix**

CONSEQUENCE					
	Catastrophic 4	Medium 4	Medium-high 8	High 12	High 16
	Severe 3	Low 3	Medium 6	Medium-high 9	High 12
	Significant 2	Low 2	Medium 4	Medium 6	Medium-high 8
	Minor 1	Low 1	Low 2	Low 3	Medium 4
		Very unlikely 1	Unlikely 2	Likely 3	Very Likely 4
		FREQUENCY			

The risk levels are used to determine whether the risks are acceptable and then to prioritise the implementation of risk control measures; prevention and mitigation (Table 9).

Table 9: **Implementation of Risk Priority Levels**

LOW **1-3**	Acceptable	No further additional controls/preventive actions are necessary, but considerations should be given to cost effective solutions or improvements.
MEDIUM **4-6**	Tolerable	Efforts should be made to reduce risk, but the costs of prevention should be carefully measured and limited. Risk reduction measures should normally be implemented within a defined period of time.
MEDIUM-HIGH **8-9**	Not Tolerable	Risk level should be reduced. Additional measures should be cost-effective but reduce the risk. If control measures are not possible to reduce the risk, then the work should not be repeated in the future.
HIGH **10-16**	Not Tolerable	Operation should not continue until the risk level has been reduced. Additional measures should be cost-effective but reduce the risk. If control measures are not possible to reduce the risk, even with unlimited resources, then the work must not be started.

2.5.2.7 Determine Prevention and Mitigation Measures

Once the risk levels were estimated (Table 10), the National Working Group members documented the existing risk control measures and considered additional risk control options and list measures required at the ports, terminals and vessels. Additional measures need to be implemented to reduce the risk levels to as low as reasonably practicable (ALARP).

Table 10 illustrates two possibilities to reduce the risk. First is to reduce the frequency (white arrow) of an accident incident from happening. These are called prevention measures. Second is to reduce the consequence (grey arrow) in case an accident or incident happens. These are called mitigation measures.

Prevention measures are intended to remove the causes of incidents or reduce the likelihood of an incident occurring. The hazard remains but the frequency of incidents involving the hazard is lowered. Control measures taken **before** an accident/incident, emergency, loss or problem occurs. For example, valves could be isolated to enable safe maintenance work, operating procedures and instructions.

Table 10: **Risk Matrix**

CONSEQUENCE	Catastrophic 4	Medium 4	Medium-high 8	High 12	High 16
	Severe 3	Low 3	Medium 6	Medium-high 9	High 12
	Significant 2	Low 2	Medium 4	Medium 6	Medium-high 8
	Minor 1	Low 1	Low 2	Low 3	Medium 4
		Very unlikely 1	Unlikely 2	Likely 3	Very Likely 4
		FREQUENCY			

Mitigation measures are intended to reduce the severity of the consequences of an incident, ensuring that there are measures in place to respond effectively to incidents, i.e. contingency planning and emergency response. They may be considered as the "last line of defence" if the risk cannot be reduced to a negligible level by other means.

Control Measures are taken **after** an accident/incident, emergency, loss or problem has occurred. Examples include fire suppression systems, fire detection systems, emergency planning and procedures.

Figure 6: **Prevention and Mitigation Measures**

2.6 RISK EVALUATION

The completed risk registers from the MRC Member Countries were analysed by NAP Office to evaluate the risk levels and determine priority areas for implementation.

2.6.1 Risk Management Approach

Trade and the transport of dangerous goods are increasing in the Lower Mekong Basin and unless ports, terminals and vessels are managed effectively the risks of incidents and major disasters will also increase. Therefore the long term goal of the Risk Analysis is to increase the efficiency of ports and terminals by reducing the risks for accidents in ports and on vessels or waterways so that the ecological health of the river is not compromised by the transportation of dangerous goods and loss-of life incidents are seriously reduced.

To contribute to this goal, risk management methodology was used to determine the prevention and mitigation measures that are both technically and financially feasible for all identified risks and impacts (Figure 7). A reasonable approach has to be maintained because the development of such measures takes time, allocation of resources, capacity building and public and private funding.

The National Working Group members visited selected sites to complete the risk registers and determine the risk level in the MRC Member Countries. The risk registers identified the hazards and determined the level of risk which would cause most harm to the environment, people and local communities if an accident occurred.

2.6.2 Priority Areas

Risk evaluation is the process of comparing the level of risk against risk specific risk criteria. This allows priority areas to be determined. Priority therefore goes to finding risk control measures that will prevent or reduce the harm of explosions, fire, spillages and pollution which have the most severe possible consequences on people and the environment.

2.6.2.1 Existing Standards in Member Countries

The current risk levels and existing prevention and mitigation measures were determined by the National Working Group members using the risk registers. The level of the standards existing or applied in each of the Member Countries was determined using the criteria illustrated below in Figure 8.

The levels of the existing standards in the Member Countries will vary, depending particularly on rules, regulations, compliance and monitoring activities and the size and type of the ports and terminals. The level of the standards existing was scored (ranging from 4 indicating very high levels of risk controls to 0 indicating that no risk controls are available).

2.6.2.2 Risk Criteria

The existing standards from the Member Countries were then compared with the following risk criteria:

- international benchmarks;
- causal factors of major incidents in the maritime, IWT and petroleum industries; and
- possible severity of impacts derived from fire, explosion and pollution incidents.

The level of international benchmarks for risk control and consequences and impacts derived from the risks of explosions, fire, injury/fatality and pollution (ranging from 4 indicating most severe possible impacts to number 0 for none or very low impact)

2.6.2.3 Calculating Priority Areas

The current risks controls and existing stands at the ports, terminals and vessels in the Member Countries from the risk registers was categorized as shown in Table 11 below.

Table 11: **Risk Controls in the Member Countries**

Risk Controls (Very Low) 0-1	Very low degree of conformity with applicable standards and a number of deficiencies. There are not adequate management systems, equipment and risk controls in place to prevent or mitigate incidents.
Risk Controls (Low) 2	Low degree of conformity with applicable standards and some deficiencies. There are only limited management systems, equipment and risk controls in place to prevent or mitigate incidents.
Risk Controls (Medium) 3	Medium level of compliance with existing standards and there are management systems and risk controls in place to prevent or mitigate incidents. Management and training requires improvement and risk controls are not effectively monitored.
Risk Controls (High) 4	Management systems and risk controls for prevention and mitigation have been implemented and are regularly monitored. Management and employees have capacity and are fully trained and can manage risks associated with operations.

The current risk controls were compared to the following risk criteria:

- consequences of potential incidents in relation to pollution, fires and explosions and riparian communities;
- causes of major incidents in the maritime, IWT and petroleum sectors; and
- regional and international benchmarks.

The priority area is derived from the comparison between the risk criteria, and the level of standards existing or currently being applied in each of the MRC Member Countries as shown in Table 12 below.

Table 12: **Definition of Priority Areas**

Priority Area 4 High	The situation is very critical, implying that the situation requires urgent intervention. Risks are very high and there is high potential for major environmental degradation, impacts on riparian communities and loss of life.
Priority Area 3 High	The situation is critical and will require improvement in the short term. Risks for death or personal injury are high and there is high potential for environmental degradation and impacts on riparian communities.
Priority Area 2 Medium	The situation requires improvement in the medium term. Medium standards but not high quality. There is conformity but still uncontrolled equipment available but quality not acceptable. Skills, capacity and management require improvement. Risks are there and could still result in personal injuries and environmental damage.
Priority Area 1 Low	The situation is under control and requires regular monitoring and risk assessment. High standards, high level of conformity, management systems are functioning well, equipment well maintained. Capacity, awareness, training and overall management excellent.

This methodology will be explored further in the Ports and Terminals chapter and the Vessels chapter, specifically for risk evaluation and to determine the priority areas for ports, terminals, vessels and ferry crossings.

1. **Activity/Operations;**
2. **Possible Hazards; and**
3. **Possible Consequences**

NAP and National Working Groups

- Consultation, site visits, questionnaires and MRC Regional Risk Assessment Workshop.

4. **Risks;**
5. **Existing Prevention and Mitigation Measures;**
6. **Risk Rating; and**
7. **Risk Level;**

National Working Groups

- Completed risk registers at selected ports, terminals, ferry crossings and vessels.

8. **Determine Prevention and Mitigation Measures; Risk Evaluation.**

Navigation Programme (NAP)

- Analyse the risk registers and questionnaires;
- Risk Evaluation, compare risk level against specific risk criteria; and
- Determine priority areas for implementation.

Figure 7: **Risk Assessment Process for Risk Analysis of the Carriage, Handling and Storage of Dangerous Goods**

Storage

- Type and class of dangerous goods
- Quantity of dangerous goods

Risk Controls

- Safety measures at the ports, terminals and vessels
- Regulation, compliance and monitoring
- Emergency response preparedness.

Location

- Water intake (drinking); protected area/important wetlands
- Trans-boundary pollution; and proximity to urban population and local communities

Figure 8: **Criteria Used to Determine Level of Existing Standards**

3. PORTS AND TERMINALS

3.1 IDENTIFICATION OF OPERATIONS AND ACTIVITIES

3.1.1 Introduction

The safe operation of ports and terminals depends on a broad range of critical operations and activities that are undertaken on a regular basis. The execution of these critical operations and activities can create hazards that, if not properly addressed, can have disastrous consequences. The risks associated with these hazards must be carefully evaluated to establish cost-effective and efficient prevention and mitigation measures. The goal of these prevention and mitigation measures must be to reduce risks to an acceptable level.

A standard risk register for ports and terminals was developed following consultation and site visits with National Working Groups in the MRC Member Countries. The ports and terminal risk register was standardised intentionally as the overall objective is to develop at a harmonised system for the storage and handling and of dangerous goods in port areas and terminals along the Mekong River. The risk analysis will determine the baseline conditions in each of the Member Countries to evaluate the level of risks, existing control measures and the future priorities.

3.1.2 Ports and Terminals Hazard Groups

The preparatory step in drafting the risk register was to identify and describe all the major operations and activities associated with the storage and handling of dangerous goods in ports areas and the storage and handling of petroleum and hazardous substances in terminals. The risk register is a comprehensive assessment tool, enabling a more structural analysis. The critical activities and operations were combined into the following hazard groups:

1. infrastructure and superstructure
2. mechanical equipment

3. electricity
4. operations
5. maintenance
6. human elements
7. management and regulations
8. global events
9. additional

These nine hazard groups have subsequently been analysed and divided into key components which are criticals. The failure of any of these key components has the potential to increase risks to the environment, safety of personnel, members of the public, property or stakeholders. The main concept in establishing the risk register was to determine what items present in a port area or a petroleum/chemical terminal can influence environment, safety, property or risks to stakeholders. Several terminal layouts and port areas were taken into consideration.

Each component was analysed and all connected activities and operations were identified and evaluated. Key components may be connected to several activities and operations. For example, a cargo pump is a critical component in terminal and port areas. Possible activities and operations connected are loading and discharging operations and also maintenance to ensure safe and continuous operation of the cargo pump. This was taken into account in the risk registers. The main activities/operations are defined as follows:

- **All** can be applied to several activities and operations. For example, correct Personal Protective Equipment (PPE) must be worn for all tasks, not only activities relating to the loading/discharging of dangerous goods;
- **Loading/discharging** (cargo operations) is transfer of dangerous goods to and from a port area/terminal;
- **Maintenance** is fixing, repairing or servicing of all equipment;
- **Management** is all actions that relate to planning, resourcing, monitoring and controlling operations;
- **Design** is a plan or a convention for the construction of an object or system;
- **Incident** is an occurrence that can lead to severe consequences;
- **Emergency** is a sudden, urgent, usually unexpected occurrence that requires immediate action;
- **Spill** occurs when the contents of something, usually in liquid form, spills onto a surface;
- **Storage** relates to storage tanks and designated storage in port areas and terminals;
- **Safety and quality management** is a systematic way of ensuring operations and activities are carried out as planned. Maintaining safety and quality management is a discipline concerned with preventing problems from occurring by creating attitudes and controls that make prevention possible.
- **Inspection** is a systemised approach involving measurement and testing in regard to an object or activity. The results are usually compared to specific requirements and standards for determining whether the item or activity is within these parameters.

- **Authorities and Regulations** includes legislation, regulations, compliance with legislation, monitoring implementation and inspection by authorities; and
- **Terminal or port management systems** are an overall plan, principles and guidelines for the safe operation of the port and terminal.

3.1.2.1 Infrastructure and Superstructure

The infrastructure hazard group contains all the fundamental facilities and systems of a port area or petroleum/chemical terminal. These are the core items of every port or terminal. The following items were included in the risk register for assessment:

- proximity to populated areas;
- access to port facilities;
- tank structure;
- cargo pumps;
- cargo pipes and hoses;
- valves;
- warehouses, sheds and other storage areas;
- cranes;
- waste reception facilities (all kinds of vessel waste);
- fixed firefighting equipment (pipes/pumps);
- portable firefighting equipment;
- fire detection equipment;
- gas detection equipment;
- personal protective equipment, safety equipment, first aid; and
- emergency equipment.

3.1.2.2 Mechanical Equipment

This hazard group contains all mechanical equipment used at petroleum terminals to perform and monitor cargo operations. For the port areas, all mechanical equipment used specifically for the transfer of dangerous goods was taken into consideration. The following items were included in the risk register for assessment:

- tank measurement instruments and capacity alarms;
- tank wagons;
- tank trucks;
- communication means;
- ordinary trucks and trailers;
- forklift trucks and reach stackers; and
- generators.

3.1.2.3 *Electricity*

This hazard group contains all electrical equipment, electrical installations and other electrical related equipment present in port areas and terminals. The following components were assessed in the risk register:

- high-voltage installations;
- all related cables and cabling;
- electrical equipment; and
- circuit breakers.

3.1.2.4 *Operations*

This hazard group contains all items concerning the transfer and storage of liquid bulk, dry bulk and packaged dangerous goods. The following components were assessed in the risk register:

- receiving/delivering of liquid bulk;
- storage of liquid bulk;
- receiving/delivering of dry bulk;
- storage of dry bulk;
- receiving/delivering of packaged dangerous goods;
- storage and segregation of packaged dangerous goods; and
- monitoring and control of stored cargo.

3.1.2.5 *Maintenance*

This hazard group contains all items related to fixing, repairing and overhauling devices. The following components were assessed in the risk register:

- maintenance of equipment; and
- hot work.

Hot work was important to include in the risk register as it is any process that can be a source of ignition when flammable material is present or can be a fire hazard regardless of the presence of flammable material.

3.1.2.6 *Human Elements*

This hazard group contains all items that can have influence or affect the capacity of a person to perform a certain operation. The following components were assessed in the risk register:

- working hours;
- education;
- experience;
- training; and
- communication and information.

3.1.2.7 Management and Regulations

This hazard group consists of items related to the management of ports and terminals and the compliance with existing regulations, technical requirements and terminal and port operating policy and procedures in use. The following components were assessed in the risk register:

- safety, quality and environmental management systems;
- inspection of port/terminal;
- terminal policy and procedures;
- security;
- emergency response plans and procedures;
- training;
- waste management
- drugs and alcohol; and
- authority control.

3.1.2.8 Global Events

This hazard group contains natural disasters and external events that can influence the safe operation of the port and terminal. Global events such as flooding, lightning, mud slides, heavy and prolonged rain storms, typhoons, high winds, tsunami or tidal wave and earthquakes were assessed in the risk register.

3.1.2.9 Additional

As the risk register is dynamic this section was created in the event that additional hazards were determined during the course of the risk assessment at the terminal and port areas related to the storage and handling of dangerous goods. National Working Groups were encouraged to use this section to determine critical activities/operations and the associated hazards and risks.

3.2 IDENTIFICATION OF HAZARDS AND POSSIBLE CONSEQUENCES

3.2.1 Introduction

Ports and terminals are viewed as the core of national and regional development. They generate important economic benefits and create jobs. They are organisationally, physically, legally and environmentally complex, with many stakeholders, many facilities and different organisations. The safety of port and terminal facilities, port workers and the surrounding communities, and the protection of the environment have become important issues that need to be addressed.

3.2.2 Ports and Terminals Hazard Groups

In the preparatory, step nine hazard groups were identified to facilitate the investigators to fill in risk registers when they made their assessments. These groups have subsequently been analysed and divided into key components. For each of the key components, all possible hazards were identified.

3.2.2.1 Infrastructure and Superstructure

1. Proximity to Populated Areas

The main hazards for ports or terminals handling dangerous goods located close to densely-populated areas are increased numbers of lives lost, persons injured or property damaged if an emergency arises. Emergency response plans must take into account the possibility that local communities will need to be evacuated, extra manpower necessary and more difficult access to the premises for emergency services. Increased frequency of trucks carrying dangerous goods on and off the premises increases the risk of those trucks getting involved in a road accident.

2. Access to Port Facilities

How easy is it for persons outside the port or terminal to gain access to areas where dangerous goods are stored? Does the port or terminal have surrounding fences, is there a security guard at the entrance, is the terminal equipped with closed-circuit television (CCTV) and does it comply with the International Ship and Port Security (ISPS) Code? The main hazard investigated in the risk register is the possibility of having uncontrolled access to port and terminal facilities. Uncontrolled access means there is a risk that members of the public could damage equipment, steal liquid bulk products, damage packaged dangerous goods or cause fires or explosions either deliberately or unintentionally.

3. Tank Structure

The risk register investigated all receptacles for the storage of liquids and gases at ports and terminals. The main hazards relating to the condition and structure of the tanks were considered. A tank collapsing or leaking can result in the spillage of flammable liquids and release explosive or toxic vapours. Figure 9 provides an example of the structure of an internal floating roof tank.

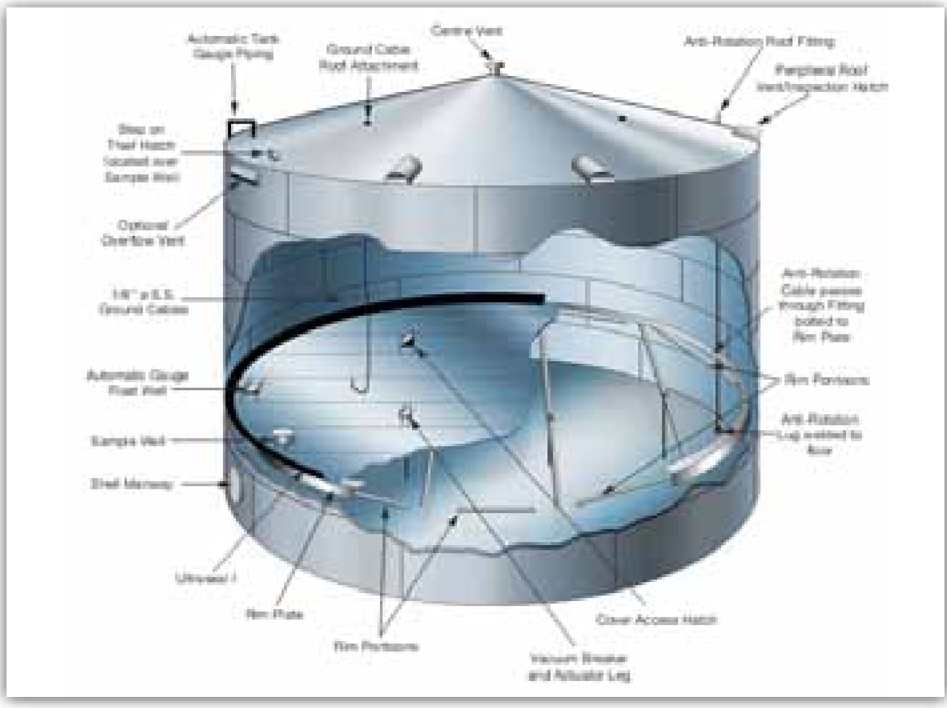


Figure 9: **Internal Floating Roof Tank**[1]

[1] http://www.landandmarine.com/TankServProducts/InternalFloatingRoof.aspx

4. Cargo Pumps

Cargo pumps (Figure 10) together with cargo pipes and hoses are the core of petroleum terminals. As cargo pumps are used on a daily basis, they should be regularly inspected and well maintained. Inspection and maintenance records should be kept and procedures developed for safe operations. The main hazards investigated were to determine what systems are in place to prevent pump failure, ensure pumps are not blocked or leaking and that there is a regular inspection of equipment. There are a number of risks associated with cargo pumps including the release of liquid toxic gas, inflammable or explosive vapours, fire, explosion, property damage, commercial loss, safety and pollution.

Figure 10: **Cargo Pumps**[2]

5. Cargo Pipes and Hoses

Cargo transfer hoses (Figure 11) and pipes (Figure 12) are often the cause of cargo spillage. They should be visually inspected for deterioration and damage at regular intervals. At least annually, they should be hydrostatically pressure tested to 1.5 times the maximum allowable working pressure (MAWP) to check for leakages or movement of end fittings. Records of these inspections should be kept during the service of the hose. Hoses in bad condition or deficient hoses should be immediately withdrawn from service. The main hazards associated with the use of cargo hoses and pipes include leaking, not being properly rigged and specifications not being followed.

Figure 11: **Cargo Transfer Hoses**[3]

Figure 12: **Cargo Pipes**

[2] http://www.bornemann.com/wanted/our-expertise-for-tank-storage-and--terminals-and-refineries/tank-terminals/the-netherlands---type-hc-370

[3] http://www.hellotrade.com/techflow-marine/cargo-offloading-and-loading-hose-system.html

Additional hazards could derive from:

- **no regular inspection**;
- **piping subject to surge pressure.** This is a sudden increase of pressure due to a change in fluid velocity caused by an unplanned pump trip or rapid valve operation. Surge pressure can cause rupture of the cargo hose which can lead to an extensive spill;
- **maximum allowable working pressure (MAWP) being exceeded.** MAWP is used as a reference by the United States Coast Guard. Other commonly-used terms are rated working pressure (RWP) and maximum working pressure (MWP);
- **gaskets leaking**; and
- **safety devices not working properly.** These could be pressure relief valves[4], emergency stop systems and powered emergency release couplings (PERC)[5] (Figure 13 and 14).

Figure 13: **Powered Emergency Release Coupling**[6]

Figure 14: **Pressure Relief Valve (painted blue)**

Cargo lines that are not in use during cargo transfer or all cargo lines when transfer is completed need to be covered with a blind flange and all matching bolts in position and well tightened. Cargo line not correctly blinded increase the risk of spillage in case of line up mistake. Figure 15 shows a cargo line that has not been blinded (this picture was made during one of the site assessment) and Figure 16 illustrates a correctly blinded cargo line.

[4] Pressure relief valve is a type of valve used to control or limit the pressure in a system or vessel which can build up by a process upset, instrument or equipment failure, or fire.

[5] Powered emergency release coupling (PERC) is a device that enables a rapid disconnection of marine loading arms from the vessel in case of an emergency such as fire onboard or excessive drift.

[6] http://www.fmctechnologies.com/LoadingSystems/Technologies/Accessories/EmergencyReleaseSystems-ERS.aspx

Figure 15: **Cargo Line Not Blinded**

Figure 16: **Correctly Blinded Cargo Line**

Other risks can be derived from:

- **no colour coding used.** Colour coding of cargo pipes is commonly used to make it easy for the operator to identify the correct line and to avoid mistakes;
- **insufficient pipe welding**;
- **piping located in areas with dense vehicle traffic.** If not properly protected, these are vulnerable to damage caused by impacts of vehicles which could lead to an extensive spill;
- **steam pipes not properly insulated.** This can cause injuries to personnel as it is visually not always clear if steam is running through the pipes;
- **no regular pressure test performed.** A hydrostatic pressure test should be performed at regular intervals to check the integrity of the pipes and hoses. A pressure test should also be performed in case the rated pressure of the hose has been exceeded;
- **no flame arrestors on vent lines.** Flame arrestors serve as a safety device and should be periodically inspected to make sure that they are free of dirt, corrosion or damage;
- **corrosion rates not regularly inspected.** This can cause reduction in the wall thickness of pipes, either external or internal. External corrosion can be caused by a contact point at a pipe support. Internal corrosion can be caused by the flow of liquid. The reduction of the wall thickness can eventually lead to a crack in the pipeline (Figure 17) or corrosion at the contact pipe of a pipe support (Figure 18).

Figure 17: **Corrosion Failure of Pipeline**

Figure 18: **Corrosion at a Contact Point at a Pipe Support**[7]

There are a number of hazards associated with cargo pipes and hoses as they are critical components of a terminal. Replacing a deficient hose during cargo transfer means commercial loss as the cargo operations need to be interrupted, cargo needs to be removed from the hose, the hose needs to be disconnected and a new section needs to connected. Rupture or leaking of a cargo hose can lead to an extensive spill with high cleanup costs or the release of liquid inflammable, toxic or explosive vapours which can have disastrous consequences such as fire or explosion.

6. Cargo Valves

Cargo valves are also critical components of terminals and port areas for discharging and loading cargo. Terminals have mainly two types of valves. These are manually-operated valves (Figure 19) and remotely-operated valves (pneumatic or hydraulic) (Figure 20). Manually-operated valves need the local attendance of an operator to open or close the valve. Remotely-operated valves are opened or closed from a location different from the valve. The main hazards associated with these types of valves are that they are blocked, leaking or fail to operate.

Figure 19: **Manually-Operated Valves**

Figure 20: **Remotely-Operated Valves**

[7] http://www.ammonite-corrosion.com/prot_coat.html

Other possible hazards can be derived from the following:

- **valves not properly labelled**. Valves can be labelled using numbers or letters;
- **indicator light not working.** Remotely-operated valves are provided with indicator lights so the operator can visually check if certain valves are open or closed;
- **emergency valves not readily accessible.** Emergency valves should be readily accessible; and
- **valves added to original system design.** Valves added to the original plant layout, mostly done with good intentions, can have disastrous consequences.[8]

The possible consequences of leaking valves include spillage, the release of flammable, toxic or explosive vapours and the interruption of cargo operations. Valves that are blocked or fail to operate can cause a reasonable increase of the pressure in cargo transfer pipes or hoses. In the event of emergency valves not being accessible this can lead to delayed emergency response.

7. Warehouse, Sheds and Other Storage Areas

Warehouse, sheds and other storage areas are commonly used for temporary storage of goods. If used to store dangerous goods, however, they need to meet certain requirements which depend on the kind of goods stored. Sheds are often used to store small amounts of dangerous goods. There are different kinds of sheds such as flammable liquid storage sheds (Figure 21), chemical sheds and waste oil sheds. Warehouses are usually used to store larger amounts of dangerous goods (Figure 22).

Figure 21: **Flammable Liquids Storage Shed**[9]

Figure 22: **Dangerous Goods Warehouse**

The main hazards involved with the storage of dangerous goods are that there is no proper segregation of the dangerous goods, the area or surface is not suitable for the storage of dangerous goods or the storage area itself is not suited for the storage of dangerous goods. The possible consequences are chemical reaction with other dangerous goods which can lead to fire, explosion or release of toxic vapours. Another hazard is that there is no or limited firefighting equipment available to respond to fires.

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[8] Chemical Process Safety – Learning from case histories, Roy E. Sanders

[9] http://www.shadesheds.com/flammable-liquid-storage.html

8. Cranes

This includes all lifting machinery used on the terminal premises to handle cargo transfer equipment such as cargo hoses and gangways and lifting machinery used in port areas to transfer dangerous goods to and from vessels (Figure 23). The main hazards associated with the operation of cranes in port areas and terminals include:

- **safe working load (SWL) being exceeded.** SWL indicates the load a crane can safely lift, suspend or lower and should be clearly marked on the crane;
- **lifting slings not being the approved type or used beyond their capacity**;
- **cranes not inspected or tested at regular intervals**; and
- **safety and warning devices not working properly**. If during loading and discharging the crane, slings or equipment fails, packaged dangerous goods could fall, leading to the release of toxic gases, flammable vapours, pollution and commercial losses. Cranes failing can also cause fatalities and severe injuries for personnel and damage to property and equipment.

9. Waste Reception Facilities

The National Working Groups used the risk register to determine whether ports and terminals have adequate waste reception facilities available to handle waste from vessels as well as port and terminal operations. The consequences of not having adequate facilities are that dangerous cargo residues and both solid and liquid wastes are disposed into the Mekong River. The protection of the environment can be enhanced significantly by reducing discharges of all kinds of vessel-generated waste and cargo residues into the river. The development of adequate port reception facilities (PRF) for waste and cargo residues from vessels, together with the establishment of systems which provide incentives for vessels to use these facilities, are major elements in the process to reduce discharges by vessels into the Mekong River.

10. Firefighting Equipment

Ports and terminals are required to have a wide range of both fixed and portable firefighting systems. Fire pumps, hydrants, hoses and portable fire extinguishers should be available and regularly inspected and tested. The risk registers determined the type of firefighting equipment available at the ports and terminals

Figure 23: **Typical Port Crane**[10]

[10] http://vme.vn/Products/San_pham_01/1.aspx

to ensure and that they are readily available to respond in an emergency situation. The hazards are that the firefighting equipment is not working properly, fire hydrants are blocked, the pump capacity is not sufficient or there is no shore connection[11] available. If there is a delayed response to fire or the firefighting equipment is not provided or not sufficient, the ports and terminals cannot respond effectively. If their extent is not limited, fires may become uncontrollable which could present severe consequences to property, environment and local communities.

11. Fire Detection Equipment

Fire detection equipment (Figure 24) is key to maintaining the overall safety and operation of a terminal. Fire detection equipment continuously monitors for fire within the terminal and provides early warning to prevent escalation of an incident, protects the terminal, safety of employees and the environment. The risk register checked if the ports and terminals have adequate fire detection equipment, if the equipment is tested at regular intervals and if records of these test are kept. Fire detection equipment not working properly or not regularly tested could lead to a delayed response to fire.

Figure 24: **Typical Fire Detection Equipment**[12]

12. Gas Detection Equipment

Gas detectors continuously monitor for abnormal situations such as the presence of combustible or toxic gas within the terminal premises, provide early warning to prevent the escalation of an incident and protect the terminal, human life and the environment. The risk register checked if the ports and terminals have gas detection equipment and that records of inspection and testing were maintained. If equipment is not available, not calibrated or not tested properly, detection of toxic vapours and gases may be delayed or not occur, leading to asphyxiation, serious injuries or fatalities.

13. Personal Protective Equipment (PPE) and Safety and First Aid Equipment

PPE refers to all clothing, helmets, gloves, eye protection and other equipment designed to protect personnel from injury, blunt impacts, electrical hazards, heat and chemicals. The primary purpose of PPE is to reduce personnel exposure to hazards and reduce the severity of injury in case of an incident. The risk register assessed whether PPE was provided, maintained and available to all personnel at the ports and terminals. The National Working Groups also checked that there were first aid equipment and safety showers, used when personnel are exposed to hazardous substances to reduce the severity of injury. If personnel are not wearing PPE or there is no adequate first aid equipment available or safety showers are not working, there is increased risk of serious injury or fatality in case of an incident.

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[11] An international shore connection is a Universal hose connection that enables to connect the vessel's fire main to the shore in case the fire pump onboard fails.

[12] http://www.saltwaterpr.com/Story/Story.aspx?story=4936

14. Emergency Equipment

Emergency equipment is specially-designated material used to deal with emergencies. The goal of this equipment is to reduce the impact of an emergency on the environment, local communities and damage to property. Emergency equipment for ports and terminals includes but is limited to oil spill containment booms, absorbent pads, emergency transfer pumps, fire axes, emergency communication equipment and emergency lighting. The most common emergencies that occur at terminal or port areas are fire, explosion, release of toxic gases, explosive vapours, chemical and oil spills.

No or not enough emergency equipment can lead to delayed response or response failure, increasing the impact of the emergency. An emergency control centre is required to coordinate emergencies with fire, police, authorities and local communities in the event of a major incident. The absence of an emergency control centre can increase risks to local communities, environment and property due to ineffective emergency response.

3.2.2.2 Mechanical Equipment

This hazard group contains all mechanical equipment used at petroleum terminals to perform and monitor cargo operations. For the port areas, all mechanical equipment used specifically for the transfer of dangerous goods was taken into consideration. The following items were included in the risk register for assessment.

1. Tank-Measurement Instruments and Capacity Alarms

Tank-measurement equipment and capacity alarms are used to determine the filling level of a cargo tank (Figure 25). Every cargo tank has a zero level and a predetermined maximum filling level. Filling above this level can cause overflow. During loading, liquid is added to the tank and this results in a rise of the liquid level. This increase is measured against the zero level of the tank. If the maximum filling level of the cargo tank is 10 metres, for example, an operator will know that he can still add a quantity of cargo equal to 6 metres of tank height if the measurement instrument indicates that the current level in the tank is 4 metres . Knowing to what level the tank is filled is important for the operator so he can determine how much cargo can still be safely added without overfilling the cargo tank. Capacity alarms provide operators with an audible and visual indication that the cargo tank has reached the maximum level of filling.

The risk registers determined whether the terminals had tank measurement instruments, capacity alarms and systems to ensure maintenance, calibration and records were well maintained. If tank measurements instruments and capacity alarms are out of order or not functioning properly, the operator is unable to determine how much cargo he can safely add if the tank is already filled till the maximum level. Filling a cargo tank above the maximum level can result in spillage and release of flammable and toxic vapours.

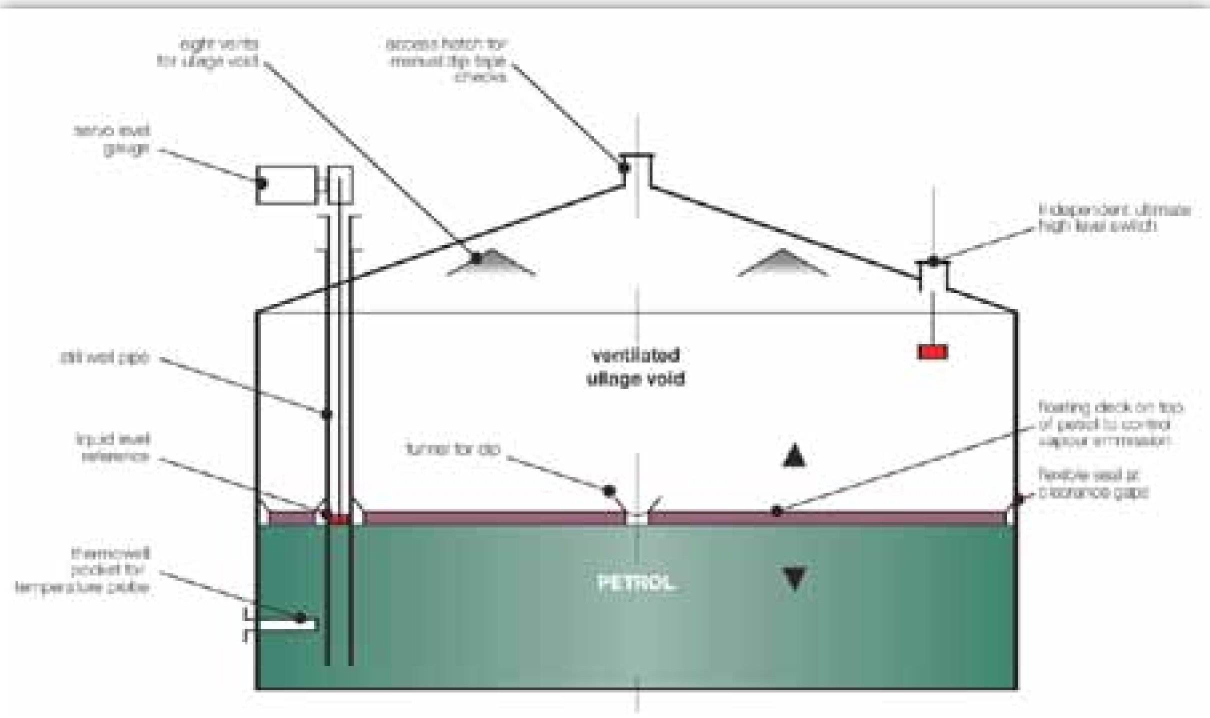

Figure 25: **Tank-Measurements Instruments and Capacity Alarms**[13]

2. Tank Wagons

Tank wagons (Figure 26) are railway wagons carrying a tank for the transport of liquid bulk. The main hazards for tank wagons are leaking valves and tank rupture. The rupture can be caused by impact of an external load. This can result in pollution and the release of flammable liquids and explosive vapours, increasing the risks of fire and explosions.

Figure 26: **Tank Wagons**[14]

[13] Recommedations on the design and operation of fuel storage sites, Buncefield major investigation board, p. 11

[14] www.railway-parts.com/wagons.html

3. Tank Trucks

A tank truck is a motor vehicle designed to carry liquids in bulk (Figure 27). They are used for the transport of a wide variety of liquid dangerous goods. Large tank trucks are, for example, used to transport gasoline to filling stations.

The main hazards of tank trucks are leaking valves or tank rupture, resulting in pollution and the release of flammable liquids and explosive vapours, increasing the risks of fire and explosions.

Figure 27: **Tank truck**

4. Communication

Communication is essential for conveying meaningful information. Conveying information at terminal or port areas is commonly done by means of handheld transceivers (walkie-talkies) or telephones of the approved type. Good communication is a critical component of maintaining safe and efficient operations at ports and terminals. Communication is required between control rooms and port personnel as well as ports/terminals to vessels and trucks. The risk registers determined the type of communication equipment available and whether the communications equipment is explosion proof. An absence of adequate means of communication at ports and terminals can lead to operational errors which can delay operation or lead to incidents. If not explosion proof, communications equipment may ignite flammable vapours during loading and discharging operations.

5. Ordinary Trucks and Trailers

Trucks and trailers are motor vehicles designed to transport cargo (Figure 28). They are commonly used to transfer cargo to and from the port or terminal premises.

The main hazards with ordinary trucks and trailers entering ports and terminals is packages falling due to improper securing of cargo. Damage to packaged dangerous goods can increase the risk of spillage, releasing toxic or flammable vapours, solids or liquid substances. Collisions of cargo with surfaces in port areas and terminals may also ignite flammable materials. Trucks can also pose hazards if there are no site safety rules such as speed limits and barriers to prevent collisions with critical equipment and personnel.

Figure 28: **Trucks and Trailers**

6. Forklifts and Reach Stackers

Forklifts are powered industrial trucks used to lift and transport materials (Figure 29). Reach stackers are commonly used in ports to quickly transport containers over a short distance and they are able to pile containers in rows (Figure 30).

Figure 29: **Forklift**[15]

Figure 30: **Reach Stackers**[16]

[15] http://www.theforkliftcertification.net/tcm-forklift-a-boon-for-the-industry.html

[16] http://www.ncports.com/gallery_detail.htm?i=98

7. Generators

Generators are mostly used as backup power sources. They can, for example, provide uninterrupted power to refrigerated containers. Emergency generators are also used to provide the port or terminal with electricity in case the main electricity sources fail in the case of fire, for example. Emergency generators can provide power to fire pumps and provide emergency lighting.

The risk register determined whether an emergency generator was installed at the ports and terminals with a system for maintenance and inspection developed. The failing or malfunctioning of a generator during operations increases the risk of delays and commercial losses. If it is overloaded or not maintained properly, a generator create sparks and ignition sources for explosive vapours.

3.2.2.3 Electricity

1. High-Voltage Cables

Electric cables are used in ports and terminals to provide electricity to all critical electrical equipment required for cargo handling; cargo pumps, lighting and fire pumps. High voltage cables are also used in ports to provide vessels with high voltage electric power delivered by cable from onshore during their time in port and terminal.

The main hazards relate firstly to the condition and whether the electrical cables are insulated and fire proof and whether there is any mechanical damage evident, inspection and testing procedures are critical at ports and terminals. Secondly, the proximity to high risk areas during loading and discharging operations needs to be considered. Electricity has the potential to cause electrocution; serious injury and fatalities to personnel and sparks are an ignition source for explosive vapours.

2. Electrical Equipment

Electrical equipment is essential for personnel to complete tasks and activities at ports and terminals. The risk register determined whether electrical equipment was explosion-proof, properly earthed and had a system for maintenance and inspection developed. Safe operating procedures and working environment was also considering for personnel operating electrical equipment. The possible consequence of electrical equipment malfunctioning can create ignition sources through overheating. Inappropriate use of electrical equipment can lead to operation errors and possibly electrocution, creating ignition sources that could cause fires or explosions.

Figure 31: **Circuit Breaker**

3. Circuit Breakers

Circuit breakers are automatic switches that stop the flow of electric current in a suddenly overloaded or abnormally-stressed electric circuit (Figure 31). In ports and terminals, circuit breakers are used to protect electric circuits necessary for cargo handling operations.

If circuit breakers are not working or the capacity of the breakers is insufficient for circuit protection, an overloaded circuit could overheat and become a possible source of ignition for fires and explosions.

3.2.2.4 Operations

The loading and discharging, storage and handling of dangerous goods are critical operations in all ports and terminals. These critical operations require specific operating procedures that depend on the types of dangerous goods, their form (solid, liquid or gas) and the way they are supplied, in bulk or as packaged. For all dangerous goods, at least the following needs to be considered:

- safe storage
- chemical and physical properties
- hazardous properties
- PPE availability
- material to contain, absorb liquid spills
- firefighting equipment

1. Receiving and Delivering Liquid Bulk

Loading and discharging liquid bulk requires careful attention. Operators need to consider many factors such as the temperature of the cargo, loading/discharging sequences, maximum filling levels and transfer rates, quantity of cargo and maximum manifold pressure.

The risk register evaluated the procedures at ports and terminals, safe operating procedures for the receiving and delivering of liquid bulk. The failure to implement procedures and the absence of supervision and communications can lead to operational errors which can increase the risks of commercial loss, property damage, pollution and safety.

2. Storing Liquid Bulk

The main hazards associated with storage of liquid bulks relate to tank separation not complying with standards and tank rupture due to internal corrosion, which can lead to release of storage tank content such as flammable liquids and explosive vapours. An insufficient area to contain spills (primary containment or bunding) can increase further the risks of pollution.

3. Receiving and Storing Dry Bulk

Not following operating procedures or not having personnel safety measures in place during loading increases the risk of personnel injury or fatality and also delays operations leading to commercial loss.

4. Receiving and Delivering Packaged Dangerous Goods

The risk register determined whether operating procedures are in place for the handling of packaged dangerous goods. If these are not handled correctly or fall during operations, they can be damaged and pose risks to personnel and, depending on the types of dangerous goods, may increase the risks of fire and explosion. Operational errors can delay operations. If packaged dangerous goods are damaged, time will be lost in taking remedial action.

5. Storing and Segregating Packaged Dangerous Goods

Storing dangerous goods requires measures to protect employees, property and the environment from risks. The most important of these requirements relate to building construction and equipment segregation goods. Facilities for storing dangerous goods should be properly identified with labels or placards, equipped with suitable emergency equipment and secured to prevent spillages or leakages have adverse effects, notably on the environment. Dangerous goods may react with other dangerous goods, chemicals or other substances. Liquids should not be stored above solids as escaping liquids may damage or penetrate packages below.

Dangerous goods incompatible with other substances must be segregated to prevent serious incidents from loss of containment or interaction. The International Maritime Organization (IMO) has published recommendations for segregating dangerous cargoes in port areas[17]. The absence of safe operating procedures or designated storage areas for packaged dangerous goods increases the chances for incompatible materials to mix and produce dangerous chemical reactions, putting property, personnel and the environment at risk.

6. Monitoring and Control of Storage Areas

The storage and handling of dangerous good requires ports and terminals to maintain a dangerous goods register, Material Safety Data Sheets (MSDS) for products, monitoring and inspection of storage areas and appropriate signs. In case of an emergency, local fire authorities and port and terminal management need to know the exact location, quantity and type of all dangerous goods stored at the site. Not having this information readily available at the time of an incident can have severe consequences, increasing the risks of fire and explosion endangering personnel, local communities and the environment.

3.2.2.5 Maintenance

Maintenance is related to fixing, repairing and service of devices and equipment. Maintenance should be performed on planned schedules and records should be kept. Maintenance and servicing of equipment is important in all heavy industries particularly ports and terminals that are handling large quantities of dangerous goods.

1. Maintenance of Equipment

The risk register determined whether there was a planned maintenance system for all equipment and procedures for performing maintenance and inspecting equipment prior to commencing activities and tasks. The failure to maintain port and terminal equipment regularly increases the risk of equipment breaking down, delaying operations and compromising the safety of personnel.

[17] IMO Ref. T3/1.02 MSC.1 Circ 1216 Recommendations on the safe transport of dangerous cargoes and related activities in port Areas. p. 44

2. Hot Work

Performing hot work in a port and terminal is a high risk activity and must be controlled. The risk register evaluated whether there was a hot work permit system in place. A hot work permit sytem ensures that hot works must be approved prior to commencement of the task. The permit system also ensures that hot works are not carried out during loading and discharging without permission, so that additional safety measures can be implemented. The possible consequences of personnel or contractors undertaking hot work can be severe as sparks and ignition sources can be generated increasing the risks of fire, explosion, pollution, personnel injury and fatalities.

3.2.2.6 Human Factors

Human factors are all factors that can have influence or affect the capacity of a person to perform a certain task/operation.

1. Working Hours

It is important that working hours are managed at ports and terminals. Operators working long hours can suffer from fatigue and are more likely to make mistakes and be less alert with reduced concentration.

2. Education

Personnel working at ports and terminals should be educated to understand operations and the hazards and risks associated. Failure to appreciate the risks may lead to unsafe work practices, endangering themselves and other personnel. It is particularly important for personnel to understand the risks of handling dangerous goods.

3. Experience

Experience of personnel must be considered at ports and terminals. Those with more experience should supervise other employees to ensure operations are completed safely and without delay. Inexperienced personnel carrying out tasks without supervision can increase operational error and mistakes, leading to commercial losses, property damage, pollution and risks to safety.

4. Training

Personnel working at ports and terminals cannot gain experience or be competent to perform tasks and activities and respond to emergencies without adequate training and supervision. Training is required for handling dangerous goods, PPE use, emergency response, first aid, firefighting and risk assessment. It is important that refresher courses, drills and exercises are completed to maintain skills and competencies. Personnel without adequate training are more likely to make operational errors, underestimate risks and not be able to respond in emergencies, increasing the risk of injuries, fatalities, pollution, fires and explosions.

5. Communication and Information

It is the responsibility of port and terminal management to inform personnel about the hazards and risks associated with tasks, activities and critical operations. The risk register determined whether the ports and terminals had accident records and hazard inspections. Personnel not aware of the hazards cannot control the risks with consequences such as operational errors and mistakes which can compromise safety, the environment and operations. It is also important that communications between port personnel and vessel crew consider language differences, particularly with international trade of dangerous goods since this can be another cause of operational error and miscommunication.

3.2.2.7 Management and Regulations

Management is one of the most important hazard groups of the risk register. Terminal management should provide a safe and healthy working environment and ensure that all operations and activities are conducted with minimum effects on the environment while complying with the regulatory framework in Member Countries where rules and regulations exist. The National Working Groups were required to evaluate the following components of management at the ports and terminals:

1. Safety and Quality

The risk register evaluated the level of safety and quality management at ports and terminals including safety and environmental procedures, health and safety committee and advisors. The absence of safety and quality management systems increases operational error, mistakes and means that management and personnel do not have a systemized way to complete tasks and activities. Safety and quality management systems also require that management and personnel assess the risks associated with activities and control measures to implement prevention and mitigation measures. Not having an adequate safety and quality management system increases the risk of incidents; pollution, safety and can decrease the efficiency of operations.

2. Inspections

It is important that inspections of ports and terminals are carried out in a planned manner. The failure to carry out inspections can lead to deficiencies being overlooked and hazards not being identified and assessed appropriately, increasing the risks of incidents and commercial loss.

3. Regulations

Port regulations are usually issued by a public port authority. They provide detailed regulations relating to the conduct of vessels, safety and order in the port area, protection of the environment, the use of pilots and documentation for the loading and discharging of goods. An absence of regulations means that ports and terminals have no guidance on how to manage operations safely

4. Ports and Terminal Policy

Ports and terminal must be committed to safe operations, minimising harm to personnel, the environment and local communities and complying with relevant regulations and standards. The port and terminal policy to invest in prevention and mitigation measures and monitor safety and the environment will increase the standards and efficiency of operations and reduce impacts.

5. Security

Ports and terminals receiving seagoing and international vessels should implement the International Ship and Port Facility Security (ISPS) Code. Security and access to ports and terminals need to be controlled to reduce the risks of property damage, contamination or acts of terrorism.

6. Emergency Response

Ports and terminals should have procedures ready for immediate implementation in case of emergency. These procedures should cover all type of emergencies that can be expected for example; a major oil spill or cargo leaks that result in a fire or explosion. The risk register determines whether the ports and terminals have emergency response plan, drills or have adequate emergency response and oil spill equipment. If there is not sufficient emergency response systems in place the port and terminal cannot respond effectively to emergency and oil spills, increasing the risks to personnel, environment and local communities as the emergency situation becomes uncontrollable.

7. Authority Control and Law Enforcement

The primary goal of authority control and law enforcement is to verify if the port and terminals comply with all existing rules, regulations and standards that apply. When they fail to comply, the authority must be able to impose significant penalties and force port and terminal management to either rectify the situation within a certain time period or suspend operations if the failure to comply poses severe threats to safety or the environment.

The port and terminal must also be monitored and inspected by competent authorities to ensure compliance with regulations and technical standards where they exist. Terminals and ports may have adequate safety and quality management systems and comply with regulations and technical standards; however it is critical that sites are assessed by competent authorities and third party audits.

8. Checklists

The risk register determined whether checklists were available at ports and terminals to complete before starting tasks and activities, particularly operations involving the storage and handling of dangerous goods. Checklists should be available for vessel shore safety, bunkering and disposal of hazardous materials. Checklists are important for personnel to ensure they know the tasks, PPE to be worn and the hazards and associated risks. Having no checklist in place increases the risks of incorrectly sequencing tasks, no safety controls, miscommunications leading to incidents.

9. Waste Management

The management of wastes at ports and terminals is very important. Ports and terminals should provide facilities and services for the reception of waste from vessels. The environmental outcome will otherwise be inappropriate disposal of waste generated by vessels and the port or terminal. Wastes from vessels are mostly cargo residues collected in the slop tanks, waste oil from maintenance operations and garbage. Waste generated by port and terminals can be waste oil from maintenance operations, cargo residues collected in drip trays and garbage.

Having no waste management system in place for all the wastes listed above will be a direct source of pollution to the Mekong River. If the waste is not cleaned up following operations, cargo residue and wastes will enter the river as run-off during storms as an indirect source of pollution.

10. Drugs and Alcohol

Drug and alcohol policies are important for ports and terminals as personnel under the influence of drugs and alcohol are more likely to make operation errors, mistakes, they have decreased reaction time and will not only endanger their own lives, but those of other personnel.

3.2.2.8 Global Events

Global events are natural disasters or uncontrollable external factors which can compromise the safe operation of ports and terminals, damage infrastructure and lead to catastrophic incidents. One third of all petroleum tank fires are due to lightning strikes.[18] Floating roof tanks (FRTs), as seen in Figure 32, can be especially vulnerable to lightning strikes. The costs can be catastrophic, with loss of product, equipment, production and life. Ports and terminals can consider contingency plans for flooding, lightning, mud slides, monsoons, typhoons high winds, tsunamis, tidal waves and earthquakes.

3.2.2.9 Additional Hazards

A section on the risk register was provided for any additional hazards identified by the National WG.

Figure 32: **Lightning Strikes Fuel Storage Tank**[19]

[18] Journal of Loss Prevention in the process industries: A study of storage tank accidents, James I., Cheng-Chung Lin

[19] http://www.engineerlive.com/Oil-and-Gas-Engineer/Safety/Preventing_petroleum_tank_lightning_strikes/23264/

3.3 RISK EVALUATION

3.3.1 Introduction

As explained in Section 2.6 (Risk Evaluation), the results from the nine hazard groups in the risk register for ports/terminals and ferry crossings were compared to risk criteria to determine priority implementation areas. The following section evaluates the storage and handling of dangerous goods in ports, terminals and ferry crossings in the MRC Member Countries. The section also provides an overview of the existing legislation, type and quantity of dangerous goods handled and the location of ports and terminals.

3.3.2 International Agreements

There are two international agreements for navigation in the Mekong River that are described briefly below. The agreements and national legislation will be discussed further in the legal chapter.

The *Agreement on Commercial Navigation on Langcang-Mekong River* (Tachileik, Shan State [East], 20 April 2000) applies to the Upper Mekong (People's Republic of China, Lao PDR, Myanmar and Thailand) and contains the following main points on the storage or handling of dangerous goods:

- The Agreement prohibits the carriage of toxic chemicals, explosives and radioactive material on the Upper Mekong. Other types and categories of dangerous goods are only allowed when agreed upon among the contracting parties.
- The Agreement was supplemented by six technical annexes that contain specific references to dangerous goods:
    - Regulations on safe navigation of vessels on the Lancang-Mekong River stipulate that vessels carrying dangerous goods have to exhibit an all round red light at night and the Code Flag "B" at daytime during berthing, loading and unloading or navigation.
    - Rules on water transport administration on the Lancang-Mekong River stipulate that:
        - the carriage of dangerous goods such as explosives, poisonous and infectious substances and radioactive materials shall be prohibited;
        - packaging and protection requirements for dangerous goods comply with the IMDG Code;
        - the shipping name shall be displayed on packages of dangerous goods with the name complying with the individual schedules of the IMDG Code and with labels and marks as required by the IMDG Code;
        - transport documents for dangerous goods shall meet IMDG Code requirements; and
        - Transport of dangerous goods is not allowed on passenger or non-steel vessels.

The *Agreement between the Royal Government of Cambodia and the Government of the Socialist Republic of Vietnam on Waterway Transportation* (Phnom Penh, 17 December 2009) contains several references concerning the storage and handling of dangerous goods:

- For commercial goods for cross-border transportation, the IMDG Code should be consulted and used as the main reference to determine if these goods are to be classified as dangerous goods;

- For cross-border transportation, it is compulsory for inland waterway vessels to have a special permit for the carriage of dangerous goods with a maximum validity of 60 days;
- Pilots are compulsory for every inland waterway vessel carrying dangerous goods engaged in cross-border navigation, regardless of tonnage, dimensions or port of call;
- Competent authorities of both countries have the right to enforce current existing laws and regulations relating to the transportation of dangerous goods but due consideration of freedom of navigation needs to be guaranteed; and
- The Mekong Facilitation Committee will assist in drafting new laws, rules and regulations and, if necessary, revise existing laws rules and regulations to harmonise them.

3.3.3 Cambodia

3.3.3.1 Legislation and Authority Control

The National Working Group members in the MRC Member Countries were required to complete questionnaires in relation to national legislation and authorities responsible for implementing and enforcing rules, regulations and decrees. Following the answers to the questionnaire, it can be concluded that there is no specific national legislation (rules, regulations, decrees) concerning the handling and storage of dangerous cargo in port areas or petroleum terminals. The Ministry of Public Works and Transport (MPWT) is responsible for preparing the national legislation in regards to inland waterway transport. It should be noted however that Cambodia is a party to the *Safety of Life at Sea (SOLAS) Convention* which has been both signed and ratified by Cambodia so it can be deemed to form part of Cambodian domestic law.[20, 21]

Any port, terminal and other industry developments are required to have an EIA (environmental impact assessment) certificate. EIA is a process for analysing the potential environmental impacts for proposed and existing projects. The main objectives of an EIA are to:

- ensure environmental aspects and impacts are considered before decisions are made;
- promote sustainable development; and
- prevent adverse environmental effects from the activities of the project.

Legislation on EIA is governed by the *Law on Environmental Protection and Natural Resource Management*[22]. In general, the EIA process takes 6 months and the Ministry of Environment (MoE) is mainly responsible for approval with support from other ministries. Further information on the legal framework for EIA and NRM is provided in the environment chapter. The overall process for environmental management is controlled by the MoE.

It was determined that there was no specific information relating to the persons who are responsible for the safety in ports at the national level. The National Working Group conducted some research and interviewed port and terminal operators and found that each port and terminal is responsible for implementing their own procedures for safety and security. Phnom Penh Autonomous Port (PPAP) has

[20] IMO, Status of Multilateral Conventions, etc. As of 01 August 2011 pp 79

[21] Online text at: http://www.imo.org/About/Conventions/StatusOfConventions/Documents/Status%20-%202011.pdf
Constitution of Cambodia article 90

[22] Online text at: http://www.mekonglawcenter.org/download/0/cambodia.htm

a safety and security department. At the petroleum terminals, the terminal manager is responsible for health safety and environment (HSE) management with support from the administration department. One of the petroleum terminals surveyed has a Health Safety and Environment (HSE) Manager who is responsible for implementing and monitoring HSE management systems across the business operations.

The administration department of each port and terminal is responsible for the implementation and compliance with port laws, by-laws and regulations relating to the transport, handling and storage of dangerous goods in port areas. The National Working Groups also determined that there are no penalties, fines or other punitive actions for the ports and terminals that do not comply with the applicable rules and regulations. There is currently limited capacity and resources within the ministry to monitor and enforce national rules and regulations. The MPWT is working to improve the management of ports, terminals and vessels in Cambodia and has recently issued the following policy statement:

"*The government is committed to develop maritime transport and port laws and regulations as well as monitoring and enforcement mechanism for all relevant international conventions and rules. To that effect, existing regulations are being updated and augmented to comply with international maritime conventions to which Cambodia is a party. A maritime law will be enacted and mechanisms set in place to ensure its implementation. It is planned to improve and update port policy and port laws and to develop a legal framework for private port operation*."[23]

This policy looks promising but for the moment there is no actual information available on the status of execution of this policy and how it will be implemented. In the master plan for waterborne transport on the Mekong River system in Cambodia dated November 2006, there is reference to the draft of a Cambodia maritime law. This draft should have been completed in 2007. The current status of this draft is, however, unclear.

The MPWT established a draft of the *Prakas for Carriage of Dangerous Goods by Inland Waterway in the Kingdom of Cambodia* in June 2011. The MPWT is also currently drafting the *Prakas on the Formation of Private Port Management Commission*.

The Commission on Private Port Management, chaired by the Minister of Public Works and Transport, is being established to manage the development, order and ensuring proper operation of private ports. Article 3 describes that the role and responsibilities of the commission are to:

- make necessary policy proposals for the development and operation of private ports;
- make proposals to establish laws/sub-decrees, or adopt draft *Prakas*/circulars concerning the development and the operation of private ports. The development and operation of private ports should be consistent with the National Port System in order to ensure safety, security and environmental protection;
- check and adopt the port development plans;
- control the management and the operation of private ports through annual reports; and
- facilitate with all relevant authorities and agencies for ensuring smooth and effective operations and services of private ports.

The following decrees are relevant to the risk analysis:

- *Sub-Decree № 218 (RGC) of December 24, 2008 on the Establishment of Cambodian Maritime Institute (CMI)* (Ogs, Year 08, N095, December 27, 2008).

[23] Online text at: http://www.mpwt.gov.kh/detail_eng/transportpolicywater.html

This sub-decree aims to establish the Cambodia Maritime Institute (CMI) to provide naval training in Cambodia at the bachelor, associate and post-graduate degree level. This institute is under the supervision on the Phnom Penh Autonomous Port (PPAP) and under the protectorate of MPWT. It comprises five faculties such as piloting, transportation management, port management and operation sciences, and construction.

3.3.3.2 Dangerous Goods Specifications

Trade is increasing through the Phnom Penh Autonomous Port (PPAP) as illustrated in Figure 33 below which shows the actual and estimated number of containers from 2005-2013.

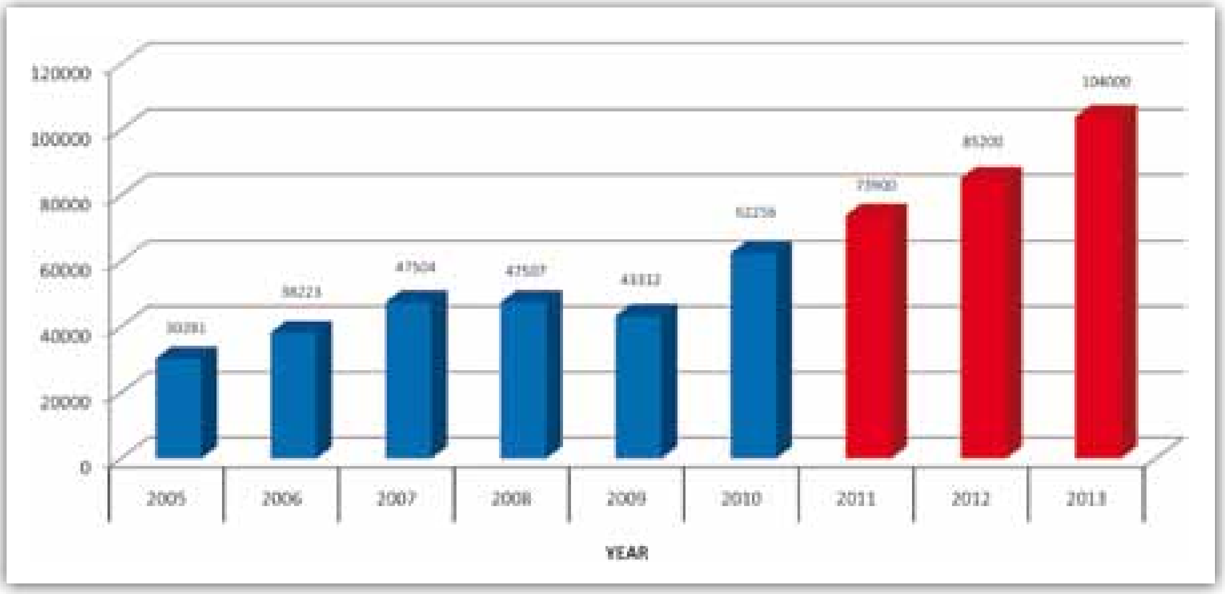

Figure 33: **Actual and Estimated Number of Containers 2005 - 2013**

The blue bars indicate the actual number of containers handled at PPAP from 2005-2010 and the red bars represent the estimated amount of containers that may be handled in the future. For 2010, the actual number of containers handled at PPAP was 62,256 units. Estimated containers that will be handled at PPAP in 2013 will further increase to 104, 000 units.[24] In 1996, the IMO estimated that 10 to 15 percent of the cargo transported by water were dangerous goods in packaged form and that this was increasing every year. Since a considerable amount of dangerous goods in packaged form is transported by means of containers, it is worth investigating the total container throughput of containers at PPAP. There is limited information available on the amount of containers that contain dangerous goods.

The different kinds of dangerous goods presently stored and transported on the Mekong River system in Cambodia are:

- fuel oil (FO)
- diesel oil (DO)

[24] http://www.ppap.com.kh/port_status.htm

- kerosene oil (KO)
- motor gasoline (MOGAS: M92, M95 and M97)
- jet fuel (Jet A-1)
- liquid petroleum gas (LPG)
- ammonium nitrate and fertilisers; and
- packaged dangerous goods in containers.

Table 13 below provides an overview of the type and quantities of dangerous goods imported through PPAP from the Mekong River in Viet Nam between 2008 and 2010.

Table 13: **Type and Quantity of Dangerous Goods in Litres (2008-2010)**

TYPE OF DANGEROUS GOODS	QUANTITY OF DANGEROUS GOODS IN LITRES			
	2008	2009	2010	Total
Fuel Oil	292,380,026	33,693,208	11,635,545	337,708,779
Diesel Oil	278,995,184	371,909,075	389,157,541	1,040,061,800
Kerosene Oil	66,803,370	208,878,982	117,116,910	392,799,262
Motor Gasoline	180,185,039	231,460,393	205,611,616	617,257,048
Jet fuel	860,778	14,634,755	18,787,141	34,282,674
Liquefied Petroleum Gas	2,870,139	4,242,525	2,768,728	9,881,392
Fertilisers	800,000	3,480,600	0	4,280,600
Other Dangerous Goods	0	3,276,902	45,439,469	48,716,371
TOTAL	**882,894,356**	**868,0299,538**	**745,077,481**	**2,436,271,555**

Source: Phnom Penh Port Authority

3.3.3.3 Petroleum Terminals

In Cambodia, currently 80 percent of petroleum products including diesel oil, M92, M95, jet fuel, intermediate fuel oil and LPG is transported from Ho Chi Minh City, Viet Nam, along the Mekong River to Phnom Penh. For the moment, Cambodia has currently no oil production. There are, however, reasonable amounts of oil (about 2 billion barrels) and significant quantities of natural gas found (on and offshore) in Cambodia. Petroleum extraction is estimated to be online by 2012-2013.[25] There are 12 petroleum terminals along the Mekong and Tonle Sap rivers (Figure 34) that supply fuel through the commercial distribution networks:

[25] http://www.asiapacificmemo.ca/cambodia-resource-curse

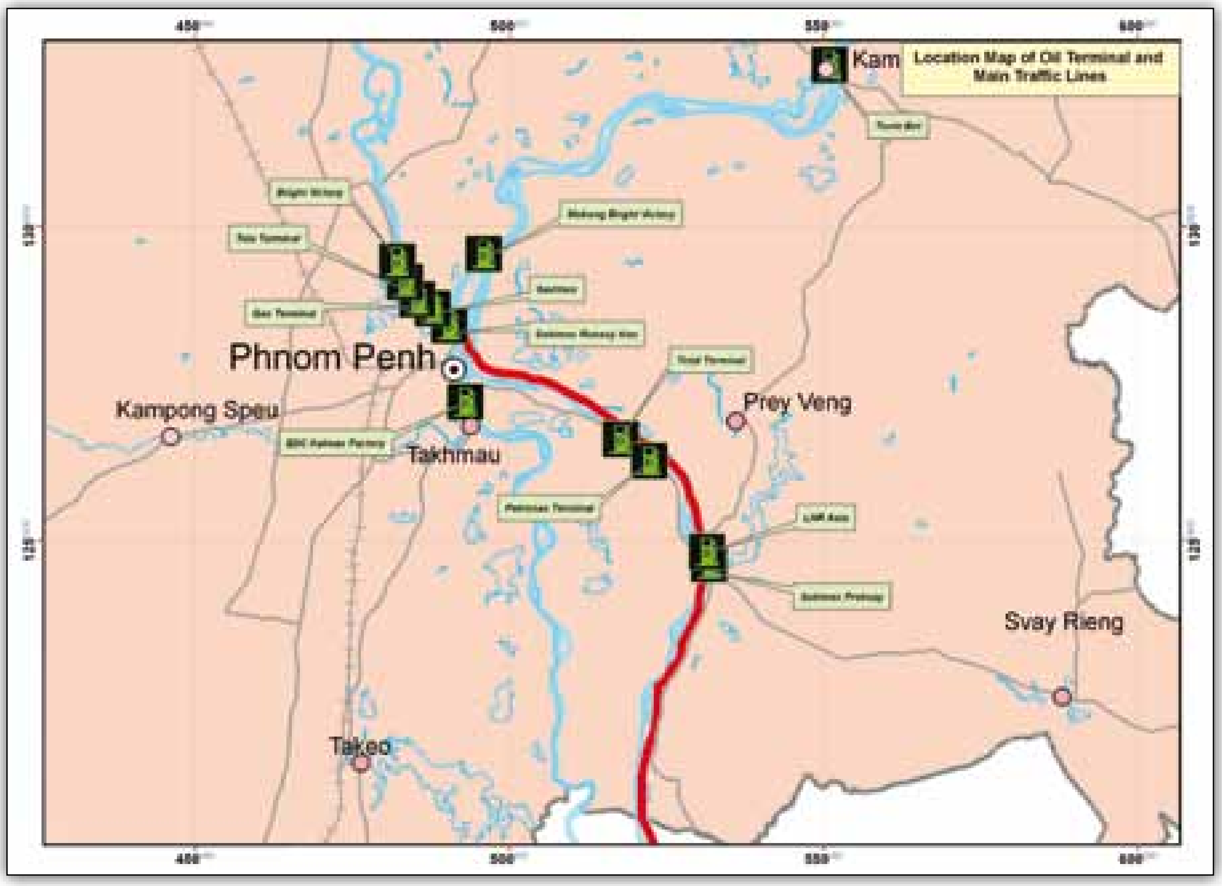

Figure 34: **Location of Petroleum Terminals in Cambodia**

Tonle Sap (TS):

1. **Sokimex Russey Keo Terminal** (Km 6, TS7): Road Number 5, Sangkat Russey Keo, Khan Russey Keo, Phnom Penh
2. **Savimex Terminal** (Km 7, TS9): Road Number 5, Sangkat Km 6, Khan Russey Keo, Phnom Penh
3. **Gas Terminal** (Prek Pnoeu Km 9, TS 15): Road Number 5, Sangkat Prek Pnoev, Ponhea Leu District, Kandal Province.
4. **Tela Terminal** (Prek Pnoev Km 11, TS17): Road Number 5, Sangkat Prek Pnoev, Ponhea Leu District, Kandal Province
5. **Bright Victory Terminal** (Prek Pnoev, TS 19): Sangkat Prek Pnoev, Ponhea Leu District, Kandal Province

Upper Mekong (UM):

6. **Mekong Bright Victory Terminal** (UM1): Road Number 6A, Bakeng Village, Moukampoul District, Kandal Province.
7. **Tonle Bet Terminal** (UM2): Tonle Bet, Kompong Cham Province.

Lower Mekong (LM):

8. **Total Terminal** (Khsom Village, LM11): Road Number 1, Banteay Dek Commune, Kien Svay District, Kandal Province.
9. **Petronas Terminal** (Chruoy Dang Village, LM19) : Road Number 1, Chruoy Dang Village, Samrong Thom Commune, Kien Svay District, Kandal Province.
10. **L H R Asia Investment Terminal** (Preksay Village, LM) : Road Number 11, Preksay Leu Village, Peam Ror Commune, Peam Ror District, Prey Veng Province.
11. **Sokimex Preksay** Terminal (Preksay Village, LM2) : Road Number 11, Preksay Leu Village, Preksay Commune, Peam Ror District, Prey Veng Province.

Tonle Bassac (TB):

12. **EDC Kalmax Factory Terminal** (TB2) : Road Number 2, Chak Angre Village, Chak Angre Commune, Meanchey District, Phnom Penh

To complete the risk register, the National Working Group visited and inspected four sites. Three petroleum terminals and one IWT port handling mostly containers were included in the risk assessment:

- **Terminal 1** had 26 tanks for the storage of petroleum products of which 16 were in use. Ten tanks had been temporarily decommissioned for maintenance and repair. Petroleum products stored and handled at the facility were Jet A1, DO, M92 and M95. This terminal also supplied heavy fuel oil on small tankers to industry for power generation on the Mekong and Bassac Rivers;
- **Terminal 2** had 10 tanks for the storage of petroleum products representing a total capacity of 16,450 m^3 including 2 tanks of 4,000 m^3, 2 tanks of 3,000 m^3 and 1 tank of 1,700 m^3. There were also 5 much smaller tanks of 150 m^3. Petroleum products stored and handled at the facility were Jet A-1, DO, MOGAS (M92 & M95) and LPG. There were 18 employees working at the facility;
- **Terminal 3** stored and handled gasoline (M92 & M95), FO, KO and LPG in tanks of 10,000 m^3, diesel in tanks of 5,000 m^3 and gasoline in tanks of 1,500 m^3. The capacity of the whole terminal was 95,000 m^3. The terminal also owned and operated three 460T tankers supplying diesel from Phnom Penh to Chhong Kneas during the high-water season, making approximately 20 trips monthly.
- **Phnom Penh Autonomous Port (PPAP)** is an international port on the Tonle Sap River 2 km upstream from the Chaktomuk confluence in central Phnom Penh. It is connected to the South China Sea via the Bassac River (Song Hau) and the mainstream of the Mekong (Tieng Giang). The access distance to the port is about 332 km from the Cuu Tieu mouth of the Bassac in the South China Sea and about 100 km from Kaam Samnor, on the Cambodian side of the Viet Nam border on the Mekong mainstream. The port handles mainly containers and general cargo. Dangerous goods that are handled and stored at the premises include fertiliser, toluene, ammonium nitrate and acetic acid (Figure 35).

Figure 35: **Phnom Penh Autonomous Port**

A ceremony for the construction of a new container dock of the Phnom Penh Autonomous Port was held on 9 March 2011. The new dock is located in Kandal Leu village, Banteay Dek commune, Kien Svay district, Kandal province and is financed by a loan from the Government of the People's Republic of China. According to the Minister of Public Works and Transport, the proposed construction area will cover an area of 6,600 m^2 with 10 ha of container docks including an administrative office and water and electricity network. The site is located along the Mekong River and the National Road No 1 of Kandal province, 30 km east of Phnom Penh. The new container dock will allow the docking of two 5,000 -tonne vessels simultaneously, with capacity of 120,000 TEUs per annum[26] in the phase and 300,000 TEUs per annum when fully developed (Figure 36).

[26] http://www.cnv.org.kh/2011_releases/09mar11_container_dock_port_speech.html

Figure 36: **Master Plan of New Phnom Penh Port**

3.3.3.4 Risk Evaluation for Ports, Terminals and Additional Operations

Upon completion of the risk assessment by the National Working Group, the data collected and risk registers were analysed and used to compile a typical risk register. This typical risk register represents the current status of an average terminal in Cambodia. As only one major port was assessed, the data of this port was used to compile an average risk register of an average port in Cambodia. These findings can be used to assess the safety and environmental protection of future ports developments in IWT.

Priority Areas were derived by comparing the existing levels of risk control measures in MRC Member Countries identified in the risk registers with international benchmarks and possible impacts including fire, explosion, pollution and loss of life (for detailed explanation see section *2.6.2 Priority Areas*).

The information was represented for each hazard group for ports and terminals, illustrating the activity/ operations, possible hazards, possible consequences and priority area. Only Priority areas 2, 3 and 4 were included as interventions as this needs to be done in the short to medium term.

One of the terminals visited had very limited controls and was used as a basis to prepare the Priority Areas (see Table 14 starting overleaf).

Table 14: **Priority Areas – Cambodia - Average Terminal**

CAMBODIA AVERAGE TERMINAL		
No.	Hazard	Priority Area
1101	Terminal close to residential area	4
1102	Trucks loaded with DG going to and from the terminal, passing dense populated areas	
1403	Cargo pump leaking	
1501	Cargo transfer hose is ruptured	
1502	Cargo pipe fractured	
1503	Piping subject to surge pressure	
1504	Transfer hose leaking	
1506	Safety devices not working (ex. Emergency Shutdown system not working)	
1509	Lines not in use not properly blinded (flange connected with all bolts tight)	
1510	Gaskets, seals or flanges leaking	
1605	Emergency valves not readily accessible	
11104	Portable firefighting equipment - Legal requirements not met	
11201	Fire detection equipment not working	
11202	Fire detection equipment not regularly tested	
11501	No emergency equipment available	
11502	Emergency equipment not sufficient	
11505	No emergency control centre	
2101	Tank high level alarm out of order	
3202	Mechanical damage to cables	
3203	Cables not fire proof	
3301	Electrical equipment and installations do not comply with the standards recognised by the competent authority	
3302	Electrical equipment for use in places where potentially explosive atmosphere is present is not explosion proof	
3303	Electrical equipment and installations are not properly operated	
3304	Electrical equipment not properly earthed	
3305	No adequate lighting	
3401	Circuit breakers not adequate for circuit protection	
3402	Circuit breakers not working	
6303	No training for operators to complete task	
6402-6403	No correct training course provided, no special training on handling DG	
6501	Accidents / hazards not communicated	
6502	No records of Accidents / hazards	
6503	Accidents / hazards not reported	
7101	No or limited safety, environmental procedures for terminal operations	

Table 14: **Priority Areas – Cambodia - Average Terminal (continued)**

No.	Hazard	Priority Area
7102	Improper or inadequate procedures are in use	
7301	No Authority control	4
7401	Terminal has no policy, bad management	
7602	No emergency response drills	
7603	No or inadequate Emergency Response equipment	
7701	Terminal personnel not properly trained on handling DG	
7706-7707	No training marine pollution prevention and environmental protection	
7708	No training on vessel waste management	
7801	No law enforcement	
7901	No regulations	
7902	Operator not aware of National regulation	
71001	No checklist regarding loading and discharging operations	
71102	No approved code of safe working practice available	
71201-71202	No solid and liquid waste management	
71201-71202	No solid and liquid waste management	
1301	Failing tank structure (ex. Tank supporting, corrosion, etc)	3
1402	Cargo pump fail to start/stop on demand	
1404	No regular inspection of cargo pumps	
1505	Maximum Allowable Pressure (MAWP exceeded)	
1507	Pressure gauges on cargo pipes not working	
1508	Safety systems manually by-passed	
1517	Piping not properly supported	
1519	No flame arrestors on vent lines	
1520	Cargo pipes not regularly pressure tested	
1601	Cargo valves blocked	
1602	Cargo valves fail to operate	
1603	Cargo valve leaking	
1606	Valves not fire rated	
1701	Warehouses/sheds not equipped with firefighting equipment	
1703	Floor/surface of warehouses/sheds not suitable for storing DG	
1901	No waste reception facilities available for vessels	
11003	No international shore connection available	
11006	Fixed firefighting pump capacity not sufficient	
11102	Portable firefighting equipment not regularly inspected/tested	
11103	Portable firefighting equipment not colour-coded	
11105	Incorrect firefighting equipment used	
11107	Firefighting equipment not working	
11401	No correct Personal protective equipment (PPE) provided	
11402	PPE not maintained according manufacturers recommendations	
11404	Safety showers not working	
11504	Spillage control equipment not sufficient	
2102	Tank high level alarm not calibrated	

Table 14: **Priority Areas – Cambodia - Average Terminal (continued)**

No.	Hazard	Priority Area
2202-2205-2301	Leaking valves on tank wagons / tank trucks containing DG	3
2302	Rupture of tank or welding seam	
2401	No Walky - Talkies available	
2403	Communication with cargo control room not working	
2501-2705	Emmision of electric spark from trucks/trailers/generators	
2704	Generator alarm/shutdown fails	
3201	Not enough clearance for overhead power lines	
4104	No supervisions during cargo operations	
4701-4702-4703	No dangerous goods register, register not up to date and no MSDS available	
5102	Terminal equipment not inspected as scheduled	
5104	No maintenance system in place	
5106	No procedures for opening process equipment/piping	
5201	Hot work permit not in use	
6201	Operator does not understand/know the hazards of the process	
6202	No education corresponding to job requirements	
6301	New operating staff not properly trained	
6302	No procedures in place to ensure operators perform a task as required	
6401	No training on correct use of PPE	
6404	No refresher training on handling DG	
7201	Improper/inadequate inspections of terminal	
7501	ISPS Code not in use/implemented	
7601	No measures in place to deal with DG spillage (Emergency Response Plan)	
7703-7704-7705	Training on firefighting equipment, emergency response procedures and accident prevention	
7709	No refreshment courses for terminal personnel handling DG	
71002-71003-71004-71005	No checklist regarding: cargo transfer, bunkering, maintenance and safety items	
71101	No management system in use	
71103	No management concerning DG	
71301	No drug and alcohol policy	
8106	Global events: high winds	

Table 14: **Priority Areas – Cambodia - Average Terminal (continued)**

No.	Hazard	Priority Area
1511	No colour coding on cargo pipes	2
1512	Pipe welding insufficient	
1513	Piping located in areas with high vehicle traffic not separated from traffic flow by vehicle guards or earthen beams	
1514	Hot steam line not insulated	
1515	Construction material not corrosion resistant	
1516	Piping specifications not followed	
1518	Corrosion rates not regularly checked	
1902	Capacity of waste reception facilities insufficient	
1903	Waste generated by port and cargo operations	
2303	Malfunctioning of meters on tank trucks	
6504	Language difference between terminal operator and vessel crew	
8102-8105-8108	Global events: lightning, typhoons, high winds and earthquakes	

The existing conditions a the the Phnom Penh Port were also evaluated, the results are illustrated (Table 15) below:

Table 15: **Priority Areas - Phnom Penh Port**

CAMBODIA PHNOM PENH PORT		
No.	**Hazard**	**Priority Area**
1702	Segregation of DG not according regulations	4
11201	Fire detection equipment not working	
11202	Fire detection equipment not regularly tested	
11505	No emergency control centre	
4301	Operating procedures for receiving/delivering dry bulk not followed	
4302-4401	No personal safety measures during receiving/delivering/storage of dry bulk	
4601	Incompatible DG not segregated	
6502	No records of accidents/Hazards	
6503	Accidents / hazards not reported	
7301	No Authority control	
7602	No emergency response drills	
7706-7707-7708	No training marine pollution prevention, environmental protection and vessel waste management	
7801	No law enforcement	
7902	Operator not aware of National regulation	
71001-71002 71003-71004 71005	No checklist regarding: loading/discharging, cargo transfer, bunkering and maintenance and safety items	

Table 15: **Priority Areas - Phnom Penh Port (continued)**

No.	Hazard	Priority Area
1102	Trucks loaded with DG going to and from the terminal, passing densely populated areas	3
1701	Warehouses/sheds not equipped with firefighting equipment	
1702	Segregation of DG not according regulations	
1703	Floor/surface of warehouses/sheds not suitable for storing DG	
1801	Crane used beyond designed capacity, Safe Working Load (SWL) exceeded	
1803	Slings for crane not of approved type	
1804	Cranes not inspected/tested at regular intervals	
1805	Limit & safety devices of cranes not working	
11101	No portable firefighting equipment stand-by	
11102	Portable firefighting equipment not regularly inspected/tested	
11103	Portable firefighting equipment not	
11104	Portable firefighting equipment - Legal requirements not met	
11105	Incorrect firefighting equipment used	
11501	No emergency equipment available	
11502	Emergency equipment not sufficient	
11503	No spillage control equipment available	
11504	Spillage control equipment not sufficient	
2502-2503-2504	Packaged DG falling from truck due to improper securing	
3101	High voltage cables are unprotected or badly insulated	
3303	Electrical equipment and installations are not properly operated	
4501	Operating procedures for delivering/receiving packaged DG not followed	
4502	Packaged DG falling or damaged during handling by forklift, crane, etc.	
4602	Package of DG damaged during handling/storage, hazardous reaction due to contamination	
4604	No safety procedures for storing DG	
4701-4702-4703	No dangerous goods register, register not up to date and no MSDS available	
5104	No maintenance system in place	
6201	Operator does not understand/know the hazards of the process	
6202	No education corresponding to job requirements	
6301	New operating staff not properly trained	
6402-6403-6404	No correct training course provided, no special training on handling DG, no refresher training provided	
6405	No regular emergency drills conducted	
6501	Accidents hazards not communicated	
7101	No or limited safety, environmental procedures for terminal operations	
7102	Improper or inadequate procedures are in use	
7603	No or inadequate Emergency Response equipment	
7701	Terminal personnel not properly trained on handling DG	

Table 15: **Priority Areas - Phnom Penh Port (continued)**

No.	Hazard	Priority Area
7703-7704	Training on firefighting equipment and emergency response procedures	3
7709	No refresher training on handling DG	
7901	No regulations	
71101	No management system in use	
71102	No approved code of safe working practice available	
71103	No management concerning DG	
8106	Global events: high winds	
1101	Terminal close to residential area	2
1201-1202	Access to port facilities uncontrolled, no surrounding wall, no fence, no controlled gate	
1806	Maximum load capacity of slings used less than maximum capacity of the crane	
1807	Cranes not certified	
11107	Firefighting equipment not working	
2501	Emission of electric spark from trucks/trailers	
2601	Forklifts & reach stackers emitting electric sparks	
2602	Equipment used beyond rated capacity, packaged DG falling off	
2603	Equipment malfunction due to no or improper maintenance, packaged DG falling off	
3102	High voltage cables in areas were inflammable goods are handled or stored are unprotected or badly insulated	
3201	Not enough clearance for overhead power lines	
3203	Cables not fire proof	
3301	Electrical equipment and installations do not comply with the standards recognised by the competent authority	
3302	Electrical equipment for use in places where potentially explosive atmosphere is present is not explosion proof	
3305	No adequate lighting	
3401	Circuit breakers not adequate for circuit protection	
3402	Circuit breakers not working	
4603	No proper containers used for storing DG	
4605	Surface not suitable for storing packaged DG	
6303	No training for operators to complete task	
6305	Operator not provided with supervision	
6504	Language difference between terminal operator and vessel crew	
7401	Terminal has no policy, bad management	
7601	No measures in place to deal with DG spillage (Emergency Response Plan)	
7705	No training on accident prevention	
8101-8102-8108	Global events: lightning, flooding and earthquakes	

ADDITIONAL ACTIVITIES AND OPERATIONS

Activity/Operations: Local Supply of Fuel
Location: Krakor, Cambodia

Figure 37: **Local Supply of Fuel in Krakor, Cambodia**

During the risk assessment, the National Working Group observed six small vessels (pictured above) that supply fuel to communities living in Krakor on the Tonle Sap. On average, each vessel carried 60 plastic containers (30 litres) of petroleum products totalling 1,800 litres. The boat operators stated that they operated for eight months during the wet season. Solid wastes from human activity were evident around the fuel supply operations. This is a small-scale operation. Cumulatively, however, there is a large amount of petroleum products supplied with very limited controls (Table 16).

Table 16: **Priority Areas for the Loading of Fuel**

No.	Possible Hazards	Possible Consequences	Priority Area
Local Supply of Fuel, Krakor			
1	Operation is not regulated by authorities	Operators not required to implement safe operating procedures	High (3)
2	No safety procedures for the operations	Operational errors during fuel transfer, fire/ explosion, pollution	Very High (4)
3	Fuel hoses and petroleum drum not maintained	Spills during fuel transfer, pollution.	Medium (2)
4	Not adequate equipment available to contain spills.	Pollution, liquid wastes disposed to the river.	High (3)
5	No waste reception facilities available.	Pollution, solid and liquid wastes disposed to the river.	High (3)

Activity/Operations: Transfer of Fuel from Truck to Barge
Location: Chhong Kneas, Cambodia

Figure 38: **Transfer of Fuel from Truck to Barge in Chhong Kneas, Cambodia**

In Chhong Kneas, also on the Tonle Sap, it was discovered that trucks supply fuel directly to barges (200 tonnes) during the eight-month high water season. The fuel is then transported to supply stations. There is no berthing facility for the barge and the operation is undertaken in close proximity to small passenger and tourist boats. There was evidence of oily wastes generated by the operations on the banks of the river. About 15,000 tonnes of fuel is transferred from the fuel trucks to the barges annually (Table 17).

Table 17: **Priority Areas for the Transfer of Fuel from Truck to Barge**

No.	Possible Hazards	Possible Consequences	Priority Area
Transfer of Fuel from Truck to Barge, Chhong Kneas			
1	Operation is not regulated by authorities	Operators not required to implement safe operating procedures.	High (3)
2	No safety procedures for the operations	Operational errors during fuel transfer, fire/ explosion, pollution	High (3)
3	No adequate berthing facility for Barge	Pollution, solid and liquid wastes disposed to the river.	High (3)
4	Not adequate equipment available to contain spills.	Pollution, liquid wastes disposed to the river.	High (3)
5	No waste reception facilities available for barge or fuel trucks.	Pollution, solid and liquid wastes disposed to the river.	Very High (4)
6	Operation in close proximity to small passenger vessels.	Endangering tourism operators in case of fire/ explosion/ toxic gas release	Very High (4)
7	No management concerning dangerous goods	Endangering property, employees, environment, due to negligence, unawareness	High (3)

FLOATING FUEL STATIONS

In Cambodia it was noted in the preparation meetings that during the high water season there are a number of floating and fixed fuel stations operating on the Great Lake. As the Tonle Sap Lake is a very important wetland and sensitive to water pollution, a sample of these re-fuelling stations were included in the Risk Analysis (Figure 39).

Figure 39: **Floating Fuel Terminals on Tonle Sap Lake, Cambodia**

Table 18: **Priority Areas for Floating Fuel Terminals, Cambodia**

No.	Possible Hazards	Possible Consequences	Priority Area
Management, Authority and Control			
1	Operation is not regulated by authorities	Operators not required to implement safe operating procedures.	**Very High (4)**
2	There are no rules and regulations for the safe operation of terminals	Unsafe operating conditions, increasing risks of incidents	**High (3)**
3	No management concerning dangerous goods	Limited awareness of dangerous goods, risks of fire, explosion and pollution	**Very High (4)**
4	Terminals not inspected by authority	Terminal in unsafe condition increasing risks of fire, explosion and pollution.	**High (3)**

Table 18: **Priority Areas for Floating Fuel Terminals, Cambodia (continued)**

No.	Possible Hazards	Possible Consequences	Priority Area
Infrastructure and Maintenance			
1	Operation in close proximity to small passenger vessels.	Increased risks of fire, explosion and property damage.	**High (3)**
2	Operation in close proximity to important wetlands and local communities	Increased risks to environment and local communities.	**Very High (4)**
3	No adequate berthing facility for Barge and/or small boats	Pollution, solid and liquid wastes disposed to the river.	**High (3)**
4	Petroleum storage tanks not inspected and maintained properly	Increased risks of spills, pollution and fire/ explosion.	**High (3)**
5	Fuel hoses and petroleum drum not maintained	Increased risks of spills, pollution and fire/ explosion.	**High (3)**
6	Terminal not maintained adequately	Terminal in unsafe condition increasing risks of fire, explosion and pollution.	**High (3)**
Waste Management, Fire and Emergency Response			
1	No portable fire extinguishers available	Ineffective response to fires, increasing risks of explosion	**High (3)**
2	No firefighting pumps available.	Ineffective response to fires, increasing risks of explosion	**High (3)**
3	Not sufficient bunding around terminal.	Pollution, liquid wastes disposed to the river.	**High (3)**
4	Not adequate equipment available to contain spills.	Pollution, liquid wastes disposed to the river.	**High (3)**
5	No waste reception facilities available.	Pollution, solid and liquid wastes disposed to the river.	**Very High (4)**

3.3.4 Viet Nam

In Viet Nam, the Ministry of Transport (MOT) is the highest government body responsible for overall maritime and IWT affairs in the whole country. It works through three executive agencies that are responsible for maritime and inland matters:

Vietnam National Maritime Bureau (VINAMARINE)

VINAMARINE is mainly responsible for all maritime matters concerning seaports and seagoing vessels. VINAMARINE implements all the international maritime safety conventions such as SOLAS, SAR, STCW, to which Viet Nam is a party. It organises examinations and issues certificates for seafarers and vessel officers. It also carries out maintenance and monitors vessel traffic regulations, surveys, inspections, pilotage, wrecks and salvage, procedures for transport of dangerous goods, certification of Vietnamese-flagged vessels and marine accident investigation.

Vietnam Register (VR)

VR is a specialist support unit that acts as a classification society; it classifies and issues technical certificates of seagoing vessels.

Vietnam Inland Waterways Administration (VIWA)

VIWA governs and maintains the inland ports, rivers, canals and navigable lakes of Viet Nam. VIWA implements the national safety regulations concerning river-going vessels on inland waterways, and monitors and maintains the safety of inland waterways; it also carries out controls, surveys, inspections and certification of these vessels/ports.

3.3.4.1 Legislation and Authority Control

According to answers to the questionnaires and research made, it can be concluded that the legislation related to ports and terminals along the Mekong River in Viet Nam is a complex system of legal documents issued by different state agencies. The Ministry of Transport (MOT) is mainly in charge of preparing national legislation for transport. Laws, ordinances and resolutions need to be submitted to the National Assembly for approval, and decrees need to be submitted to the Prime Minister for approval. MOT approves the circulars, joint circulars, regulations and decisions needed to be approved by the Ministry of Transport and other relevant ministries.

The *Agreement between the Royal Government of Cambodia and the Government of the Socialist Republic of Vietnam on Waterway transportation* (Phnom Penh, 17 December 2009) contains several references concerning dangerous goods. These references are described in the legal chapter.

The main national laws that apply inland waterways are:

1. *Viet Nam Inland Waterway Law* 23/2004/QH11; and
2. *Decree No 21/2005/ND-CP* which regulates the implementation of this law.

Classification (inland or sea) of inland ports and terminals is regulated in *Decision 31/2004/QD-BGTVT*, dated 21 December 2004. This classification is based on the scale of the structure, size of the vessels that can be accommodated and the annual throughput. If the port/terminal is classified as an inland terminal the Viet Nam Inland Waterway Port Authority is responsible for port regulations and enforcement. The criteria for classifying either seaports, which are under the control of VINAMARINE, or river ports, which are under the control of VIWA, are complex and unclear so both types of ports coexist along the same stretch of river. On the same river waterway, there may exist two port authority systems, one under control of VINAMARINE and the other under control of VIWA. All inland ports in the Mekong Delta are state-owned or private companies.

The following decision/circulars apply for inland waterway ports and landing stations:

- *Decision No 27/2008/QD-BGTVT* (4 December 2008) regulates the responsibilities and authorities of VIWA;
- *Circular No 25/2010/TT-BGTVT* (31 August 2010) regulates the implementation of inland waterway ports and landing stages;
- *Circular No 34/2010/TT-BGTVT* (8 November 2010) regulates the operation of the Port Authority (port state control) systems; and
- *Circular No 101/2008/TT-BTC* (11 November 2008 regulates the implementation for fee, charge and fine collection of inland waterway ports and landing stages.

For inland ports and terminals, VIWA is responsible for implementing and ensuring compliance with port laws, by-laws and regulations relating to the transport, handling and storage of dangerous goods and protection of the environment. Port operators are in charge for the safety and protection of the environment in ports and terminals.

Decree No. 29/2005/ND-CP of March 10, 2005 promulgating the list of dangerous goods and the inland waterborne transport thereof contains classification of dangerous goods, which is similar to the classification of dangerous goods by the International Maritime Dangerous Goods (IMDG) Code. The most important components are:

- Annex 1 of the decree which contains a list of dangerous goods;
- Chapter III, Article 8 which states that storekeepers and handlers of dangerous goods need to be trained under programmes set by the Ministry of Transport;
- Article 9 which states that the storekeeper has the overall responsibility for the loading/discharging and supervision of dangerous goods; and
- Section 1, Appendix 3 which describes sizes, signs and colours of dangerous goods symbols. Permits for transport, handling and storage are issued by the Ministry of Public Security for goods of Class 1,2,3,4 and 9, the Ministry of Science and Technology for goods of Class 5,7 and 8, the Ministry of Health for Class 6 goods and fertilisers for household use, and the Ministry of Natural Resources and Environment for other dangerous goods.

The Annex of *Circular MSC.1/Circ. 1301*, 9 February 2009, *Carriage of dangerous goods.* The IMDG Code contact information for the designated national competent authority. Section 7.9.3 of the IMDG Code identifies the main offices of the designated national competent authorities and bodies including:

- designated national competent authorities;
- competent authorities and bodies designated for the testing and certification of packagings, intermediate bulk containers (IBCs) and large packagings; and
- competent authorities and bodies which have been designated as competent inspection agencies or authorities for testing, approval, acceptance and other duties connected with portable tanks, road tank vehicles, multiple-element gas containers (MEGCs) and bulk containers (BK2).

These functions are dedicated to the Director General of VIWA and the International Relations Department is the focal point for further information. The Maritime Code of Vietnam has not yet fully adopted the IMDG Code, although this is planned for 2012. Considering the experience VIWA has with the IMDG Code, this would represent an excellent opportunity to expand and cover inland ports which receive both maritime and inland vessels.

Law on Fire Prevention and Firefighting, 2001

Firefighting equipment in ports and terminals is regulated by this law, and the following decrees relate to its implementation:

Decree No.35/2003/ND-CP (4 April 2003) details the implementation of some articles; and

Circular No. 04/2004/TT-BCA (31 March 2004) of the Ministry of Public Security guides the implementation of Decree No. 35/2003/ND-CP dated 04/04/2003 and stipulates that the Ministry is responsible for port/terminal fire protection.

Circular 14/2005/TTLT-BLDTBXH-BYT-TLDLDVN (8 March 2005) on recording and reporting labour accidents every six months by standard format.

The standards system in Viet Nam currently consists of over 6,000 national standards. The first of these standards were developed in 1963. The directorate for Standards, Metrology and Quality (STAMEQ), of the Ministry of Science and Technology is the national standards body. The *Law on Standards and Technical Regulations* was adopted by the National Assembly in June 2006 and took effect on January 1 of 2007. Under this law, standards and technical regulations are simplified to three levels: national standards (TCVNs) and organisational standards (TCCSs), national technical regulations (QCVNs) and local technical regulations (QCDPS). Standards are applied voluntarily but technical regulations are mandatory.

Almost all technical standards regarding construction and equipment of terminals are according to Vietnamese technical standards (TCVN). These standards are developed on the basis of research results, the application of scientific and technological achievements, experience and the adoption of international standards relevant to the socio-economic conditions of Viet Nam[27]. These TCVNs are, however, applied voluntarily. There are currently no mandatory technical regulations (QCVNs) that apply for terminals.

3.3.4.2 Dangerous Goods Specifications

The following dangerous goods are transported stored and handled in Viet Nam: DO, KO, gasoline (M 92 & M95), LPG and fertilisers. The main functions of the terminals in the Mekong Delta are importing fuel and oil, and then supplying through commercial distribution networks. Fuel is imported from petroleum terminals in Ho Chi Minh City and most fuel products from the industrial zone at Dung Quat oil refinery (Quang Ngai province), either via Ho Chi Minh City or directly from Dung Quat.

3.3.4.3 Petroleum Terminals

The main terminals are located in Can Tho, My Tho and Tien Giang provinces. Quantities of dangerous goods handled at selected terminals are shown in the Table 19 below:

Table 19: **Petroleum Terminals and Throughput (million tonnes/year) in Mekong Delta**

No	Province and Port	Quay Length	Throughput (million tonnes/year)
1	PetroMekong	151m	0.45
2	CAWACO	210 m	0.6
3	Phuc Thanh Oil Co	41 m	0.1
4	Tra Noc Oil Co	45 m	0.1
5	Can Tho Oil Co	138 m	0.3
6	Hau Giang Oil Co	160 m	0.4
7	Tay Nam Bo Oil Co	80 m	0.2
8	Tra Noc Co	82 m	0.2
9	Cao Lanh Oil Co	90 m	0.4
10	Tay Nam Bo Oil Co	60 m	0.4

Information from these terminals was included in the project from Can Tho, My Tho and Dong Thap provinces. It is difficult to estimate the number of terminals operating as some are private terminals,

[27] Standards, regulatory reform and development in APEC: Case studies of Viet Nam and Thailand By Adam McCarty , National Economics University, Hanoi

floating terminals and some are registered with VIWA, VINAMARINE and provinces.

There are the two inland waterway port authorities in VIWA that are responsible for the control of fuel ports, ports and landing stages in the Mekong Delta in Viet Nam. Port Authority No 3 has control over 137 fuel ports and 676 ports and landing stages. Port Authority No 4 has control over 137 fuel ports and 1,426 ports and landing stages. The exact locations, type and quantity of dangerous goods and cargo throughput at the fuel ports is not known and requires further investigation.

To complete the risk assessment, four petroleum terminals were visited and inspected by the National Working Group by using the risk register:

1. **Tay Nam Bo Petroleum Terminal** is located at Tra Noc II Industrial Zone, Binh Thuy District, Can Tho City. Construction of the terminal was completed in 1998. It has 17 tanks for storing petroleum products and a total storage capacity of 99,300 m^3 (8 tanks of 3,000 m^3, 6 tanks of 12,500 m^3 and 3 tanks of 100 m^3). Petroleum products stored and handled at the terminal are DO, KO and Gasoline (M92 & M95). There are 50 employees of whom two are dedicated to administration. The terminal operator is the Tay Nam Bo Petroleum Co;

   The terminal has two jetties for supplying fuel. A small jetty discharges to vessels less than 60t and tankers between 60-1,000t, receiving up to 200 vessels a month. The other jetty is for receiving and discharging petroleum products to tankers greater than 1,000t and receives about 400 vessels annually. The terminal has a tow boat and oil spill response equipment for oil spills and fires. There appeared to be sufficient bunding to contain oil spills on the terminal jetty and pontoon. However, the boom was not in good working condition and needed replacing;

2. **Binh Duc Petroleum Terminal** is located in My Tho, Tien Giang province. The construction of the terminal was completed in 1997. It has 4 tanks for storing petroleum products and a total storage capacity of 5,700 m^3 (1 tank of 1,500 m^3, 3 tanks of 1,300 m^3 and 3 tanks of 100 m^3). Petroleum products stored and handled at the terminal are DO & Gasoline (M92). There are 40 employees of whom two are dedicated to administration. The terminal operator is Oil Tien Giang Co;

3. **Quang Trung Petroleum Terminal** is located in My Tho. The construction of the terminal was completed in 1997. It has 4 tanks for storing petroleum products and a total storage capacity of 4,000 m^3 (4 tanks of 1,000 m^3). Petroleum products stored and handled at the terminal are DO, KO and Gasoline (M92 & M95). There are 35 employees of whom two are dedicated for the administration. The terminal operator is Oil Tien Giang Co; and

4. **Dong Thap Petroleum Terminal** is located in Dong Thap. The construction of the terminal was completed in 2004. It has 6 tanks for storing petroleum products and a total storage capacity of 30,000 m^3 (6 tanks of 5,000 m^3). Petroleum products stored and handled at the terminal are DO, and Gasoline (M92 & M95). There are 40 employees of whom two are dedicated for the administration. The terminal operator is Oil & Gas Dong Thap Co.

3.3.4.4 Risk Evaluation for Ports, Terminals and Additional Operations

Upon completion of the risk assessment by the National Working Grouop, data and risk registers were analysed and used to compile a typical risk register. This typical risk register represents the current status of an average terminal in Viet Nam (Table 20).

Table 20: **Priority Areas for Viet Nam Terminals**

VIET NAM TERMINAL		
No.	**Hazard**	**Priority Area**
7708	No training on vessel waste management	4
1505	Maximum Allowable Pressure (MAWP exceeded)	3
1506	Safety devices not working (ex. Emergency Shutdown system not working)	
1507	Pressure gauges on cargo pipes not working	
1508	Safety systems manually by-passed	
1509	Lines not in use not properly blinded (flange connected with all bolts tight)	
1510	Gaskets, seals or flanges leaking	
1511	No colour coding on cargo pipes	
1514	Hot steam line not insulated	
1515	Construction material not corrosion resistant	
1517	Piping not properly supported	
1601	Cargo valves blocked	
1602	Cargo valves fail to operate	
1603	Cargo valve leaking	
1605	Emergency valves not readily accessible	
1606	Valves not fire rated	
1701	Warehouses/sheds not equipped with firefighting equipment	
1702	Segregation of DG not according regulations	
1901	No waste reception facilities available for vessels	
11001	Pump of fixed firefighting equipment not working	
11003	No international shore connection available	
11004	Fire hydrant blocked	
11005	Water spray curtain not working	
11006	Fixed firefighting pump capacity not sufficient	
11102	Portable firefighting equipment not regularly inspected/tested	
11201	Fire detection equipment not working	
11202	Fire detection equipment not regularly tested	
11501	No emergency equipment available	
11502	Emergency equipment not sufficient	
11505	No emergency control centre	
2201	Meters of tank wagons containing jet fuel or gasoline malfunctioning	
2202-2301	Leaking valves on tank wagons/trucks containing jet fuel or gasoline	
2203	Tank wagons containing jet fuel or gasoline: rupture of tank or welding seam	
2402	Walky Talkies not explosion proof	
2403	Communication with cargo control room not working	

Table 20: **Priority Areas for Viet Nam Terminals (continued)**

No.	Hazard	Priority Area
2501-2705	Emission of electric spark from trucks/trailers/generators	3
2704	Generator alarm/shutdown fails	
5201	Hot work permit not in use	
5202	Sparks from welding activities	
6301	New operating staff not properly trained	
6302	No procedures in place to ensure operators perform a task as required	
6303	No training for operators to complete task	
6304	Operator makes an incorrect reading	
6501	Accidents hazards not communicated	
6502	No records of accidents/Hazards	
6503	Accidents / hazards not reported	
6504	Language difference between terminal operator and vessel crew	
7201	Improper/inadequate inspections of terminal	
7301	No Authority control	
7401	Terminal has no policy, bad management	
7701	Terminal personnel not properly trained on handling DG	
7703-7704-7705	Training on firefighting equipment, emergency response procedures and accident prevention	
7706-7707	No training marine pollution prevention and environmental protection	
7709	No refreshment courses for personnel handling DG	
7801	No law enforcement	
7901	No regulations	
7902	Operator not aware of National regulation	
71003-71004-71005	No checklist regarding: bunkering, maintenance and safety items	
71202	No liquid waste management	
71301	No drug and alcohol policy	
8105-8107	Global events: typhoon, tsunami or tidal wave	
1101	Terminal close to residential area	2
1102	Trucks loaded with DG going to and from the terminal, passing dense populated areas	
1103-1104	Open fire or hot works outside the terminal, close to tanks with DG	
1201	Access to terminal facilities uncontrolled, no surrounding walls, no fences, no controlled gates	
1301	Failing tank structure (ex. Tank supporting, corrosion, etc)	
1302	Bad welding seams on tank structure	
1403	Cargo pump leaking	
1404	No regular inspection of cargo pumps	
1501	Cargo transfer hose is ruptured	
1502	Cargo pipe fractured	
1503	Piping subject to surge pressure	
1504	Transfer hose leaking	

Table 20: **Priority Areas for Viet Nam Terminals (continued)**

No.	Hazard	Priority Area
1512	Pipe welding insufficient	2
1513	Piping located in areas with high vehicle traffic not separated from traffic flow by vehicle guards or beams	
1516	Piping specifications not followed	
1518	Corrosion rates not regularly checked	
1519	No flame arrestors on vent lines	
1520	Cargo pipes not regularly pressure tested	
1608	Valve indicator lights not working	
1609	Valve added to original system design, valves that are not on the original site plans	
1902	Capacity of waste reception facilities insufficient	
1903	Waste generated by port and cargo operations	
11002	Piping of fixed firefighting equipment not correctly aligned	
11101	No probable firefighting equipment stand-by	
11104	Portable firefighting equipment - Legal requirements not met	
11105	Incorrect firefighting equipment used	
11106	No fixed foam system	
11107	Firefighting equipment not working	
11401	No correct Personal protective equipment (PPE) provided	
11404	Safety showers not working	
11405	PPE not inspected at regular intervals	
11503	No spillage control equipment available	
11504	Spillage control equipment not sufficient	
2101	Tank high level alarm out of order	
2102	Tank high level alarm not calibrated	
2204	Meters on tank wagons containing diesel or IFO malfunctioning	
2205	Leaking valves on tank wagons containing diesel or IFO	
2206	Tank wagons containing diesel or IFO: rupture of tank or welding seam	
2302	Tank trucks containing jet fuel or gasoline: rupture of tank or welding seam	
2303	Malfunctioning of meters on tank trucks containing jet fuel or gasoline	
2304	Leaking valves on tank wagons containing diesel or IFO	
2401	No Walky - Talkies available	
3101-3102	High voltage cables in dangerous areas unprotected or badly insulated	
3201	Not enough clearance for overhead power lines	
3301	Electrical equipment and installations do not comply with the standards recognised by the competent authority	
3302	Electrical equipment for use in places where potentially explosive atmosphere is present is not explosion proof	
3303	Electrical equipment and installations are not properly operated	
3304	Electrical equipment not properly earthed	
3401	Circuit breakers not adequate for circuit protection	

Table 20: **Priority Areas for Viet Nam Terminals (continued)**

No.	Hazard	Priority Area
3402	Circuit breakers not working	2
4104	No supervisions during cargo operations	
4201	Tank separation not to according standards (distance between storage tanks)	
4202	No or insufficient area to contain spills	
4203	Tank rupture due to internal corrosion	
6201	Operator does not understand/know the hazards of the process	
6202	No education corresponding to job requirements	
6305	Operator not provided with adequate supervision	
6402-6403-7701	No correct training course provided, no special training on handling DG	
6404	No refresher training on handling DG	
6405	No regular emergency drills conducted	
7102	Improper or inadequate procedures are in use	
7501	ISPS Code not in use/implemented	
7601	No measures in place to deal with DG spillage (Emergency Response Plan)	
7602 7603	No emergency response drills No or inadequate Emergency Response equipment	
7702	No training on first aid	
71001-71002	No checklist regarding Loading/discharging and transfer of cargo	
71101	No management system in use	
71102	No approved code of safe working practice available	
71103	No management concerning DG	
71201	No solid waste management (garbage, maintenance residues)	
8102-8103 8106-8108	Global events: lightning, mud slide, high winds and earthquake	

The National Working Group was granted access only to state-owned companies and these were included in the risk assessment. There are, however, many other privately-owned companies operating in the Mekong Delta that were not included in the Risk Analysis.

Additional Operations

During the site visits, a number of fixed and floating refuelling stations were observed in the Mekong Delta. In general, the floating fuel terminals under state-owned companies were in good condition. However, some of the private terminals had very limited controls (Table 21).

Table 21: **Priority Areas for Floating Fuel Stations, Viet Nam**

No.	Possible Hazards	Possible Consequences	Priority Area
Management, Authority and Control			
1	Operation is not regulated by authorities	Operators not required to implement safe operating procedures.	Very High (4)
2	There are no rules and regulations for the safe operation of terminals	Unsafe operating conditions, increasing risks of incidents	High (3)
3	No management concerning dangerous goods	Limited awareness of dangerous goods, risks of fire, explosion and pollution	Very High (4)
4	Terminals not inspected by authority	Terminal in unsafe condition increasing risks of fire, explosion and pollution.	High (3)
Infrastructure and Maintenance			
1	Operation in close proximity to small passenger vessels.	Increased risks of fire, explosion and property damage.	High (3)
2	Operation in close proximity to important wetlands and local communities	Increased risks to environment and local communities.	Very High (4)
3	No adequate berthing facility for Barge and/or small boats	Pollution, solid and liquid wastes disposed to the river.	High (3)
4	Petroleum storage tanks not inspected and maintained properly	Increased risks of spills, pollution and fire/explosion.	High (3)
5	Fuel hoses and petroleum drum not maintained	Increased risks of spills, pollution and fire/explosion.	High (3)
6	Terminal not maintained adequately	Terminal in unsafe condition increasing risks of fire, explosion and pollution.	High (3)
No.	**Possible Hazards**	**Possible Consequences**	**Priority Area**
Waste Management, Fire and Emergency Response			
1	No portable fire extinguishers available	Ineffective response to fires, increasing risks of explosion	High (3)
2	No firefighting pumps available.	Ineffective response to fires, increasing risks of explosion	High (3)
3	Not sufficient bunding around terminal.	Pollution, liquid wastes disposed to the river.	High (3)
4	Not adequate equipment available to contain spills.	Pollution, liquid wastes disposed to the river.	High (3)
5	No waste reception facilities available.	Pollution, solid and liquid wastes disposed to the river.	Very High (4)

The floating terminals require further investigation. In Tien Giang province, for example, the operation of floating fuel terminals has been prohibited due to concerns with safety and environmental protection.

Figure 40: **Floating Fuel Station in Mekong Delta, Viet Nam**

3.3.5 Thailand

3.3.5.1 Legislation and Authority

The main national legislation that applies for ports and terminals concerning handling and storage of dangerous goods on the Mekong River are:

- *Act on Navigation in Thai Water* (B.E. 2456 or 1913);
- *Marine Department Announcement 411/2542: Measures on Safety Discharge and Loading of Petroleum and Chemical Products;*
- *Marine Department Announcement 412/2542: Guidelines and Action Plan and Pollution Elimination for Handling Dangerous Goods in Port*; and
- *Safety Measures for Handling Petroleum Products on the Mekong River* (issued under the *Agreement on Commercial Navigation on the Lancang-Mekong River*).

The *Act on Navigation in Thai Water (*B.E. 2456 or 1913)[28]: may be one of the oldest Thai laws relating to navigation. As the act is an old law, it has been amended on several occasions and there are also many Ministerial Regulations and Announcements issued under the Act.

The *Thai Navigation Act* (Volume 14) as amended in 1992 prohibits dumping any refuse including oil and chemicals into rivers, canals, lakes and waterways that may pollute the environment or disrupt navigation on Thai waterways.

[28] Original name of the act was “the Act on Navigation in Siam Water B.E. 2456”

In 1974, the Thai government ratified the *Convention for the Safety of Life at Sea (SOLAS) 1974*. The Convention came into force in Thailand on 18 March 1975. As a result, in 1976, the Director General of the Harbour Department, with the approval of the Minister of Communication, issued the Harbour Department's *Announcement No. 353/2539* regarding the classification of dangerous goods and the IMDG Code was incorporated into the Act. We can conclude that Thailand is familiar with the classification of dangerous goods according the IMDG Code and with the IMDG Code in general.

The structure of the policy and institutional framework for the water and transport sector is relatively clear. Policy and planning comes from the Ministry of Transport (MOT) and the Office of Transport and Traffic Policy and Planning, while regulation is carried out by the Marine Department. Operators comprise both private companies and state-owned enterprises. The Marine Department and the Port Authority of Thailand (PAT), the regulators of the ports, are also responsible for the operation and development of major international ports, namely Bangkok Port, Laem Chabang Port and Ranong Port, and two regional ports on the Mekong River which are Chiang Saen Port and Chiang Khong Port. The PAT is the largest port operator in Thailand and falls under the supervision of the Ministry of Transport[29]. Compliance with rules and regulations is enforced by means of penalties such as fines, imprisonment or license withdrawal.

On 2 March 1991, an explosion caused by an unidentified chemical substance occurred in a dangerous goods warehouse in Bangkok. This explosion lead to the development of a safety system for the handling of dangerous goods. The incident prompted the PAT to emphasise the importance of proper handling of dangerous goods under a project that ran from 1991 to 1997. In March, 2003, the PAT joined a *Port Safety and Health and Environmental Management System* (PSHE-MS) project with support from the *Partnership in Environmental Management for the Seas of East Asia* (PEMSEA). In 2006, Bangkok Port received a recognition certificate for dangerous goods service from PEMSEA. In 2007, the project was extended to Leam Chabang Port which received its recognition certificate in 2009. For the regional ports, however, there is no progress yet.

In July, 2008, a project was developed for port waste management in Bangkok Port, Leam Chabang Port and Maptaphut Port[30]. Nothing is planned yet for ports and ferry crossings along the Mekong River.

The *Port Authority of Thailand* Act (B.E. 2494 or 1951), as amended in B.E. 2543 (2000), describes the work activities to be carried out by the PAT. These include management, monitoring and control of the five public ports under its supervision. The PAT is entitled to decide on appropriate management and operations of each port under is control (Table 22).

Table 22: **Responsibilities for Management of Ports in Thailand**

Agency	Policy	Regulation and Monitoring	Implementation
Ministry of Transport	X		
Office of Transport and Traffic Policy and Planning	X		
Marine Department		X	X
Port Authority of Thailand		X	X
Private Sector			X

The Government of Thailand has maintained a policy that allows the private sector to participate in

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30 Full report: http://www.md.go.th/safety_environment/04_3_pdf/PDF-Exe/Executive-Eng.pdf

port services, either by operating existing facilities or by funding the development of new or additional facilities and operating them. Before private operators can commence, they need the following permits issued by the competent authorities:

- Berth Construction Permit issued by the Marine Department before constructing the port according to the Navigation in *Thai Water Act* (B.E. 2456);
- Berth Inspection Permit issued by the Marine Department before the port is commissioned according the Navigation in *Thai Water Act (*B.E. 2456);
- Port Business Permit issued by the MOT through the Marine Department under National Executive Council N. 58 concerning Business Affecting Public Security and Well-Being;
- Ministerial Regulation, Specification of Occupational Safety, Hygiene and Environment Management Standards (B.E. 2549)[31].

Rules issued under Sections 6 and 103 of the *Labour Protection Act* (B.E. 2541 or 1988) regulate employers' occupational safety and health obligations. The Act applies to mineral and rock mines, petroleum and petrochemical businesses, manufacturing, construction, hotels etc (Section 1). The four chapters cover legal definitions (Section 2), the establishment of safety manuals (Sections 3-4), training of workers (Sections 5-6), appointment of OSH delegates (Sections 7-18), establishment of OSH committees (Sections 23-35) and OSH reports and notifications (Sections 33-41).

Chapter 8 of the *Labour Protection Act* (B.E. 2541 or 1988)[32] concerns occupational safety and health, creates Work Safety, Occupational Hygiene and Environmental Conditions Committees and provides for labour inspection.

The *Notification of the Ministry of Labour and Social Welfare Regrading Working Safety of Employees* applies to workers in the mining, energy, petroleum, water, construction and transportation sectors. It provides for the appointment of a safety official at the shop, foreman, and executive level in enterprises with less than 50 employees. In enterprises with more than 50 employees, there shall be a professional safety officer as a full-time position.

The *Notification of Ministry of Labour and Social Welfare: The Committee for Safety, Occupational Health, and Surrounding Condition in Work Performance*[33] covers employers with fifty or more employees. They are required to establish a Committee for Safety, Occupational Health, and Surrounding Conditions of Work Performance, whose duties include making recommendations and reports on safety conditions at the workplace. The Committee shall include employees or employee representatives, meet at least once a month, and employee participants shall be paid regular wages for work done in relation to the Committee.

Notification of the Ministry of Industry No. 25 (B.E. 2531) issued pursuant to the *Provisions in the Factories Act* (B.E. 2512[34]) replaces Clause 20 and accompanying schedules in Notification of the Ministry of Industry No. 2 (B.E. 2513) of 1970 in regard to the duties of recipients of a factory operating licence. It deals with storage and disposal of hazardous materials in accordance with guidelines prescribed by the Industrial Factories Department.

Other instruments relating to occupational safety and health are:

Ministerial Regulation, Specification of Occupation Safety, Hygiene and Environment Management Standards (B.E. 2549)

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[31] Official Gazette, 2006-06, Volume 60, No. 6, pp. 279-294

[32] Government Gazette (English translation), 1998-03, Vol. 52, No. 3, p.43

[33] Royal Thai Government Gazette (Translation), 1995-09, Vol. 49, No. 17, pp. 339-346

[34] English version in Royal Thai Government Gazette, 1988-09-30, Vol. 42, No. 27, p. 269-279

Ministerial Regulation on Administration and Management of the Aspect of Occupational Safety and Health and Working Environment relating to Machines, Cranes and Boilers (B.E. 2552).[35]

Ministerial Regulation Specifying Factory Electrical System Safety Measures (B.E. 2550) issued under the *Factory Act* (B.E. 2535)[36] regulates electrical safety, including inspection of electrical installations.

The *Hazardous Substance Act* (B.E. 2535) of 29 March 1992 contains provisions on the control of hazardous substances, duties and civil liabilities, and penalties.[37]

Notification of the Ministry of Interior regards safety in connection with electricity.[38] Chapter VII, governs personal protective equipment.

The *Enhancement and Conservation of the National Environmental Quality Act* (B.E. 2535 or 1992);

Public Health Act (B.E. 2535) regulates nuisance activities related to water pollution such as odour, chemical fumes, wastewater discharge systems of buildings, factories or animal feedlots that cause harmful health effects.

3.3.5.2 Dangerous Goods Specifications

According to the questionnaires, the different kinds of dangerous goods stored and handled on the Mekong River are petroleum products such as gasoline, diesel, asphalt and fertiliser. These are mainly intended for Thai and Lao domestic consumption. The dangerous goods are primarily carried by tanker trucks and truck trailers onboard ferries between Thailand and Lao PDR.

3.3.5.3 Main Ports and Terminals

There are two main port/terminals in Thailand:

Chiang Saen Port:

Located on the bank of the Mekong River, Chiang Saen district, Chiang Rai Province (Figure 41), this port serves as the main gateway for transporting goods from the Greater Mekong Sub-region (GMS), especially southern China which uses it as a mid-point depot prior to export through Laem Chabang Port. As a result of the GMS Economic Cooperation Agreement signed by six countries (Cambodia, China, Lao PDR, Myanmar, Thailand and Viet Nam), Chiang Saen Port has gained strategic importance as an optional transportation route. This applies particularly to China which has a huge production capacity and an enormous consumer market.

Figure 41: **Aerial View of Chiang Saen Port**

[35] Royal Thai Government Gazette, 2009-09, Vol. 63, No. 9, pp. 459-501

[36] Royal Thai Government Gazette (International Translations Office), 2007-08, Vol. 61, No. 8, pp. 425-428

[37] Unofficial English Translation: http://www.diw.go.th/law/hazae.html

[38] Labour Laws (revised 1985), p. 168-207

Chiang Saen Port officially opened in 2003. The port has two pontoons with bridges that link with the quayside and can accommodate 8-10 freighters. Trucks can load and transfer cargo on the vessels at all times. The port has a parking area for 50 trucks and is equipped with one mobile crane (capacity 50 tonnes) and a conveyor belt (Figure 42). The main dangerous goods handled are Diesel and MOGAS (IMDG Class 3) and fireworks (IMDG Class 1). The oil tankers calling at Chiang Saen Port are from China, Lao PDR and Myanmar. The gross tonnage of these tankers ranges from 80 to 200 tonnes. The quantity of fuel exploitation at Keawalee Terminal is shown in Table 23 below.

Figure 42: **Chiang Saen Port**

Table 23: **Quantities of Fuel Exploitation at Keawalee Terminal, Thailand**

Dangerous Good Type	Quantities Of Fuel Oil Exportation In Litres				
	2006	2007	2008	2009	2010
Diesel & MOGAS (IMDG Class 3)	5,189,000	6,692,000	7,907,000	11,184	12,449
Fireworks (IMDG Class 1)	-	-	-	1,039 tonnes	3,160 tonnes

A new port is being built in Chiang Saen. Known as Chiang Saen II, it is located about 10 km south of the first port and is expected to contribute greatly to Thailand's logistics development. It was reported by the MOT that the first Chiang Saen Port had become too small to accommodate the rapid growth of trade and transportation between Thailand and China. The expansion of the first port is not allowed, since it is located within a designated historical area being preserved as a part of national heritage. Moreover, the Treasury Department is developing this area to be registered as a World Cultural Herit-age Site. The historical site will also be promoted as a major tourist destination in northern Thailand. The main objective of developing the new port will be to promote Thailand as the centre of trade, investment and transport in the Upper Mekong region, linking with southern China. The new port of Chiang Saen will also help develop Chiang Rai into a major gateway between Thailand and southern

China that will serve as a factor to bring about development on a continual basis. With railway development to this gateway and port development in the Andaman Sea, Thailand will be able to provide a multimodal transport corridor and open up a new trade lane, linking with southern China, India, the Middle East, Africa and Europe.[39]

The construction of Chiang Saen Port II started in 2008 and was scheduled to be completed in mid-2012. The port is designed as a multipurpose port with storage areas for general cargo, a container yard and a tank farm with an adjacent tanker berth. In the future, the People's Republic of China intends to import 150,000 m^3 of fuel through the new port. The port will be able to accommodate simultaneously ten 50-metre vessels (500 DWT). Its total area will be 640,000 square metres, which is about 40 times bigger than the first port. Chiang Saen Port II will consist of:

- 6 berths loaded by manpower;
- 9 berths loaded by conveyer belt;
- 6 container terminals;
- 1 petroleum berth and
- 6 passenger berths.

Figure 43: **Chiang Saen Port II**

[39] Government Public Relations Department: http://thailand.prd.go.th/view_inside.php?id=2488

Keawalee Pier

- At Keawalee Pier, most operations consist of fuel transfer from trucks to vessels (Figures 44):

Figure 44: **Fuel Transfer from Truck to Vessel at Keawalee Pier**

Chiang Khong Port

Chiang Khong Port is a small river port located on the bank of the Mekong River in Chiang Khong district, Chiang Rai Province. The port is a one berth port opposite Muang Huay Xay, Bor Kaew district, Lao PDR. Behind the port is a road linking Chiang Khong with Chiang Saen district. The port is an important passenger port transporting numerous passengers and cargo loaded on vehicles between Chiang Khong and Hua Xay (Figures 45 and 46). The ferries are mainly used to carry fuel trucks, construction materials and consumables between Thailand and Lao PDR. The berth is 24 metres wide and 180 metres long. The port operator is the Port Authority of Thailand (PAT).

Figure 45: **Chiang Khong Port**

Figure 46: **Chiang Khong Port – Fuel Trucks Boarding A Ferry**

There are numerous ferry crossings between Thailand and Lao PDR along the Mekong River, the main ferry crossings included in this study are located in Chiang Khong, Bungkham and Mukdahan (Figure 47).

Figure 47: **Typical Ferry Readies for Landing in Thailand**

3.3.5.4 Risk Evaluation for Ports, Terminals and Additional Operations

In order to complete the risk assessment two ports were visited and inspected by the National Working Group by using the risk register (Table 24):

- Chiang Saen Port; and
- Keawalee Terminal.

Table 24: **Priority Areas for Inland Ports, Thailand**

THAILAND PORT		
No.	**Hazard**	**Priority Area**
1102	Trucks loaded with DG going to and from the terminal, passing dense populated areas	4
1301-4201-4501	No designated storage area for DG	
1302	No register of DG and no Material Safety Data Sheets (MSDS) available	
1401	No waste reception facilities for ferries	
1402	Waste generated by trucks and port operations not collected	
1501	No fixed fire pump available or fire pump not working	
1502	No fire hoses available	
1503	No fire hydrants or fire hydrants no accessible	
1601	No portable fire extinguishers available at the port or on the ferry	
1602	Portable fire extinguishers not regularly inspected or tested	
1603	Limited type of fire extinguishers available (Water, CO2, dry powder, foam)	
1701	No correct PPE provided (hard hats, high-vis clothing, eyewear, etc)	
1702	Life saving equipment (lifebuoys and life jackets) not available on ferry/ port	
1801	No emergency equipment available	
1802	No oil spill response equipment available onboard ferry or at ferry site)	
3101	High voltage cables in port/ferry site are unprotected or not insulated	
3201	Not enough clearance for overhead power lines	
4402	Trucks not inspected effectively to determine if DG carried are in good condition, have the correct MSDS and correct safety and fire equipment	
4502	No proper containers used to store DG, containers labelled incorrectly	
4503	No dangerous goods register available or no MSDS at the port or on the ferry	
4601	No proper working language, signs or symbols	
5201	Hot work permit not used for welding, cutting in port or on ferry	
5202	No control of welding operations in port areas or on ferry	
6101	New operating staff not properly familiarised / trained	
6102	No procedures in place for ferry operations (loading ferry, navigation, etc)	
6201	No training for port or ferry operators	

Table 24: **Priority Areas for Inland Ports, Thailand (continued)**

No.	Hazard	Priority Area
6202	Special training for handling DG not provided	4
6203	No regular emergency drills conducted	
6302	Accidents/hazards not reported	
7101	No or limited safety procedures for the ferry crossing operations to prevent accidents and pollution	
7102	Improper or inadequate procedures are in use	
7501	No measures in place to deal with DG spillage (Emergency Response Plan)	
7502	No emergency / Live Saving response drill	
7602-7603-7604-7605-7606	No training on: Emergency/firefighting equipment, Safe navigation/ferry operations, accident prevention, environmental protection, waste management (port/ferry)	
8101-8105	Global events: flooding and typhoon	
91	Local fuel transfer not regulated by authorities	
92	No safety procedures for local fuel transfer	
93	Fuel hoses and drums for local fuel transfer not maintained	
94	No adequate equipment available to contain spills	
95	No waste reception facilities at local fuel transfer site	
1101	Port close to residential area	3
2101-2102	No process to inspect Tank trucks containing diesel, IFO, gasoline or LPG before boarding ferry	
2201-2202-2203	No process to inspect ordinary trucks/trailers carrying DG	
2401	The port has no emergency generator	
3202	Mechanical damage to cables	
3301	Electrical equipment/installations not regularly inspected and in poor condition	
4101-4301	No procedures for loading of trucks carrying DG in bulk	
4102	No communication between port and ferry during loading of trucks carrying DG	
4401	No procedures for loading of trucks carrying packaged DG	
5101	Terminal/port equipment not regularly inspected and maintained	
5102	No maintenance schedule for maintenance at the port/ferry	
6301	No records of accidents/hazards	
7201	Improper/inadequate inspections of ferry crossing operations	
7301	No regulations for ferry crossing operations	
7302	Operator not aware of National Regulations	
7601	No training on first aid	
7607	Operator not aware of National Regulations	
7701	No checklist for loading/unloading ferry	
7702-7703	No checklist to inspect trucks carrying DG and loading fuel to ferry	
7704-7705	No checklist for maintenance of the port/ferry, safe navigation/ferry operations	
8104-8106-8107	Global events: heavy and prolonged rain storms, high winds and Tsunami or tidal wave	

Table 24: **Priority Areas for Inland Ports, Thailand (continued)**

No.	Hazard	Priority Area
1201	Access to the port uncontrolled, no surrounding wall, no fence, no controlled gate	2
2301	No VHF radios or communication available	
2302	No communication between port and ferry	
2304	No communication between left and right bank (ports)	
7401	No security or customs procedures in place to prevent unauthorised access	
7801	No solid waste management (garbage and maintenance residues)	
7802	No liquid waste management (oily water) from the ferries	
7901	No drug and alcohol policy	
8103-8108	Global events: mud slide and earthquake	

3.3.6 Lao PDR

3.3.6.1 Legislation and Authority

The national legislation regarding the storage and handling of dangerous goods is prepared by the Department of Waterways, Ministry of Public Works and Transport and the department of PWT province. The main existing legislation:

- *Draft Rule on Safety of the Port;*
- *Draft Rule on Dry Port;*
- *Draft Regulation on Handling and Storage of Dangerous Goods;* and
- *Draft Rule on Inland Waterway Transportation of Dangerous Goods.*

These documents are however only available in Lao at this stage.

MPWT is responsible for the import/export and the Ministry of Natural Resources and Environment (MONRE) for the storage and handling of dangerous goods, including EIA process. The Boats Association and the provincial PWT departments are responsible for implementing and ensuring compliance with port laws, by-laws and regulations relating to the storage and handling of dangerous goods in port areas.

Operators of ports and petroleum terminals are required to submit an environmental management plan to the Government. The requirements for a private operator to install a fixed or floating refuelling station or small petroleum terminal on the Mekong River follow the *Decree on Measurement Management No: 163/PM,* 26 October 1993.

Ports and Petroleum terminals are required to submit an emergency response plan to the Prime Minister's Office, Ministry of Public Work and Transport, Ministry of Finance, Ministry of Public Security, Ministry of Public Health, Ministry of Agriculture and Forestry and the Lao National Mekong Committee.

3.3.6.2 Dangerous Goods Specifications

Petroleum products, gasoline and diesel, together with toxic chemicals such as mercury and sodium cyanide used for gold mining, are the principal dangerous goods transported, handled and stored. Other commodities stored and handled are logs, cement, rice, concrete pipes, construction materials, timber and agricultural products. The illegal transport of fertilisers, herbicides and pesticides across the Mekong River from Thailand to Lao PDR needs further investigation.

3.3.6.3 Main Ports and Terminals

Km 4 State Port

Km 4 State port is located in Vientiane Capital and is managed by the Ministry of Public Works and Transport (MPWT) (Figure 48). The 29 employees are responsible for coordinating port operations, customs, security and forestry. Cargo exports have, however, decreased due as transport companies have opted for improved roads as a more viable and reliable transport link. However, the Mekong River still provides an important transport link between rural provinces in Lao PDR and the capital. The main types of cargo handled are construction materials, agricultural products and timber. Km 4 Port has two underground storage tanks on the premises, each having a storage capacity of 10,000 litres. These tanks are filled by fuel trucks which are responsible for testing the integrity of the fuel tanks prior to loading. The tanks in the port were flooded by Mekong waters in 2008, when management had the lids opened to check the condition of the tanks and their contents. On that occasion some 20 m^3 of diesel were spilled into the Mekong.

Figure 48: **Km 4 State Port**

3.3.6.4 Risk Evaluation for Ports, Terminals and Additional Operations

The Lao Port Priority Areas is a combination of risk registers from Km 4 State Port, Luang Prabang Cargo and Passenger Ports, Nakasan Passenger Port and Huay Xay, Ban Thuya and Pakxanh Ferry Crossings (Table 25).

Table 25: **Priority Areas for Inland Ports, Lao PDR**

LAO PDR PORTS		
No.	**Hazard**	**Priority Area**
1101	Port close to residential area	4
1102	Trucks loaded with DG going to and from the terminal, passing dense populated areas	
1301-4201-4501	No designated storage area for DG	
1302	No register of DG and no Material Safety Data Sheets (MSDS) available	
1401	No waste reception facilities for ferries	
1402	Waste generated by trucks and port operations not collected	
1501	No fixed fire pump available or fire pump not working	
1502	No fire hoses available	
1503	No fire hydrants or fire hydrants no accessible	
1601	No portable fire extinghuishers available at the port or on the ferry	
1602	Portable fire extinghuishers not regularly inspected or tested	
1603	Limited type of fire extinghuishers available (Water, CO2, dry powder, foam)	
1701	No correct PPE provided (hard hats, high-vis clothing, eyewear, etc)	
1702	Life saving equipment (lifebuoys and life jackets) not available on ferry/port	
1801	No emergency equipment available	
1802	No oil spill response equipment available onboard ferry or at ferry site)	
3201	Not enough clearance for overhead power lines	
4402	Trucks not inspected effectively to determine if DG carried are in good condition, have the correct MSDS and correct safety and fire equipment	
4502	No proper containers used to store DG, containers labelled incorrectly	
4503	No dangerous goods register available or no MSDS at the port or on the ferry	
4601	No proper working language, signs or symbols	
5201	Hot work permit not used for welding, cutting in port or on ferry	
5202	No control of welding operations in port areas or on ferry	
6202	Special training for handling DG not provided	
6301	No records of accidents/hazards	
6302	Accidents/hazards not reported	
7101	No or limited safety procedures for the ferry crossing operations to prevent accidents and pollution	
7201	Improper/inadequate inspections of ferry crossing operations	
7301	No regulations for ferry crossing operations	
7302	Operator not aware of National Regulations	

Table 25: **Priority Areas for Inland Ports, Lao PDR (continued)**

No.	Hazard	Priority Area
7501	No measures in place to deal with DG spillage (Emergency Response Plan)	4
7502	No emergency / Live Saving response drill	4
7602-7603 7604-7605-7606	No training on: Emergency/firefighting equipment, Safe navigation/ ferry operations, accident prevention, environmental protection, waste management (port/ferry)	4
7607	Operator not aware of National Regulations	4
7702-7703	No checklist to inspect trucks carrying DG and loading fuel to ferry	4
7802	No liquid waste management (oily water) from the ferries	4
8105	Global events: typhoon	4
9102	Storage area is open and no infrastructure for storage	4
9104	The port is used for a long tile without maintenance	4
2101-2102	No process to inspect Tank trucks containing diesel, IFO, gasoline or LPG before boarding ferry	3
2201-2202-2203	No process to inspect ordinary trucks/trailers carrying DG	3
4101-4301	No procedures for loading of trucks carrying DG in bulk	3
4401	No procedures for loading of trucks carrying packaged DG	3
5101	Terminal/port equipment not regularly inspected and maintained	3
5102	No maintenance schedule for maintenance at the port/ferry	3
6101	New operating staff not properly familiarised / trained	3
6102	No procedures in place for ferry operations (loading ferry, navigation, etc)	3
6203	No regular emergency drills conducted	3
7102	Improper or inadequate procedures are in use	3
7704-7705	No checklist for maintenance of the port/ferry, safe navigation/ferry operations	3
7801	No solid waste management (garbage and maintenance residues)	3
8104-8106	Global events: heavy and prolonged rain storms and high winds	3
9101	Runway to and from the port is small and steep	3
9103	Soil erosion from the slope of the bank and impact on infrastructure	3
1201	Access to the port uncontrolled, no surrounding wall, no fence, no controlled gate	2
3101	High voltage cables in port/ferry site are unprotected or not insulated	2
3202	Mechanical damage to cables	2
4102	No communication between port and ferry during loading of trucks carrying DG	2
6201	No training for port or ferry operators	2
7401	No security or customs procedures in place to prevent unauthorised access	2
7601	No training on first aid	2
7701	No checklist for loading/unloading ferry	2
7901	No drug and alcohol policy	2
8101-8103-8108	Global events: flooding, mud slide and earthquake	2

3.4 INTERMEDIATE REGIONAL AND NATIONAL CONCLUSIONS

3.4.1 Introduction

The Mekong River is the heart and soul of mainland Southeast Asia. More than 60 million people depend on the Mekong as a source of fish (the river supports one of the world's most diverse fisheries, second only to Brazil's Amazon River) and other aquatic products for food and income, water to grow crops and as a transport route which provides access to markets. The multitude of ecosystems within the Mekong River Basin supports a huge diversity of plants and animals, with new species still being discovered.

The rapid economic and demographic growth, emerging industrialisation, urbanisation and infrastructure development of the countries along the Mekong River are increasing stress on natural resources, the environment and water quality. Associated problems such as increased solid waste production, sewage and increased industrial wastewater disposed of with no or limited treatment are the major sources of increased stress. Additional stress caused by accidents/incidents at terminals handling or storing dangerous goods should be avoided. Large spills of petroleum products cause environmental damage, and an inevitable loss of aquatic resources with serious economic repercussions.

While the adverse effects of oil spills on the natural environment are widely recognised among the riparian countries and immediately apparent as they are visible, the sustained release of smaller - often visually undetectable - amounts of oil from terminals can be just as damaging. The carriage, handling and storage of dangerous goods are activities that are potentially dangerous for people, property and the environment if not carefully handled and regulated. During the risk assessment, the main risks concerning dangerous goods were considered regarding their potential effects on populations, property and the environment.

The eventual goal will be to find a way to manage the carriage, handling and storage of dangerous goods so that benefits are optimal and eventual risks are reduced to an acceptable level and, if an accident/incident occurs, that well-prepared emergency plans are in place to reduce the impact on people, property and the environment.

3.4.2 Petroleum Terminals

A study of major storage tank accidents[40] reviews 242 accidents at storage tanks in industrial facilities in North America, Asia, Australia, Europe, South America and Africa over a period of 40 years (Table 26). These accidents have occurred in:

- petroleum refineries;
- terminals and pumping stations;
- petrochemical plants;
- oil fields; and
- other types of industrial facilities such as power plants, gas plants, pipelines, fertiliser plants, etc.

The study is based on reviews of published accidents so the results depend on the accessibility of accident information. The results of the study are based on major accidents/incidents only. Minor accidents involving pollution or a few injuries are not included in the study.

[40] Journal of loss Prevention in the process industries, A study of storage tank accidents, James I. Chang, Cheng-Chung Lin

Table 26: **Types of Facilities Where Accidents Occurred**

Year	Refinery	Terminal/ Storage	Chemical Plant	Oil Field	Misc.	TOTAL
1960-1969	10	5	1	0	1	**17**
1970-1979	22	11	0	0	3	**36**
1980-1989	25	17	5	2	4	**53**
1990-1999	41	22	16	1	5	**85**
2000-2003	18	9	9	3	12	**51**
TOTAL	**116**	**64**	**31**	**6**	**25**	**242**

3.4.2.1 Types of Accidents

Crude oil, gasoline and oil products such as fuel oil and diesel were the major products involved in these accidents. Fire was the most frequent type of loss with 145 cases followed by explosions with 61 cases. Fires and explosions together accounted for 85 percent of the accidents. Oil spills were the third most frequent type of loss followed by releases of toxic gas/liquids. The table below indicates an overview of the different types of accidents (Table 27).

Table 27: **Types of Accidents**

Year	Fire	Explosion	Spill	Toxic Gas	Misc	TOTAL
1960-1969	8	8	0	0	1	**17**
1970-1979	26	5	5	0	0	**36**
1980-1989	31	16	3	2	1	**53**
1990-1999	59	22	2	1	1	**85**
2000-2003	21	10	8	10	2	**51**
TOTAL	**145**	**61**	**18**	**13**	**5**	**242**

3.4.2.2 Cause of Accidents

The most frequent causes of accidents were lightning, maintenance error/hotwork, operational error, equipment failure, sabotage, crack and rupture, leak and line rupture, static electricity, open flames and natural disasters. The table below indicates an overview of the main causes of tank accidents (Table 28).

Table 28: **Causes of Tank Accidents**

Cause	1960-1969	1970-1979	1980-1989	1990-1999	2000-2003	TOTAL
Lightning	4	10	19	37	10	**80**
Maintenance/hot work	1	5	9	12	5	**32**
Operational error	1	5	6	8	9	**29**
Equipment failure	3	1	5	7	3	**19**
Sabotage	2	5	2	6	3	**18**
Crack/rupture	0	3	3	3	8	**17**
Leaks and line rupture	0	3	2	5	5	**15**
Static electricity	2	1	2	2	5	**12**
Open flame	1	0	4	2	1	**8**
Nature disaster	1	2	1	1	2	**7**
Runaway reaction	2	1	0	2	0	**5**
Total	**17**	**36**	**53**	**85**	**51**	**242**

3.4.2.3 Ten Largest Tank Accidents Between 1963 and 2002

The table below gives on overview of the ten largest tank accidents between 1963 and 2002, illustrating the total economic loss and a small description of the cause (Table 29).

Table 29: **Ten Largest Tank Accidents**

Country	Year	Cause	Description	Loss ($ million)
Greece	1986	Maintenance error	Sparks from a flame-cutting torch ignited fuel from a tank spill in a dike of a fuel oil tank. The fire spread to other areas resulting in the destruction of 10 out of 12 tanks.	330
Qatar	1977	Leak and line rupture	A 260,000-barrel tank containing 236,000 barrels of refrigerated propane at -45° C failed. An adjoining refrigerated butane tank and most of the process area were also destroyed by fire.	179
Netherlands	1968	Runaway reaction	Frothing occurred when hot oil and water emulsion in a slop tank reacted with volatile slop, causing a violent vapour release and boil-over. The fire destroyed 3 hydrocarbon plants, a sulphur plant and 80 tanks.	141
USA	1979	Lightning	Nearly simultaneous explosions during a electrical storm occurred aboard a 70,000 DWT tanker that was offloading and at an 80,000 barrel ethanol facility at a refinery.	138
USA	1978	Unknown	Unidentified failure led to the release of light hydrocarbons which spread to an ignition source. Eleven tanks in this alkylation unit were destroyed.	120
Kuwait	1981	Open Flame	Fire destroyed 8 tanks and damaged several others. The cause of the fire was not disclosed.	73

Table 29: **Ten Largest Tank Accidents (continued)**

Country	Year	Cause	Description	Loss ($ million)
Kuwait	1981	Open Flame	Fire destroyed 8 tanks and damaged several others. The cause of the fire has not been disclosed	73
India	1997	Leak and line rupture	LPG ignited during tank loading for a vessel. A thick blanket of smoke spread panic among residents, resulting in 37 deaths and 100 people injured. Fifteen storage tanks burned for two days.	64
Italy	1985		Twenty-four of 32 tanks at a marine petroleum products terminal were destroyed by a fire that began with a tank overfill. Explosion caused destruction of the terminal buildings and nearby industrial and residential structures.	60
USA	1983	Operational error	An overfilling of a floating-roof tank spilled 1,300 barrels of gasoline into a tank dike. The vapour cloud was carried by wind to a nearby incinerator and ignited. The resulting explosion destroyed two adjacent tanks and the terminal.	52
USA	1983		A low pressure LNG feed drum ruptured in a crude oil station, resulting in fire damage to one third of the module and exterior of surrounding structure within 100 feet.	47
Average property loss in millions of 2002 dollars				

3.4.2.4 Example of a Recent Accident and Related Costs

At the Buncefied Fuel Depot of Britain's Hertfordshire Oil Storage Terminal, a tank overfilled due to instrumentation failure in December, 2005. A high-level gauge had failed to show that the tank was full. The devastation at Buncefield was estimated in excess of $16 million in stored material alone, in addition to the destruction of the site itself and the effect on the surrounding business. Forty-three people were injured. At least 20 businesses at a nearby industrial estate housing 630 businesses lost their premises, affecting the livelihoods of some 500 people (Buncefield Investigation 2006) (Figure 49).

Figure 49: **Buncefield Accident**[39]

The total quantifiable economic cost of the Buncefield incident was estimated at £894 million ($1.8 billion), excluding the cost of site rebuilding. The table below gives a summary of the overall cost of the Buncefield incident, by main category:

[39] http://www.cjwalsh.ie/2011/10/23/

Table 30: **Summary of the Overall Cost of the Buncefield Incident**[41]

Sector	Total Cost	
	GBP (£) million	USD ($) million*
Site operators (compensation claims)	625	1,227
Aviation	245	481
Competent Authority and Government response	15	29
Emergency response	7	14
Environmental impact (drinking water)	2	4
Total	**894**	**1,755**

* Based on the exchange rate December 2006 : £ 1 = $1.96258

The conclusions of the paper are that the causes and the contributing failures that led to these accidents would have been avoided if good engineering in design, construction, maintenance and operation had been practised with the implementation and execution of a safety management programme.

Eliminating all hazards will never be possible as there will always be contributing factors that cannot be ruled out and others that are either unpredictable or uncontrollable. The risk of accidents can, however, be significantly reduced if the regulatory authority establishes minimum standards for compliance for design, construction, maintenance, operations and safe management of terminals. In the event of an incident, an organised and effective response to an emergency can be achieved. It is then the responsibility of terminal management to meet or exceed these standards and be able to respond effectively in case an emergency occurs.

3.4.3 Ports

In ports where packaged dangerous goods in containers are handled or stored, the following primary activities take place:

- unloading/loading of these containers from vessels via forklifts, reach stackers and/or cranes to/from the storage stacks;
- loading/unloading of container trucks via forklifts and/or reach stackers to/from the storage stacks;
- storage of containers in the stack waiting for export/import;
- on-site transportation of these containers;
- storage and handling of packaged dangerous goods in warehouses; and
- storage of diesel fuel for on-site vehicle use.

In general, with these primary activities on the site, the following four major hazards can be associated:

1. Damage to containers and potential loss of containment caused by dropping or impact of a container on a solid object during a lift.
2. Damage to containers and potential loss of containment caused by a vehicle accident on or off-site.

[41] The Buncefield incident 11 December 2005, The final report of the major incident investigation board, Volume1

3. A “spontaneous” leak occurring from containers during storage of the container on-site.
4. Loss of containment from a diesel fuel tank resulting in a pool fire.

These incidents can escalate in the event that a fire occurs on-site.

Each accident/incident mentioned above can have disastrous consequences: pollution, injury or death and damage or loss of assets. Additionally, these accidents can represent a sustainable cost for the port/ terminal operator. Costs for the port terminal operator can included but are not limited to:

- disruption of cargo operations;
- administrative work;
- compensation for the individual, the cargo/transport owner;
- repair costs;
- increased insurance costs; and
- damage to the reputation of the port/terminal.

The consequences of an incident at a port where dangerous goods in containers are handled/stored will normally be inferior to an accident at a terminal where large quantities of liquid dangerous goods in bulk are handled/stored. The consequences of these incidents will be reduced if proper emergency planning is in place.

3.4.4 Risk Analysis of Ports and Terminals

The main objective of the risk analysis of the carriage, handling and storage of dangerous goods along the Mekong River is to control and manage the risks associated with the storage and handling of dangerous goods. Controlling and managing these risks will result in a reduction of pollution, injury or death of people and damage or loss of assets. A detailed risk register was drafted containing a number of hazards divided into nine groups. Sample ports/terminals were selected in coordination with the respective National Working Groups. For Cambodia, three terminals handling petroleum products in bulk and one port was selected. For Viet Nam, three terminals handling liquid petroleum products in bulk were selected

Upon completion of the risk register, the risk level and the existing control measure(s) were used to determine a priority area. This priority area has a scale from 0 to 4 with 4 being Very High. The terminal with limited controls is a combination of different terminals. It provides an idea of the worst case scenario and does not reflect in any way the risks at one particular terminal.

3.4.4.1 General Observations

- Terminals handling petroleum products in bulk with high standards assigned a higher risk priority level for the same hazard than petroleum terminals with lower standards. The reason for this is that terminals with high standards have a better understanding of the principles of risk assessment and have a better appreciation of the associated risks;

- Language barriers made it difficult at some locations where international vessels were operating and some questions were initially misinterpreted;
- During site visits, it was only possible to verify the existence of certain documents, operational procedures, safety procedures etc since these documents are not always available in English and the exact contents could not be verified.
- There is a significant national and regional difference between the overall standards of the terminals included in this study.
- Subjecting terminals to external audits results in higher standards and lower risk priority levels.
- The site visits conducted were announced and planned well in advance.
- There was one terminal where the risk priorities were alarmingly high, posing a major threat to people, property and the environment.

The horizontal bar graphs, inserted at the beginning of the section for each member country, illustrate the division of risk priority areas per hazard group. They are the result of all the data of the risk assessments made by the National Working Groups, subsequently analysed and summarised into one graph. All the risk priority areas (1 to 4) of all hazards are included to provide a general overview (Figures 50 and 51).

3.4.5 Cambodia

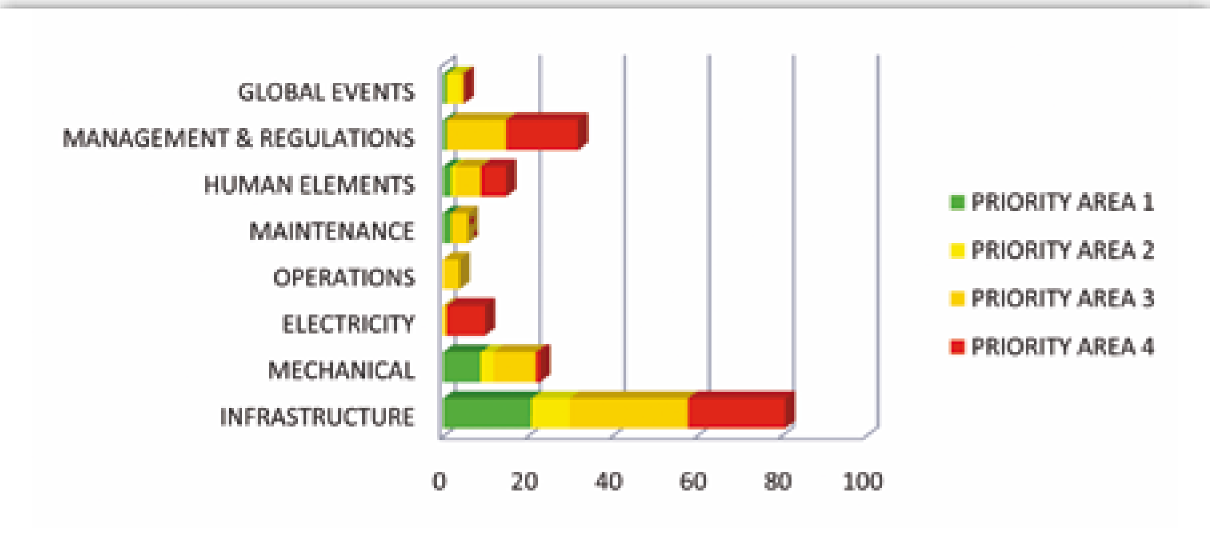

Figure 50: **Cambodia - Average Terminal**

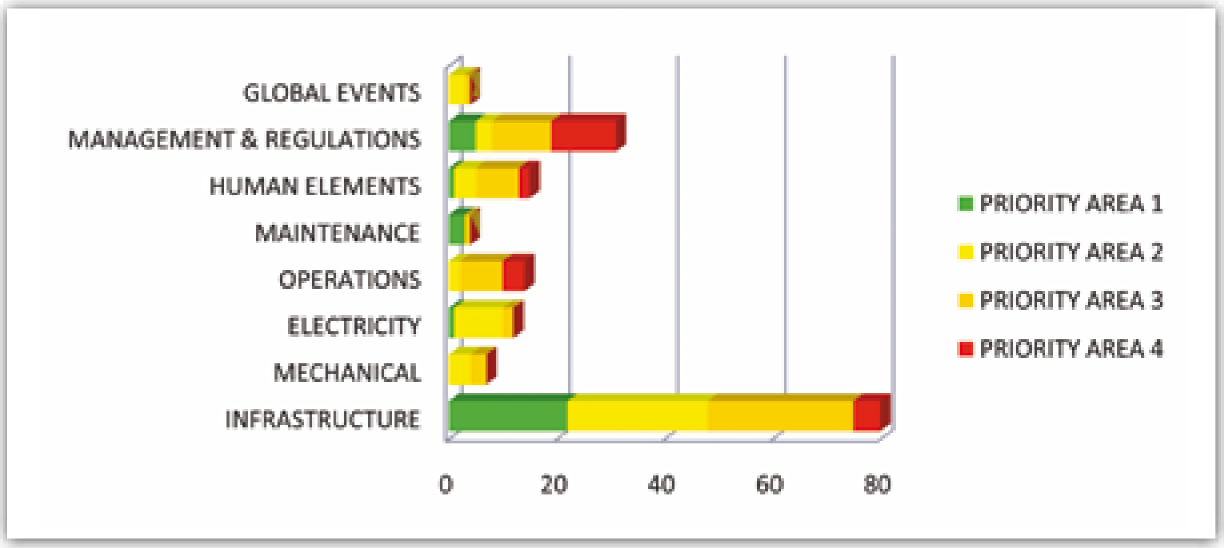

Figure 51: **Cambodia - Phnom Penh Port**

The graph illustrates the priority area per hazard group. We can conclude there are mainly four hazard groups with numerous high and very high priority areas: **infrastructure, electricity, human elements and management and regulations.** The major priority areas in all hazard groups are high to very high (Priority Areas 3 & 4). The absence of regulations, authority control and law enforcement have a risk Priority Area 4.

As already discussed earlier and as confirmed by the findings of the National Working Group in the risk register, there is currently no legislation on the transport, handling and storage of dangerous goods in Cambodia. The immediate consequence of having no fundamental legal framework is that:

- no laws, rules or regulations have been implemented;
- no authority control or enforcement is possible as the controlling authority has limited laws, rules or technical standards that can be used as a reference to undertake inspections; and
- no guidelines have been produced to assist private port and petroleum companies to manage health, safety and environmental issues.

There are many hazards from different hazard groups that have a higher priority due to the lack of a legal framework as illustrated in Table 31 below:

Table 31: **Example of Priority Areas Related to Legal Framework**

4701	All	No DG register	No knowledge of location/ quantity and nature of DG. Wrong response in case of emergency	3
4702	All	DG register not up to date		3
4703	All	MSDS not available	Properties of stored DG unknown: wrong response in case of emergency	3

If there was a legal requirement to keep a dangerous goods register and keep it up to date with the necessary Material Data Safety Sheets (MSDS) then the risk priority area of these items would certainly decrease.

In Cambodia, individual ports and terminals have to decide themselves about how they are going to deal with certain hazards and the standards they are going to use for implementing control measure(s) to reduce the risk of these hazards to an acceptable level. Leaving this responsibility to individual ports or terminals potentially compromises the way they are going to deal with certain hazards or control measures to be implemented as they are often subject to commercial pressure. This can be determined if we look at the results of the risk register. Some terminals have, for example, made resource/time available for organising training of employees, drills and courses and inspection of equipment, oil spill equipment etc. Other terminals, often under commercial pressure, comply with minimum safety standards only, and have limited resources and time available for training terminal personnel, organising drills and courses and with breakdown maintenance performed instead of preventive or predictive maintenance. This, however, exposes not only terminal personnel but also adjacent communities and the environment to severe risks.

Having a fundamental legal framework alone, however, is not enough. Authorities must have the education and resources to verify if this legal framework is actually implemented and take appropriate action if non-compliance occurs. Penalties for violations should be severe enough to discourage violations. These inspections, if carried out at regular intervals combined with efficient law enforcement, will give the ports and terminals an incentive to comply with the legal framework.

3.4.5.1 Conclusions for the Terminals

- The combination of having a legal framework for the carriage, handling and storage of dangerous goods, sufficient measures to control the implementation of this framework and an efficient law enforcement system would reduce the average risk priority area of the risk register in Cambodia.
- A clear reporting and communication procedure has not been established to ensure that the competent authorities are notified in case of an accident/incident. Each accident must be considered as a learning opportunity. If properly analysed, lessons can be learned to prevent recurrence.
- Some terminals are located in densely populated areas and have trucks coming and going on/off the premises for loading/discharging dangerous goods. The impact of these trucks passing through densely populated areas being involved in a accident can affect many people and infrastructure.

Figure 52: **Terminal Located in a Densely-Populated Area**

- Not all terminals have emergency-shutdown systems so vessels are not able to initiate manually an emergency shutdown during loading/discharging dangerous goods.
- High-level alarms are not regularly tested or calibrated. When a tank containing flammable liquid overfills, fire or explosion are usually unavoidable. Any spark nearby may ignite flammable vapours released from the tank. The overall system for tank-filling control should be of high integrity with sufficient independence to insure timely and safe shutdown to prevent tank overflow. Periodic testing and maintenance of overfill-prevention systems will minimise the likelihood of any failure that could result in loss of containment.
- Flammable gas-detection equipment is not functioning or not calibrated. Fixed flammable gas detection equipment in the secondary containment is a measure to detect hazardous conditions arising from loss of primary containment. Portable gas-detection equipment is used to check the presence of flammable gas in confined spaces, before starting hot work, etc. Only one terminal had portable gas-detection equipment calibrated externally.
- It remains unclear if all terminals have sufficient emergency equipment and/or an emergency control centre. There are no requirements concerning oil-spill response or containment. Emergency equipment is used to minimise the consequence of an incident and is therefore vital for each terminal handling dangerous goods. Considering the location of certain terminals, there are no requirements about coordination between terminal and local authorities for evacuation plans for local communities.
- No hot-work permit system is in use. Maintenance/hot work is the second most frequent cause of storage-tank accidents. Therefore, hazard-reduction measures must include proper hot-work procedures such as obtaining a hot-work permit, this permit most cover having a fire watch and fire-extinguishing equipment present, proper testing for explosiveness, covering and sealing all drains, vents, man-ways, open flanges and sewers.
- Some terminals have no or limited maintenance system in place. Break down maintenance is performed instead of preventative & predictive maintenance.
- Some terminals have no colour-coding system for portable fire extinguishers which are sometimes found in a visibly bad condition and are often not readily accessible.

Figure 53: **Poorly Maintained Equipment**


Figure 54: **Fire Extinguishers in Poor Condition and Not Readily Accessible**

- Some cargo pipes and hoses are in bad condition, some cargo pipes are not properly supported and some hose ends not properly blinded. Furthermore, cargo hoses are apparently not regularly pressure tested. Hose assemblies should be regularly hydrostatically tested to check their integrity. Hoses for which the rated pressure has been exceeded must be removed from service and retested before further use.
- Some terminals do not comply with the ISPS Code. However, it must be noted that terminals that don't comply with the ISPS Code have reasonable security measures in place such as fences around the premises, guards at gates and CCTV.
- No checklists are available for critical operations. The purpose of a checklist is to detect a potential error before it leads to harm.

Figure 55: **Cargo Pipes and Hoses Not Properly Supported**

- There is a significant difference between safety management systems at terminals. Safety management systems cover the following basic elements: safety organisation, process safety information, operating procedures, training, work permits, mechanical integrity, maintenance, emergency planning and response, occupational health, incident investigation etc.

3.4.5.2 Conclusions for the Ports

- Dangerous goods are not segregated. The storage and handling of dangerous goods should be sufficiently isolated from other facilities to protect the dangerous goods from external hazards. Incompatible dangerous goods should be segregated to avoid chemical reaction, fire, explosion or the release of toxic vapours. Dangerous goods should be separated from ignition sources as far as practical.
- Cambodia has signed and ratified the SOLAS Convention. Although primarily aimed at vessel operators, the IMDG Code extends to everyone dealing with dangerous goods in the international transport and logistics network. Port and terminal operators and staff in particular have to be familiar with the provisions and requirements of the IMDG Code. With the adoption of Amendment 34-08 to the IMDG Code on 1 January 2010, the requirement that shore-based personnel involved in the handling of dangerous goods for sea transport be provided with appropriate training became mandatory for all countries. The mandatory training requirement has been adopted in recognition that the

Figure 56: **Container with IMDG Cargo at Phnom Penh Autonomous Port**

successful application of the requirements and objectives of the IMDG Code is dependent on those involved having an appreciation of the risks and a detailed understanding of the requirements. The pictures below illustrate containers stuffed with dangerous goods at Phnom Penh Autonomous Port.

- Although Cambodia has signed and ratified the SOLAS Convention, the Phnom Penh Autonomous Port does not yet fully comply with the ISPS Code. In 2006, Cambodia received official development assistance from Japan to help improve security facilities and surveillance in the port area and help establish a firm security structure to meet the mandatory request of the ISPS Code. The following was supplied:[42]

  - CCTV camera surveillance system;
  - ID pass card system; and
  - security station.

  The *Maritime Transportation Security Act* of 2002 (MTSA) has mandated that the United States Coast Guard evaluates the effectiveness of anti-terrorism measures in foreign ports and provides for the imposition of conditions of entry on vessels arriving to the United States from countries that do not maintain effective anti-terrorism measures (MTSA, 46 USC § 70108). Security efforts made by Phnom Penh Autonomous Port have been rewarded as the Coast Guard has determined that it is maintaining effective anti-terrorism measures[43] (Port Security Advisory [4/11]).

- Port cranes are used beyond rated capacity which means that limit safety devices are not working, not tested or not present.
- Firefighting equipment is either not available or not sufficient.
- Insufficient or no material, emergency equipment or spillage-control equipment is available to deal with an emergency and there are no emergency control centres.
- There is no management concerning dangerous goods and there are no operating procedures for receiving/delivering dry bulk or for storing/handling dangerous goods.
- The port has no dangerous goods register and some MSDS are not available.
- The port employees have not received special training on how to handle and store dangerous goods, emergency procedures or aquatic pollution prevention.
- Emergency response drills are not organised on a regular basis involving all port/terminal personnel. Emergency response drills are the best way to test emergency response plans and the effective response of the crisis team members. Additionally, they are an excellent way to improve emergency planning and communications.

3.4.5.3 *Conclusions on Additional Activities and Operations*

- During the risk assessment, the National Working Group observed several small vessels that supply fuel to communities living in Krakor. The vessels carry an average of 1,800 litres of petroleum products in plastic containers for local fuel supply. As these vessels operate on average eight months per year during the wet season, a significant amount of fuel is

[42] http://www.kh.emb-japan.go.jp/economic/oda/odalist_march2011-e.pdf

[43] https://homeport.uscg.mil/cgi-bin/st/portal/uscg_docs/MyCG/Editorial/20111014/PSA%204-11.pdf?id=b7984190f8b9f924b4a60db7570fe67d3bfb405c

transferred. The National Working Group expressed concern about these operations as they take place with no or very limited controls. For these operations, no safe operating procedures are required and the risk of operational errors resulting in fire/explosion or pollution is very high. These operations urgently need to be regulated or prohibited as the risk priority area is very high.

- In Chhong Kneas, the National Working Group observed that trucks supply fuel directly to barges (200 tonnes) during eight months of the high-water season. The fuel is then transported to fuel supply stations. About 15,000 tonnes are transferred per year. There are no berthing facilities and these operations are undertaken in close proximity to small passenger vessels and tourist boats. Since no safe operating procedures are required, the risk of operational errors resulting in fire/explosion or pollution is high. These operations urgently need to be regulated or prohibited as the risk priority area is high to very high and pollution has already been observed on the banks of the lake.

- During the high-water season, there are several fixed and floating fuel stations operating on the Tonle Sap Lake. With no safety operating procedures required, the fuel station operators have limited awareness of dangerous goods and the risks involved. These operations need to be urgently regulated or prohibited as the overall risk priority area is very high and the lake is considered an important wetland that is sensitive to water pollution.

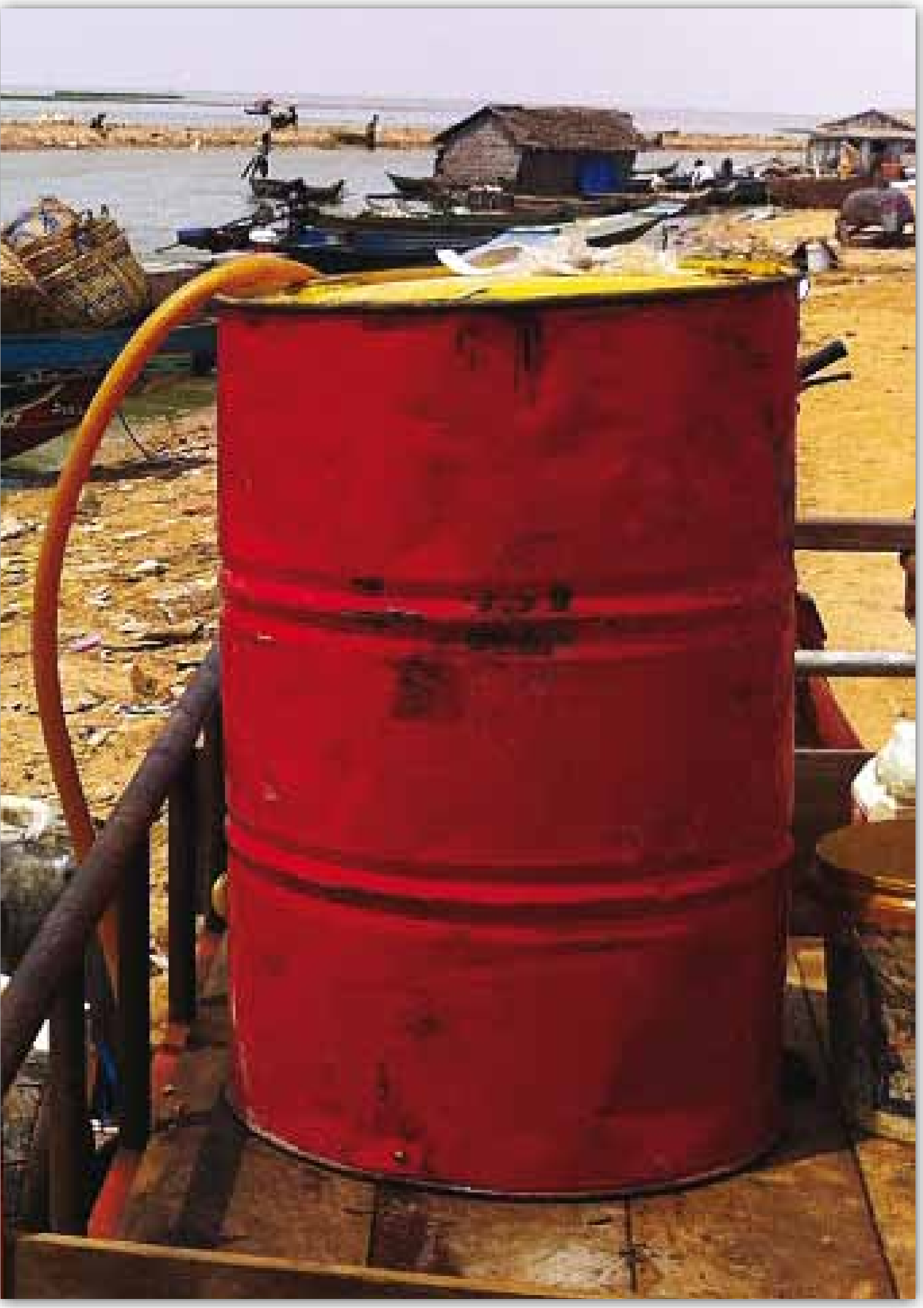

Figure 57: **Fuel Transfer with a Very High Risk Priority**

3.4.6 Viet Nam

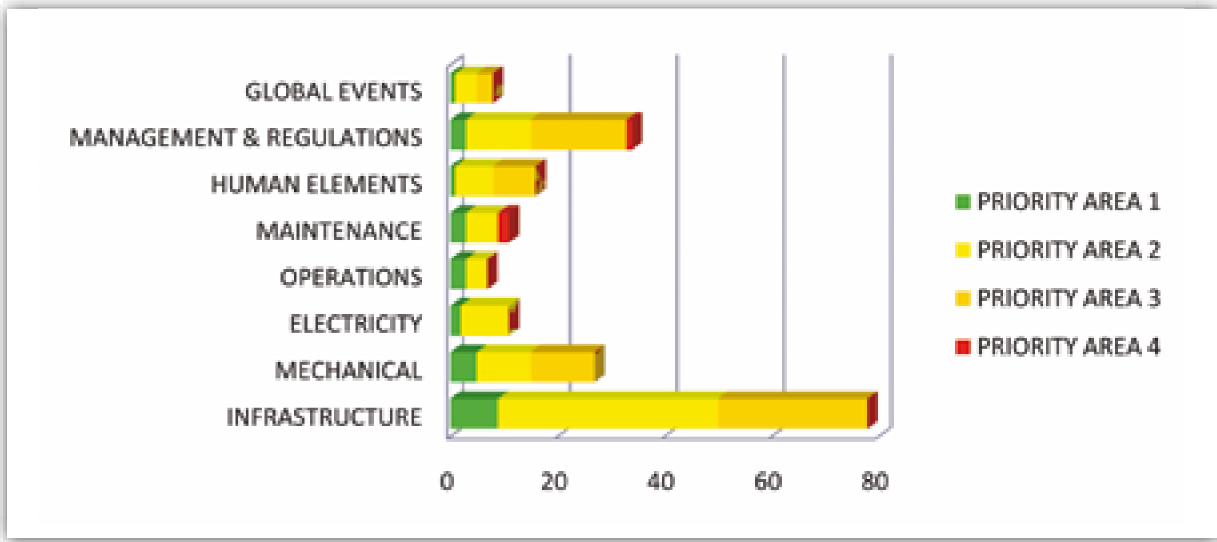

Figure 58: **Viet Nam - Terminals**

Figure 58 illustrates the priority area per hazard group. The hazard groups with the highest priority area are management and regulations, human elements mechanical and infrastructure. The absence of authority control and law enforcement has a risk Priority Area 3.

As already discussed, legislation concerning the transport, handling and storage of dangerous goods is a complex system of legal documents issued by different state agencies. Most aspects are covered by existing legislation and Vietnam Standards (TCVNs) regarding terminal construction and equipment. Several international standards such as ISO (International Organisation for Standardisation), IEC (International Electrotechnical Commission) and ASTM (American Society for Testing and Materials) have been adopted as TCVNs. However, the system of standards is complex and only about 40 percent of the national standards system has been developed by adopting relevant international and regional standards (e.g. ISO). The complexity of the legislative system and monitoring compliance by terminals handling petroleum products requires well-qualified inspectors who have thorough knowledge of the legislative system and standards.

According to figures provided by VIWA for the Mekong Delta in Viet Nam, there are two inland waterway port authorities (comparable with port state control) for the terminals. Port Authority 3 is responsible for 676 ports of which 137 are used for fuel transfer. Port Authority 4 is responsible for 1,426 ports of which 137 are used for fuel transfer. With 50 inspectors, Inspection Groups 5 and 8 are responsible for controlling the 2,102 ports under Port Authorities 3 & 4 as well as vessels and aids to navigation. Does the capacity for effective monitoring compliance of the terminals need to be strengthened, is there a lack of quantity and quality of personnel and are there sufficient funds?

The Government of Viet Nam recently issued *Decree No. 117/2009/ND-CP* which regulates penalties for environmental violations in an effort to raise the awareness of people and enterprises about the need for environmental protection. Companies which do not make environmental assessments are liable to fines of between VND 200 million ($9,500) and VND 300 million ($14,300). These fines are not big enough to deter violators and Viet Nam intends to increase them. Minister of Home Affairs Nguyen Thai Binh has told the National Assembly that the draft Law on Administrative Fines will see increases across the spectrum up to a maximum of VND 2 billion ($100,000).[44]

During a National Assembly discussion about enforcement of pollution laws in Viet Nam in November, 2011, the following main points were noted:

- many legal documents are produced too slowly or were too general, making them difficult to enforce;
- authorities have not yet paid due attention to environmental protection while penalties for violators are low;
- environmental impact assessments receive little attention during investor licencing processes, despite being compulsory under the Law on Environmental Protection;
- there are enough legal documents but the problem is the low quality and the ineffective execution of these documents;
- many provinces turn a blind eye to violations because they want to attract investment and hence generate jobs and contribute to growth; and
- while the Law on Environmental Protection of 2005 relates to seven ministries and localities, coordination is neither smooth nor in accordance with their responsibilities and regular inspections are not yet being conducted.

The management of oil spills in the seaports of Viet Nam is well regulated. The National Committee for Search and Rescue (VINASARCOM) is the lead agency for oil spill response and is responsible for the implementation of national contingency plans. Viet Nam has three national oil spill response centres. The third, opened in October 2011, is equipped with a modern vessel equipped with the latest technology. The centre is able to cope with Tier II spills (100 to 2,000 tonnes). For inland waterways, however, there are no such provisions.

For the inland waterway ports/terminals, there is no regional oil spill management plan and there are no national provisions for oil spill equipment, nor a national oil spill response centre.

3.4.6.1 Conclusions for the Terminals

- Due to the presence of a legal framework and technical standards, the general standards of the terminals are good and there is more regional consistency between terminals. Observed differences mainly relate to the year of construction of the terminals.
- In general, cargo pipes, hoses and valves meet the relevant technical Vietnamese standards (TCVN). Pipes are properly supported and are provided with a colour-coding system. Cargo valves and pumps are maintained according to relevant Vietnamese technical standards.
- During the risk assessment, it was observed that cargo pipes not in use are only partly bolted. At most, only half of the bolts were in place and secured which could lead to a spill if pressure is applied (see Figure 60).

[44] http://www.cleanbiz.asia/story/vietnam-increase-environmental-fines

Figure 59: **Example of Cargo Pipes at a Typical Vietnamese Terminal**

- Most Vietnamese terminals (head office) already have ISO certificates. Others are expecting ISO accreditation in the near future.
- Naked lights on the decks of vessels are not immediately related to terminals but can influence general safety during cargo transfer (see Figure 61).

Figure 60: **Cargo Pipes Not In Use Not Fully Bolted**

Figure 61: **Naked Light Onboard Vessel Docked at Terminal**

- Safety devices are not working. Safety devices are intended to be used either manually or automatically when cargo transfer conditions are not as expected (safety relief valves open if pressure increases above the limit, emergency stop buttons provided in case of emergency, filling level becomes above limits, etc.). Failure of these devices can eventually lead to a spill.
- Valves, gasket seals or flange leaks can cause minor spills or extensive spills if not noticed and remedied in due time (see Figure 62).
- Emergency valves not readily accessible can lead to a delayed response in case of emergency.
- No international shore connection. In the event of fire and breakdown of the vessel's fire pump(s), the terminal cannot connect to the fire main on the vessel, leading to a delayed response and possibly an uncontrollable fire.

Figure 62: **Minor Spill Probably Due to Gasket/Flange Leak**

- Terminal fire protection falls under the responsibility of the Ministry of Public Security. According to the National Working Group, they receive specific training regarding terminal safety/firefighting equipment.
- If no waste reception facilities are available for vessels, all waste generated onboard will be dumped into the river or at other locations on land.
- Most of the terminals have an on-site emergency response plan and emergency equipment available. However, the National Working Group has indicated that in the equipment is not sufficient to respond in the event of a substantial emergency. There is no national emergency control centre.
- In Dong Thap, much fuel is supplied to local smaller terminals by means of trucks from the main terminal. The condition and hazards related to these trucks should be well monitored in the future.
- Use of explosion-proof equipment should be mandatory for vessels calling at fuel terminals.
- There is a need for additional training and awareness regarding the storage and handling of dangerous goods, environmental protection and waste management.
- The National Working Group indicated that privately-owned terminals and floating fuel stations, although not included in the risk assessment, are not aware of existing national regulations and technical standards. They have no or limited safety management and risk controls in place. This could not, however, be verified as these terminals are beyond the scope of this project.
- No waste management. The terminals have no waste-reception facilities available for waste from vessels. There is, however, the possibility of having a third party come and collect the waste. Oily water produced at terminals is mostly treated on site by an oily-water separator and then discharged into the river. There are no technical guidelines on oily waste collection and treatment. Government inspection and public awareness of oily waste management and treatment is insufficient. One of the sites visited had an oily water separator. Oily water was passed through the separator and then discharged straight into the river. The effluent that passed through the separator was inspected visually but not sampled nor measured for eventual remaining contamination.

3.4.6.2 Conclusions on Additional Activities and Operations

During a field trip along the Mekong, numerous fixed and floating pumping stations were observed. Some of these pumping stations are located in dense populated areas and can store quantities up to 15 m^3 (15,000 litres) of fuel. Fuel stations under state companies seem to be in good condition. However, the privately-owned ones have no or limited controls. Given the location of these pumping stations and the reasonable amount of fuel that is stored, they require further investigation. Such fuel stations have already been prohibited in Tien Giang province due to safety and environmental protection.

3.4.7 Regional Conclusions on Cambodia and Viet Nam

The overall quality standards of terminals in Viet Nam is better than in Cambodia. On a national level, the standards of the Vietnamese terminals are consistent mainly due to the existence of a legal framework and applicable technical standards. In Cambodia, however, there is no consistency in the quality standards of the terminals included in the risk assessment. This is mainly due to the lack of a legal framework. Notwithstanding the absence of the necessary legal framework, Cambodia has good quality standards at several private terminals.

As can be seen in the risk register, most ports and terminals in Cambodia and Viet Nam have no facilities to receive solid or liquid waste. Having proper waste reception facilities for vessels can be an incentive to dispose waste ashore rather than in the river. The disposal of all kinds of waste into the river has already reached alarming levels. In Viet Nam, however, it is possible to let third parties collect waste from vessels. Viet Nam has environmental laws regarding waste management but there are no technical guidelines on oily waste collection and treatment. Government inspection and public awareness of waste management and treatment is still insufficient.

Both Viet Nam and Cambodia have indicated the need for additional training regarding the carriage, handling and storage of dangerous goods. Awareness of the associated risks still needs still to be increased. Training should be provided for all employees involved in the process. Training needs mostly include but are not limited to:

- specific training on the storage and handling of dangerous goods;
- firefighting equipment and procedures;
- emergency response procedures;
- accident prevention;
- environmental protection; and
- waste management.

In Cambodia, emergency response plans and sufficient equipment is not always available or is too limited. In Viet Nam, the terminals have local on-site emergency plans and equipment available. But at the national level, there are no or limited provisions. Taking into account the trans-boundary consequences of a major pollution incident, there is no regional oil spill management plan for the Mekong.

Neither in Cambodia nor Viet Nam have statistics available on any accidents/incidents. In Cambodia there is no clear reporting procedure to ensure that Ministry of Public Works and Transport, the Ministry of Environment and local authorities are notified in case of an accident/incident. Although Viet Nam has a circular on reporting labour accidents, there is no evidence provided by the National Working Group that accidents such as oil spills and fires are reported accordingly to the competent authorities.

3.4.8 Thailand

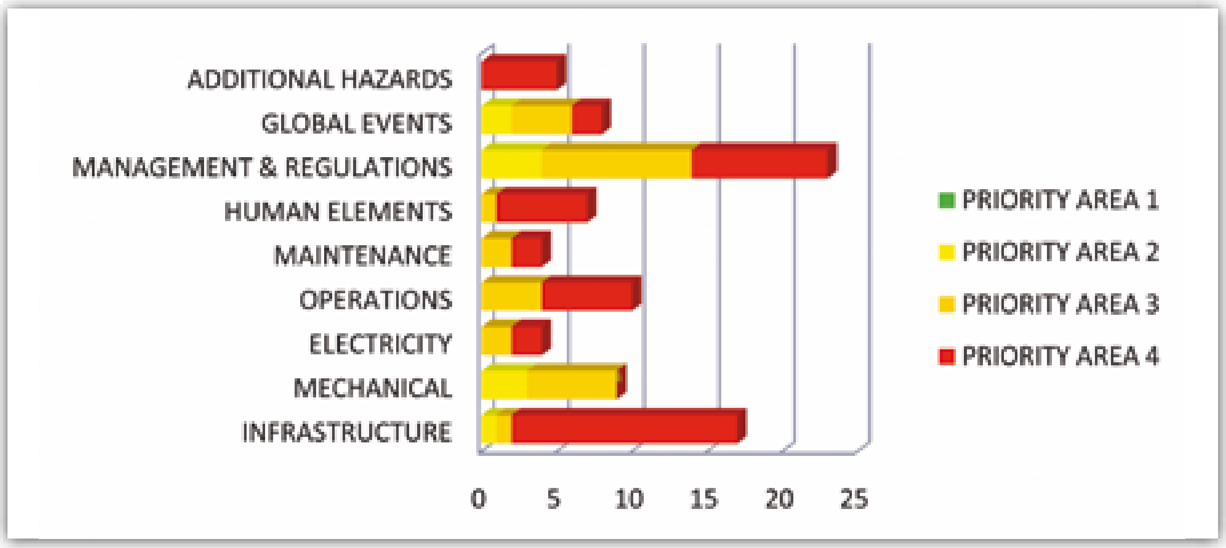

Figure 63: **Thailand - Ports**

Figure 63 illustrates the priority areas per hazard group. Almost all hazard groups contain several items with a very high priority area. The National Working Groups have indicated that there is a clear and urgent need for action to reduce the risks.

The legal framework concerning transport and handling of dangerous goods covers almost all aspect and is relatively clear. Compliance with rules and regulations is enforced by means of penalties such as fines, imprisonment or license withdrawal. The Port Authority of Thailand (PAT) is familiar with Port Safety and Health and Environmental Management Systems (PSHE-MS) as proven by the recognition certificates for dangerous goods service obtained by Bangkok Port and Leam Chabang Port. The PAT has developed port waste management systems for several international Thai ports. These efforts should be continued and encouraged.

Standards for international maritime ports need to be applied to inland ports on the Mekong River. As can be concluded from the risk assessment made by the National Working Group, the regional ports have a clear need for the development of similar systems (PSHE-MS, port waste management etc). The construction of Chiang Saen Port II, seen as a major gateway between Thailand and southern China, is expected to be completed in 2012. This would be an excellent opportunity and starting point to extend the PAT efforts already made for the international ports to the regional ports.

Additionally, the National Working Group noticed some local fuel-transfer operations that pose a considerable risk to the environment and safety of people. These local fuel supplies are not regulated by the authorities and are carried out with unsuitable materials (drums and hoses in bad condition). There is no equipment available to contain spills, no safety procedures available, no emergency equipment available etc. These local fuel supplies are small-scale activities but need to be controlled.

There are numerous ferry crossings transporting considerable amounts of dangerous goods (tank trucks, packaged dangerous goods on trucks) between Thailand and Lao PDR. According to the risk assessment by the National Working Group, there is an urgent need for regulating these ferry crossings.

3.4.8.1 Conclusions

- At some ports and ferry crossings, there is no fixed or portable firefighting equipment available. If limited portable firefighting equipment is available, it is not regularly tested/inspected. Ports or ferry terminals depend on firefighting equipment onboard the vessels/ferries.
- Some ports have no designated area for the storage of dangerous goods. No proper containers are used to store dangerous goods and these containers are not properly labelled. There is no register of dangerous goods available.
- No procedures are available for the transfer of fuel from trucks to barges.

Figure 64: **Fuel Transfer from Truck to Barge**

- No waste reception facilities are available for ferries or at local fuel transfer sites. Waste generated by trucks and port operations is not collected.
- No measures are in place to deal with spillage of dangerous goods (emergency response plans) and equipment available is not adequate to contain spills.
- No correct PPE is provided and there is no lifesaving equipment available at ferry sites.
- No emergency/lifesaving response drills are conducted.
- There is a lack of training on handling dangerous goods, emergency/firefighting equipment, safe navigation, ferry operations, accident prevention, environmental protection or waste management.
- There are no procedures for ferry-crossing operations, communications between port and ferry, safety procedures, inspection of trucks before boarding ferry, loading/unloading dangerous goods, hot works carried out in port or on the ferries or reporting of accidents/hazards (there are no records of accidents/hazards).

- No checklists available for loading/unloading ferries, maintenance of the port/ferry, safe navigation, ferry operations and inspection of trucks.
- New staff not properly familiarised/trained, operators not aware of national regulations.
- Some terminal and port equipment are in poor condition, not regularly inspected and maintained. No maintenance records are available and no maintenance system in place.
- The access to the port uncontrolled, no surrounding wall, no fence and no controlled gate. No procedures are in place to prevent uncontrolled access.
- No VHF radios available for communication. There is no communication between the port and the ferries and no communication between left and right bank.

3.4.9 Lao PDR

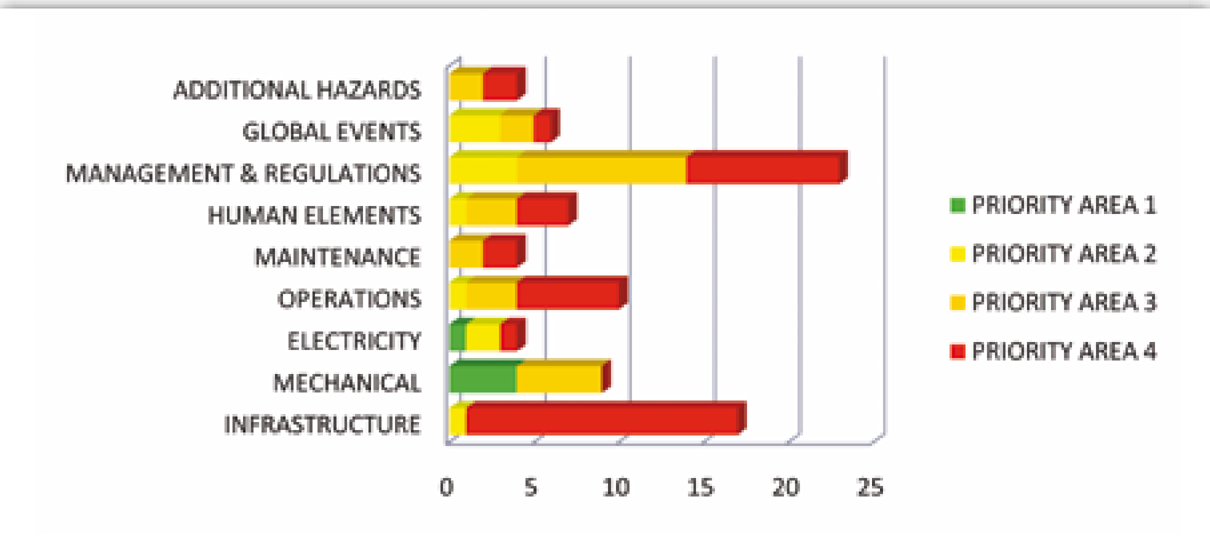

Figure 65: **Lao PDR - Ports**

Figure 65 illustrates the priority area per hazard group. Almost all hazard groups contain several items with a very high priority area. The National Working Group indicated that there is a clear and urgent need for action in order to reduce the risks.

No dangerous goods are currently handled and stored at Km 4 State Port.

As all national laws, rules and regulations, and decrees that apply to inland waterway ports and terminals are in Lao, the exact content of these documents could not be established.

The Waterways Department does not evaluate or monitor compliance with environmental laws. The Water Resources and Environment Authority (WREA) is responsible for implementing and enforcing environmental laws in Lao PDR. There should be more communication between the Waterways Department and WREA to ensure that environmental laws are applied to port and vessel operations.

The MPWT and the Waterway Department has very limited capacity to respond to emergency situations or to investigate incidents properly. Lao PDR requires urgent investment in emergency response.

There are 29 Lao ports along the Mekong River. Most are quite small and used to transport goods for domestic use. The ferry crossings are used to transport tank trucks, asphalt, fertiliser and other dangerous goods from Thailand to Lao PDR.

Figure 66: **Mekong River Ports in Lao PDR and Thailand**[45]

[45] The existing Chiang Saen Port is scheduled to become a passenger terminal after Chiang Saen Port II opens in 2012. The new port is located about 10 km downstream from the existing port at the confluence of a tributary and the Mekong River.

3.4.9.1 Conclusions

- At Km 4 State Port and some ferry crossings, there is no fixed or portable firefighting equipment available. If (limited) portable firefighting equipment is available the equipment is not regularly tested/inspected. The port or ferry terminal depends on the firefighting equipment onboard the vessels/ferries.

Figure 67: **Poor Maintenance of Port Equipment**

- Km 4 State Port and the ferry crossings have no designated area for the storage of dangerous goods. No proper containers are used to store dangerous goods and these containers are not properly labelled. There is no register of dangerous goods available.
- No waste reception facilities are available for the port / ferries or local fuel transfer sites. Waste generated by trucks and port operations is not collected.
- No measures are in place to deal with spillage of dangerous goods (emergency response plan) and equipment available to contain spills is not adequate.
- No correct PPE is provided and no lifesaving equipment is available at the ferry site.
- No emergency/lifesaving response drills are conducted.
- There is a lack of training on the handling of dangerous goods, emergency/firefighting equipment, safe navigation, ferry operations, accident prevention, environmental protection and waste management.

- There are no procedures for ferry-crossing operations, communications between ports and ferries, safety procedures, inspection of trucks before boarding ferries, loading/unloading dangerous goods, hot works carried out in port or on the ferries or reporting of accidents/hazards (there are no records of accidents/hazards).
- No checklists are available for loading/unloading ferries, maintenance of the port/ferry, safe navigation, ferry operations or trucks inspections.
- New staff are not properly familiarised/trained, and operators are not aware of national regulations.
- Some terminals and port equipment are in poor condition, and not regularly inspected or maintained. No maintenance records are available and no maintenance systems are in place (see Figures 67, 68 and 69).

Figure 68: **Poor Maintenance of Port equipment**

Figure 69: **Power Supply Arrangements for Fuel Pump**

- Access to port is uncontrolled, with no surrounding walls or fences or gate. No procedures are in place to prevent uncontrolled access.
- No VHF radios are available for communication. There is no communications between ports and ferries and no communications between the left and right banks.

General Conclusions

The general awareness of the risks associated with the carriage, handling and storage of dangerous goods and the consequences these can have on the environment, people and property are not always well understood and needs to be improved. All parties involved in the process should be well aware of all possible hazards and their eventual consequences. Such involvement should not be limited to the management level but all personnel.

Some hazards identified can, although not always, be eliminated at almost no cost just by exercising good management practice. Figure 70 illustrates an example of pollution that can be eliminated at almost no cost.

3.4.10 Regional Oil Spill Prevention and Response

The adverse effects of oil spills on the natural environment are widely recognised among the riparian countries and immediately apparent as they are visible. But the sustained release of smaller - often visually undetectable - amounts of oil in wastewater from terminals can be just as damaging.

On the 12 January 2006, ministers, senior government officials and various other stakeholders from Cambodia, Thailand and Viet Nam gathered in Hanoi and issued a joint statement on partnership in Oil Spill Preparedness and Response Cooperation (OPRC) in the Gulf of Thailand. The joint statement contains a tripartite inter-governmental agreement which commits participating countries to mutual support and assistance in combating oil spills in the gulf region. The joint statement endorses a framework programme for joint oil spill preparedness and response in the region, specifying obligations and responsibilities of participating countries as well as a coordinating mechanism and arrangements for implementing the framework programme. The joint statement and framework programme are regarded by the participating countries as an important legal basis for multilateral cooperation in oil spill preparedness and response in the Gulf of Thailand[46]. This agreement shows clearly that trans-boundary oil spill management is possible between the riparian countries. However, a similar programme for the Mekong River has not yet been developed.

Figure 70: **Small fuel spill in port area**

All ports and terminals of the riparian countries seem to struggle with problems regarding waste management. Most ports/terminals have no provisions to accept waste from vessels. However, all riparian countries seem to have some environmental laws in place regarding waste management. At the same time, there are no technical guidelines on oily or solid waste from vessels and terminals. Government inspection and public awareness of waste management and treatment is insufficient.

Although the riparian countries find themselves in different stages of development with varying levels of wealth, population, literacy and access to clean water and sanitation, many share the same problems regarding the risks associated with the carriage, handling and storage of dangerous goods. Solving these problems can only be achieved though good cooperation and efficient exchange of information between governments and the private sector. This is an excellent opportunity to collaborate and share information so that the risks and consequences involved can be reduced in a economically feasible way to an acceptable level for all concerned.

[46] http://www.pemsea.org/sites/addressing-transboundary-concerns-in-pollution-hotspots-gulf-of-thailand


PETROVIETNAM
PV OIL

4. VESSELS

4.1 IDENTIFICATION OF OPERATIONS AND ACTIVITIES

4.1.1 Introduction

There are many critical operations and activities onboard that need to be performed to ensure the safe operation of vessels. The main engine and equipment onboard must be well maintained, standard procedures developed for critical operations, emergency response plans implemented and crewmembers well trained (ISM Code 1.2 Objectives). There are specific hazards associated with the critical operations and activities. The levels of risk must be evaluated to ensure prevention and mitigation measures are developed to protect the environment, safety of crewmembers and the public.

A standard risk register for vessels was developed following consultation and site visits with National Working Groups in the Member Countries. The vessels risk register was standardised intentionally as the overall objective is to develop a harmonised system for the carriage, handling and storage of dangerous goods along the Mekong River. The risk analysis will determine the baseline conditions in each of the Member Countries to evaluate the level of risks, prevention and control measures, and the future priorities.

4.1.2 Vessel Hazard Groups

The preliminary step in the risk register was to identify and describe all the major operations and activities onboard vessels and the associated hazards to evaluate the risks. To allow for more effective analysis, the vessel operations and activities were categorised into the following nine hazard groups:

1. mechanical;
2. structural;
3. electrical;
4. physical environment;

5. dangerous goods;
6. fire hazards
7. human factors;
8. management, and
9. lifesaving/firefighting equipment.

Each of these nine hazard groups has specific items concerning the safe operation, construction, maintenance and management of the vessel and its cargo. The National Working Groups in the Member Countries used the risk registers to assess the critical equipment, operations and activities onboard the vessels. When reviewing the assessments the hazard groups were divided into two areas:

- **Components:** a uniquely, identifiable system required to complete an activity. Here, the most critical components to ensure the safe operation and condition of the vessel; and
- **Operations:** the most critical activities and tasks that need to be performed onboard the vessel to ensure safe operations.

A description of the key components and operations was determined for each of the nine hazards groups for vessels.

4.1.2.1 Mechanical

Mechanical equipment onboard is required for propulsion, navigation and for loading and discharging of cargo; the following items were included in the risk register for assessment:

- main engine;
- steering gear and emergency steering gear;
- generators; and
- equipment for loading and discharging, including:
  - cargo pumps;
  - cargo pump room;
  - cargo hoses and pipes;
  - valves;
  - tank-measurement devices; and
  - high-level alarms.

4.1.2.2 Structural

The structural components of a vessel are essential for navigation and safe operations, particularly tankers and barges transporting dangerous goods. There are specific structural requirements for tankers (design) that are required for prevention and mitigation of incidents. The purpose is to make navigation and cargo operations safer and prevent spillage of cargo and, in case of spillage, reduce the impact and limit pollution. The following components were included in the risk register:

- single hull;
- condition of cargo and ballast tanks;
- tank structure;

- slop tank;
- sewage treatment plant;
- spill belt;
- drip tray;
- bulwark or fence; and
- navigational equipment, including:
  - radar equipment (Figure 71);
  - navigation charts;
  - fog horn;
  - very high frequency (VHF) equipment used for short-range radiotelephony, so providing communications with shore, terminal or other barges using selected VHF channels (Figure 72);
  - echo-sounder, a device for measuring the depth of water under the keel; and
  - Global Positioning System (GPS), a space-based global navigation satellite system that provides location and time information in all weather. It is a system of satellites, allowing small electronic receivers to determine their location within a few metres. When put onboard, it allows barges to check their exact location on the river and, in combination with correct navigation charts, makes navigation safer (avoiding shoals, submerged rocks) (Figure 73).

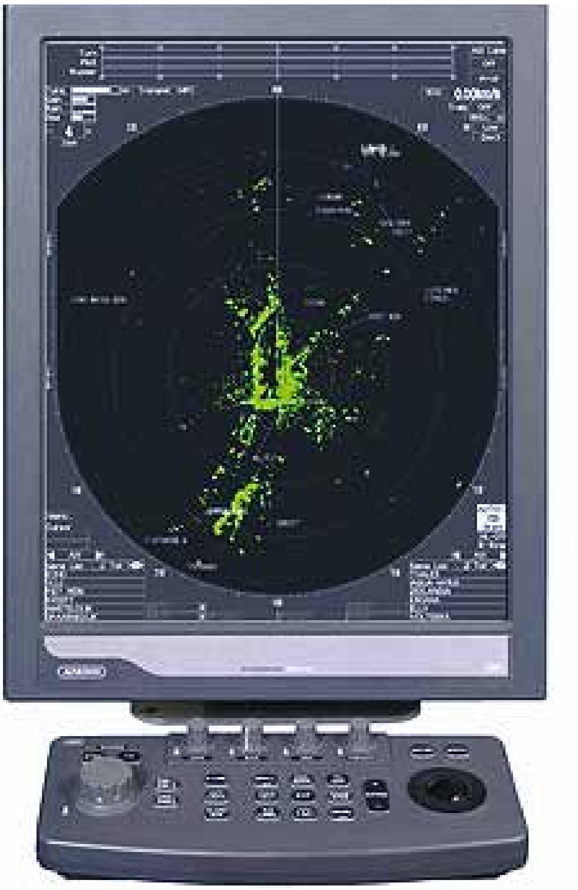

Figure 71: **Radar equipment**

Figure 72: **VHF Equipment**

Figure 73: **GPS**

The critical operations that were assessed for structural were navigation, cargo handling, planned and preventive maintenance onboard vessels and technical requirements for the design, construction and inspection in MRC Member Countries.

4.1.2.3 Electrical

There are a number of electrical installations and equipment onboard vessels which have the potential to create sparks which may cause fires or explosions. Electrical installation and equipment can also cause electrocution or property damage if not maintained or operated properly. The following components were assessed in the risk register:

- electrical installations and cables;
- electrical equipment used onboard for operations and maintenance such as deck lights, cargo pumps; and
- explosion-proof equipment, including:
  - walkie-talkies;
  - mobile phones;
  - VHF radio; and
  - torches.

The risk register assessed the tasks and activities associated with the installation, operation and maintenance of electrical equipment.

4.1.2.4 Physical Environment

The physical environment refers to the conditions in which the vessel is operating and how this may affect the operational activities and tasks undertaken onboard the vessels by crewmembers. The risk register assessed the following components:

- cargo stowage;
- cargo lashing;
- confined spaces;
- work space conditions like noise, vibration, slippery surfaces and poor lighting;
- equipment maintenance; and
- navigational aspects, including:
  - conditions of the river (rapids, currents)
  - weather conditions;
  - traffic density; and
  - navigation aids.

The physical environment is very important to consider in the transportation of dangerous goods as external factors can have impacts on the efficiency and safety of operation.

4.1.2.5 Dangerous Goods

The management of dangerous goods is very important to consider in isolation. There are intrinsic hazards associated with the physical properties of the dangerous good which requires more stringent management plans for the transport, handling and storage. The risk register considered the management of packaged dangerous goods, dangerous goods in bulk (liquid), residues and waste generated from vessel operations. Accordingly, the risk register included the following key components for assessment:

- material safety data sheet (MSDS);
- dangerous goods stowage plan;
- cargo manifests;
- packaged dangerous goods;
- dangerous goods in container;
- liquid bulk;
- content of bilges and slop tanks;
- cargo residue from operations; and
- authority control.

There are a number of operations and activities that were assessed in the risk register for the transport of dangerous goods. With respect to vessels, the following operations were assessed:

- handling and storing dangerous goods onboard;
- loading and discharging dangerous goods;
- bunkering;
- tank cleaning;
- disposal of cargo residues, bilge and liquid wastes; and
- maintaining relevant documentation for transport of dangerous goods.

4.1.2.6 Fire Hazards

There are many activities and tasks that, when undertaken under certain conditions onboard the vessel, can increase the risks of fire and explosion. The risk register assessed the following components:

- hot works (welding, cutting, grinding);
- non-smoking requirements;
- open light; and
- sparks from non-explosion proof equipment (phones, radios, torches).

The operations onboard were assessed to determine whether prevention plans were in place to restrict and monitor activities and tasks that could increase the risks of fire and explosions. The safe work procedures, the emergency response and firefighting measures were assessed in the hazard groups, management and lifesaving equipment.

4.1.2.7 Human Factors

There are many human factors that can affect the performance of crewmembers onboard vessels which can lead to operational errors and incidents which can endanger their own lives and those of other crewmembers, the environment and members of the public. Human factors need to be considered prior to loading, discharging and other critical operations. The risk register evaluated the following components:

- fatigue;
- level of education and training;
- skills and experience;
- information provided to crewmembers;
- communication and signage; and
- exposure to physical hazards and weather conditions.

Any one of the above factors or combination can affect the crewmembers' ability to undertake critical activities and tasks onboard the vessel.

4.1.2.8 Management

Management is important to consider as it examines the systems and processes of the vessel operator and charterer concerning critical operations onboard and safe navigation. Management also considers the inspection and monitoring activities of relevant line agencies and authorities to ensure vessels comply with technical requirements in the Member Countries. Management systems should be established onboard to ensure the safety of the vessel, crew and the environment. The following components were considered in the risk register:

- safe working procedures;
- safety and security measures;
- checklists;
- training, education and certification of crewmembers;
- waste and garbage management plans;
- emergency response plans;
- safe manning levels;
- authority, law enforcement and inspections;
- quality management systems; and
- company authority and control.

All critical operations carried out onboard should be done in accordance with company policy and procedures, management systems and be in compliance with rules, regulations, decrees and technical standards in the Member Countries.

4.1.2.9 Lifesaving and Firefighting Equipment

Lifesaving and firefighting equipment are necessary onboard to ensure crewmembers can respond effectively in the event of fire, emergency or other incident. Equipment is also needed onboard to detect fires, smoke and alarms installed to alert crewmembers of emergency situations. The risk register assessed the following components:

- lifesaving equipment;
- firefighting equipment;
- fire detection and alarm;
- emergency fire pump;
- fire control plan; and
- personal protective equipment (PPE)

Operations that were assessed include the emergency response and firefighting plans, drills and the installation, correct maintenance and use of lifesaving and firefighting equipment.

4.2 IDENTIFICATION OF HAZARDS AND RISKS

4.2.1 Introduction

Vessel activities and operations create significant benefits for trade and transport of cargo. But there are hazards associated that present potential risks to people, property and the environment which need to be effectively managed in the Member Countries. Controlling the risks of explosion and limiting the risks for environmental pollution by improving safety, security and efficiency of vessel operations depends on a number of factors: responsible owners and operators, well-trained crewmembers, compliance with national regulations and international standards, development of new technologies and management approaches.

4.2.2 Vessel Hazard Groups

Prior to evaluating the risk levels associated with vessel operations and activities, it is important to understand the potential hazards and risks onboard vessels. The hazards and potential risks were assigned to the critical operations and activities in the nine hazard groups as used previously. This section provides an overview of the most critical hazards and potential risks related to vessel operations and activities involving the transportation of dangerous goods along the Mekong River.

4.2.2.1 Mechanical

Hazards can arise due to mainly limited maintenance and inspection of the vessel's main engines and equipment onboard. This can affect the safe operation of the vessel and present risks to the environment, safety and property.

1. Main Engines, Steering Gear and Emergency Generator

The hazards in relation to main engines (Figure 74), steering gear and the emergency generator can arise from no, irregular or poor maintenance and limited inspections of machinery essential for the safe operation of the vessel. The risks are oil and fuel leaks, malfunctioning, overheating or breakdown of main engines. If the main engines break down, depending on the circumstances, this could result in major incidents including grounding, collision, fire and pollution of the surrounding environment.

Figure 74: **Main Engine**

2. Cargo Pumps

The hazards in relation to cargo pumps (Figure 75) arise from no, irregular or poor maintenance and limited inspections. The pump room (Figure 76) that houses cargo pumps, ballast pumps and the associated piping and valves for their operation needs adequate ventilation. If not, this can increase the risks of fire and explosion from the leakage of flammable materials and vapours. The use and maintenance of mechanical ventilation by extraction to maintain the atmosphere in a safe condition is required. The pump room can contain a number of potential ignition sources if proper maintenance and inspections are not undertaken. Other possible consequences are a breakdown of the cargo pump, which means interruption of the cargo operations or commercial loss and leaks, increasing the risks of fire and explosion from ignition of flammable materials and vapours.

Care should be taken of the content of the bilges in the pump room, as there may be cargo remains collected.

Figure 75: **Cargo Pumps on Deck**

Figure 76: **Cargo Pump Room**

3. Cargo Pipes and Hoses

The hazards and risks related to cargo and bunker hoses, pipelines (Figure 77) and manifolds arise from the poor condition or incorrect use for the service intended. Cargo and bunker hoses often cause leaks if they are not in good condition or properly installed and inspected.

Figure 77: **High-Standard Cargo Pipes**

Other hazards include:

- structural damage to pipes;
- irregular pressure in cargo pipes or hoses, or pressure surge due to a sudden increase in the pressure of the liquid in a pipeline by abrupt change in flow rate, which can rupture the cargo hose or fracture the pipe, causing an important spill;
- not properly supported cargo lines and manifolds causing pipe fracture;
- exceeding the Maximum Allowable Working Pressure (MAWP), or maximum pressure allowed;
- tank cover gasket, seal or packing to prevent the escape of gas and fluid either not being fitted or deliberately removed, causing high risk of sparks during opening or closing the tank cover and possible release of flammable or toxic vapours during loading and discharging;

- absence or incorrect use of safety devices such as emergency shutdown systems, pressure relief valves (Figure 78) that provide for the flow of small volumes of vapour, air or inert gas mixtures caused by increased temperature in the cargo tank and so increased pressure;
- flange connections of unused lines absent or not fitted correctly, causing leaks;
- vent lines without flame arrestors. A flame arrestor is a permeable matrix of metal, ceramic or other heat-resisting materials which can cool even an intense flame, and any following combustion products, below the temperature required for the ignition of the flammable gas on the other side. The condition of the flame arrestor must be regularly checked if they are not blocked (Figure 79);
- pipelines not grounded can cause static electricity that presents fire and explosion hazards during the handling of flammable liquids and other tanker operations such as tank cleaning, ullaging (measuring the space above the liquid in a cargo tank in order to calculate the quantity of cargo in the tank) and sampling (taking a sample from a tank to check the quality of the liquid cargo in the tank);
- Certain operations can give rise to accumulations of electric charge that may be released suddenly in electrostatic discharges with sufficient energy to ignite flammable product gas/air mixtures. There is, of course, no risk of ignition unless a flammable mixture is present. Three stages necessary for an electrostatic ignition of a flammable atmosphere are charge separation, charge accumulation and electrostatic discharge; and
- Ruptured cargo hoses.

Possible consequences during cargo operations or bunkering are leaks or spillage, pollution and commercial loss. The release of inflammable, toxic or explosive vapours might result in severe consequences such as fire or explosion.

Figure 78: **Pressure Relief Valve**

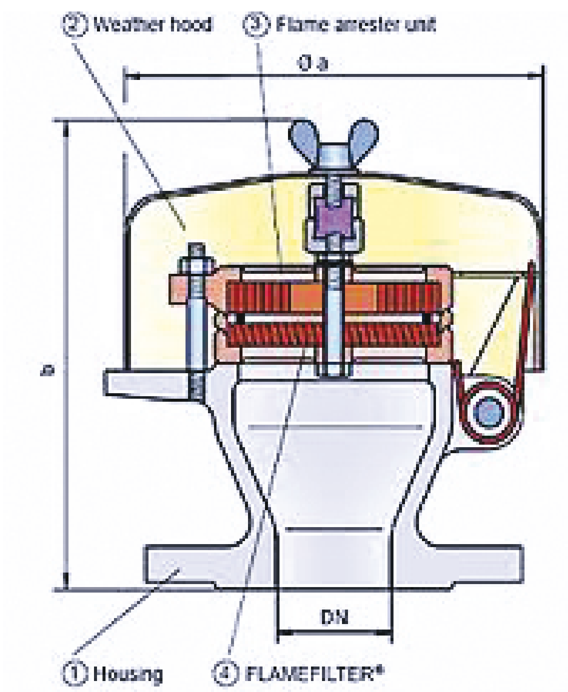

Figure 79: **Flame Arrestor Unit**

4. Cargo Valves and Manifold

Hazards are valves that are leaking, blocked, not labelled or marked for identification, and emergency valves that are not accessible. Among the possible consequences are interruptions of cargo operations which could result in commercial loss, spillage and release of inflammable or explosive vapours, and delayed response in case of emergencies.

5. Tank-Measurement Instruments and Tank-Capacity Alarms

On tanker barges, the main hazards are the absence of or incorrect functioning of the tank-measurement instruments (Figure 81) and tank-capacity alarms (Figure 80). The alarm should provide audible and visual indication and be set at a level that will enable operations to be shut down prior to the tank being overfilled. Under normal operations, the cargo tank should not be filled higher than the level at which the overfill alarm is set. Individual overfill alarms should be tested prior to loading or discharging. The possible consequence is tank overflow, resulting in pollution incidents and, depending on the kind of dangerous goods being loaded or discharged, the release of flammable liquids or vapours which can lead to fire or explosion.

Figure 80: **Tank-Capacity Alarm Panel**

Figure 81: **Tank-Measurement Device**

4.2.2.2 Structural

Structural hazards related to the design and construction of the vessel that is suitable for the transport of dangerous goods.

1. Single or Double Hull

The National Working Groups were required to investigate whether the vessel inspected was single or double hull. There is some debate on the effectiveness of double or single hulls to mitigate the risk of pollution during a collision or grounding incident (Australian Maritime Safety Authority – April 2001). If it is accepted that the highest risk of collision or grounding is likely to occur near ports, where tankers typically sail at slow speeds in congested and constrained waters, then there is a greater probability that any collision or grounding is likely to be low energy. Under these circumstances, double hulls will reduce the risk of an oil spill during the most critical part of a voyage.

In high-energy collisions, however, the distance to the inner hull is not sufficient and the inner compartment is penetrated as well. There are also disadvantages with double hulls as maintenance and inspection of tanks can be more costly and, if the outer hull is penetrated, the stability of the vessel can be less than that of a single-hull vessel. A possible conclusion might be that regardless of its hull construction configuration, any tanker which is not properly designed, constructed, maintained or operated poses a greater risk than one that is of good quality design and construction, well maintained and diligently managed and operated throughout its working life.

On many stretches of the Mekong River, the river bed is covered with rocks. If an accident occurs, it will be a high-energy one in which case there is a high chance that the inner compartment will be penetrated as well. In such cases, both single and double-hull vessels will create pollution.

2. Tank Structure and Condition of Cargo and Ballast Tanks

The main hazards are rusted (insufficient steel thickness) and corroded tanks and bad welding seams which can cause pollution and contamination of cargo and ballast water.

3. Slop Tank

Slops are a mixture of cargo residue and washing water, rust or sludge suitable or not for pumping. On a tanker, a slop tank (Figure 82) is necessary to collect cargo residues, and mixtures of water and cargo, after discharging and washing of cargo tanks. The main hazard is the absence of a slop tank, as the consequence in such cases is a source of pollution, due to disposal of cargo residues into the river.

Figure 82: **Slop Tank on Deck**

4. Spill Belt

This is generally a belt constructed close to the vessel's side to collect liquid cargo of up to 200 litres, resulting from a tank overflow, spillage during cargo operations and bunkering in order to prevent the spill from entering the river. The main hazard is that if the vessels are not equipped with a spill belt (Figure 83) and there is a cargo spillage or leak on deck during loading and discharging operations, then the spill cannot be contained and will be immediately disposed of into the river. During rainfall, all cargo residues on deck will flow immediately into the river when a sufficient spill belt is not constructed.

Figure 83: **Spill Belt**

5. Drip Tray

A drip tray (Figure 84) is constructed to collect the small amounts of liquid bulk that are regularly spilled when connecting the loading and discharging hose or pipe at the manifold. The main hazard is the absence of fixed or portable containment, with the consequence that spilled cargo is disposed in the river, causing significant pollution. Fixed drip trays are the best solution. If no permanent means are fitted, portable drip trays should be placed under each connection in use to retain any leakage.

Figure 84: **Portable Drip Tray**

6. Fencing or Railing

The main hazard on many barges is the absence of adequate fencing or railing to prevent crewmembers from falling overboard, one of the most common accidents which often results in drowning.

7. Navigation Equipment

The absence of radars, VHF, echo-sounders, GPS, fog horns and (electronic) navigation charts means a lack of information is available to the vessel. Vessel information such as under keel clearance, position of other vessels, fairway limits and communication mechanisms are important for maintaining safe navigation. The possible consequence is that the vessel cannot maintain safe navigation which can have serious consequences in terms of endangering crew, vessel, cargo and the environment and lead to possible navigation accidents.

4.2.2.3 Electrical

Electrical hazards are related to the intrinsic hazards of electrical installations and electrical equipment onboard. On vessels carrying dangerous goods, within a certain area, especially during loading or discharging, any of the following equipment which is not intrinsically safe or explosion proof has the potential to cause a spark, including:

- naked lights;
- open light;
- walkie-talkie;
- portable VHF;
- mobile phone; and
- torch.

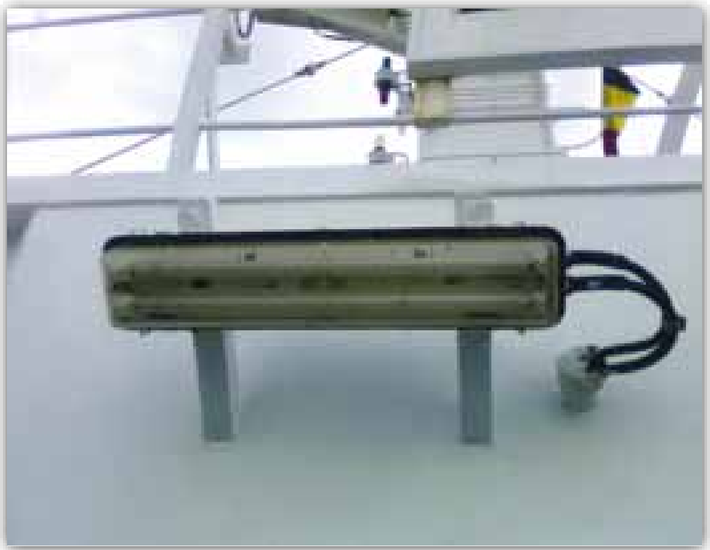

Figure 85: **Standardized Explosion-Proof Deck Light**

The inappropriate use of this equipment during loading and discharging operations can lead to potential for fire and explosion if a spark is created. Naked lights refer to open flames or fires, lit cigarettes, cigars, pipes, or similar smoking materials, any other unconfined sources of ignition, electrical and other equipment liable to cause sparks while in use, unprotected light bulbs or any surface with a temperature that is equal to or higher than the auto-ignition temperature of the products handled in the operation. When handling dangerous cargo, the main hazard is the use of naked lights or naked flames within a distance of 25 meters of the hazardous area of the vessel. The same hazard exists with vessel-to-vessel telephones, VHF radios, mobile phones and torches.

4.2.2.4 Physical Environment

Physical environment refers to existing conditions and inherent hazards onboard the vessel which can increase the risk of an incident. The existing conditions can, depending on the nature, sometimes be improved by intervention of the crewmembers through proper maintenance and onboard inspections.

The most hazardous environment onboard vessels for crewmembers are confined or enclosed spaces. These are spaces with limited openings for entry and exit, limited ventilation, and are not designed for continuous occupancy by crewmembers (Figure 85). They includes cargo spaces, double bottoms (Figure 86), fuel tanks, ballast tanks, pump rooms, cofferdams, void spaces, duct keels, engine crankcases and sewage tanks.

Possible consequences are suffocation or a fatality, due to lack of oxygen or the presence of toxic vapours. Explosion can occur due to the presence of explosive vapours in the confined space if the crewmember is operating electrical equipment that is not intrinsically safe or explosion proof. Confined or enclosed spaces must be tested for the presence of explosive gas mixtures, oxygen deficiency or toxic gases before being entered.

Figure 85: **Confined Space Warning**

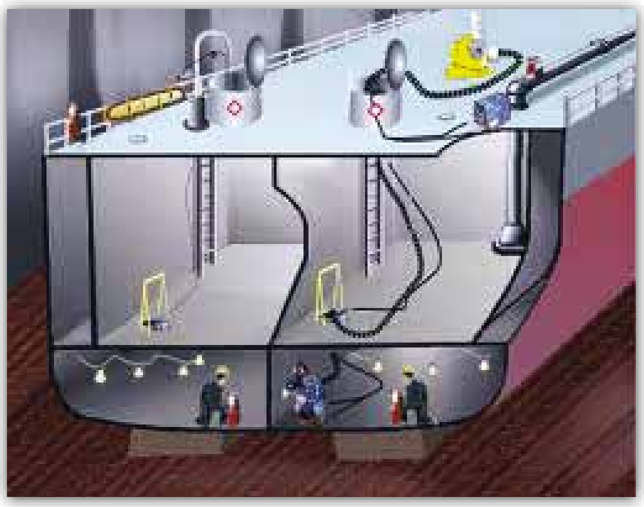

Figure 86: **Confined Space Double Bottom**

Weather conditions such as heavy rainfall, storms and high winds can create hazards for the safe operation of the vessel and cannot be controlled so the risks of collision or grounding increase if there is not enough navigation equipment onboard. Navigation hazards such as strong currents, shallow water, rapids and traffic density can also increase the risk of accidents.

Stowage and lashing of the cargo, dangerous goods and other items are very important in terms of considering the safe navigation of the vessel. Badly stowed cargo, like dangerous goods that are not properly segregated can present a serious hazard. In case of contamination, depending on the kind of dangerous goods, possible consequences are fire, explosion and release of toxic vapours. Cargo which is not sufficiently lashed can cause damage to the vessel and cargo due to shifting caused by movement of the vessel, waves created by passing (seagoing) vessels or during storm events. Another consequence may be the loss of stability, resulting in capsizing of the vessel. The improper handling of packaged dangerous goods or damage to packaged dangerous goods poses a hazard onboard the vessels as the consequences might be release of dangerous goods in the hold, which can potentially result in fire, explosion, or release of toxic vapours.

4.2.2.5 Dangerous Goods

In this part of the Risk Register, special attention is drawn to the operations and activities related to the transportation of dangerous goods and the international standards that are required for road, rail, maritime and inland shipping. The inherent physical properties of dangerous goods pose hazards to the environment, people and members of the public if appropriate management systems and procedures are not developed onboard. Also, special attention is given to the handling of the bilge water, slop tank content and cargo residues from tank cleaning and vessel operations.

The National Working Groups were required to evaluate the quantities of dangerous goods stored onboard and determine whether the following critical information was available in relation to the types of dangerous goods:

- the UN Number: a four-digit number assigned by the UN to identify dangerous goods;
- the Proper Shipping Name (PSN), a standard name given to dangerous goods for transport purposes;
- cargo manifest;
- IMDG Segregation table;
- dangerous goods stowage plan; and
- Material Safety Data Sheet (MSDS).

The above documents provide guidance on the correct handling and storage of dangerous goods; failure to follow these instructions can increase the risks of fire, explosion, personal injury, health risks and pollution. The MSDS provides employers and crew with the necessary information to handle the cargo and safely manage the risk from hazardous substance exposure. The IMDG table provides information on segregation of dangerous goods and cargo. The dangerous cargo stowage plan and UN number provide important information on the quantity and location of the dangerous goods so crewmembers can respond effectively in case of an emergency.

The risk register also evaluated whether there were management systems onboard for handling and labelling packaged dangerous goods. If they are not labelled correctly as required by the IMDG Code, they can pose health risks and, in some cases, increase the likelihood of fire, explosion or release of toxic vapours.

Every barge has bilges onboard; a mixture of oil, water and fuel (from normal engine operations), which should be disposed of properly. Bilges are often discharged directly into the river if there are no adequate waste-reception facilities available for cargo vessels and tankers. Bilges are a daily source of pollution. Pump-out facilities, or facilities for waste-reception, are essential for handling bilge content and slop tank content (cargo residues, tank cleaning) and other waste from barges, as they have specifically assigned tanks for this. The transfer to shore-side pump-out facilities is currently the most effective way to address the impacts of bilge content and other waste from barges.

4.2.2.6 Fire Hazards

Hot work: describes operations where heat and/or spark(s) may be produced and is not limited to welding and gas cutting operations as it also includes operations such as grinding and abrasive cutting. The risk register evaluated whether the vessels have effective hot work procedures in place. Lack of effective controls can easily have severe consequences such as explosion and fire when hot work is carried out. Hot work represents two specific hazards. One is that open flames or flying sparks can ignite flammable gases and vapours (that are produced by liquids and solids). The other is that hot work itself may produce toxic fumes and gases. Hot works increase the risks of fire and explosion. The use of other portable electrical appliances has to be controlled to prevent sparks.

Smoking/Open Light: smoking areas have to be identified, and requirements for smoking observed. Portable and permanent notices prohibiting smoking and the use of naked lights should be displayed at the point of access to the vessel and at the exits from the accommodation area, especially during bunkering and loading and discharge operations (Figure 87).

Naked Light or Naked Flame: includes flame, spark formation, naked electric light or any surface with a temperature that is equal to or higher than the minimum ignition temperature of the products handled in the operation. Naked light regulations have to be observed.

Figure 87: **No Smoking Sign**

4.2.2.7 Human Factors

In this part of the risk register, possible hazards and consequences arising from human-related factors including skills, experience, education, communication and information were evaluated along with hazards arising from crewmembers working extended hours (fatigue) and the physical environment in which they are working. Human factors can lead to incorrect handling of dangerous goods, mistakes and operational errors as well as pollution, personal injury or fatalities, property damage, collision, grounding, fire and explosion.

Crewmembers performing extended working hours may suffer from physical and mental exhaustion which leads to reduced concentration and increases the likelihood of operational errors. Similarly crewmembers working in high temperatures combined with humidity may suffer from heat illness, exhaustion, and dehydration.

4.2.2.8 Management

Management is one of the most important hazard groups in the risk register as it affects all the aspects involved in, or associated with managing the safe operation and navigation of the vessel. The National Working Groups were required to evaluate components of the management systems. Management system can be defined as a set of the following interactive or interrelated elements, used by different organisations, authorities, shipping companies and terminals, to implement policy and achieve objectives (ISO 9001:2000). The following components were analysed in the risk registers:

Safe Working Procedures: detailed explanation of the tasks and activities to be carried out for specific operations, i.e. bunkering, loading and discharging petroleum products;

Prevention Measures: procedures and systems onboard to protect the property, safety and the environment and to respond effectively to emergency situations;

Training and Education: for crewmembers in relation to first aid, firefighting, lifesaving, dangerous goods, emergency procedures and waste management;

Checklist: the use of checklists (list of items to be checked prior to starting the work activity) is very important as it points out the Personal Protective Equipment (PPE) to use, and the kind and sequence of items and activities to be checked and agreed upon. It has to be signed by all parties involved. Checklist can be made for many operations: loading/discharging, bunkering, watch keeping;

Figure 88: **Oil spill response kit**

Waste Management Plans: systems for the management of solid (garbage and maintenance residues) and liquid (bilge water, sewage and liquid residues containing oil or chemicals) waste. Management plans should be in place in order to prevent pollution by vessels;

Emergency Response Plans: systems and equipment onboard to respond to emergency situations Figure 88;

Drugs and Alcohol: drug and alcohol abuse by crewmembers can, apart from hampering their own ability to perform duties in a safe and responsible manner, also jeopardize the safety and efficiency of the other crewmembers and of the vessel itself. Drugs and alcohol in even small quantities have the effect of distorting perception and slowing down personal reactions, and increasing the risk of incidents;

Dangerous Goods: lack of management of dangerous goods in terms of procedures for loading and discharge operations, handling and storage, emergency response plans and absence of MSDS and dangerous goods manifest and planning present risks to crewmembers, property and the environment;

Safe Manning: is a function of the number of qualified and experienced crewmembers necessary for the safety of the vessel, crew, passengers, cargo and property for the protection of the aquatic environment. The ability of the crewmembers to maintain observance of the requirements is also dependent upon conditions relating to training, hours of work and rest, occupational safety, health and hygiene and the proper provision of food[47];

Drills and Muster List: are necessary to familiarize the crewmembers with emergency response plans by conducting exercises like fire drills, abandon ship drills and responding to oil spills. Not conducting such exercises means that the crew is not prepared to deal with an emergency situation in terms of experience, efficiency, designated task, activity sequence, use and condition of firefighting or lifesaving equipment;

[47] 21st session in November 1999, the IMO Assembly adopted resolution A.890(21)

Ship Survey and Inspections: in addition to onboard inspections undertaken by shipowners and crewmembers, it is important that surveyors from classification societies such as Det Norske Veritas (DNV), Germanisher Lloyd (GL) and Lloyds Register (LR) inspect vessels to certify that the ship, its components and machinery are built and maintained according to the standards required for their class. Classification societies set technical rules, confirm that designs and calculations meet these rules, survey ships during the process of construction and commissioning, and periodically survey vessels to ensure that they continue to meet the rules. Lack of quality control and planned and preventive maintenance can lead to deterioration of a ship's condition; and

Authority Control and Law Enforcement: absence of common regulations, authority control, law enforcement and compliance activities may result in improper conduct by private companies operating along the river and by foreign vessels in relation to protecting safety and the environment. The risk register and questionnaires determined the legal framework, rules, regulation and technical standards in the Member Countries and whether there are responsible authorities for monitoring and enforcement activities. If there is no legal framework or enforcement, then vessels will not comply with national and international standards for transport of dangerous goods and increase the risks to property, safety, security, customs control and the environment.

Company Policy and Company Control: when companies do not follow the rules and regulations stipulated by the authorities or there are no rules and regulations for them to follow, the likelihood of incidents will increase. The risk register and questionnaire determined whether private operators have policies and procedures to comply with national and international standards in the Member Countries.

4.2.2.9 Lifesaving and Firefighting Equipment

To prevent, deal with or detect a fire, adequate equipment and mechanisms should be provided onboard the vessel. Fire detection equipment including smoke-detection alarms should be kept in good working condition to detect the fire in time and limit its extent. An up-to-date fire-control plan should be available, marking all the firefighting equipment onboard the vessel.

Firefighting equipment should be kept onboard in the appropriate places as foreseen in the ship's construction plan. Firefighting equipment not in place or not operating may have severe consequences for safety, property and the environment as crewmembers will not be able to respond effectively in an emergency situation. The same applies for lifesaving equipment such as rescue boats (Figure 89), life jackets and lifebuoys. Regular inspections, maintenance and drills were evaluated.

Figure 89: **Rescue Boat**

Adequate lifesaving and firefighting equipment onboard can reduce the severity of incidents. The risk registers also evaluated the availability of Personal Protective Equipment (PPE) available for crewmembers onboard the vessel including safety glasses, gloves, ear muffs, steel-capped boots, helmets and life jackets. PPE can reduce the severity of injuries but should not be relied upon to prevent injuries.

4.3 RISK EVALUATION

4.3.1 Introduction

The results from the nine hazard groups in the risk register for vessels was compared to risk criteria to determine priority areas for implementation. The following section provides the evaluation of the storage and handling of dangerous goods in ports, terminals and ferry crossings in the MRC Member Countries. The section also provides an overview of the existing legislation, type and quantity of dangerous goods transported, international and domestic trade, and the location of ports and terminals.

4.3.2 Cambodia

4.3.2.1 Overview

The Mekong River receives both kind of vessels up to Phnom Penh: inland barges and seagoing (maritime) vessels up to 5,000 DWT. The main traffic is dedicated to inland shipping, for the domestic market and cross-border trade with Viet Nam. Occasionally, a seagoing vessel enters Cambodia through the Mekong, mainly for general cargo or bulk, and LPG tankers.

Cambodia depends greatly on the import of oil products as, so far, no oil exploitation has started within the territory or economic boundaries of the country. Oil products and derivatives such as intermediate fuel oil, kerosene, diesel oil, and gas are used for energy production, transportation, industries and local consumption. Most of the tankers carrying these products are registered under the Vietnamese flag although some of the domestic feeders are Cambodia registered. The Risk Analysis of tankers in Cambodia will therefore be discussed by referring to the Risk Analysis of tankers in Viet Nam. In any case, all tankers using the Mekong River system in the delta, whether they are Cambodian or Vietnamese, should have common and appropriate standards as there is cross-border traffic. It is to be noted that the quality of the equipment, management and operations onboard the domestic feeder tankers in Cambodia is less than the quality standards of the Vietnamese tankers. Acknowledging that the Vietnamese tankers will be subject to improvements in the future, so will the Cambodian tankers, and to even a higher degree because of the current differences in quality.

4.3.2.2 Legislation and Authority Control

There exists a long list of international conventions related to the marine environment. Operations at sea are firstly regulated by the Law of the Sea (1982), in which provisions on environmental protection are defined. The Law of the Sea also defines provisions related to maritime transportation, through the description of responsibilities of states on managing seagoing vessels and sea ports. Other conventions specify different aspects of environmental protection in maritime transportation. All the legal instruments are described in detail in the Chapter 6 (Regional and International Legal Framework).

Table 32 represents the current status of participation by Greater Mekong Countries in international conventions by IMO. Other members of the Association of Southeast Asian Nations (ASEAN) have also ratified many conventions related to environmental protection in the maritime sector.

Table 32: **Participation by Greater Mekong Countries in international conventions by IMO 2011**

Cambodia	China	Lao PDR	Myanmar	Thailand	Viet Nam	X = accession, ratification, etc D = denunciation
X	X		X	X	X	IMO Convention 48
	X			X		IMO amendment 91
	X		X	X	X	IMO amendments 93
X	X		X	X	X	SOLAS Convention 74
X	X		X		X	SOLAS Protocol 78
X	X				X	SOLAS Protocol 88
						Stockholm Agreement 96
X	X		X	X	X	LOAD LINES Convention 66
X	X				X	LOAD LINES Protocol 88
X	X		X	X	X	TONNAGE Convention 69
X	X		X	X	X	COLREG Convention 72
	X					CSC Convention 72
						CSC amendments 93
						SFV Protocol 93
X	X		X	X	X	STCW convention 78
						STCW-F Convention 95
	X					SAR Convention 79
						STP Agreement 71
						STP Protocol 73
	X			X	X	IMSO Convention 76
	X			X	X	INMARSAT OA 76
						INMARSAT amendments 94
	X				X	INMARSAT amendments 98
						IMSO amendments 2006
						IMSO amendments 2008
	X			X	X	FACILITATION Convention 65
X	X		X	X	X	MARPOL 73/78 (Annex I/II)
X	X					MARPOL 73/78 (Annex III)
X	X					MARPOL 73/78 (Annex IV)
X	X					MARPOL 73/78 (Annex V)
	X					MARPOL Protocol 97 (Annex VI)
	X					London Convention 72
	X					London Convention Protocol 96
	X					INTERVENTION Convention 69
	X					INTERVENTION Convention 73
X	D					CLC Convention 69
X	D					CLC Protocol 76
X	X				X	CLC Protocol 92
	D					FUND Convention 71
						FUND Protocol 76
X						FUND Protocol 92
						FUND Protocol 2003
						NUCLEAR Convention 71
	X					PAL Convention 74
	X					PAL Protocol 76
						PAL Protocol 90
						PAL Protocol 02
						LLMC Convention 76
						LLMC Protocol 96
X	X		X		X	SUA Convention 88
X	X		X		X	SUA Protocol 88
						SUA Convention 2005
						SUA Protocol 2005
	X					SALVAGE Convention 89
	X			X		OPRC Convention 90
						HNS Convention 96
	X					OPRC/HNS 2000
	X				X	Bunkers Convention 01

There are, however, a few important and relevant conventions in which Cambodia does not participate:

- *International Convention on the Establishment of an International Fund for the Compensation for Oil Pollution Damage* (1971 – FUND). The Convention has three protocols (1976, 1992 and 2003). Cambodia has participated only in the FUND protocol of 1992.
- *International Convention on Pollution from Ships* (1973, as amended in 1978 – the MARPOL 73/78). The convention has 6 annexes. The convention entered into force on 18 March, 1991. Cambodia has participated in MARPOL Convention 73/78, Annex I, II, II, IV and V (IMO 2005). Cambodia participates in all, except MARPOL PROTOCOL 1997, Annex VI.
- *International Convention on Oil Pollution Preparedness, Response and Cooperation* (OPRC) (1990);
- *Protocol on Preparedness, Response and Cooperation to Pollution Incidents by Hazardous and Noxious Substances* (HNS Protocol) (2000);
- *International Convention of the Control of Harmful Anti-Fouling Systems on Ships* (AFS) (2001); and
- *International Convention for the Control and Management of Ships' Ballast Water and Sediments*.

4.3.2.3 Inland Navigation

Apart from registration of vessels, there is currently no national legislation in Cambodia on inland waterway barges or the transport of dangerous goods by inland waterways.

Registration of inland waterway barges is carried out by the Inland Waterway Transport Department under the Ministry of Public Works and Transport (MPWT) and the Inland Waterway Transport Departments of Phnom Penh Municipality and the provinces. The same departments are responsible for inspecting barges and will be responsible for implementing and ensuring compliance with rules, regulations, standards and laws. A number of circulars are being prepared by the MPWT including:

- *Circular on Waste Management from Ships in Inland Waters* (September 2010); and
- *Circular on Dangerous Goods Transportation Technique on Inland Waterways* (December 2010) and *Circular on the License for Barges and Ships* (July 2010).

These circulars are not yet in force. The MPWT is preparing the following circulars in relation to Inland waterborne transport (IWT):

- *Circular on Protection and Prevention the Traffic Accidents along Inland Waterways*

  This circular has been compiled to maintain safety during navigating along rivers and avoiding any accidents along inland waterways; and

- *Circular on Management of Means of Waterway Transport.*

  This circular has been established by the Ministry of Public Works and Transport to ensure proper management of all kinds of vessels and/or boats navigating on the waterways to ensure safety, comfort, hygiene, traffic order, and to protect the lives of crew, passengers, tourists, property, means of transport and the environment.

In addition, the MPWT is preparing:

- *Draft of Prakas on Dangerous Cargoes Transport along Inland Waterway*

  The main objectives of this *prakas* are to:

  - prevent loss of human and animal life, state and private property during the transport of dangerous cargoes along inland waterways in Cambodia;
  - prevent the transport of dangerous cargoes without technical conditions; and
  - keep good order, security, safety and environment along inland waterways.

- *Draft of Prakas on Waste Management from Vessels along Rivers in the Kingdom of Cambodia*

  The main objectives of this *prakas* are:

  - management of all kinds of waste from vessels navigating along rivers in Cambodia;
  - protection from dangers impacting on the health of humans and fishes and loss of public and private property during transportation as well as prevention of environmental pollution along rivers in Cambodia;
  - maintenance of good order, security, safety and the environment along inland waterways; and
  - prevention of any infringement on the environment by vessel owners using inland waterways in Cambodia.

- *Draft of Prakas on Procedures of Giving Ship Identity Card*

  The main objectives of this *prakas* are applied to responsibilities of means of inland waterborne transport at the national level and under.

- *Draft on Inland Waterway Transport*

  The main objectives of this draft are:

  - keeping good order, security and safety in waterway transport;
  - protecting human life, animals and the environment;
  - preventing dangers to human health, damage to public and private property; and
  - protecting any infringement caused from the use of inland waterways and promoting the development of inland waterborne transport in Cambodia.

4.3.2.4 Cross-Border Navigation

Under the Agreement between the Royal Government of Cambodia and the Government of the Socialist Republic of Viet Nam on Waterway Transportation, which entered into force on 20 January 2010, a number of clauses are introduced that are legally binding for both countries. The clauses include legalities on the following items:

- permits to transport dangerous goods;
- pilotage of vessels engaged in cross-border transportation carrying dangerous goods (compulsory for all vessels carrying dangerous goods and general cargo vessels equal or above 250 GRT);

- criminal jurisdiction; and
- the role of the Bilateral Navigation Facilitation Committee in drafting and overseeing rules and regulations on the transportation of dangerous goods.

4.3.2.5 Dangerous Goods Specifications

The different kinds of dangerous goods presently stored and transported on the Mekong River by inland barges include:

- fuel oil (FO);
- diesel oil (DO);
- KO;
- MOGAS (M), M92, M95 and M97;
- Jet A-1;
- liquefied petroleum gas (LPG);
- toluene; and
- ammonium nitrate and fertilisers.

Table 33 below illustrates the number vessels per type calling at Phnom Penh Port during the period 2006-2010.

Table 33: **Phnom Penh Port Ship Calls**

	2006	2007	2008	2009	2010
TOTAL (VESSELS)	**1,264**	**1,398**	**1,543**	**1,520**	**1,057**
Inter-Vessel/Barge	254	377	484	387	318
Oil Vessel	831	894	951	1,026	657
Cambodia Vessel	147	125	108	107	82
Domestic Barge	32	2	0	0	0

4.3.2.6 Barges Specifications

Most of the barges (Cambodian and Vietnamese) coming to Cambodia that are carrying dangerous goods are shown in Table 34.

Table 34: **Specification of Barges**

	2008	2009	2010
Tanker Barges	962	1,049	877
General Cargo & Container Vessels	316	558	689

Table 35: **Number of Registered IWT Vessels at MPWT IWT Department, Phnom Penh**

		To 2007	2008	2009	2010	2011	Fill up total
1	General cargo, sand boat	47	377	484	387	318	
2	Passenger	1	894	951	1,026	657	
3	Tankers	2	125	108	107	82	
4	Trailer / tug boat	9	2	0	0	0	
5	Non-motor boat						
6	Ferry / dredge boat	32					
7	Personal / family boat	1					
8	Fishing boat						
9	Foreigner boat						
10	Tourist boat	5					
11	Rescue boat						
	Others (Pontoon, ……)	6					
	Fill up total	**103**					

Source: MPWT

The following are the average dimensions of inland waterway barges operating in Cambodia:

- **Length over all (LOA):** between 50.9 m and 62.00 m
- **Breadth:** between 8.80 m and 12.00 m
- **Draught maximum:** between 3.30 m and 4.20 m
- **Cargo carrying capacity:** between 500 and 1,500 tonnes

4.3.2.7 Main Traffic Lines

The most significant traffic lines are cross-border trade between Viet Nam and Cambodia, with cargo mainly coming from Nha Be Oil Terminal, Dong Thap Oil Terminal and Can Tho Oil Terminal in Viet Nam.

4.3.2.8 Risk Evaluation

Four vessels, berthed at Cambodian terminals, were inspected by the National Working Group by using the risk register: two cargo vessels and two tanker barges. The barges were both Vietnamese-flagged vessels. From the two cargo barges, a typical risk register was prepared to represent the cargo vessels.

Table 36: **Priority Areas for Cargo Vessels in Cambodia**

CAMBODIA CARGO VESSEL		
No.	**Hazard**	**Priority Area**
2801	No bulwark / fence	4
4301	Badly stowed cargo: DG are not segregated	
4302	No procedures exists for the handling of packaged DG (damage to package of DG due to improper handling)	
5402	Disposal of bilge content to reception facility is too expensive	
5403	No adequate authority control on bilge content removal (oil record book)	
7501	Crewmember don't understand/ knows the hazards of the process, little knowledge of DG and of critical procedures undertaken onboard	
7702	wrong communication between crossing vessels because of different language use	
8105-8110-8111	No procedures on bunkering operations, entering enclosed spaces and hot work	
8304-8305-8306 8307-8308-8309	No training on: handling DG, emergency procedures, accident prevention, marine pollution prevention, environmental protection and vessel waste management	
8403	No checklist for bunkering operations	
8501	No solid waste management (garbage, maintenance residues)	
8502	No Liquid waste management (Bilge water, wash water, sewage & liquid residues containing oil or chemicals)	
8601	No emergency response plans available	
8701	No drug and alcohol policy	
8801	No management concerning dangerous goods	
81001	No courses for crewmembers in DG and shipboard operations	
81301	Class inspection: not existing , not carried out at regular interval	
81501	No authority control	
9301	Fire and Smoke detection alarm: absent or not working	
91001	Gas detection absent, not working or not calibrated	
91101	Oxygen level measurement absent, not working or not calibrated	
91202	Breathing apparatus not available	
2901	No radar available during bad visibility, heavy rain or showers	3
4501	Confined spaces have not been identified onboard (crew is unaware of the existence of confined or enclosed spaces)	
4502	Entering enclosed space: lack of oxygen or (Toxic) vapours present	
4906	Density of traffic	
4907	Lack of navigation aids: buoys, leading lights	
4908	Lack of reporting system, Vessel Traffic Services (VTS)	
5101	Hazard depending on kind of DG onboard (see Material Safety Data Sheet [MSDS]): Flammable, Toxic, Corrosive, Infectious,…	
5103	No MSDS available	
5104	Packaged Dangerous Goods not properly labelled	

Table 36: **Priority Areas for Cargo Vessels in Cambodia (continued)**

No.	Hazard	Priority Area
5105	Dangerous goods in CTU (Cargo Transport Unit - container): stuffing of CTU not according legal requirements	3
5401	Waste reception facilities for bilge content (mixture of oil-fuel-water) are not available	
6101	No checklist completed prior to hot works	
7201	Insufficient skill, training	
7402	Crewmember does not perform a required action	
7403	Crewmember performs a wrong action	
7404	Crewmember performs an action at the wrong place	
7405	Crewmember performs actions in the wrong sequence	
7406	Crewmember performs an action at the wrong time	
7601	Insufficient information/ communication regarding the DG onboard, and important activities onboard	
7701	Lack of communication, no appropriate means of communication (no VHF, no Walkie-Talkie)	
8103	No procedures on transfer operations	
8104-8107-8108-8109	No procedures on spill containment, cargo handling, deck watch keeping or bridge watch keeping	
8115	No procedures on grounding	
8204	No management concerning firefighting equipment	
8205	No safety committee	
8302	No training on the use of firefighting equipment	
8401-8402-8404-8406-8408	No checklist regarding: Loading/ discharging, cargo transfer, watch keeping safety items and navigation tools	
8902	Certification is not provided to prove courses followed and examination result acceptable	
81002	No refresher courses for crewmembers in DG and shipboard operations	
81101	Fire drills are not conducted onboard	
81401	No regulation	
81601	No policy, bad management	
81701	No control, bad management	
9101	Fire extinguishers: absent, no regular check (yearly), out of order	
9102	Fire hoses: missing or bad state	
9104	Fire hydrants: blocked	
9106	Breathing apparatus not available	
9201-9203	Poor maintenance of firefighting pump, no regular testing	
91201	Safety glasses, goggles, face shield: not available	
91206	Harness, life lines, life jacket: not available	
91208	Reflective jacket: not available	

Table 36: **Priority Areas for Cargo Vessels in Cambodia (continued)**

No.	Hazard	Priority Area
1302	Generator failure causing black out	2
2201	Cargo and/or ballast tanks rusted (insufficient steel thickness)	
2601	Lack of spill belt/plate	
2902-2904-2905-2906	No VHF, navigation charts, GPS or fog horn	
3101-3102-3104	High voltage area: Lack of warnings, signs, easy accessible and no or insufficient insulation	
3202	Cables: no or insufficient insulation	
3301	Electrical equipment not earthed (deck lights, pumps.. etc)	
4401	Cargo is not lashed sufficiently	
4801	No or insufficient maintenance of equipment	
41001-41003	Weather: storm or lightning	
41007	Night navigation in dangerous river stretches (rocks, rapids, etc)	
5102	No Dangerous Goods stowage plan	
5106	Transport documents not supplied, or incomplete, no necessary information on shipped DG	
7101	Extended working hours, insufficient rest	
7401	New operating staff not properly trained	
7407	Crewmember not under supervision	
8102-8112-8113-8116	No safe working procedures on loading/ discharging, emergency situations, fire/explosion, collision or contact	
8201-8202-8203	No management on safety measures, protective equipment or life saving equipment	
8301-8303	No training: First aid, lifesaving equipment	
8405-8407	No checklist regarding: maintenance, survival equipment	
8903	No medical check up performed and certified, to prove fitness of crewmember	
81102	No abandon ship drill	
81201	No muster List	
9103	Fire monitors: missing or bad state	
9105	Fire axe missing	
9401	Fire Control Plan: not available	
9801-9901	Life buoys & lIfe jackets: absent or in poor condition	
91207	Helmet: not available	

4.3.3 Viet Nam

4.3.3.1 Background Information

Viet Nam is the main importer, exporter and carrier of dangerous goods along the Mekong River among the four countries. This country is most developed in terms of standardising carriage of dangerous goods. The Government of Viet Nam is doing its best to manage and control the risks but has to face a rapid expansion of vessels and trade in dangerous goods. Law enforcement may not be adequate enough to conduct regular inspections or impose fines when necessary.

Viet Nam is also the only country that registers and reports shipping accidents. Samples of such recordings follow, although not all occurred in the Mekong River system:

On September 7, 2001, the m/v "Formosa One" collided with the "Petrolimex" in Vung Tau harbour, causing 900 cubic metres of oil commodities to disperse into an area of high environmental sensitivity. This was a serious oil spill that impacted vast areas of the estuarine and coastal zones (859 km^2), including shrimp farming, mangroves and the major swimming areas. The total loss from the accident was estimated at VND 257 billion ($17 million).[48]

Table 37: **Summary of Overall Cost from Collision of m/v Formosa One**

Sector	Total Cost (millions)	
	VND	USD ($)
Aquaculture	52,387	3.492
Tourism (2001-2002)	69,913	4.661
Agriculture	6,553	0.436
Biotic resources	38,373	2.558
Health sector and public Health	11,740	0.783
Coast treatment and restoration work	63,712	4.247
Surveying	15,027	1.002
Total	**257,705**	**17.180**

4.3.3.2 Legislation and Authority Control

Legislation in Viet Nam related to maritime and inland waterway transportation is very extensive and covers almost all important areas that should be taken into account when considering transport of dangerous goods onboard.

4.3.3.3 Maritime Navigation

As in the case of Cambodia, there is maritime and inland navigation in Viet Nam. Viet Nam has endorsed many of the IMO conventions. All the legal instruments are described in detail in Chapter 6 (Regional and International Legal Framework). Table 32 represents the status of the accession of Viet Nam to international conventions governed by the International Maritime Organisation (IMO 2011). Other ASEAN countries have also ratified many conventions related to environmental protection in the maritime sector.

[48] Source: Asia Pro Eco Programme. Establishing Scientific Support for Environmental Management for Ports in Vietnam and Cambodia VN/ Asia Pro Eco/01(91168) by Le Xuan Quynh, Lien Verbeeck & Luc Hens - Hanoi, 2005

- *International Convention on the Establishment of an International Fund for the Compensation for Oil Pollution Damage (*1971 – FUND). The convention has three protocols: 1976, 1992 and 2003. Cambodia has participated in the FUND protocol of 1992 but Viet Nam does not participate in this Convention and its protocols;
- *International Convention on Pollution from Ships (*1973), as amended in 1978 – the MARPOL 73/78. The convention has 6 annexes. In 1990, Viet Nam approved Annex I and II of the MARPOL Convention. The convention entered into force on 18 March, 1991; and

There are four important conventions in which Viet Nam does not participate:

1. *International Convention on Oil Pollution Preparedness, Response and Cooperation* (OPRC) (1990);
2. *Protocol on Preparedness, Response and Cooperation to pollution incidents by Hazardous and Noxious Substances* (HNS Protocol) (2000);
3. *International Convention of the Control of Harmful Anti-fouling Systems on Ships* (AFS) (2001), and
4. *International Convention for the Control and Management of Ships' Ballast Water and Sediments*.

Besides international legislation, Viet Nam has endorsed national decrees relating to transportation of dangerous goods:

- *Decree 30/CP* on *Activities of People and Foreign Navigation Facilities in Viet Nam's Waters* dated 29 January 1980;
- *Maritime Code of Viet Nam* approved by the National Assembly on 30 June 1990, in force since 1 January 1991;
- *Decree No. 13/CP on Regulation on the Management of Maritime Shipping at Seaports and in the Maritime Navigable Zones of Viet Nam* by the Government dated 25 February 1994;
- *Decree on the Tasks of Viet Nam's Marine Police including the Task of Marine Environment Protection* by the Permanent Committee of the 10th National Assembly dated 28 March, 1998;
- *Decree No. 160/2003/ND-CP on Administering Maritime Activities at Vietnamese Ports and Maritime Waters* by the government dated 18 December 2003. In this decree, regulations were set out for opening and closing ports, shipping operations and coordinating activities between specialised agencies at ports and shipping zones to guarantee maritime security, order and hygiene as well as to prevent environmental pollution;
- The *Maritime Code of Vietnam* approved by the National Assembly on June 14th 2005; and
- Seaport regulations by the directors of port authorities. Decision promulgating regulations on environmental protection by port authorities at Vietnamese seaports.


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4.3.3.4 Inland Navigation

The transport of dangerous cargoes by inland waterway barges is regulated by the following:

- *Law on Inland Waterway Transportation of 2004*;
- *Decree No. 29/2005/ND-CP;*
- *Circular No. 20/2011/TT-BGTVT* (rules for management of passenger transport);
- *Circular No. 21/2011/TT-BGTVT* (rules for registration of inland vessels);
- *Decision No. 25/QD-BGTVT* (rules for registry of inland vessels);
- *Decision No. 33/2004/QD* (rules for management of cargo transport);
- *Decision No. 34/2011/QD* (rules for inland waterway port authority); and
- *Circular No. 14/2011/ TT-BGTVT* (rules for crewmembers on inland waterways).

Standards applicable for vessels carrying dangerous goods regarding construction, lifesaving and firefighting equipment, crew standards and waste management are regulated by the norms for classification and registration of inland waterborne transport including:

- *Decision No. 28/2004/QD-BGTVT*; and
- *Decree No. 125/2005/ND-CP*.

National legislation on the carriage of dangerous cargoes onboard vessels is prepared by the Ministry of Transport (MOT), the Vietnam Inland Waterway Administration (VIWA), the Vietnam Register and the Ministry of Public Security and the Departments in municipalities and and provinces. Apart from police, navy and fishing vessel, registering of inland waterway barges is the responsibility of the municipal and provincial Departments of Transport.

Inspecting inland waterway barges, implementation of and ensuring compliance with the rules regulations, standards and laws is carried out by the Waterway Public Security Administration, the Inland Waterway Public Security Department, the Ministry of Public Security, the Inland Waterway Inspection Department, VIWA and the Ministry of Transport and the local port authorities.

Well-equipped units with rescue vessels and adequate communication means (VHF) are available as part of the Waterway Public Security Station and the Inland Waterway Inspection Team. As for law enforcement control, fines for violating laws and regulations are laid down in *Decree 09/2005/ND-CP.*

4.3.3.5 Cross-Border Navigation

The *Agreement between the Royal Government of Cambodia and the Government of the Socialist Republic of Viet Nam* on Waterway Transportation includes:

- permits to transport dangerous goods;
- pilotage of vessels engaged in cross-border transportation carrying dangerous goods;
- criminal jurisdiction, and
- the role of the Bilateral Navigation Facilitation Committee in drafting and overseeing rules and regulations on the transportation of dangerous goods.

4.3.3.6 Legal and Institutional Aspects Regarding Emergency Response

Responses to oil spill incidents are regulated by *Decision No 63/2000/QD-Ttg* dated 7 June 2000 by the Prime Minister on renaming and amendment duties of the Vietnamese Search and Rescue Committee and *Decision No 129/2001/QD-Ttg* dated August 2001 by the Prime Minister that approves the National Response Oil Spill Plan from 2001 to 2010. On 29 December 1995, the Ministry of Science, Technology and Environment issued *Circular 2262*.

The VIWA, under the Ministry of Transport, and the Dyke Management and Flood and Storm Administration, under the Ministry of Natural Resources and Environment, are included in the Viet Nam Search and Rescue Committee. While there are rescue units in Ho Chi Minh City and coastal areas, coverage of the Mekong Delta is not clear.

The members of Viet Nam Search and Rescue Committee are:

- Ministry of Defence;
- Ministry of Public Security;
- Ministry of Agriculture and Rural Development;
- Ministry of Natural Resources and Environment;
- Ministry of Information and Communications; and
- Ministry of Transport.

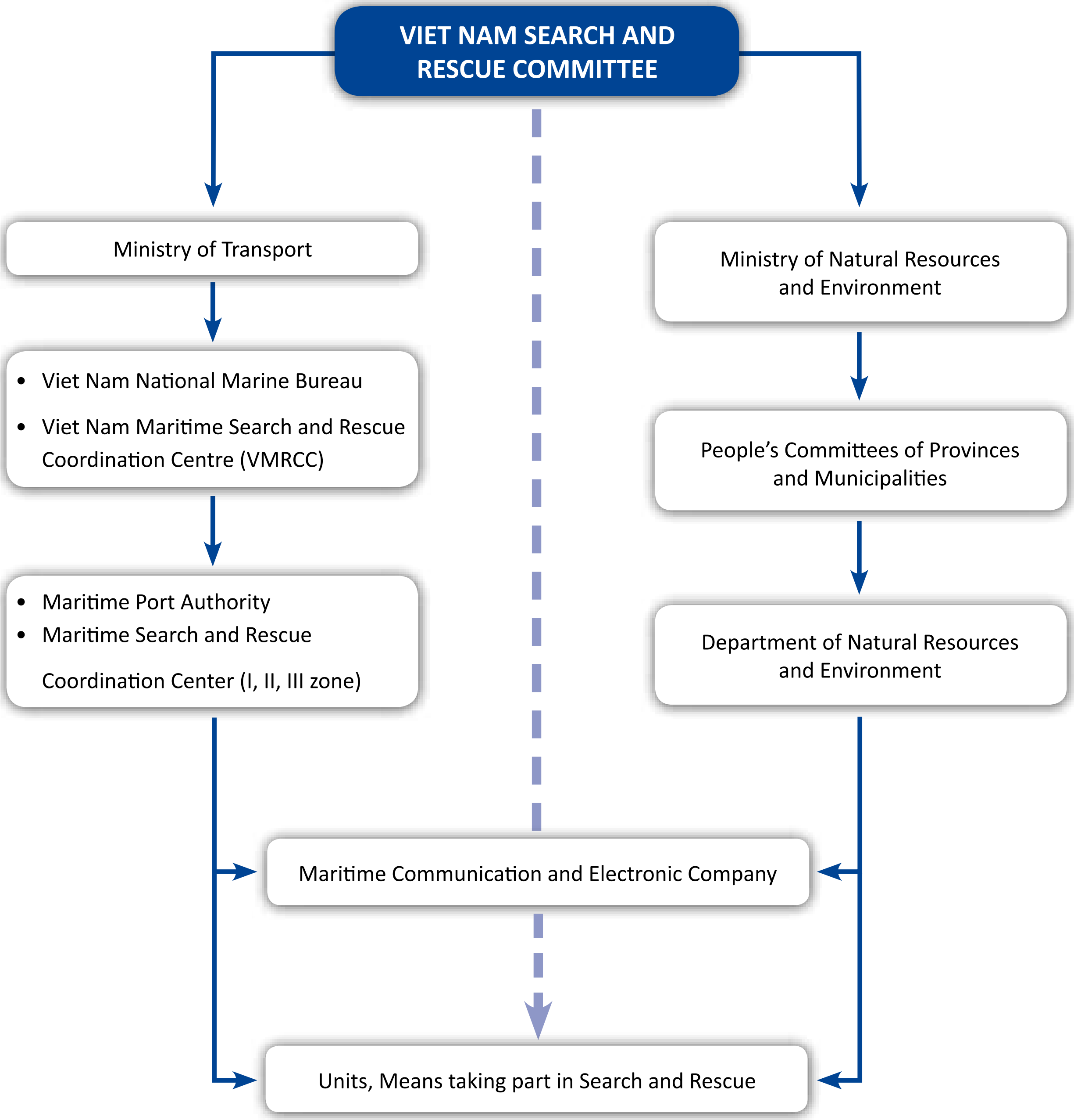


Figure 90: **Management of Oil Spills in Seaports in Viet Nam**

4.3.3.7 Dangerous Goods Specifications

The main types of dangerous goods transported on the Mekong River on the inland barges in Viet Nam included in the study are:

- gasoline;
- M92, M95; and
- diesel.

4.3.3.8 Main Traffic Lines

The most important transport routes for vessels carrying dangerous cargo in southern Viet Nam are:

1. Vĩnh Xương - Tiền River Tiểu estuary (main estuary) or Đại estuary or Hàm Luông, Cổ Chiên, Cung Hầu estuary or Ba Lạt estuary;
2. Châu Đốc - Hậu River (Định An or Trần Đề estuary);
3. Lâm Đồng plateau - Đồng Nai River - Trị An Lake - Ho Chi Minh City (Cát Lái T-junction) - Sài Gòn River - Lòng Tàu River - Soài Rạp River - Soài Rạp estuary or Gành Rái estuary;
4. Ho Chi Minh City - Tẻ Canal - Đôi Canal - Chợ Gạo Canal - Tiền River - Lấp Vò Canal (Sa Đéc) - Hậu River - Ba Thê Canal - Hà Tiên province;
5. Ho Chi Minh City - Tẻ Canal - Đôi Canal - Định Bến Lức Market (Long An province) - Thủ Thiêm River - Tháp Mười Canal - Tứ Giác Long Xuyên (Ba Thê - Hậu Giang province) - Hà Tiên province;
6. Ho Chi Minh City - Tẻ Canal - Đôi Canal - Chợ Gạo Canal - Tiền River - Chợ Lách Canal - Măng Thít River - Quản Lộ Phụng Hiệp Canal - Cà Mau province - Năm Căn;
7. Ho Chi Minh City - Tẻ Canal - Đôi Canal - Chợ Gạo Canal - Chiệt Sậy Canal - Mỏ Cày Canal - Cổ Chiên River - Trà Vịnh Canal - Rạch Lọt - Cần Chong Canal - Phú Hữu Bãi Sầu Canal - Bạc Liêu Cổ Cò Canal - Cà Mau province;
8. Hà Tiên - Rạch Giá - An Biên - An Minh - Cà Mau - Năm Căn.

Figure 91: **Main Cross-Border Traffic Lines in the Delta**

Figure 92: **Main Traffic in Southern Viet Nam**

4.3.3.9 *Barge Specifications*

About 755,000 barges are sailing on the inland navigation system in Viet Nam of which 2,151 are involved in shipping dangerous goods (2,133 as tanker barges, 3 barges for the transport of liquefied gas and 15 barges for the carriage of other liquids classified as dangerous cargo).

In Viet Nam the tankers used can be divided into three categories:

1. 800-1,500 DWT inland tanker vessels, primarily used for cross-border trade between Cambodia and Viet Nam. These vessels mainly transport petroleum products from Saigon Port to Cambodia along the Mekong River and also for domestic trade;
2. 150-300 DWT tanker, feeders from the main terminals to the domestic clients such as factories, electricity providers, petroleum terminals and floating and fixed fuel stations; and
3. less than 150 DWT fuel boats for local supply.

The main types of dangerous goods carried on the river by barges in the Mekong Delta are:

- gasoline;
- liquefied petroleum gas; and
- other liquids.

Table 38 below shows the number of barges carrying dangerous goods and the exploitation capacity per year. Further investigation is required to determine what the other liquids carried are.

Table 38: **Number of Registered Tanker Barges in Southern Viet Nam**

Type	Quantity	Total capacity (tonnes)	Annual exploitation capacity (tonnes)
Gasoline	2,133	343,067	17,153,350
Liquefied Petroleum Gas	3	2,656	132,800
Other liquids	15	5,403	270,150
TOTAL	**2,151**	**351,126**	**17,556,300**

4.3.3.10 *Risk Evaluation*

The National Working Group inspected five vessels berthed at terminals in Viet Nam by using the risk register. Three were oil tanker barges and two were seagoing gas carriers. From the three tanker barges, one typical risk register was prepared to represent the inland tanker barges.

The critical result of the analysis is shown by the last column of all tables below representing the priority for intervention or improvement for each activity/operation onboard the vessel.

Low Standard Tanker Barge means a tanker where no or insufficient control is executed by the authorities, the receiving or delivering terminal and the vessel owner. The evaluation in terms of priority is given in the following table.

Table 39: **Priority Areas for Low-Standard Tanker Barges**

VIET NAM TANKER – LOW STANDARD		
No.	**Hazard**	**Priority Area**
2402	Slop tank on deck is rusted/bad state	4
3401	Open light on deck and in pump room	
3501	Walkie-talkie, mobile phone, torches and other equipment are not explosion proof	
4501	Confined spaces have not been identified onboard (crew is unaware of the existence of confined or enclosed spaces)	
4502	Entering enclosed spaces: lack of oxygen or (toxic) vapours present	
6101	No checklist completed prior to hot works	
6102	Welding (sparks)	
7702	Wrong communication between crossing vessels because of different language use	
8110	No procedures on entering enclosed spaces	
8111	No procedures on hot works	
8112	No procedures on emergency situations	
8113	No procedures on fire/explosion	
8305	No training on Emergency Procedures	
8306	No training on accident prevention	
8307	No training on marine pollution prevention	
8308	No training on environmental protection	
8309	No training on vessel waste management	
8501	No solid waste management (garbage, maintenance residues)	
8502	No liquid waste management (bilge water, wash water, sewage & liquid residues containing oil or chemicals)	
8601	No emergency response plans available	
8801	No management concerning dangerous goods	
91202	Entering enclosed spaces, tank cleaning: breathing apparatus not available	
1401	Cargo pump in pump room: limited inspections and limited maintenance	3
1402	Cargo pump in pump room is leaking	
1501	Structural damage to cargo pipes in pump room: rust spots, steel thickness affected (corroded)	
1502	Structural damage to cargo pipes on deck: rust spots, steel thickness affected (corroded)	
1503	Cargo hose used for loading or discharging is ruptured	
1504	Irregular pressure in cargo pipes during loading or discharging (pressure in pipes going fast up and down)	
1505	Maximum Allowable Working Pressure exceeded (MAWP)	
1508	Tank cover gasket missing, tank openings not properly sealed	
1509	Safety devices not working (e.g. Emergency Shut Down system not working, pressure relief valves not working…)	
2101	Single hull: hazards in case of grounding, contact or collision	
2401	Lack of slop tank (tank on deck used to collect the residues of the cargo remaining in the cargo tanks after discharging)	

Table 39: **Priority Areas for Low-Standard Tanker Barges (continued)**

No.	Hazard	Priority Area
2501	No sewage treatment plant (plant + storage tank)	3
2502	No sewage disposal procedures	
2601	Lack of spill belt/ plate/ gutter bar	
2701	Lack of drip tray	
2702	Drip tray rusted or bad state	
2901	No radar available during bad visibility, heavy rain or showers	
2905	No GPS available	
3104	High voltage cables have no or insufficient insulation	
3202	Electrical cables have no or insufficient insulation	
4906	Density of traffic	
4907	Lack of navigation aids: buoys, leading lights	
4908	Lack of reporting system, Vessel Traffic Services (VTS)	
5102	No dangerous goods stowage plan	
5103	No MSDS available	
5401	Waste reception facilities for bilge content (mixture of oil-fuel-water) are not available	
5402	Disposal of bilge content to reception facility is to expensive	
5403	No adequate authority control on bilge content removal (oil record book)	
5501	Waste reception facilities for slop tank content: cargo residue or mixture of different cargo residues are not available	
5502	Disposal of slop tank content to reception facility is to expensive	
5503	No adequate authority control on slop tank content removal (cargo record book)	
5602	Tank cleaning: no checklist available	
6201	No open light, naked light, no smoking requirements	
6301	No explosion proof equipment	
7201	Insufficient skill, training	
7501	Education: crewmember does not understand/ knows the hazards of the process, little knowledge of DG, little knowledge on critical procedures undertaken onboard	
7601	Insufficient information/communication regarding the DG onboard, and important activities onboard	
8103	No procedures on cargo transfer operations	
8104	No procedures on spillcontainment	
8108	No procedures on deck watch keeping during cargo operations	
8109	Bridge: sailing, no procedures on watch keeping	
8115	No procedures on grounding	
8201	No management on safety measures	
8204	No management concerning firefightingequipment	
8302	No training on firefightingequipment	
8304	No traning on DG	
8404	No checklist regarding watch keeping	
8406	No checklist regarding safety items	
8408	No checklist regarding navigation tools	

Table 39: **Priority Areas for Low-Standard Tanker Barges (continued)**

No.	Hazard	Priority Area
81002	No refresher courses for crewmembers in DG and shipboard operations	3
81101	Drills: fire drills are not conducted onboard	
81601	No company policy or bad management	
81701	No company control or bad management	
9104	Fire hydrants blocked	
9106	Firefighting equipment: breathing apparatus not available	
9201	Firefighting pump: poor maintenance	
9203	Firefighting pump is not regularly tested	
91201	PPE: safety glasses, goggles, face shield not available	
91208	PPE: working at night on the vessel, reflective clothing is not available	
1302	Generator failure: black out	2
1403	Cargo pump on deck: limited inspections and limited maintenance	
1404	Cargo pump on deck is leaking	
1405	No regular checks for normal "wear and tear" of cargo pump (e.g. cavitation)	
1506	Loading/ discharging: pressure gauge not working	
1507	During loading or discharging: lines not in use, flanges not fully bolted or not properly blinded (closed with blind flange)	
1510	During loading or discharging: safety systems manually by-passed	
1511	During loading or discharging: piping not grounded	
1514	Material used for the vessel's construction (cargo pipes, tanks) is not corrosion resistant (will affect steel thickness in the future)	
1601	During cargo operation: valve blocked	
1602	During cargo operation: valve fails to operate	
1603	During cargo operation: valve is leaking	
1606	Vessel's design: valve used is not fire rated	
1608	Indicator light on cargo control panel are not working	
1609	Valve is added to the original system design	
1701	Tank measurement instruments are not working	
1801	Tank capacity alarm or high level alarm is out of order	
2201	Cargo and ballast tanks are rusted (insufficient steel thickness)	
2301	Tank structure: bad welding seams, welding corroded	
2801	Vessel's design: no bulwark or fence	
2902	Navigation: no VHF available	
2904	Navigation: no navigation charts available	
2906	No fog horn available in bad visibility	
3101	High voltage: lack of warnings or signs	
3102	High voltage: easy accessible	
3103	High voltage: unprotected installation (open installation, not protected by fireproof box)	
3201	Mechanical damage to cables	
3301	Electrical equipment not earthed (deck lights, pumps)	
4801	No or insufficient maintenance of equipment	

Table 39: **Priority Areas for Low-Standard Tanker Barges (continued)**

No.	Hazard	Priority Area
41001	Weather: storm	2
41003	Weather and cargo operations: lightning	
41007	Night navigation in dangerous stretches (rocks, rapids)	
5101	Hazard depending on kind of DG onboard (see MSDS: flammable, toxic, corrosive, infectious)	
5106	Transport documents not supplied, or incomplete, no necessary information on shipped DG	
5602	Tank cleaning: MSDS is not available for discharged cargo	
7101	Extended working hours, insufficient rest	
7401	New operating staff not properly trained	
7402	Crewmember does not perform a required action	
7403	Crewmember performs a wrong action	
7404	Crewmember performs an action at the wrong place	
7405	Crewmember performs actions in the wrong sequence	
7406	Crewmember performs an action at the wrong time	
7407	Crewmember not under supervision	
7701	Communication: lack of communication, no appropriate means of communication (no VHF, no walkie-talkie)	
8102	No Safe Working Procedures on loading/discharging	
8105	No Safe Working Procedures on bunkering operations	
8106	No Safe Working Procedures on tank cleaning	
8107	No Safe Working Procedures on cargo handling	
8116	No Safe Working Procedures on collision or contact	
8202	Safety Measures: no management concerning protective equipment	
8203	Safety Measures: no management concerning lifesaving equipment	
8205	Safety Measures: no safety committee	
8301	No training on first aid	
8303	No training on lifesaving equipment	
8401	No checklist regarding loading or discharging	
8402	No checklist regarding cargo transfer	
8403	No checklist regarding bunkering	
8405	No checklist regarding maintenance	
8407	No checklist regarding survival equipment	
8701	No drug & alcohol policy	
8902	Safe Manning: certification is not provided to prove courses followed and examination result acceptable	
8903	Safe Manning: no medical check up performed and certified to prove fitness of crewmember	
81001	No courses for crewmembers in DG and shipboard operations	
81102	No abandon ship drill	
81201	No muster list	
81301	Inspection of vessel's condition: class inspection, not existing; not carried out at regular interval	
81401	Authority regulation making: no regulation	

Table 39: **Priority Areas for Low-Standard Tanker Barges (continued)**

No.	Hazard	Priority Area
81501	Authority regulation control: no control	2
9101	Firefighting: fire extinguishers absent, no regular check (every 2 years), out of order	
9102	Firefighting: fire hoses are missing or in bad state	
9103	Firefighting: fire monitors are missing or in bad state	
9105	Firefighting: fire axe is missing	
9301	Fire detection: fire and smoke detection alarm is absent or not working	
9401	Firefighting control: fire control plan is not available	
9901	Life jacket: absent or poor condition	
91001	Gas detection: absent or not working or not calibrated	
91101	Oxygen level measurement: absent or not working or not callibrated	
91206	PPE, fall protection: harness, life lines, life jacket not available	
91207	PPE, helmet: not available	

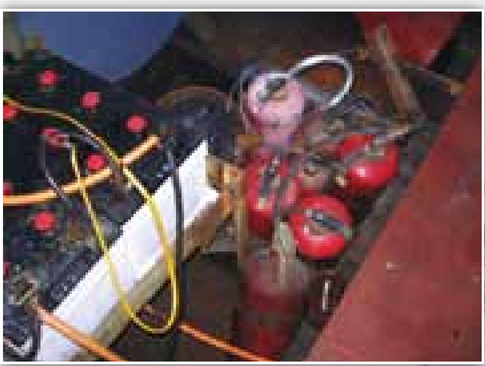


Figure 93: **Fire Extinguishers on Low-Standard Tanker Barge**

Figure 94: **Deck Arrangement on Low-Standard Tanker Barge**

Figure 95: **Absence of Fence and Spill Belt on Low-Standard Tanker Barge**

Figure 96: **Lifebuoys on Low-Standard Tanker Barge**

A High-Standard Tanker Barge means a tanker that is allowed only to load or discharge at a certain terminal when certain requirements defined by the terminal are fulfilled and regularly checked by external audits, on a yearly basis, for example. A detailed checklist, made up by the terminal, is used to determine whether the tanker barge is allowed to operate with the "high-standard" terminal or not. A lot of items in the risk register can be found in the checklist.

The following table gives the priority areas of the High Standard Tanker Barge:

Table 40: **Priority Areas High-Standard Tanker Barge**

VIET NAM TANKER – HIGH STANDARD		
No.	**Hazard**	**Priority Area**
1701	Tank measurement instruments are not working	4
1801	Tank capacity alarm or high level alarm is out of order	
2502	No sewage disposal procedures	
8104	No procedures on spill containment	
8306	No training on accident prevention	
8307	No training on marine pollution prevention	
8308	No training on environmental protection	
8309	No training on vessel waste management	
8403	No checklist regarding bunkering	
8501	No solid waste management (garbage, maintenance residues)	
81001	No courses for crewmembers in DG and shipboard operations	
91001	Gas detection: absent or not working or not calibrated	
91101	Oxygen level measurement: absent or not working or not callibrated	
1511	During loading or discharging: piping not grounded	3
2101	Single hull: hazards in case of grounding, contact or collision	
2501	No sewage treatment plant (plant + storage tank)	
3104	High voltage cables have no or insufficient insulation	
4906	Density of traffic	
4907	Lack of navigation aids: buoys, leading lights	
41001	Weather: storm	
5101	Hazard depending on kind of DG onboard (see MSDS: flammable, toxic, corrosive, infectious)	
5403	No adequate authority control on bilge content removal (oil record book)	
5502	Disposal of slop tank content to reception facility is to expensive	
5503	No adequate authority control on slop tank content removal (cargo record book)	
6101	No checklist completed prior to hot works	
7403	Crewmember performs a wrong action	
7501	Education: crewmember does not understand/ knows the hazards of the process, little knowledge of DG, little knowledge on critical procedures undertaken onboard	

Table 40: **Priority Areas High-Standard Tanker Barge (continued)**

No.	Hazard	Priority Area
7601	Insufficient information/communication regarding the DG onboard, and important activities onboard	3
7702	Wrong communication between crossing vessels because of different language use	
8105	No Safe Working Procedures on bunkering operations	
8111	No procedures on hot works	
8112	No procedures on emergency situations	
8205	Safety Measures: no safety committee	
8304	No training on DG	
8305	No training on Emergency Procedures	
8404	No checklist regarding watch keeping	
8408	No checklist regarding navigation tools	
8502	No liquid waste management (bilge water, wash water, sewage & liquid residues containing oil or chemicals)	
8902	Safe Manning: certification is not provided to prove courses followed and examination result acceptable	
81002	No refresher courses for crewmembers in DG and shipboard operations	
81301	Inspection of vessel's condition: class inspection, not existing; not carried out at regular interval	
81401	Authority regulation making: no regulation	
81501	Authority regulation control: no control	
91202	Entering enclosed spaces, tank cleaning: breathing apparatus not available	
1302	Generator failure: black out	2
1404	Cargo pump on deck is leaking	
1501	Structural damage to cargo pipes in pump room: rust spots, steel thickness affected (corroded)	
1503	Cargo hose used for loading or discharging is ruptured	
1504	Irregular pressure in cargo pipes during loading or discharging (pressure in pipes going fast up and down)	
1505	Maximum Allowable Working Pressure exceeded (MAWP)	
1506	Loading/ discharging: pressure gauge not working	
1507	During loading or discharging: lines not in use, flanges not fully bolted or not properly blinded (closed with blind flange)	
1509	Safety devices not working (e.g. Emergency Shut Down system not working, pressure relief valves not working...)	
1512	Piping welds insufficient	
1513	Pipelines not properly supported	
1516	Vessel is constructed with vent lines without flame arrestors	
1601	During cargo operation: valve blocked	
1608	Indicator lights on cargo control panel are not working	
1609	Valve is added to the original system design	

Table 40: **Priority Areas High-Standard Tanker Barge (continued)**

No.	Hazard	Priority Area
2401	Lack of slop tank (tank on deck used to collect the residues of the cargo remaining in the cargotanks after discharging)	2
2402	Slop tank on deck is rusted/bad state	
3101	High voltage: lack of warnings or signs	
3102	High voltage: easily accessible	
3103	High voltage: unprotected installation (open installation, not protected by fireproof box)	
3201	Mechanical damage to cables	
3401	Open light on deck and in pump room	
4908	Lack of reporting system, Vessel Traffic Services (VTS)	
41003	Weather and cargo operations: lightning	
41007	Night navigation in dangerous stretches (rocks, rapids)	
5103	No MSDS available	
5106	Transport documents not supplied, or incomplete, no necessary information on shipped DG	
5401	Waste reception facilities for bilge content (mixture of oil-fuel-water) are not available	
5402	Disposal of bilge content to reception facility is too expensive	
5501	Waste reception facilities for slop tank content: cargo residue or mixture of different cargo residues are not available	
5601	Tank cleaning: MSDS is not available for discharged cargo	
5602	Tank cleaning: no checklist available for discharged cargo	
6102	Welding (sparks)	
6301	No explosion proof equipment	
7201	Insufficient skill, training	
7401	New operating staff not properly trained	
7402	Crewmember does not perform a required action	
7404	Crewmember performs an action at the wrong place	
7405	Crewmember performs actions in the wrong sequence	
7406	Crewmember performs an action at the wrong time	
7407	Crewmember not under supervision	
7701	Lack of communication, no appropriate means of communication (no VHF, no walkie-talkie)	
8102	No Safe Working Procedures on loading/discharging	
8103	No procedures on cargo transfer operations	
8106	No Safe Working Procedures on tank cleaning	
8107	No Safe Working Procedures on cargo handling	
8108	No procedures on deck watch keeping during cargo operations	
8109	Bridge: sailing, no procedures on watch keeping	
8110	No procedures on entering enclosed spaces	
8113	No procedures on fire/explosion	
8115	No procedures on grounding	

Table 40: **Priority Areas High-Standard Tanker Barge (continued)**

No.	Hazard	Priority Area
8116	No Safe Working Procedures on collision or contact	2
8202	Safety Measures: no management concerning protective equipment	
8203	Safety Measures: no management concerning lifesaving equipment	
8303	No training on first aid	
8401	No checklist regarding loading or discharging	
8402	No checklist regarding cargo transfer	
8406	No checklist regarding safety items	
8407	No checklist regarding maintenance	
8601	No emergency response plans available	
8801	No management concerning dangerous goods	
8903	Safe Manning: no medical check up performed and certified to prove fitness of crewmember	
81101	Drills: fire drills are not conducted onboard	
81601	No company policy or bad management	
81701	No company control or bad management	
91201	PPE: safety glasses, goggles, face shield not available	

4.3.4 Thailand

4.3.4.1 Legislation and Authority Control

The national legislation applied in respect to the transport of dangerous cargoes by inland waterway barges is the *Ship Survey Regulation No. 19* (B.E. 2534) and the *Thai Vessel Act (*B.E. 2481).

Standards applicable for inland waterway vessels carrying dangerous goods regarding construction, lifesaving and firefighting equipment is regulated by the *Ship Survey Regulation No. 19* (B.E. 2534).

Preparation of national legislation on the carriage of dangerous cargoes onboard barges is executed by branches of the Marine Department. Barges are inspected at least once every year by the Ship Surveyor of the Marine Office and the Ship Standard Bureau. Concerning safety matters, special inspections are carried out on a frequency of 600/year. Authority is delegated by the Marine Department to the Royal Thai Navy and the Marine Police to undertake inspections onboard barges. Implementation of and ensuring compliance with rules, regulations, standards and laws is ensured by the Marine Department.

4.3.4.2 Dangerous Goods Specifications

The different kind of dangerous goods transported by inland waterway barges on the Mekong River are petroleum products, gasoline, diesel and asphalt. The cargo is traded for consumption in Thailand and Lao PDR.

Different ferry crossings between Lao PDR and Thailand carry trucks loaded with a variety of dangerous goods such as fuel and chemicals used for mining purposes. Gold exploration executed by private miners use dangerous and polluting chemicals that mean a real threat for the environment (mercury and sodium cyanide are both used for extracting gold in gold mining, and are both highly toxic substances and therefore environmentally sensitive).

4.3.4.3 Main Traffic Lines

Chiang Saen-Tonpuang, Chiangkong-Huay Xay, Palchum-Bolikunsai, Bungkarn-Bolikunsai, Nakon Phanom-Kummun, Mukdahan-Savannaket. Ports: Chiang Saen and Chiang Khong.

Ferry crossings between Thailand and Lao PDR along are situated at the following locations: Chiang Khong, Bungkham, and Mukdahan.

4.3.4.4 Barge Specification

The number of barges registered in Thailand for the Mekong River is very limited, only 9 barges have to be considered. Thailand does make significant use of the Mekong river and its associated waterways for domestic transport or passenger services. Attention should be paid to the state of the numerous local ferries and the different ferry sites (see Chapter 3, Ports and Terminals).

4.3.4.5 Risk Analysis

Apart from ferry crossings, inland waterway traffic level is low in Thailand and Lao PDR, especially of barges under the Lao or Thai flags. However, there is an increasing number of Chinese-flagged barges active in the region, increasing traffic with China and Myanmar.

Of the vessels operating at Chiang Saen Port and Keawalee Terminal, 70 percent are Chinese-flagged, 20 percent are Myanmar-flagged and 10 percent are Lao-flagged vessels. The National Working Group from Thailand strongly believes that there should be a regulation that allows the Marine Safety Administration to inspect the condition of other flag vessels as well the safety of operations. Currently there is only limited authority and regulations to enforce any rules related to safety and environmental protection in the Upper Mekong. As China has requested to import 150,000,000 litres of diesel via the new port of Chiang Saen in the future, traffic may grow rapidly and efficient control is necessary.

In this context, the National Working Group of Thailand assessed a Chinese tanker barge and priority areas can be found in the following table:

Table 41: **Priority Areas for Chinese Tanker Barge**

CHINA - TANKER		
No.	**Hazard**	**Priority Area**
2801	Vessel's design: no bulwark or fence	4
4908	Lack of reporting system, Vessel Traffic Services (VTS)	
5101	Hazard depending on kind of DG onboard (see MSDS: flammable, toxic, corrosive, infectious)	
5102	No dangerous goods stowage plan	
5103	No MSDS available	
5401	Waste reception facilities for bilge content (mixture of oil-fuel-water) are not available	
5402	Disposal of bilge content to reception facility is to expensive	
5403	No adequate authority control on bilge content removal (oil record book)	
6101	No checklist completed prior to hot works	

Table 41: **Priority Areas for Chinese Tanker Barge (continued)**

No.	Hazard	Priority Area
8110	No procedures on entering enclosed spaces	4
8202	Safety Measures: no management concerning protective equipment	
8203	Safety Measures: no management concerning lifesaving equipment	
8204	No management concerning firefighting equipment	
8304	No training on DG	
8403	No checklist regarding bunkering	
8501	No solid waste management (garbage, maintenance residues)	
8502	No liquid waste management (bilge water, wash water, sewage & liquid residues containing oil or chemicals)	
8601	No emergency response plans available	
8801	No management concerning dangerous goods	
9301	Fire detection: fire and smoke detection alarm is absent or not working	
2901	No radar available during bad visibility, heavy rain or showers	3
2902	Navigation: no VHF available	
2903	Navigation: no echo-sounder, shallow water	
2904	Navigation: no navigation charts available	
2906	No fog horn available in bad visibility	
4501	Confined spaces have not been identified onboard (crew is unaware of the existence of confined or enclosed spaces)	
4502	Entering enclosed spaces: lack of oxygen or (toxic) vapours present	
4907	Lack of navigation aids: buoys, leading lights	
41005	Fog/ bad visibility	
41007	Night navigation in dangerous stretches (rocks, rapids)	
5106	Transport documents not supplied, or incomplete, no necessary information on shipped DG	
6102	Welding (sparks)	
7201	Insufficient skill, training	
7501	Education: crewmember does not understand/ knows the hazards of the process, little knowledge of DG, little knowledge on critical procedures undertaken onboard	
7601	Insufficient information/communication regarding the DG onboard, and important activities onboard	
7701	Communication: lack of communication, no appropriate means of communication (no VHF, no walkie-talkie)	
7702	Wrong communication between crossing vessels because of different language use	
8105	No Safe Working Procedures on bunkering operations	
8112	No procedures on emergency situations	
8113	No procedures on fire/explosion	
8114	No procedures on abandon ship emergency situation	
8115	No procedures on grounding	
8116	No procedures on collision, contact	
8201	No management on safety measures	
8205	Safety Measures: no safety committee	
8305	No training on Emergency Procedures	
8408	No checklist regarding navigation tools	

Table 41: **Priority Areas for Chinese Tanker Barge (continued)**

No.	Hazard	Priority Area
81002	No refresher courses for crewmembers in DG and shipboard operations	3
81101	Drills: fire drills are not conducted onboard	
81102	No abandon ship drill	
9106	Firefighting equipment: breathing apparatus not available	
9701	Life saving equipment: rescue vessel is absent or in poor condition	
91202	Entering enclosed spaces, tank cleaning: breathing apparatus not available	
1102	Main engine used on maximum power for long period, insufficient cooling, insufficient inspection, bad quality fuel used	2
1103	Main engine: engine breakdown	
1201	Steering gear: poor maintenance steering pump	
1202	Steering gear: chain break	
2905	No GPS available	
4601	Slippery surfaces: greasy surface in engine room/ on deck	
4801	No or insufficient maintenance of equipment	
4802	Low standard of equipment used for dedicated jobs	
4803	Maintenance performed with the wrong materials or parts	
4901	Hazards related to navigation: strong current	
4902	Hazards related to navigation: shallow water	
4903	Hazards related to navigation: rapids	
4905	Hazards related to navigation: limited local knowledge	
4906	Density of traffic	
41001	Weather: storm	
41002	Weather: heavy rain falls	
41004	Weather: high winds	
41006	Weather: over flooding	
5201	DG: substances used for the overall maintenance (paint, oil, grease, cleaning products)	
5301	DG: oil grades (fuel oil, diesel oil, hydraulic oil, lubricating oil) used for main engine, steering gear, generator, pumps	
7101	Extended working hours, insufficient rest	
7301	Exposure to environmental conditions: high temperature, high humidity	
7401	New operating staff not properly trained	
7402	Crewmember does not perform a required action	
7403	Crewmember performs a wrong action	
7404	Crewmember performs an action at the wrong place	
7405	Crewmember performs actions in the wrong sequence	
7406	Crewmember performs an action at the wrong time	
7407	Crewmember not under supervision	
8102	No Safe Working Procedures on loading/discharging	
8107	No Safe Working Procedures on cargo handling	
8109	Bridge: sailing, no procedures on watch keeping	
8111	No Safe Working Procedures on hot works	
8301	No training on first aid	

Table 41: **Priority Areas for Chinese Tanker Barge (continued)**

No.	Hazard	Priority Area
8302	No training on firefighting equipment	2
8303	No training on lifesaving equipment	
8306	No training on accident prevention	
8307	No training on marine pollution prevention	
8308	No training on environmental protection	
8401	No checklist regarding loading or discharging	
8406	No checklist regarding safety items	
8701	No drug & alcohol policy	
8901	Safe manning levels are not maintained	
8902	Safe manning: certification is not provided to prove courses followed and examination result acceptable	
8903	No medical check up performed and certified to prove fitness of crewmember	
81001	No courses for crewmembers in DG and shipboard operations	
81201	No muster list	
81301	Inspection of vessel's condition: class inspection, not existing; not carried out at regular interval	
81401	Authority regulation making: no regulation	
81501	Authority regulation control: no control	
81601	No company policy or bad management	
81701	No company control or bad management	
9101	Fire fighting: fire extinguishers absent, no regular check (every 2 years), out of order	
9102	Firefighting: fire hoses are missing or in bad state	
9104	Fire hydrants blocked	
9105	Firefighting: fire axe is missing	
9108	Firefighting: helmet not available	
9109	Firefighting: sand not available	
9201	Firefighting pump: poor maintenance	
9203	Firefighting pump is not regularly tested	
9401	Firefighting control: fire control plan is not available	
9501	Lifeboats: absent or in poor condition	
9801	Life buoys: absent or in poor condition	
9901	Life jackets: absent or in poor condition	
91201	PPE: safety glasses, goggles, face shield not available	
91204	PPE: appropriate gloves not available	
91205	PPE: steel capped safety boots not available	
91206	PPE: harness, life lines not available	
91207	PPE: helmet not available	

4.3.4.6 Ferry Crossings

The Thai National Working Group visited and inspected three major ferry sites and ports at Bungkhan, Chiang Khong and Nakhon Phanom port. The Lao National Working Group visited and inspected the ferry terminals at Nakasan (passenger port), Pakxanh, Ban Tuay port, Huay Xay, Choum Khong port and Chiang Keo port.

The ferry terminals are situated close to residential areas, and involve a lot of traffic from trucks, some of which are loaded with dangerous cargoes. On most ferry sites no or insufficient parking places are available.

The ferry terminals are freely accessible and gates are not suitable for restricting members of the public who have no business being on the site.

A designated storage area for stowage of dangerous goods and inventories of dangerous goods present at the terminals were not available.

Solid and liquid waste reception from ferries (such as bilges) and other participants of the ferry site is poor or not existent, and waste is disposed into the river.

The terminals do not provide access to emergency services in case of casualties from fires, explosions, or ferry accidents. Emergency response and evacuation plans are not in place.

Operators of the terminal are unaware of the cargo of trucks, and are not educated in dealing with dangerous goods.

No adequate firefighting equipment, lifesaving equipment, personnel protective equipment, or oil spill equipment is available on the terminals .

Communication between operators on the right and the left bank terminals and between shore and ferry is done by mobile phone, as no VHF is available, restricting clear and fast communication and understanding.

Safety management, safe working procedures, regular ferry inspections, authority regulations or control, custom procedures, regular training of personnel, checklists (loading/discharging ferry, truck inspection, ferry bunkering, maintenance, safe navigation and safe ferry operation) is poor or not existent

4.3.5 Lao PDR

4.3.5.1 Legislation and Authority Control

The Ministry of Public Works and Transport (MPWT) is currently responsible for overseeing all transport and public works in Lao PDR. A Waterways Department has been established and is responsible for inland waterway transport. It prepares national legislation on the carriage of dangerous cargoes onboard inland waterway barges. Registering of barges, yearly inspections, implementation and ensuring compliance with rules and regulations is also the responsibility of the Department of Waterways.

The following regulations, guidelines, technical standards and notifications currently apply to inland waterborne transport in Lao PDR:

- *Guideline on River Traffic Regulation No. 219/MCTPC,* 19 April 2000;
- *Guideline on River Transport Regulation No. 104/MCTPC,* 12 January 2000;
- *Guideline on Request for Ship Building Permission No. 1442/MCTPC,* 26 January 1996;
- *Notification for Operating of Passenger Speed Boat No. 1663/MCTPC*, 1 June 1997;
- *Standard of Technical Inspection for Ship and Ferry. No. 0030/Transport Section,* 8 January 1996;
- *Regulation on transport business establishment, forwarders and maintenance services*

owned by state, group of people, state-private, private and individual. No. 1423/CTPC, 22 June 1996; and

- *Regulation on Truck and Transport Boat Association. No. 1414/CTPC,* 22 July 1996.

Currently there are no special requirements for the carriage of dangerous goods, the discharge of bilges, sewage, cargo residues or solid waste.

4.3.5.2 Dangerous Goods Specifications

Petroleum products, gasoline and diesel, together with toxic chemicals (for gold mining purposes) such as mercury and sodium cyanide are the principal dangerous goods transported by barges or in trucks on ferries when crossing the Mekong River. Other commodities transported are logs, cement, rice, concrete pipes, construction materials, timber and agricultural products. Fertilisers, pesticides and herbicides are reported as being illegally transported on the Mekong River in small boats from Thailand to Lao PDR.

4.3.5.3 Main Traffic Lines

Vientiane to Paklay, Luang Prabang to Bokeo, and Vientiane to Savannakhet. Ferry services are provided between:

- Pakxanh Port (Km 1,397), Lao PDR and Bungkhan, Thailand: 4 ferries for trucks mainly loaded with agricultural products, construction materials, fertiliser, cement, petroleum products, LPG, asphalt and 17 small ferries for max 30 passengers;
- Nakasan Port (Km 727), Lao PDR and Siphandone area: about 108 small passenger ferries, carrying between 5 and 50 passengers, mostly tourists;
- Choum Khong Port (Km 2007), Lao PDR and Chiang Man Port and Chiang Keo Port, Thailand: 21 high-speed craft, 145 small passenger ferries;
- Huay Xay port (Km 2,315), Lao PDR and Chiang Khong Port, Thailand: 9 ferries (4 under Thailand flag) for trucks loaded with petroleum products, cement, agricultural products, construction material and a number of ferries for passengers;
- Ban Tuay port (Km 1,467), Lao PDR and Bungkhan port, Thailand: not in service yet, 2 ferries intended for mining-related and container transport; and
- Nakhon Phanom port, Thailand and Thakhek Port, Lao PDR.

Figure 97: **Ferry crossing between Lao PDR and Thailand**

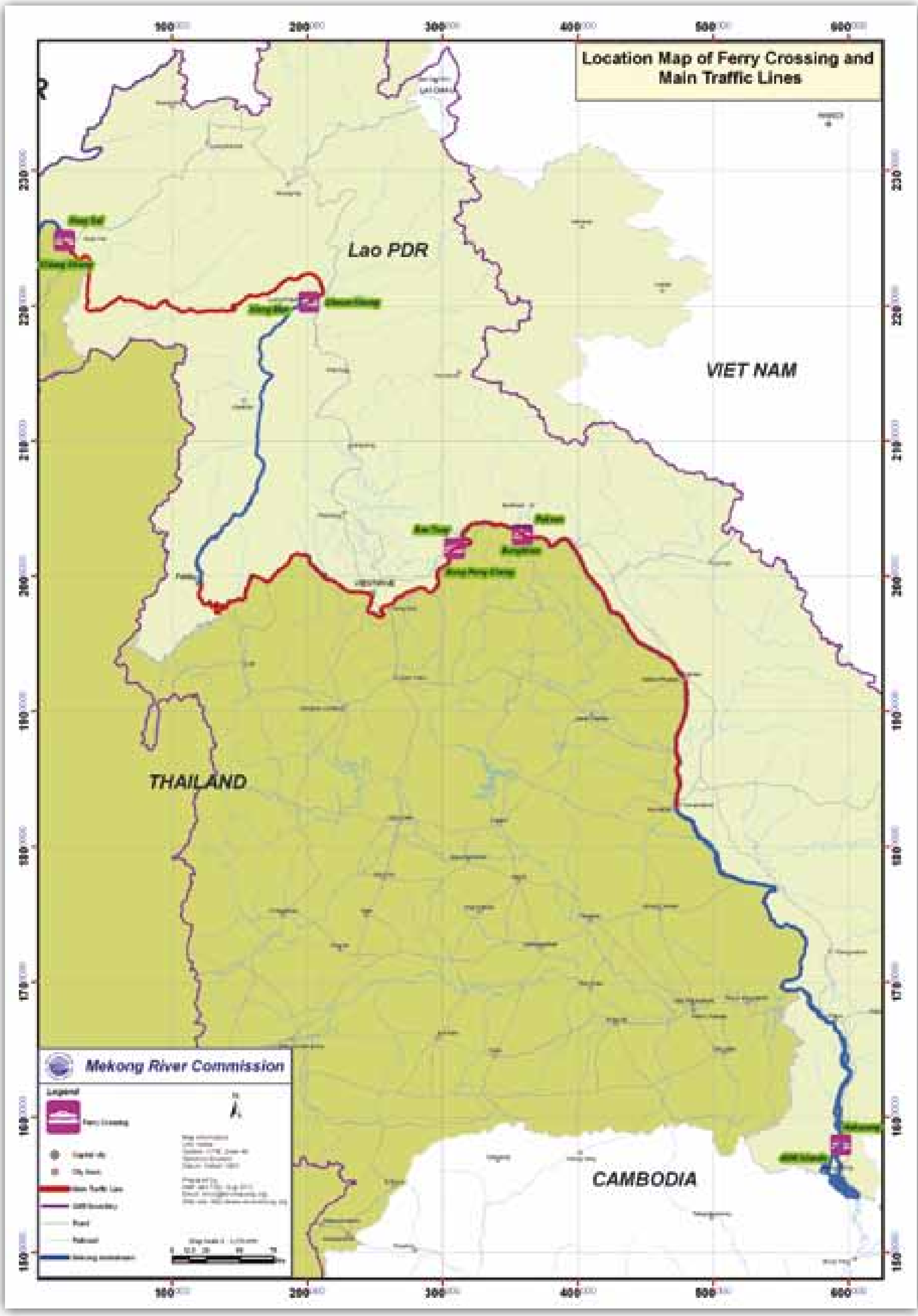


Figure 98: **Main Traffic Lines in Lao PDR and Thailand**

Table 42: **Priority Areas for Lao Cargo Vessels**

LAO CARGO VESSELS		
No.	**Hazard**	**Priority Area**
2801	Vessel's design: no bulwark or fence	4
4903	Hazards related to navigation: rapids	
4907	Lack of navigation aids: buoys, leading lights	
4908	Lack of reporting system, Vessel Traffic Services (VTS)	
5101	Hazard depending on kind of DG onboard (see MSDS: flammable, toxic, corrosive, infectious)	
5102	No dangerous goods stowage plan	
5103	No MSDS available	
5104	Packaged DG not properly labelled	
5105	Dangerous goods in CTU (Cargo Transport Unit - container): stuffing of CTU not according legal requirements	
5401	Waste reception facilities for bilge content (mixture of oil-fuel-water) are not available	
5402	Disposal of bilge content to reception facility is to expensive	
5403	No adequate authority control on bilge content removal (oil record book)	
6101	No checklist completed prior to hot works	
7201	Insufficient skill, training	
7601	Insufficient information/communication regarding the DG onboard, and important activities onboard	
7701	Communication: lack of communication, no appropriate means of communication (no VHF, no walkie-talkie)	
8102	No Safe Working Procedures on loading/discharging	
8105	No Safe Working Procedures on bunkering operations	
8109	Bridge: sailing, no procedures on watch keeping	
8110	No Safe Working Procedures on entering enclosed spaces	
8111	No Safe Working Procedures on hot works	
8112	No Safe Working Procedures on emergency situations	
8113	No procedures on fire/explosion	
8114	No procedures on abandon ship emergency situation	
8116	No procedures on collision, contact	
8201	No management on safety measures	
8202	Safety Measures: no management concerning protective equipment	
8203	Safety Measures: no management concerning lifesaving equipment	
8204	No management concerning firefighting equipment	
8205	Safety Measures: no safety committee	
8304	No training on DG	
8305	No training on Emergency Procedures	
8403	No checklist regarding bunkering	
8501	No solid waste management (garbage, maintenance residues)	
8502	No liquid waste management (bilge water, wash water, sewage & liquid residues containing oil or chemicals)	
8801	No management concerning dangerous goods	
81001	No courses for crewmembers in DG and shipboard operations	

Table 42: **Priority Areas for Lao Cargo Vessels (continued)**

No.	Hazard	Priority Area
81002	No refresher courses for crewmembers in DG and shipboard operations	4
81101	Drills: fire drills are not conducted onboard	
81102	No abandon ship drill	
9102	Firefighting: fire hoses are missing or in bad state	
9104	Fire hydrants blocked	
9106	Firefighting equipment: breathing apparatus not available	
91202	Entering enclosed spaces, tank cleaning: breathing apparatus not available	
9301	Fire and smoke detection alarm: absent or not working	
9701	Rescue boat: absent or poor condition	
1201	Steering gear: poor maintenance of steering pump	3
1202	Steering gear: chain break	
2902	Navigation: no VHF available	
4301	Cargo stowage: badly stowed cargo, DG are not segregated	
4302	No procedures exists for the handling of packaged DG (damage to package of DG due to improper handling)	
4401	Cargo is not lashed sufficiently	
4501	Confined spaces have not been identified onboard (crew is unaware of the existence of confined or enclosed spaces)	
4502	Entering enclosed spaces: lack of oxygen or (toxic) vapours present	
4901	Hazards related to navigation: strong current	
4902	Hazards related to navigation: shallow water	
4905	Hazards related to navigation: limited local knowledge	
41002	Weather: heavy rain falls	
41004	Weather: high winds	
41005	Weather: fog/ bad visibility	
41007	Weather: night navigation in dangerous river stretches (rocks, rapids)	
5106	DG: transport documents not supplied, or incomplete, no necessary information on shipped DG	
6102	Hot works: welding (sparks)	
7401	New operating staff not properly trained	
7402	Crewmember does not perform a required action	
7403	Crewmember performs a wrong action	
7404	Crewmember performs an action at the wrong place	
7405	Crewmember performs actions in the wrong sequence	
7406	Crewmember performs an action at the wrong time	
7407	Crewmember not under supervision	
7501	Education: crewmember does not understand/ knows the hazards of the process, little knowledge of DG, little knowledge on critical procedures undertaken onboard	
7702	Wrong communication between crossing vessels because of different language use	
8115	No procedures on grounding	
8301	No training on first aid	
8302	No training on firefighting equipment	
8303	No training on lifesaving equipment	

Table 42: **Priority Areas for Lao Cargo Vessels (continued)**

No.	Hazard	Priority Area
8401	No checklist regarding loading or discharging	3
8406	No checklist regarding safety items	
8408	No checklist regarding navigation tools	
8701	No drug & alcohol policy	
8901	Safe manning levels are not maintained	
8903	No medical check up performed and certified to prove fitness of crewmember	
81201	No muster list	
81301	Inspection of vessel's condition: class inspection, not existing; not carried out at regular interval	
81401	Authority regulation making: no regulation	
81601	No company policy or bad management	
81701	No company control or bad management	
9101	Firefighting: fire extinguishers absent, no regular check (every 2 years), out of order	
9201	Firefighting pump: poor maintenance	
9203	Firefighting pump is not regularly tested	
9401	Firefighting control: fire control plan is not available	
9501	Lifeboats: absent or in poor condition	
9801	Life buoys: absent or in poor condition	
9901	Life jackets: absent or in poor condition	
91204	PPE: appropriate gloves not available	
91205	PPE: steel capped safety boots not available	
91206	PPE: harness, life lines not available	
91207	PPE: helmet not available	
1102	Main engine used on maximum power for long period, insufficient cooling, insufficient inspection, bad quality fuel used	2
1103	Main engine: engine breakdown	
2901	No radar available during bad visibility, heavy rain or showers	
2905	No GPS available	
2906	No fog horn available for bad visibility	
4601	Slippery surfaces: greasy surface in engine room/ on deck	
4801	No or insufficient maintenance of equipment	
4802	Low standard of equipment used for dedicated jobs	
4803	Maintenance performed with the wrong materials or parts	
41001	Weather: storm	
5201	DG: substances used for the overall maintenance (paint, oil, grease, cleaning products)	
5301	DG: oil grades (fuel oil, diesel oil, hydraulic oil, lubricating oil) used for main engine, steering gear, generator, pumps	
7101	Extended working hours, insufficient rest	
7301	Exposure to environmental conditions: high temperature, high humidity	
8107	No Safe Working Procedures on cargo handling	
8902	Safe Manning: certification is not provided to prove courses followed and examination result acceptable	
81501	Authority regulation control: no control	

4.4 INTERMEDIATE NATIONAL AND REGIONAL CONCLUSIONS

4.4.1 Introduction

Inland waterborne transport remains by far the most environmentally-friendly mode of transportation. An average-sized barge is consuming about 15 to 25 percent of the fuel consumed by a truck per tonne-kilometre. With only 5 litres of fuel, an inland barge can transport one tonne of cargo over a full 500 km. With the same amount of fuel, a train would come to a halt after 333 km, a truck after barely 100 km and a plane would crash after only 6.6 km of flight.[49]

It is also a relatively safe mode of transportation. The number of casualties involved in accidents onboard of vessels is far less than road accidents where many drivers and passengers lose their lives. Despite all the potential of being the most safe and cleanest way to carry cargo, transport of dangerous cargo by barge on the Mekong River is still a very risky and environmentally-unsafe business. The potential for fire, explosion and pollution events onboard a petroleum tanker or cargo vessel is increasing unless stricter controls are implemented and the safety of the waterways is improved.

The IMO estimates that more than half of packaged goods and bulk cargoes transported by sea today can be regarded as dangerous, hazardous or harmful to the environment. (*IMO and Dangerous Goods at Sea - the Transport by Sea of Dangerous and Harmful Goods Including Marine Pollutants and Waste. www.imo.org*). A great deal of these substances, materials and articles are also dangerous or hazardous from a human safety point of view.

The release of packaged or containerised dangerous goods during transport can have serious consequences onboard a vessel. Records of dangerous goods releases from a US and a UK database for an 11-year period covering 1998–2008 were analysed to identify and categorize main contributing factors. The majority of releases, estimated as 97 percent of the events in the US and 94 percent of events in the UK, were not even caused by accidents, such as collisions. Preparation of goods for transport, packaging, stuffing containers, and loading vessels were the main factors contributing to the release of dangerous goods onboard the vessel. For container vessel casualties that occurred during the same period, 1998–2008, accidents involving packaged dangerous goods were estimated to account for 15 percent of all fatalities. The main causes were self-ignition or ignition of incorrectly-declared dangerous goods.

These were only a few references to causes of accidents involving dangerous cargo. Another important cause is fire. The risk for fire ranks second in maritime casualties after stranding and grounding according to a survey of total loss accidents in merchant shipping over a period of 25 years. Fire aboard commercial vessels, particularly in the engine room, often leads to total loss of the vessel and/or her cargo, and to loss of life. Fire together with grounding; represent more than 50 percent of all marine casualties. Fire plus explosion adds up to 25 percent of the casualties.[50]

On the Mekong River, the risks are higher for petroleum tankers and there are also risks associated with the carriage of packaged dangerous goods onboard cargo vessels. Often the captain and crewmembers are not aware of the dangerous goods in the containers and how to minimise the risks during transport and handling. The containers are closed and sealed before they arrive at the port, and are not opened until they arrive at their final destination ashore. In regards to petroleum tankers, the management of oil companies is not necessarily fully aware of how their products are being carried or handled. In some cases, they may not care once the cargo is outside of their responsibility. The combination of fire with dangerous goods makes it even more hazardous for the people, environment and property, and will require ample attention in the recommendations following this analysis.

[49] http://www.binnenvaart.be/en/binnenvaartinfo/troeven.asp

[50] Source Marine Accident and Casualty Investigation Boards, 2008

Another very common individual cause of dangerous goods related accidents is human error. An analysis of the European Community's database on transportation of dangerous goods found that almost half of the accidents are caused by a human error, or at least this was a major contributor for the accident, whereas at the same time only some 8 per cent of accidents were caused by a technical failure. Human errors may be caused by a number of different factors such as poor training, carelessness or indifference. The large share of human caused accidents can be seen as a potential improvement, since the human factor may be affected by more efficient education and training, as well as enhancement of the existing safety culture and attitudes towards potential risks in the human behaviour.

As it is generally accepted that the majority of all accidents are linked to the human element, the following defines and presents the percentage of dominant human errors cited in the analysis reviews from various sources (Table 43).

Table 43: **Causes of Dangerous Goods Incidents**

Main category	Examples	% cited in various sources
Management	Insufficient manning, faulty standards regulations, policies, practices	30%
Operator status	Fatigue, inattention, vision, workload	22%
Working environment	Hazardous natural environment poor maintenance, inadequate aids to navigation inadequate information	20%
Knowledge	Inadequate general technical knowledge inadequate knowledge of own vessel handling unawareness of task responsibility	14%
Decision making	Faulty understanding of current situation decision based on inadequate information	14%

Source: U.S. DOT (1995)

These observations are derived from experiences in countries and regions where navigation has already been developed and regulated, and yet accidents still occur frequently, with extensive impacts. Now the Mekong River draws yet another picture. Navigation development has not been even in all Greater Mekong Countries. In the People's Republic of China and Viet Nam, the standards of the fleet and crew on the Mekong River have advanced most of all six countries. Thailand's river fleet on the Chao Praya also responds to better standards but the fleet on the Mekong River is so small that development here is behind. But even with development, the poor status of vessel standards, the lack of training and certification of crew, limited vessel inspection and almost no law enforcement will remain in the short term if nothing is done. Shipping experts agree that the increasing trend in waterborne transport of chemicals and dangerous goods along the Mekong River also gives rise to an increasing number of accidents involving such products. This puts great demands on the personnel who are responsible for actions against such accidents in order to protect people and the environment from damage.

The safety of transporting dangerous goods is most efficiently improved when the general safety on all transport modes is regulated well. The dangerous goods are very seldom the actual cause of an accident. However, the consequences of accidents where dangerous goods are part of the cargo may be significant. The cornerstones of safe transport of dangerous goods are sufficient level of knowledge, and a positive safety culture and attitude. Without these two basic principles, the Mekong River cannot be safeguarded against impacts from shipping.

In this risk assessment, all the risk levels associated with vessel operations and activities involving the transportation of dangerous goods along the Mekong River have been evaluated. To do this, the hazards and potential risks were assigned to the critical operations and activities in nine hazard groups ranging from mechanical, structural, electrical but also human factors and managerial aspects.

After the risks were estimated for all the hazard groups including their sub-groups, the actual risks were evaluated. In this study, the risk evaluation followed a process of comparing the level of risk against specific risk criteria. This allowed priority areas to be determined. These are derived from comparison between the risk criteria, and the level of standards existing or currently being applied in each of the MRC Member Countries. In the end, the highest priority will go to risk control measures that will prevent or reduce the harm of explosions, fire, spillages and pollution which have the most severe possible consequences on people and the environment.

4.4.2 Cambodia

Waterborne transportation on the Mekong River system in Cambodia involves both inland barge traffic and seagoing - called maritime - shipping. The main traffic is dedicated to inland shipping for the domestic market and cross-border trade with Viet Nam. Because of the bilateral navigation agreement, the introduction of foreign barges into each other's territories is set to increase.

4.4.2.1 Legislation and Authority Control

From a legal perspective, most reference is made to maritime shipping. It can be noted that Cambodia has endorsed many of the international conventions (mainly under the IMO) related to the marine environment. There are, however, a few important and relevant conventions that are not participated in by Cambodia including:

- *International Fund for the Compensation for Oil Pollution Damage;*
- *International Convention on Oil Pollution Preparedness Response and Cooperation to Pollution Incidents by Hazardous and Noxious Substances;*
- *International Convention of the Control of Harmful Anti-Fouling Systems on Ships;* and
- *International Convention for the Control and Management of Ships' Ballast Water and Sediments.*

In terms of national legislation, apart from registration of vessels, there are no national rules and regulations in respect to inland waterway barges or the transport of dangerous goods by inland waterway barges. There are some circulars being prepared by the MPWT on *Waste Management from Ships in Inland Waters* (September 2010), on *Dangerous Goods Transportation Technique on Inland Waterways* (December 2010), and on the *License for Barges and Ships* (July 2010). These circulars are not yet in force.

Further to this, the MPWT is preparing the *Circular on Protection and Prevention the Traffic Accident along Inland Waterways*, and the *Circular on Management of Means of Waterway Transport*. In addition, the MPWT is preparing draft *prakas* on *Dangerous Cargoes Transport along Inland Waterway*, and on *Waste Management from Vessels along Rivers in the Kingdom of Cambodia*. Although such initiatives need to be appreciated, these circulars and *prakas* would need to be carefully reviewed and would better be formulated in line with the conventions in Viet Nam because in the end all rules and regulations have to be harmonised to common rules and regulations which is clearly instructed in the Bilateral Navigation Agreement.

Control by the authorities through monitoring, regulating, law enforcement and issuing fines is very limited in the navigation sector in Cambodia. The Waterway Department needs serious reinforcements.

4.4.2.2 Types of Dangerous Goods

The oil products and derivatives such as fuel oil, diesel oil, kerosene, MOGAS, and liquid petroleum gas are used for energy production, transportation, industries and local consumption and are imported by tankers under the Vietnamese flag, although there are some smaller tanker feeders under the Cambodian flag. The risk analysis of the tanker in Cambodia was done onboard Vietnamese tankers.

It is to be noted that the quality of the equipment, management and operations onboard of the domestic feeder tankers in Cambodia is less than the quality standards of the Vietnamese tankers. Other goods such as toluene, and ammonium nitrate and fertilisers are also carried in bulk but not onboard conventional tankers.

Many of the containers that are shipped in from abroad contain dangerous goods. In many cases, they are not labelled correctly and there is no adequate documentation. The tankers that supply petroleum are predominately from Ho Chi Minh City and inland terminals in the Mekong Delta on the Mekong and Bassac Rivers (Figure 99)

Figure 99: **Vietnamese Tankers Discharging Cargo to a Cambodian Terminal on the Mekong River**

4.4.2.3 Risk Assessment

The risk assessment for Cambodia was completed for a cargo vessel and the National Working Group also completed risk registers for Vietnamese tankers which was integrated into the regional findings.

Figure 100, one of the results of the risk evaluation processes conducted in Cambodia, illustrates the priority area for each of the nine hazard groups. We can observe that there are mainly four hazard groups with important high priority areas: **management, human factor, dangerous goods, and lifesaving equipment**. The major priority areas in these hazard groups are high to very high (Priority Areas 3 & 4, **lifesaving and firefighting**).

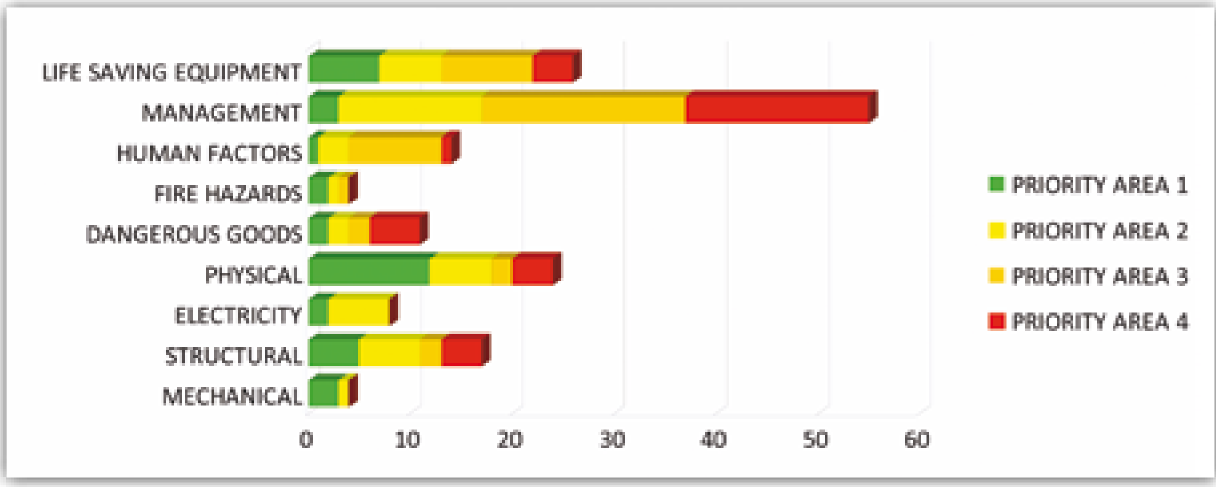


Figure 100: **Cambodia - Cargo Vessel**

The risk evaluation of the typical general cargo vessel demonstrates that the main problems identified are related to management, legal and institutional shortcomings, and lack of awareness and training.

As confirmed by the findings of the National Working Group in the risk register, there is hardly any legislation concerning the carriage of dangerous goods in Cambodia. The immediate consequence of having no fundamental legal framework is:

- no laws, rules or regulations have been implemented;
- there are no engineering or technical standards to which the vessels have to respond;
- no authority control or enforcement is possible as the controlling authority has limited laws, rules or technical standards that they can use as a reference to undertake inspections; and
- no budgets are made available to conduct controls on the vessels.

Among the most serious management problems observed by the National Working Groups are:

- no procedures for the handling of packaged dangerous goods;
- no procedures or checklists for bunkering operations, entering enclosed spaces and hot work;
- no emergency response plans available;
- no waste management (for both liquid and solid waste);
- no drug and alcohol policy;
- no class inspection; and
- no process for the disposal and management of bilge contents.

More on a technical side was the problem that dangerous cargo onboard is not segregated, both on general cargo and container vessels.

The highest risks are related to awareness, training and management issues. Not only on shortcomings but the real lack of training or understanding on handling dangerous goods, emergency procedures, accident prevention, pollution prevention, environmental protection and vessel waste management was identified. Too often there is no proper preparation of the works or guidance in case problems arise. This was found through the following:

- There is no documentation or MSDS available and dangerous goods are not labelled;
- Confined spaces have not been identified onboard. Actually the crew is unaware of the existence of confined or enclosed spaces, and no measurements for oxygen are done prior to entering;
- There no procedures on spill containment, cargo handling, deck watch keeping or bridge watch keeping;
- No procedures on grounding; and
- No management concerning firefighting equipment and safety onboard. Moreover there is no training on the use of firefighting and lifesaving equipment and no fire or emergency drills are held onboard.

In general, the skills of the crew with respect to dangerous cargo are quite low and human errors occur regularly as crewmembers do not perform a required action or perform an action at the wrong place, or in a wrong sequence.

The fact that packaged dangerous goods are not properly labelled is not a mistake by the vessel but by the freight forwarders, cargo stuffer or stevedores on the shore. They must ensure the labelling is done and is correct. Moreover, it was also reported that stuffing of the cargo does not follow any legal requirements and is not done properly. Although this was considered as a medium risk, this item should actually be ranked among the highest risks. In terms of technical shortcomings, the most important causes for accidents or emergency response may be:

- no radar available during bad visibility, heavy rain or showers;
- lack of communication, no appropriate means of communication (no VHF, no walkie-talkie);
- fire extinguishers absent, no regular check (yearly), out of order;
- personal protective equipment is not available;
- fire hoses are not available or in bad condition; and
- lifesaving equipment is not provided or well maintained.

Then there are also the pure navigational issues which do not necessarily reflect the situation onboard but more so on the waterways. The following points have been described as involving medium to high risk:

- there is still a lack of navigation aids such as buoys and leading lights; and
- no reporting system available and no Vessel Traffic Services (it must be noted, however, that the MRC has installed the first AIS system on the Mekong River in Cambodia).

4.4.3 Viet Nam

Viet Nam utilises navigation more than the other countries in the Mekong Basin and has extensive maritime and domestic transport in the Mekong Delta. Viet Nam is also the most developed in terms of standards and rules and regulations for the transport of dangerous goods. The Government of Viet Nam, through the Ministry of Transport (MOT) and line agencies VIWA and VINAMARINE are doing their utmost to manage and control the associated risks. Due to the magnitude of inland navigation in Viet Nam, however, there is a lack of skilled staff, budgets and resources to control and conduct proper law enforcement on all vessels, terminals and ports. Moreover, the rapid expansion of vessels and trade of dangerous goods is moving faster than improvements to monitoring, control and law enforcement. In the short term the potential for navigation accidents, fires, explosions, loss of life and damage to the environment will increase.

Like many other developing countries, socio-economic development has priority over environmental protection and safety measures, risk controls are often only implemented following a major incident. Hence, it is hoped that this Risk Analysis, recommendations and implementation plans will reach all levels of government, national line agencies and key stakeholders to ensure the current situation will be improved to face the predicted development.

Viet Nam is also the only country that has made noticeable progress in terms of managing the transport of dangerous goods in the Mekong River Basin. Viet Nam requires that vessels are registered and encourages reporting on shipping accidents which are prerequisites for monitoring.

4.4.3.1 Legislation and Authority Control

Legislation in Viet Nam related to maritime and inland waterway transportation is very extensive and covers almost all important areas that should be taken into account when considering transport of dangerous goods onboard. There is extensive maritime and inland navigation in Viet Nam. From an international perspective, Viet Nam has endorsed most of the maritime IMO conventions. There are, however, a few important conventions that are not participated in by Viet Nam, including the:

- *International Convention on Oil Pollution Preparedness, Response and Cooperation* (OPRC) 1990;
- *Protocol on Preparedness, Response and Cooperation to pollution incidents by Hazardous and Noxious Substances* (HNS Protocol) 2000;
- *International Convention of the Control of Harmful Anti-Fouling Systems on Ships* (AFS) 2001; and
- *International Convention for the Control and Management of Ships' Ballast Water and Sediments*.

On a national level, Viet Nam has endorsed national decrees relating to transportation of dangerous goods dealing with:

- *Maritime Code of Viet Nam*;
- *Regulation on the Management of Maritime Shipping at Seaports and in the Maritime Navigable Zones of Viet Nam*;
- *Tasks of Viet Nam's Marine Police including the ask of Marine Environment Protection*;
- *Administration of the Maritime Activities at Vietnamese Ports and Maritime Waters* (regulations were set out for the opening and closing of ports, shipping operations and coordinating activities between specialised agencies at port and shipping zones in order to guarantee maritime security, order and hygiene as well as prevent environmental pollution. It was not made clear from the National Working Group how well this is applied to inland ports; and
- *Seaport Regulations by the Directors of Port Authorities*. Decision promulgating regulations on environmental protection by port authorities at Vietnamese seaports.

The transport of dangerous cargoes by inland waterway barges is regulated by the following:

- *Law on Inland Waterway Transportation of 2004*;
- *Decree No 29/2005/ND-CP*;

- *Circular on the Rules for Management of Passenger Transport*;
- *Circular and Decision on the Rules for Registration of Inland Vessels*;
- *Decision on the Rules for Management of Cargo Transport*;
- *Decision on the Rules for Inland Waterway Port Authority*; and
- *Circular on the Rules for Crewmember on Inland Waterways*.

There are norms for classification and registration of IWT which include standards applicable for vessels carrying dangerous goods regarding construction, life and firefighting equipment, crew standards and waste management. The national legislation on the inland carriage of dangerous cargoes is prepared by the Vietnam Inland Waterway Administration (VIWA), the Vietnam Register (VR) and the Ministry of Public Security (MPS) and the Public Security Departments of cities and provinces. Registering of inland waterway barges is the responsibility of the Departments of Transport (DOT) of cities and provinces; not including police, navy and fishing vessels. Inspection, implementation of and ensuring compliance of the law is carried out by the Waterway Public Security Administration, the Inland Waterway Public Security Department, the Ministry of Public Security, the Inland Waterway Inspection Department, VIWA and the MOT local port authorities. There are well-equipped units with rescue-boats as part of the Waterway Public Security Stations and the Inland Waterway Inspection Team.

4.4.3.2 Legal and Institutional Framework for Emergency Response

Responses to oil spill incidents are implemented by the Viet Nam Search and Rescue Committee through the National Response Oil Spill Plan under the Ministry of Science, Technology and Environment. The VIWA, under the MOT, and the Dyke Management and Flood and Storm Administration, under Ministry of Natural Resources and Environment, are among the partners of the Viet Nam Search and Rescue Committee. It is, however, unclear how the oil spill response plan is applied to the Mekong River system and if central rescue units in Ho Chi Minh City and coastal areas extends to the Mekong Delta.

4.4.3.3 Types of Dangerous Goods

Provided by the National Working Group in Viet Nam, the main types of liquid dangerous goods transported on the Mekong River on inland barges in Viet Nam included in the study were Gasoline, M92, M95, and Diesel Oil. Considering the imports and exports, and the industrial needs of the country, one may expect that there are many more types of dangerous goods carried in liquid bulk in the Mekong Delta, including chemicals and fertilisers for the agricultural sector. The Risk Analysis only included petroleum tankers and terminals so further investigation would be required to determine carriage of packaged dangerous goods to the inland and maritime ports. There are numerous dangerous goods transported by container and in general cargo. Most of the rivers and canals in the delta are used for dangerous goods and, as far as known, there seems to be no geographic restrictions on their carriage. The most important routes for cross-border trade between Cambodia and Viet Nam are the Bassac River, the Vam Nao Pass and the Mekong River which have been approved as transit routes under the Bilateral Navigation Agreement. The majority of the trade links Ho Chi Minh City with Can Tho and Phnom Penh so access to Saigon Port in Ho Chi Minh City is crucial.

Of the 755,000 barges that are sailing on the inland navigation system in Viet Nam about 2,200 are involved in shipping dangerous goods in bulk. Besides this, many of the cargo and container barges carry hazardous cargo in packaged form. For the tankers there are three categories:

1. 800 – 1,500 DWT, primarily used for cross-border trade between Cambodia and Viet Nam (Figure 101)

2. 150-300 DWT feeder tankers from the main terminals to the domestic clients such as factories, electricity providers, petroleum terminals and floating and fixed fuel stations; and

3. Less than 150 DWT fuel boats for local supply: (Figure 102).

Figure 101: **800-1500 DWT for Domestic and Cross Border Trade**

Figure 102: **Less than 150 DWT Fuel Boats for Local Supply in Viet Nam**

4.4.3.4 Risk Assessment

The risk assessment for tankers in Viet Nam includes risk registers completed in Viet Nam and Cambodia by both National Working Groups. The results were integrated to determine the priority areas for high and low-standard tankers involved in cross-border and domestic transport in Viet Nam.

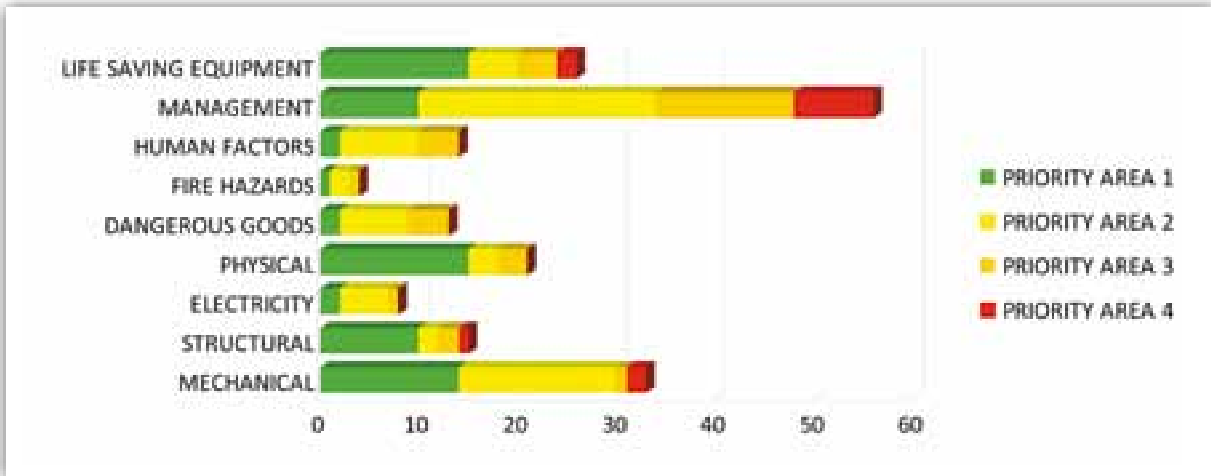


Figure 103: **Viet Nam - Tanker, High Standard**

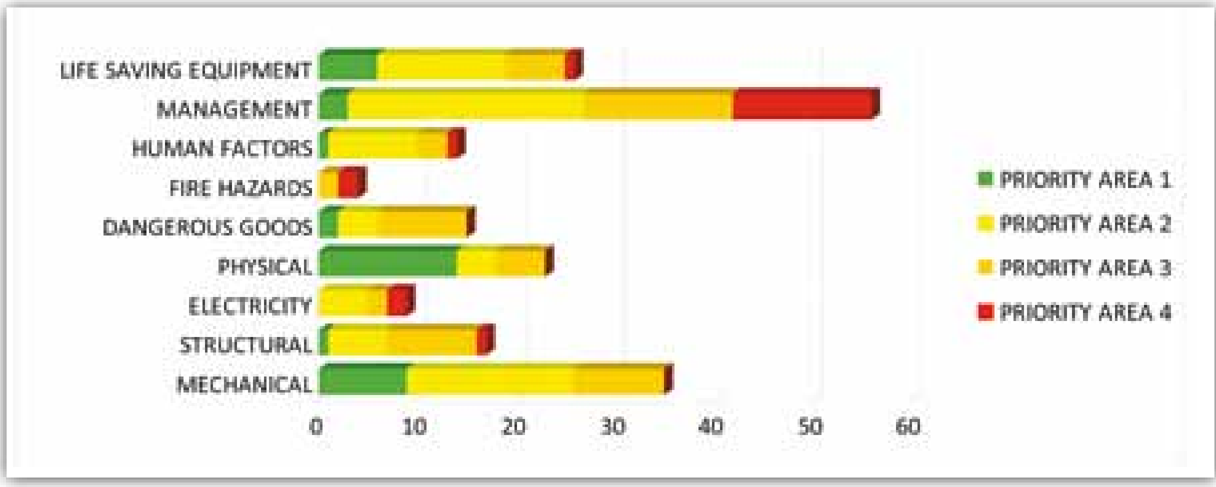


Figure 104: **Viet Nam - Tanker, Low Standard**

There seems to be a remarkable difference between the IWT tankers in Viet Nam not only in terms of construction, equipment and operations but also the management by the crew and fleet owners. Because of this gap, the study investigated High-Standard Tankers and Low-Standard Tankers. Both graphs show the results of the risk evaluation processes.

There are quite a number of issues in the *management* hazard group and it seems that many of the low priority areas under the High-Standard Tanker become medium to high priorities under the Low-Standard Tanker. A remarkable difference is for the *fire* hazard group fire. Although the High-Standard Tanker seems to follow international standards, it seems that the-Low Standard Tanker does not.

The *electrical* considerations and technical compliances also seem to be a problem for the Low-Standard Tankers. There is some differences between *structural* and *mechanical* hazards. In regards to *mechanical* issues, the Low-Standard Tanker has no Priority Area 4 in contrast to the High Standard Tanker which does, reflecting a better understanding by the crewmembers of the risks associated with the transport of dangerous goods.

Even though the High-Standard Tanker ranks much better than the Low-Standard Tanker, there are still many Priority Areas 3 and 4, highlighting the need for intervention also for the High-Standard Tanker particularly in relation to management, training awareness of dangerous goods and mechanical and structural items. When concluding on the risk evaluations for improvements, the study will base itself on the existing Low-Standard Tanker as these represent the worst-case scenario that needs to be dealt with.

As confirmed, the national legislation in Viet Nam is the best among the four MRC Member Countries and could serve as a foundation for common standards, especially for Cambodia through the bilateral agreement. But standards and legislation are not comprehensive and need further study.

Management onboard vessels is the responsibility of the captain and crewmembers. However, many management policies have to come from the fleet owner. Among the most serious management problems observed by the National Working Group are:

- no management procedures concerning dangerous goods and tank cleaning;
- lack of procedures and/or checklists on hot works and entering enclosed spaces;
- no restrictions on open light, naked light, no smoking requirements;
- no procedures on deck watch keeping during cargo operations;
- no procedures on emergency situations, lifesaving and firefighting equipment, safety and security measures, spill containment;

- no solid waste and sewage disposal management (garbage, maintenance residues) and no liquid waste management (bilge water, wash water, sewage & liquid residues containing oil or chemicals); and
- no procedures on grounding or preventing other navigational accidents.

In general, the skills of the crew with respect to dangerous cargo are better than in Cambodia but still too low. Human errors occur regularly as crewmembers do not perform required actions or perform actions at the wrong place, or in the wrong sequence. Regarding training, it was observed and evaluated that much improvement is required for training on handling dangerous goods including product knowledge, loading/discharging operations, tanker vessel stability, emergency procedures, accident prevention, pollution prevention, environmental protection and vessel waste management.

In terms of structural and mechanical shortcomings, the most important causes for accidents or emergency response are listed below.

Mechanical:

- cargo pump in pump room is leaking;
- irregular pressure in cargo pipes during loading or discharging (pressure in pipes going fast up and down), Maximum Allowable Working Pressure exceeded (MAWP);
- tank cover gasket missing, tank openings not properly sealed. Safety devices not working (e.g. Emergency Shut Down system not working, pressure relief valves not working);
- cargo hose used for loading or discharging is ruptured;
- high voltage cables have no or insufficient insulation;
- electrical cables have no or insufficient insulation; and
- firefighting pumps not properly working, or even missing.

Structural:

- single hull: hazards in case of grounding, contact or collision;
- lack of sloptank;
- no sewage treatment plant (plant + storage tank);
- structural damage to cargo pipes in pump room, structural damage to cargo pipes on deck;
- lack of spill belt/ plate/ gutter bar, drip tray; and
- waste reception facilities for bilge content (mixture of oil-fuel-water) are not available.

There are some urgent authority measures and controls that need to be dealt with:

- disposal of bilge content and slop tank to reception facility is too expensive;
- there is no adequate authority control on slop tank or bilge content removal (oil record book); and
- waste reception facilities for slop tank content of cargo residues are not available.

In terms of equipment it seems that there are:

- only limited walkie-talkies;
- no explosion-proof torch lights;
- equipment is not explosion-proof;
- often no radar available;
- often no GPS available;
- no oxygen level measurement apparatus; and
- no breathing apparatus.

There are also the pure navigational issues which do not necessarily reflect the situation onboard but more so on the waterways. But because of the much higher density of traffic the following points should have the highest risk:

- lack of navigation aids including buoys and leading lights;
- no reporting system available and no Vessel Traffic Services (VTS);
- better communication systems between the vessels; and
- training on waterway safety and awareness by waterway users.

4.4.4 Thailand

Waterborne transportation on the Mekong River in Thailand only involves inland barge traffic only. The main traffic is dedicated to inland shipping for cross-border trade between Thailand and the People's Republic of China. Export of petroleum products to China has already started but the main trade will begin once Chiang Saen II Port is built. Planned export volumes are around 150,000 tonnes of gasoline and diesel oil per year. Cross-river ferry traffic of dangerous goods is an important matter to investigate.

4.4.4.1 Legislation and Authority Control

The national legislation applied in respect of the transport of dangerous cargoes by inland waterway barges is the *Ship Survey Regulation No. 19 (*B.E. 2534) and the *Thai Vessel Act* (B.E. 2481). There are also national standards applicable for inland waterway vessels carrying dangerous goods regarding construction, life and firefighting equipment under the *Ship Survey Regulation*.

Preparation of the national legislation on the carriage of dangerous cargoes onboard barges is executed by branches of the Thailand Marine Department (TMD). Ship Standard Bureau and Legal Bureau Registration of inland waterway barges is carried out by the Marine Office Branch and the Ship Registration Bureau. The barges are inspected at least once every year by the Ship Surveyor of the Marine Office and the Ship Standard Bureau. Concerning safety matters, authority is delegated by the Marine Department to the Royal Thai Navy, and the Marine Police to undertake inspections onboard barges. Implementation of and ensuring compliance with rules, regulations, standards and laws is ensured by the Marine Department.

As confirmed by the findings of the National Working Group in the risk register, there is almost no legislation concerning the carriage of dangerous goods in Thailand for the Mekong River. Actually, the *Agreement on Commercial Navigation on the Lancang-Mekong River among the Governments of the PR of China, the Lao PDR, Myanmar and Thailand*, signed at Tachileik, 20 April 2000, has been a catalyst for increased navigation. Since it comes with technical protocols, it seems that the rules and regulations under this agreement, which reaches downstream to Luang Prabang, overrule national legislation when it comes to cross-border traffic. However, Article 18 of the Agreement reads: "*Vessels and their crew members and passengers of one Contracting Party, during their stay and passage through the territory of another Contracting Party, shall respect the common navigation rules and the laws and regulations of the country of that Contracting Party, in particular, customs and immigrations, environment protection and ecology balance and other laws and regulations concerning public order and security. The Contracting Parties shall give due publicity to all such laws and regulations.*''

Article 17 stipulates that ''*For the safety of life, health and the protection of the environment the carriage under this Agreement of hazardous materials such as toxic chemicals, explosives and radioactive material shall be prohibited. However, the carriage of some other types and categories of dangerous goods and the safety measures thereof may be agreed upon by consultation among the Contracting Parties*." In other words, the Agreement prohibits the carriage of toxic chemicals, explosives and radioactive material on the Upper Mekong. The carriage of other types and categories of dangerous goods is only allowed when agreed upon among the Contracting Parties.

In practice, the Agreement was supplemented by the following six technical annexes:

- *Regulations on Safe Navigation of Vessels on the Lancang-Mekong River;*
- *Rules on Water Transport Administration on the Lancang-Mekong River;*
- *Guidelines on the Maintenance and Improvement of the Navigability of the Lancang-Mekong River Regulations on the Investigation and Handling of Waterborne Traffic Accidents on the Lancang-Mekong River*; and
- *Regulations on Management of Search & Rescue, Salvage and Wreck Removal on the Lancang-Mekong River.*

4.4.4.2 Types of Dangerous Goods

The different kind of dangerous goods transported by inland waterway barges on the Mekong River are petroleum products, gasoline, diesel and asphalt. The cargo is traded for cross-border export and for domestic consumption in Thailand and Lao PDR.

Different ferry crossings between the two countries carry trucks loaded with a variety of dangerous goods, such as fuel and chemicals used for mining purposes. Gold exploration executed by private miners uses dangerous and polluting chemicals that mean a real threat for the environment.

The main traffic lines are from Chiang Saen to People's Republic of China, Palchum-Bolikunsai, Bungkarn-Bolikunsai, Nakon Phanom-Kummun, Mukdahan-Savannaket. The main ports are Chiang Saen and Chiang Khong. Chiang Saen II is under construction. The ferry crossings between Thailand and Lao PDR included in the risk analysis are situated at Chiang Khong, Bungkham, and Mukdahan.

The number of barges registered in Thailand for the Mekong River is very limited, only nine have to be considered. Thailand does make significant use of the Mekong River and its associated waterways for domestic transport or passenger services although the registration of Thai vessels will increase once Chiang Saen II Port is complete. Attention should be paid to the state of the numerous local ferries.

4.4.4.3 Risk Assessment

Thailand does not have a tanker vessel registered under its own flag on the Mekong River. Since most of the trade between the four countries in the Upper Mekong is between People's Republic of China and Thailand, adn that most of the tankers will start their voyage in Chiang Saen II, a risk register on a Chinese tanker was conducted at Keawalee Terminal (Figure 105).

Figure 105: **Chinese Tanker Loading Fuel at Keawalee Terminal, Thailand**

The National Working Group strongly believes that there should be a regulation that allows the Marine Safety Administration to inspect the condition of other flag vessels as well the safety of operations. Currently, there is only limited authority and regulations to enforce any rules related to safety and environmental protection in the Upper Mekong. As People's Republic of China has requested to import 150,000 tonnes of gasoline/diesel via the new port of Chiang Saen II in the future, traffic can grow rapidly and efficient control is necessary. In this context the National Working Group of Thailand assessed a Chinese Tanker barge and the priority areas can be found in the following figures:

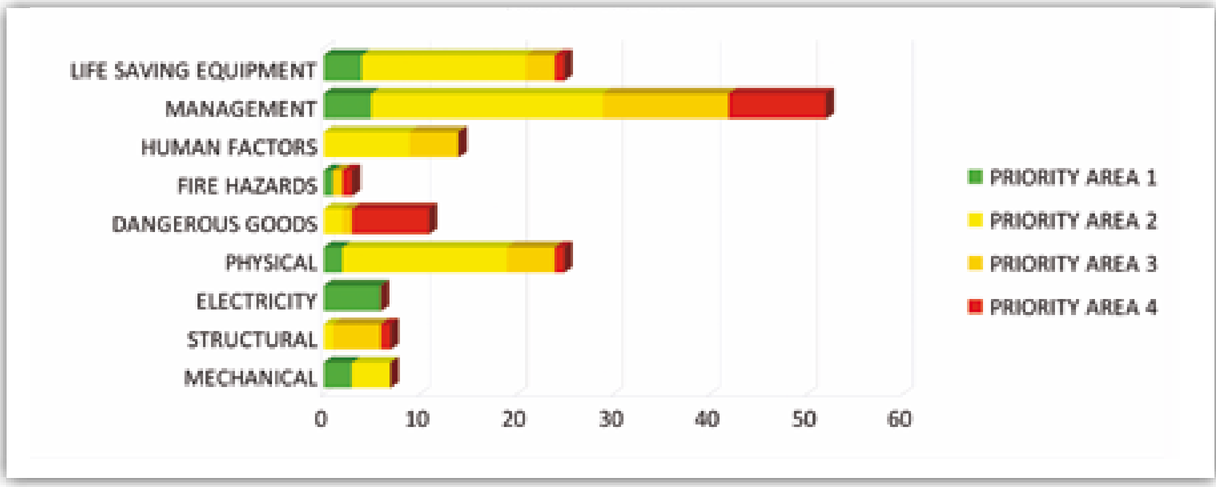


Figure 106: **China - Tanker**

The hazard groups with important high priority areas: *management*, *human factors* and *dangerous goods.* The major priority areas in these hazard groups is high to very high (Priority Areas 3 & 4).

Among the most serious management problems observed by the National Working Group are:

- no management procedures concerning dangerous goods, tank cleaning;
- safety Measures: no management concerning protective equipment;
- no checklist regarding bunkering;
- lack of procedures and/or checklists on hot works, entering enclosed spaces;
- no restrictions on open light, naked light, no smoking requirements;
- no solid waste and sewage disposal management (garbage, maintenance residues) and no liquid waste management (bilge water, wash water, sewage & liquid residues containing oil or chemicals);
- language differences between the Chinese crew and Thailand port authority; and
- limited procedures on grounding or other navigational accidents.

In general, the skills of the crew with respect to dangerous cargo are adequate because there they have been trained in People's Republic of China. But they are still too low and human errors occur. Regarding training, it was observed and evaluated that much improvement is required for training on handling dangerous goods including product knowledge, loading/discharging operations, tanker vessel stability, emergency procedures, accident prevention, marine pollution prevention, environmental protection, vessel waste management and the labelling of dangerous goods.

In terms of structural and mechanical shortcomings, the most important causes for accidents or emergency response are quite similar to the issues addressed on the Vietnamese tankers and will not be repeated here. The vessels from the People's Republic of China are quite different to the tankers operating in Viet Nam. Some modified cargo vessels are used for transporting dangerous goods which is an issue in itself.

There are some urgent authority measures and controls that need to be dealt with:

- security: terrorist attacks or other criminal activities have happened and can happen again;
- there is not adequate authority control on slop tank or bilge content removal (oil record book);
- waste reception facilities for slop tank content of cargo residues are not available;
- night navigation in dangerous stretches (rocks, rapids) should not be allowed; and
- transport documents not supplied or incomplete and no necessary information on dangerous goods.

The waterways and conditions in the Upper Mekong are more difficult to navigate than in the Mekong Delta and the waterway can be major cause for groundings, collisions and hitting rocks which, in the case of tankers, will definitely lead to pollution and possible explosions. Further assessment of the waterway is included in the waterways chapter. The following points should have the highest priority:

- limited navigation aids, such as buoys and leading lights;
- night navigation should be restricted and navigation during bad visibility (heavy rain) should be stopped;

- there is no reporting system available and no Vessel Traffic Services;
- better communication systems between the vessels, ports and waterway authorities; and
- training on waterway use.

4.4.5 Lao PDR

As in the case of Thailand, waterborne transportation on the Mekong River in Lao PDR involves inland barge traffic and ferry crossings for the transport of cargo and dangerous goods. The Mekong River stretches do not only cover the border with Thailand but also penetrate the country in two areas, making Lao PDR the country with the longest stretch of the Mekong River among the four MRC Member Countries.

4.4.5.1 Legislation and Authority Control

The Ministry of Public Works and Transport (MPWT) is currently responsible for overseeing all transport and public works in Lao PDR, and a Waterways Department has been established to be responsible for inland waterway transportation. The Waterways Department prepares the national legislation on the carriage of dangerous cargoes onboard inland waterway barges. Registering of barges, yearly inspection of the barges and implementation and ensuring compliance with the rules and regulations is also the responsibility of the Department of Waterways.

There are guidelines, such as the *Guideline on River Traffic Regulation*, and *Guideline on Request for Ship Building Permission*; *Standards of Technical Inspection for Ship and Ferry*, and *Regulations that Apply to Inland Waterway Transport*, and *Regulations on Truck and Transport Boat Associations.*

Explanations on the *Agreement for Commercial Navigation on the Lancang-Mekong River among the Governments of the PR of China, the Lao PDR, Myanmar and Thailand*, signed at Tachileik, 20 April 2000 are in the previous section on Thailand and also in the chapter on legal frameworks.

4.4.5.2 Types of Dangerous Goods

The different kind of dangerous goods transported by inland waterway barges on the Mekong River are petroleum products, gasoline and diesel, together with toxic chemicals (for gold mining purposes) such as mercury and sodium cyanide. The principal dangerous goods are transported by barges or in trucks on ferries when crossing the Mekong River. Other commodities transported are logs, cement, rice, concrete pipes, construction materials, timber and agricultural products. Fertilisers, pesticides and herbicides are reported as being illegally transported on the Mekong River in small boats from Thailand to Lao PDR.

The main routes are Vientiane to Paklay, Luang Prabang to Bokeo, and Vientiane to Savannakhet. Ferry services are provided between Pakxanh Port, Lao PDR and Bungkhan, Thailand; Nakasan Port, Lao PDR and the Siphandone area; Choum Khong Port Lao PDR and Chiang Man Port and Chiang Keo Port, Thailand; Huay Xay Port Lao PDR and Chiang Khong Port, Thailand; Ban Tuay Port (Km 1,467), Lao PDR and Bungkhan Port, Thailand (although not in service yet, two ferries are intended for mining-related and container transport); Nakhon Phanom Port, Thailand and Thakek Port, Lao PDR. The National Working Group assessed a cargo vessel in Lao PDR.

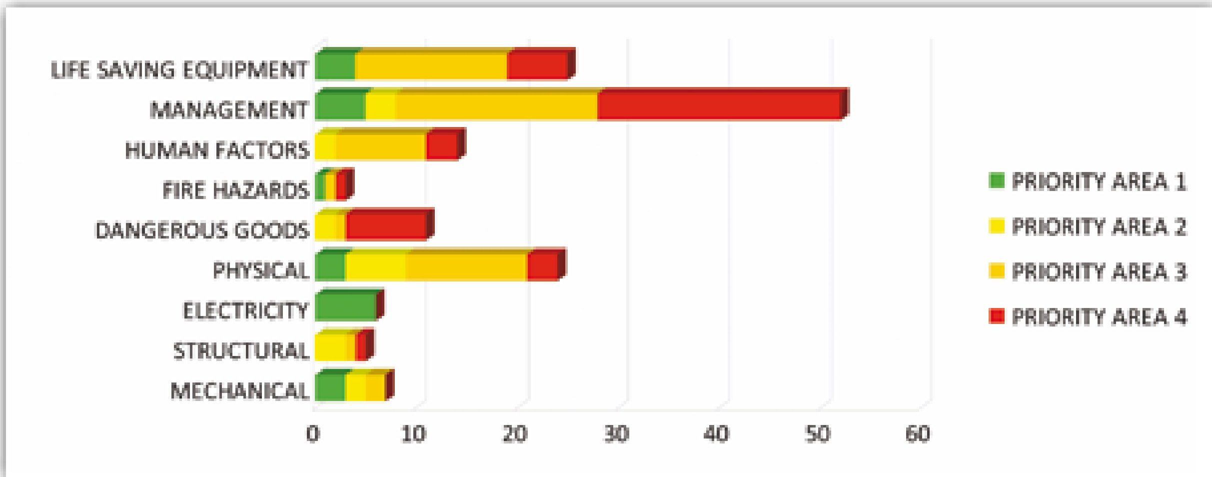


Figure 107: **Lao PDR - Cargo Vessel**

The results of the risk evaluation processes on the cargo vessel, clearly illustrates the priority area for each of the nine hazard groups (Figure 107). The four hazard groups with important high priority areas are lifesaving equipment, management, human factors and dangerous goods. The major priority areas in these hazard groups are high to very high (Priority Areas 3 & 4).

Figure 108: **Cargo Vessels Loading and Unloading in Luang Prabang, Lao PDR**

On general cargo in Lao PDR, most of the problems will deal with overall safety, especially with regards to the dangers of the waterways themselves. As confirmed by the findings of the National Working Group in the risk register, there is almost no legislation concerning the carriage of dangerous goods in the Lao PDR. In addition to the lack of engineering and technical standards for which vessels have to comply, there is no authority control or enforcement possible. The controlling authority has limited laws, rules and technical standards to use as references to undertake inspections. No budgets are available to conduct controls on the vessels.

It is challenging not to cross the line into general safety onboard Lao vessels as there is so much work to be done. Because of the hazardous stretches of river, and the low degree of development in the shipping sector, serious work needs to be undertaken on all kinds of barges in Lao PDR. Hazardous cargo will have the biggest impacts on humans, the environment and infrastructure.

Among the most serious management problems observed by the National Working Group are:

- no specific procedures for ferries and landing facilities;
- no evacuation plan for passengers and crew onboard ferries;
- no communication with authorities on shore in case of accidents;
- no procedures for the handling of packaged dangerous goods;
- no cargo segregation is done;
- no procedures or checklists for bunkering operations, entering enclosed spaces and hot work;
- no emergency response plans available;
- no waste management (for both liquid and solid waste);
- no drug and alcohol policy;
- no class inspection;
- no disposal management of bilge contents;
- dangerous goods are not labelled;
- security: terrorist attacks or other criminal attacks have occurred on the Mekong River and can happen again;
- disposal of bilge content or solid waste to reception facility is not possible;
- there is no adequate authority control on bilge content removal;
- night navigation in dangerous stretches (rocks, rapids) should not be allowed; and
- transport documents not supplied, or incomplete, no necessary information on shipped dangerous goods.

There are no fire or smoke-detection alarms or gas-detection, oxygen-level measurement or breathing apparatuses. The highest risks are related to awareness, training and management issues, notably the lack of training or understanding on handling dangerous goods, emergency procedures, accident prevention, pollution prevention, environmental protection and vessel waste management:

- there is no MSDS available;
- there are no procedures on spill containment, cargo handling, deck watch keeping or bridge watch keeping;
- no procedures on grounding;

- no management concerning firefighting and lifesaving equipment; and
- there is no training on the use of firefighting equipment. As such, there are no fire or lifesaving drills conducted onboard.

In general, the skills of the crew with respect to dangerous cargo and awareness of the risks are quite low. Human errors occur regularly as crewmembers do not perform required actions or perform actions at the wrong place, or in the wrong sequence.

In terms of technical shortcomings, the most important causes for accidents or emergency response may be:

- no radar available during bad visibility and heavy rain;
- lack of communication, no appropriate means of communication (no VHF, no walkie-talkie);
- fire extinguishers and fire hoses are either not onboard or not in good working condition; and
- lifesaving equipment and personal protective equipment (PPE) are not available.

There are also the pure navigational issues which do not necessarily reflect the situation onboard but also the condition and hazards of the waterways. The following points have been described as involving medium to high risks:

- there is still a huge lack of navigation aids such as buoys, leading lights and GPS routing system;
- no GPS available;
- no reporting system available and no Vessel Traffic Services;
- no updates of the charts; and
- no low water level alerts.

4.4.6 Regional Conclusions

The level of development and the status of a regulatory framework vary considerably from country to country. Concerning navigation on the Mekong River, Viet Nam leads the way in terms of legal, institutional and technical/operational arrangements and requirements. Viet Nam also depends most on a well-functioning system as the domestic and international trade of dangerous goods and cargo is much higher than in the other MRC Member Countries. The risks for pollution and major incidents are much higher due to sheer magnitude of shipping. Thailand has some national legislation for IWT. However, the expertise from Thailand Marine Department should be applied to further enhance safety and environmental protection on the Mekong River. Cambodia and the Lao PDR are behind, and this is more of a concern in Cambodia as international trade is increasing through Phnom Penh Port and terminals. It is assumed that the carriage of other dangerous good including chemicals for the industrial sectors will increase over time.

Even though the carriage of hazardous goods is based on different standards in each country, it can be observed from the risk analysis that the majority of shortcomings under the high priority areas are common for all four countries. When discussing regional harmonisation of standards those common priority areas could form the basis for regional Mekong standards.

Further to domestic trade, there are cross-border navigation links between overseas ports, Cambodia and Viet Nam (Lower Mekong), and between the People's Republic of China, Lao PDR, Myanmar and Thailand (Upper Mekong). The Khone Falls are a physical barrier for navigation between the Lower and Upper Mekong. Cross-border transport is of most interest to the MRC. Common rules and regulations are required in areas where there is active trade between countries and vessels of one country move into another country. Only seagoing vessels that cross Viet Nam and visit Phnom Penh follow international maritime rules. All other vessels on the Mekong are inland barges.

Unlike the case for maritime shipping, which mainly follows rules of international bodies such as the IMO, there exists no international legal framework for inland navigation. There are international benchmarks, such as those used on the European Rivers (ADN) to which reference can be made. But the level of development of navigation on the Rhine River, for example, may be beyond the levels of development and technical expertise for the Mekong River in the short term. A reasonable approach for a harmonised system has to be found for the Mekong River system. There may be a need for two harmonised systems for Lower and Upper Mekong navigation which can be linked in the future. When formulating the harmonisation principles, it will be paramount to use the current intergovernmental navigation agreements as legal foundations:

(i) Cambodia, the Lao PDR, Thailand, and Viet Nam, the countries of the Lower Mekong Basin, are members of the Mekong River Commission (MRC). The MRC was established under the *Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin*, signed at Chiang Rai, 5 April 1995 (MRC Agreement). The People's Republic of China and Myanmar, located in the Upper Mekong Basin, are dialogue partners of the MRC. *Article 9, Freedom of Navigation*, covers the Mekong River from the Golden Triangle down to the sea.

(ii) The People's Republic of China, Lao PDR, Myanmar and Thailand are signatories to the *Agreement on Commercial Navigation on Lancang-Mekong River*, which relates to the "Upper Mekong" in terms of navigation (rather than the basin), and was signed at Tachileik on 20 April 2000. This agreement covers the Lancang-Mekong stretches between the Chinese port of Simao and the Lao port of Luang Prabang.

(iii) In theory, consideration should be given to the *Convention between Siam and France relating to the Regulation of the Relations between Siam and Indochina*, signed in Bangkok, 25 August 1926, which applies to the "Middle" Mekong, between Luang Prabang and the Khone Falls.

(iv) Cambodia and Viet Nam are signatories to the *Agreement on Waterway Transportation*, signed at Phnom Penh, 17 December 2009. This treaty relates to the ''Lower" Mekong and covers the Mekong from Kompong Cham to the sea, the Tonle Sap River, the Bassac River from Phnom Penh to the sea, the Vam Nao Pass and selected canals in the delta.

An international benchmarking analysis has been carried out. There is an overview of the subjects dealt with by the international instruments pertaining to the Mekong, by the national laws and regulations pertaining to the transport of dangerous goods which were enacted or prepared by the Riparian States of the Mekong River Basin, as well as by the international benchmarking instruments. The overview allows the reader to (1) to identify the subjects covered by the current legal regime pertaining to transport of dangerous goods on the Mekong (2) compare the available legal rules with the international benchmarking instruments and (3) identify gaps in the rules for waterborne transportation on the Mekong. The comparison of the legal regime pertaining to transport of dangerous goods on the Mekong with the international benchmarks reveals that the current regime is imperfect with important gaps and major differences between the riparian countries.

The existing treaties on navigation on the Mekong River contain different mechanisms for the harmonisation of regulations, including on the transportation of dangerous goods. No available treaty covers the Mekong in its entire length ("Upper," "Middle" and "Lower"). The 1995 MRC Agreement confirms the power of each riparian state to adopt national regulations for its own stretch of the river. The MRC Council may take an initiative to harmonise such regulations. However, such harmonised rules must subsequently be transposed into national regulations.

The *Quadripartite Agreement on Commercial Navigation on Lancang-Mekong River* contains a mechanism for the establishment by the riparian states of "common" rules on the transportation of dangerous goods on the Upper Mekong. It remains to be investigated whether such common rules should be regarded as directly applicable without any further intervention of national regulatory bodies.

In theory, consideration should be given to the *Convention between Siam and France relating to the Regulation of the Relations between Siam and Indochina.* The Convention contains a mechanism for the preparation of harmonised rules which is however no longer operational today.

Concerning the Lower Mekong Basin, the 2009 *Agreement on Waterway Transportation* specifically instructs the Mekong Navigation Facilitation Committee to make proposals for the adoption by the contracting parties of harmonised rules and regulations on the transportation of dangerous goods.

If a harmonisation of rules on the transportation of dangerous goods for the entire course of the Mekong is considered useful, an alternative option would be to establish harmonised rules for the transportation of dangerous goods on the Mekong under a separate international treaty or an "ad hoc" treaty.

The improvement of the transport of dangerous goods will need an integrated approach to ensure that not only are technical standards of vessels improved but also that there is harmonised legal framework and enhanced institutional capacity of national line agencies to monitor and ensure compliance. The shipping companies, crewmembers and waterway users will also benefit from increased awareness on the risk associated with dangerous goods and the potential impacts of oil spill pollution and navigation accidents. Recommendations in Volume II provides priorities for implementation in relation to technical, management, capacity building and training and awareness in the priority areas identified in this Risk Analysis in Volume I.

5. WATERWAYS

5.1 RISK ASSESSMENT OF WATERWAYS

5.1.1 Introduction

This part of the study intends to investigate the waterway and its infrastructure (bridges, river training works, dredged channels, bank protections, overflow dikes, etc.), with the exception of all sorts of landing places for ships and vessels (ports and terminals, jetties etc.). The objectives of the waterway assessment is to identify which stretches of waterways in the whole Mekong system are suitable for carriage of dangerous goods.

A stretch can be described as a certain length of river between two river ports of economic importance (cargo, passengers, bulk, commercial etc). A river stretch or river section will be found suitable if no particular hazard or obstacle is found for the waterborne carriage of dangerous goods between these two points. In other words, if one single important obstacle causes a high risk for navigation, the entire stretch is sanctioned with this risk level and consequently found unsuitable.

Risks from ports, terminals and vessels have been analysed in previous chapters. The risks from the waterway and navigation channel itself (baseline conditions) are specific to the waterway assessment. The waterway and its natural navigation channel is a creation from nature and the risks involved in using this waterway (the Mekong mainstream) are a direct consequence of its geometry, its physical characteristics and its hydraulic dynamics (water flow). Hydraulic dynamics on their turn are a straight consequence of the waterway geometry and its physical characteristics.

So far, the Mekong River mainstream channel is mainly untouched. A few improvements or changes have been made, especially in the northern stretches, which are rocky and often strewn with rock outcrops and natural obstacles to navigation. Clearance of rapids and mid-water obstacles (submerged during high-water levels while visible above the low waterline during low-water conditions) are subject to environmental impact assessment depending on the importance of the rock removal and the volume of excavation to be made. In the lower parts of the Mekong, particularly in the Mekong Delta (which originates in Kompong Cham), some changes to the river have been made, mainly as a result of dredging. The bulk of the actual dredging has little or nothing to do with planned navigation improvement (they are almost all sand and gravel exploitations). Dredging, however, indirectly influences the current and the (moveable) river bed, thereby changing the river morphology. It is generally believed that these influences are not an immediate threat to the safety of navigation.

Navigation distinguishes between long-haul and cross-haul traffic. Long-haul traffic is between two major ports, where dangerous goods can be transported. They have to be loaded and/or unloaded in ports and/or terminals and are carried by vessels over a river section which is either suitable for such navigation or not (acceptable or unacceptable risk).

Cross-haul traffic is "crossing the river" usually by ferries and recently more and more over bridges. Ferries constitute at least the same level of risk as any other long-haul transport since whatever they carry on deck may be a hazard to the environment in case of accident.

5.1.2 Principles

For a uniform assessment of the waterway hazards and risks a number of principles had to be considered and adopted. The principles can be summarised as followed:

1. The entire Lower Mekong River has to be divided into stretches or sections which go from port to port (or terminal to terminal), as it is accepted that only in ports and terminals dangerous goods can be loaded/unloaded. Passenger ports do not qualify;
2. There is no navigation between the upper stretches of the Lower Mekong Basin (Lao PDR, Thailand) and the lower stretches (Cambodia, Viet Nam) which are separated by the Khone Falls on the Cambodia-Lao border. Navigation conditions are totally different on the two stretches and even rules and regulations differ;
3. The sections, defined as above, are examined in accordance with the risk level and take the ranking of the most dangerous spot within the section;
4. The risk assessment of the waterway only deals with the river and its assets, whether man-made or not;
5. The total risk encountered at a certain spot is a combination of various ''waterway factors" which are making navigation difficult, tricky, dangerous and perilous. These waterway factors have to be ranked into a scale of *pollution hazard*, not incident probability (e.g. difference between the likelihood of grounding on a sand bank and hitting an underwater obstacle like a hidden rock outcrop or a shipwreck). The real ''total'' danger does not stem from every single ''waterway factor" on its own *but from a combination of these factors*. There does not seem to be a standardised formula for a mathematical calculation of a certain risk "area'' in a river section. Advice must therefore be sought, almost as a prerequisite, from the waterway users for an objective risk assessment of a certain spot in the river;
6. The outcome of the study (risk analysis of the waterway), including the principles and the applied procedures, must be approved by all riparian countries;

7. Risks vary according to the water levels in the Mekong. A definition of "high-water level", during which risks are different from the low-water level conditions, must be prepared and accepted by the riparian countries. The study suggests therefore that under "high-water level condition" a water level is defined as being three meters above the chart datum in every point of the river. The study also suggests that clear marks along the shore of the river, where shallows exist, should be erected to inform shipping of the existing water level condition towards the chart datum. High-water level conditions usually apply over a period of 200 to 250 days a year; and

8. As the final goal and focus of this study is to implement effective prevention measures to avoid pollution, only physical river navigation improvement works qualify for reducing risks in waterways, be they improved aids to navigation, channel markings or physical removal of obstacles. This study, however, does not relate to "physical removal of obstacles" at this stage and does not opt for any physical improvement or change of the existing navigation channel. The study therefore only deals with the risk assessment of the existing navigation conditions of the channel (baseline situation) and the safety of waterway assets (whether man-made or natural).

5.2 METHODOLOGY

The aim of the actual waterway risk assessment study is to produce reliable maps, endorsed by the riparian countries, indicating the levels of suitability for the transport of dangerous goods in the light of eventual environmental disasters occurring from the waterway.

Vessels, ports and terminals have similarly been assessed in their domain and the combination of all these risk assessments will come up with (a) guidelines and recommendations for the use of waterways (b) the loading and unloading procedures of dangerous goods and (c) safety regulations onboard of vessels transporting dangerous goods.

The entire exercise is meant to (i) avoid accidents which have serious impacts on the environment and (ii) determine emergency-response measures, which are technically and economically (financially) feasible, in case accidents occur.

Every potential danger in the waterway must therefore be objectively assessed on the possibility of accidents causing environmental damage and widespread (cross-bordering) pollution. The study will result in assigning higher risk factors to vulnerable areas sensitive to water quality pollution including water intakes, important wetlands, agriculture, aquaculture and protected areas.

To allow effective analysis of the risks associated with the waterways, the following categories of hazards were adopted:

(a) Waterway Geometrics

- sharp curves without over widths;
- rocky bottoms and river banks;
- submerged obstacles like hidden rock outcrops, shipwrecks, big boulders etc;
- narrow channels not allowing the crossing of two vessels or overtaking; and
- high bottom gradients with hidden thresholds.

(b) Hydraulics of the Water Flow

- strong funnel-shaped currents;
- strong turbulent currents;
- water upsurges;
- whirlpools; and
- side currents from tributaries of side channels.

(c) Location of the Hazards

- upstream from important water intakes;
- upstream from big cities;
- upstream from important wetlands;
- protected areas or biospheres, for example Tonle Sap Lake and entrance to the lake during the flood season (water flowing towards the lake); and
- Upstream from special zones with protected species (Irrawaddy dolphins).

(d) Navigation, Traffic, Communication and Man-Made Obstacles

- traffic density and presence of high-speed vessels (ski boats, hovercraft etc.);
- fishing nets across the river;
- dredging vessels and pontoons or moored barges in the channel;
- limited communication between vessel and shore;
- limited communication between vessels;
- existing aids to navigation systems;
- busy ferry crossings obstructing long-haul traffic;
- piers and causeways from ports and/or terminals;
- night navigation;
- limited information on existing water levels and vessel traffic density; and
- low high-tension lines and other man-made obstacles.

It is emphasised that the combination of one or more of these hazards is more than simply adding up individual hazards or risks.

Hazards under (a) and (b) may be different during low or high-water level conditions. Hazards under (c) and (d) are largely not influenced by the water level.

Special attention is attached to the Tonle Sap Lake. During the filling of the lake at the start of the wet season, the risk of pollution and environmental damage from spillage due to accidents is much higher than after the flood season, as receding waters flow towards the sea. The biodiversity of this area is so sensitive that the greatest precaution should be taken and the most stringent regulations should be imposed to the carriage of dangerous goods.

Three levels of risk were considered for the waterway assessment:

- **Green** = safe enough to transport dangerous goods on board tankers during the considered water-level conditions;
- Yellow = some precautions have to be taken for the transport of dangerous goods on board tankers. Some dangerous goods may not be allowed to be transported during the "yellow" conditions; and
- **Red** = unsuitable for the transport of dangerous goods on board of tankers.

The waterway assessment has been made for two different water-level situations: the low-water season and the high-water season. As explained above, the high-water season is considered to start when the waters have risen three meters above chart datum in every point of the river. The minimum depth of the channel is then: LAD + 3 m (LAD = least available depth in a certain river section).

Figures 109 and 110 show the entire river stretch between the Golden Triangle and the river mouths at the South China Sea in the Mekong Delta.

Figure 109: **Mekong Risk Assessment - Low Water-Level Situation**

Figure 110: **Mekong River - Risk Analysis Waterways**

5.3 CURRENT SITUATION IN MEMBER COUNTRIES

5.3.1 Lao PDR and Thailand

This study focuses on river sections grouped into stretches with common hydrographic and topographic characteristics. In certain sections where the river forms the border between Lao PDR and Thailand, it is difficult to be specific.

The waterway was assessed from its upper reaches to its lower reaches and the navigation dangers in the most critical areas described. Furthermore, the navigation conditions during high water and low water were also examined.

Substantial input was obtained from river pilots during meetings in Luang Prabang and Vientiane. Their comments and assessments are outlined below.

5.3.1.1 Section Golden Triangle (Km 2,373) – Chiang Saen (Km 2,364): distance = 9 km

Although none of the pilots had extensive experience in this short section, there were no dangers of note reported that may threaten the safety of navigation in this stretch. No mention of specific increased risks during low or high water were reported although there was some discussion of insufficient water depth and areas of unstable sandbanks that could pose a hindrance in some instances.

All pilots involved in the consultation process agreed that this particular section should be assessed as “green” during both the high and low-water seasons.

Table 44: **Waterway Assessment- Golden Triangle to Chiang Saen**

GOLDEN TRIANGLE-CHIANG SAEN		
	Low Water	High Water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.3.1.2 Section Chiang Saen (Km 2,364) – Chiang Khong/Huay Xay (Km 2,314): distance = 50 km

This stretch was considered to be generally safe by the pilots consulted, with the exception of two specific rapids. In order to traverse these rapids, vessel skippers would need to take significant and unacceptable risks. These stretches were:

(a) Don Thi (Km 2,335)

The river at Don Thi does not feature any visible rapids or turbulence. However there are a number of hidden rock outcrops in the main (right) channel. Due to these hidden rock outcrops, vessels prefer to take the shallower channel to the left (northern) bank between the sand bank and the river bank. This channel is extremely shallow but safe for smaller craft as there are no submerged obstructions.

Unfortunately, this channel is not deep enough to be used by cargo vessels during the low water season. For navigation to continue during low-water periods, larger vessels must use the main channel, which places them at significant risk of hitting one of the submerged rocky outcrops. This channel is therefore unsafe during low-water conditions.

This risk also extends to mid-water level conditions as many of these rocky outcrops remain partially submerged and dangerous for navigation.

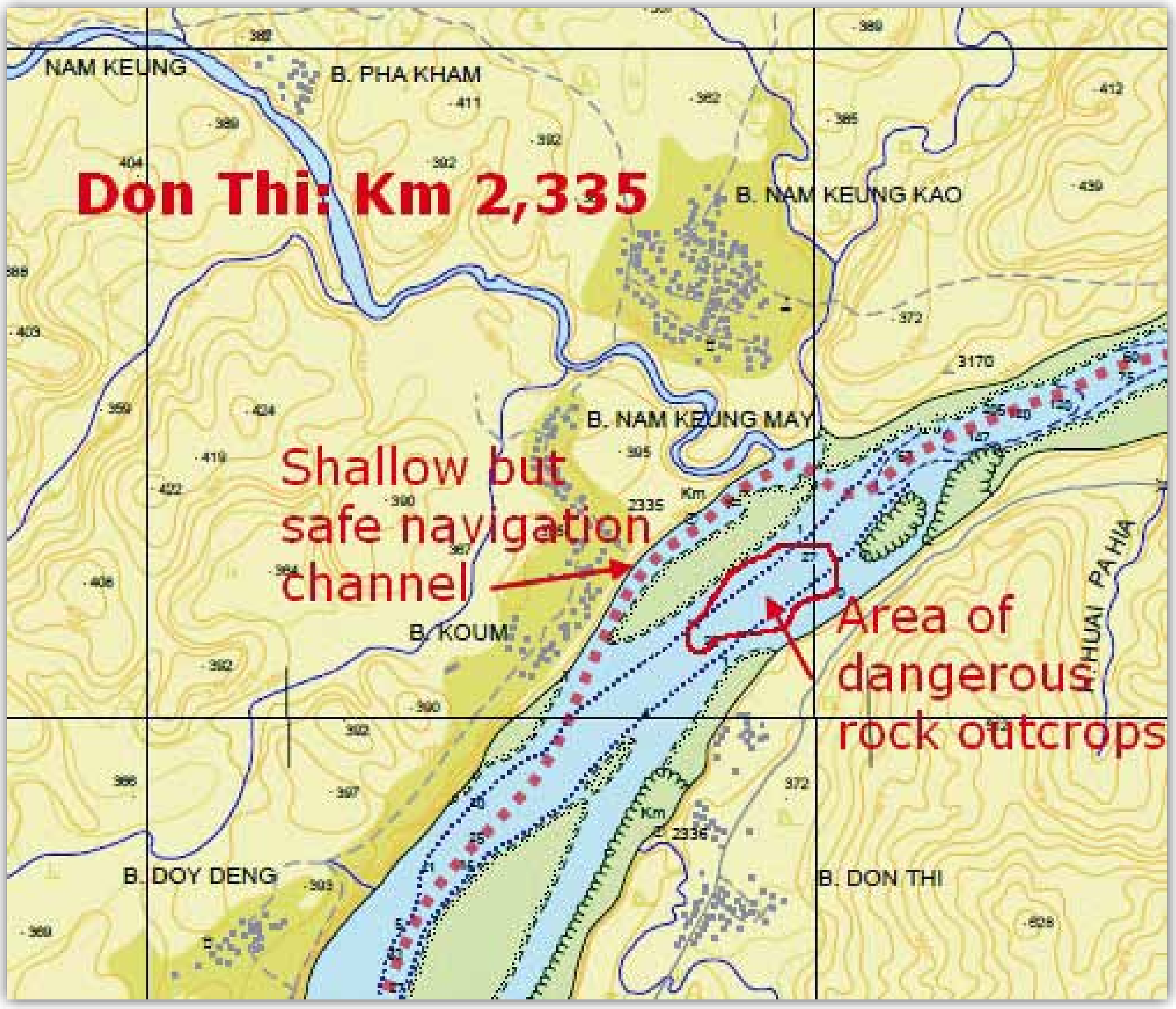


Figure 111: **Don Thi (Km 2,335)**

Figure 112: **Image Showing Rocky Outcrops Near Ban Nam Keung**

(b) Khon Phi Luang or Pha Lac (Km 2,328.6)

Khon Phi Luang is the primary constraint preventing vessels from proceeding further downstream from Chiang Saen to Chiang Khong and Huay Xay. Pilots reported that the navigation channel at Khon Phi Luang is narrow, with a difficult rock island in the middle that creates two separate channels. Strong currents and a sharp bend are also present, making this a dangerous area unsuitable for cargo vessels.

Authorities were unable to obtain approval to remove the rock island in the middle of the river without a comprehensive EIA being submitted for assessment. The pilots and captains consulted during the project assessed this stretch as “red” during both the low and high-water seasons.

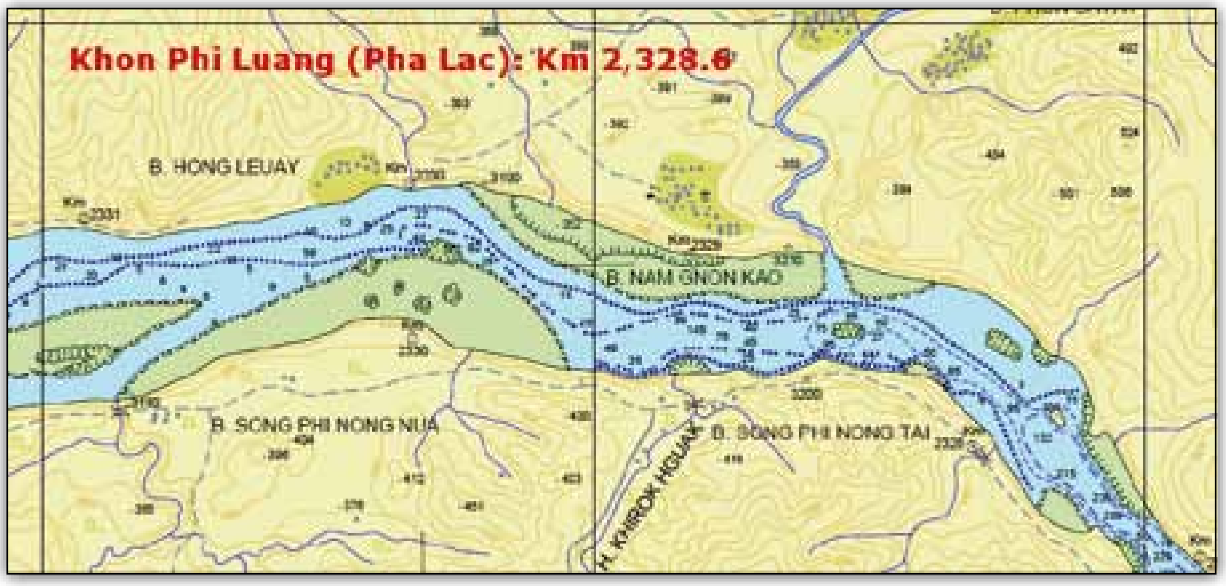


Figure 113: **Khon Phi Luang (Km 2,328.6)**

Figure 114: **Navigation Conditions at Khon Phi Luang (Km 2,328.6)**

The following grid is the summary of the Chiang Saen – Chiang Khong section:

Table 45: **Waterway Assessment- Chiang Saen to Chiang Khong**

CHIANG SAEN – CHIANG KHONG		
	Low water	High water
Waterway Geometrics	(red)	(red)
Waterway Hydraulics	(green)	(yellow)
Location of the hazard	(green)	(green)
Man-made conditions	(green)	(green)

5.3.1.3 Section Chiang Khong/Huay Xay (Km 2,314) to Pak Beng (Km 2,172): distance = 142 km

Many rapids and dangerous areas are present in this stretch, posing a substantial risk to navigation.

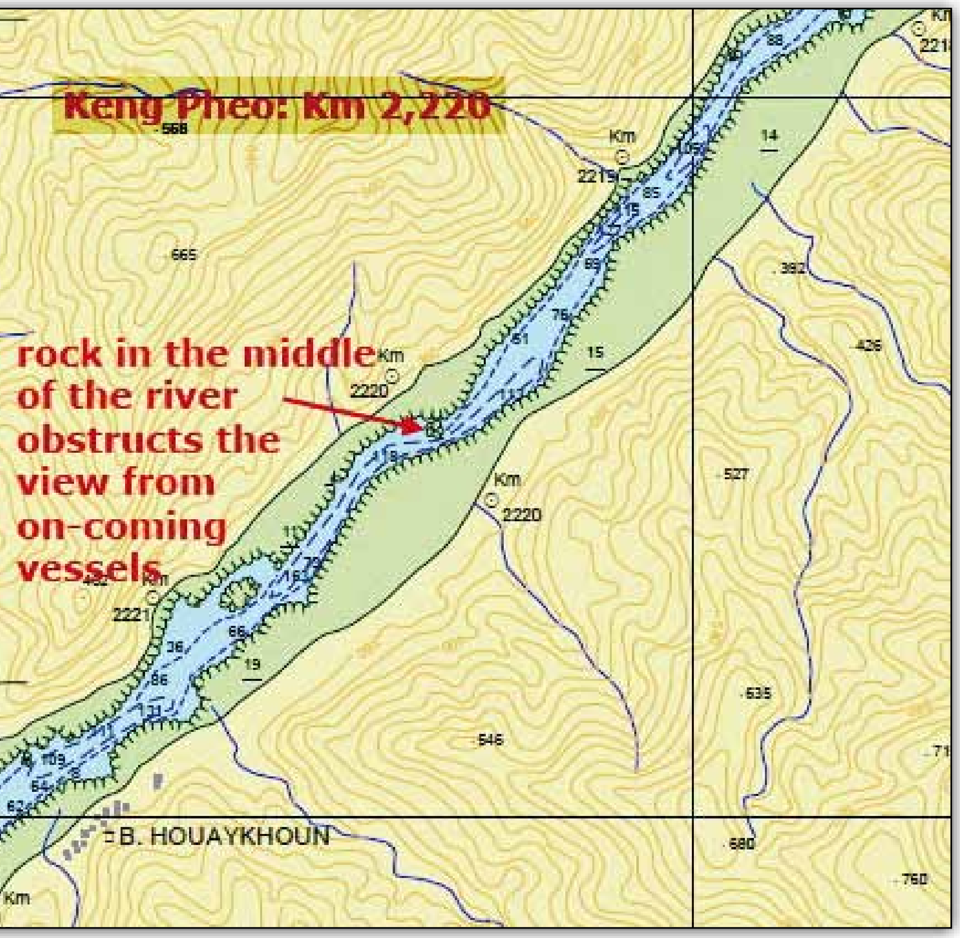
(a) Khon Din (Km 2,238)

Pilots reported that more aids to navigation should be installed in the Khon Din area. There are a few sharp bends and hidden rock outcrops which do not allow two vessels to pass each other at this spot. The river bed is rocky and shallow, with a high gradient and strong currents. There are turbulences, water upsurges and whirlpools.

Figure 115: **Khon Din (Km 2,238)**

(b) Keng Pheo (Km 2,220)

Dangers at this rapid are mainly caused by poor visibility. To mitigate this risk, a sheltered observation post has been established along the waterway on top of the rocks. This is the only way to ensure that two vessels do not engage this rapid from opposite directions at the same time.



At this location, the channel is narrow and currents are strong. There are submerged rocks near the right bank just upstream from the island, which prevent down-stream vessels from manoeuvring closer to the right bank in order to have a better view of approaching vessels coming from behind the island. As a result of the limited manoeuvrability in this area, there is a risk of collision if vessels are not notified of each other's position in advance.

The limitations on manoeuvrability in the narrow channel between the island and the right bank are further exacerbated by strong currents and whirlpools found in this area.

Figure 116: **Navigation Conditions at Keng Pheo (Km 2,220)**

Keng Pheo with the observation post in blue shelter on the rocks

(c) Keng Lae (Km 2,208)

Keng Lae features a number of sharp bends in the narrow channel. These bends are caused by several rock outcrops found near both the right and left river bank.

As a result of these scattered rock outcrops, this area is not suitable for cargo vessels transporting dangerous cargo. The rock outcrops are often partly or fully submerged, posing an unacceptable risk to navigation.

Figure 117: **Navigation Conditions at Keng Lae (Km 2,208)**

The risk assessment due to waterway hydraulics has been assessed as "yellow" during low-water level conditions (Khon Din and Keng Pheo) and "red" during high-water level conditions.

5.3.1.4 Section Pak Beng (Km 2,172) to Luang Prabang (Km 2,010): distance = 162 km

(a) Keng Leuk (Km 2,031)

Keng Leuk, situated between the Tham Thing cave (river mouth of the Nam Ou) and Luang Prabang, was assessed by the pilots to be an extremely dangerous rapid during low-water conditions. In April 2011, a cargo vessel loaded with cement heading upstream to China hit a hidden rock near the left bank and became stranded on the right bank where it sank. A number of factors contributed to this incident. The navigation channel here varies between the dry season and the wet season. During the dry season, vessels take the red-green gate (old French channel markers) which is narrow with a sharp S-bend. During the wet season, the gate is skipped and the vessels stay close to the left bank to travel upstream. Furthermore, many rock outcrops are close to the navigation channel and some of them have recently been marked by buoys to warn vessels of the danger. Some days prior to the incident, it was reported that a vessel snagged a buoy close to the left bank where many hidden rock outcrops are located. The buoy is reported to have been dragged out of its correct position, which may have contributed to the accident involving the cement-carrying vessel. The incident was not reported to the MRC.

Downstream of Tham Thing cave where this incident occurred is a very busy area. Many passenger vessels and small boats bring tourists to this region to visit the restaurants at the mouth of the Nam Ou and observe an impressive escarpment. These attractions bring thousands of tourists every month.

During medium and high-water levels, the old French markers here are submerged. Vessels then use the high-water navigation channel which passes close to the left bank. At these times the submerged obstacles (hidden rock outcrops and old French markers) are deep enough to no longer hinder navigation.

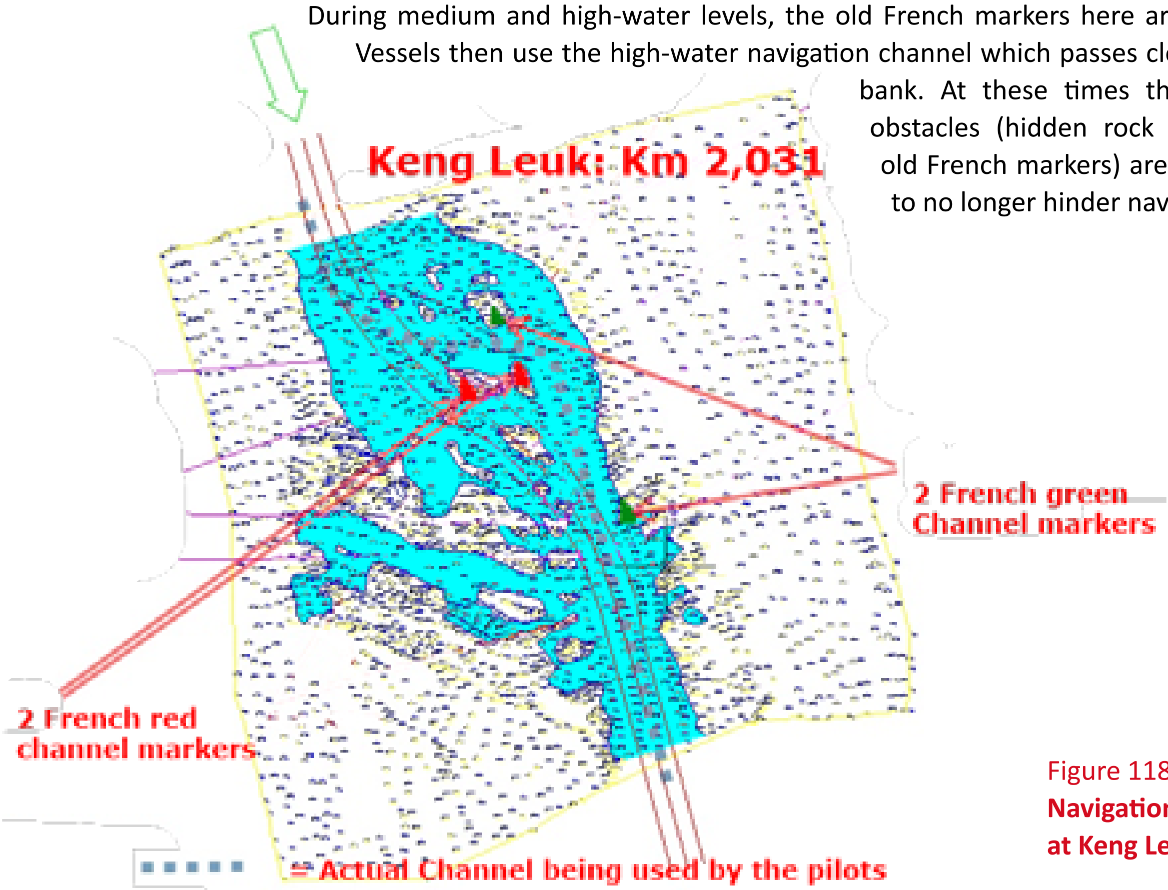


Figure 118:
Navigation Channel at Keng Leuk (Km 2,031)

Figure 119: **French Channel Marker Near Kheng Leuk (Km 2,031)**

(b) Keng Khen (Km 2,052)

Keng Khen is a dangerous area which was surveyed during the Condition Survey of Dangerous Areas for Navigation between Hay Xuay and Luang Prabang (DA20). It contains a number of islands and rock outcrops. There are two narrow channels, one for upstream vessels (blue on the satellite image), tending more to the right bank, and another for downstream vessels (red) which tends towards the left bank. Rock outcrops in the downstream channel are the most dangerous in this area as these are all located in the middle of the navigation channel.

A number of scattered rock outcrops upstream of the island contribute to making navigation in this area difficult and dangerous. During the wet season (high-water conditions), all vessels take the left channel (red) in both directions because of the strong currents and the large number of dangerous rock outcrops in the right channel.

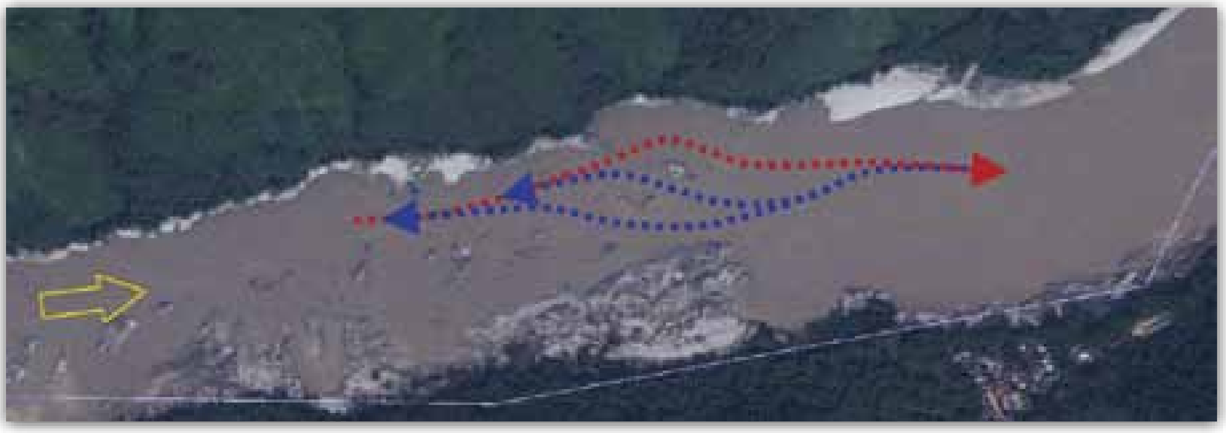


Figure 120: **Navigation Channel at Keng Khen (Km 2,052)**

(c) Lam Phay Nhay (Km 2,079)

This dangerous area, also surveyed under the Condition Survey of Dangerous Areas for Navigation between Huay Xay and Luang Prabang (DA18), has a couple of old French markers. The channel is narrow and provides poor visibility of approaching vessels. Currents here are strong and water upsurges make navigation extremely dangerous. Vessels have to make a sharp turn to avoid obstacles below the waterline as the following sequence of photos shows.

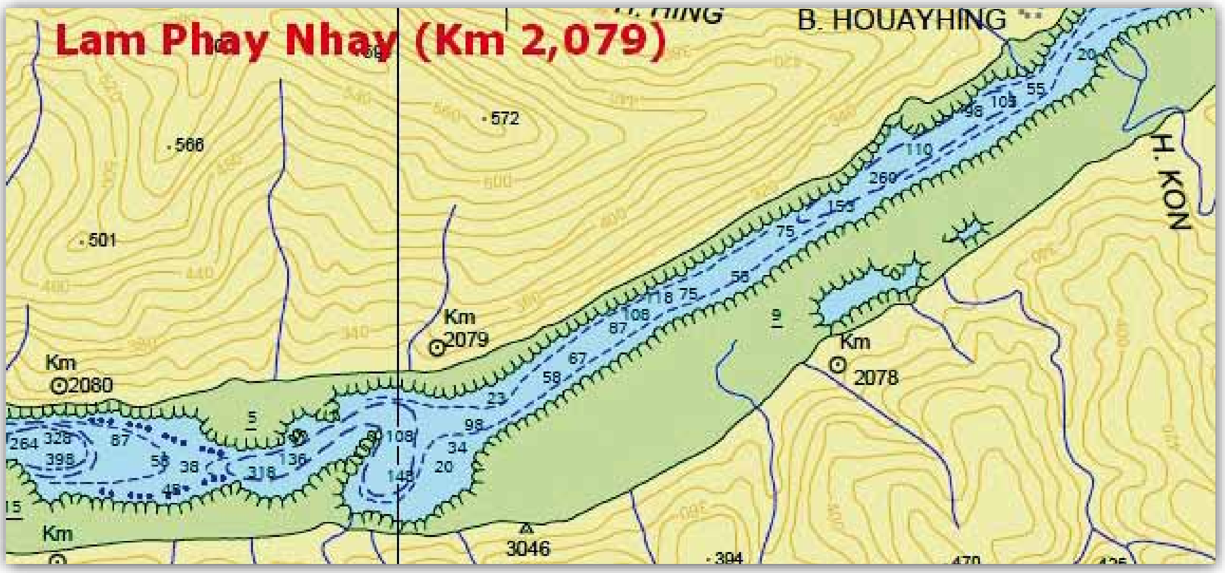


Figure 121: **Lam Phay Nhay (Km 2,079)**

Figure 122: **Lao PDR Cargo Vessel Approaching Lam Phay Nhay (Km 2,079)**

This sequence of photos on the previous page above clearly shows the difficulties that pilots and captains have to deal with to avoid submerged rock outcrops and upsurges. The last picture in this sequence shows the old French markers in the background (see arrow).

The picture below shows clearly how impressing an upsurge such as those found in the Lam Phay Nhay dangerous area can be.

Figure 123: **Waterway Condition Lam Phay Nhay (Km 2,079)**

The waterway risk assessment for the section Pak Beng - Luang Prabang has been determined as "red" during both water-level conditions for both waterway geometrics and hydraulics. Although situated upstream of the historical city of Luang Prabang, it is not considered a threat with regard to ''location of the hazard.'' This assessment is due to the fact that navigation in this section is presently limited in size and tonnage. The degree of possible pollution due to spillage of dangerous goods actually transported or possibly being transported is minimal due to the absence of any dangerous goods traffic and therefore this has been assessed as "green" during both water-level conditions.

Table 46: **Waterway Assessment Pak Beng to Luang Prabang**

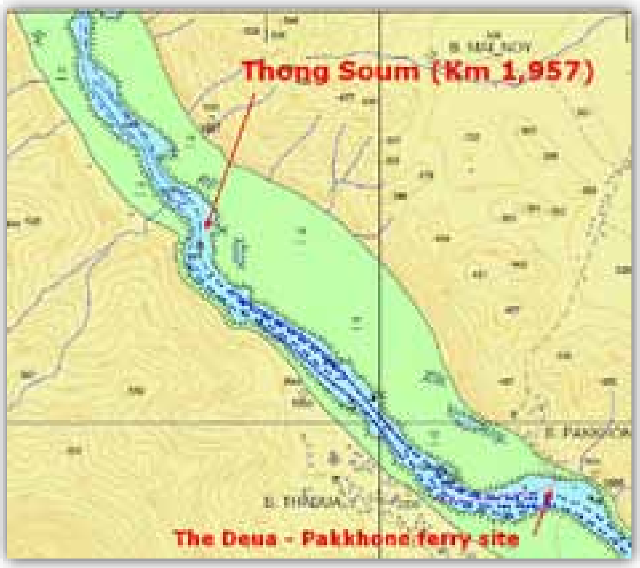
PAK BENG – LUANG PRABANG		
	Low water	**High water**
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.3.1.5 Section Luang Prabang (Km 2,010) – Pak Lay (Km 1,800) – Vientiane (Km 1,585): distance = 425 km

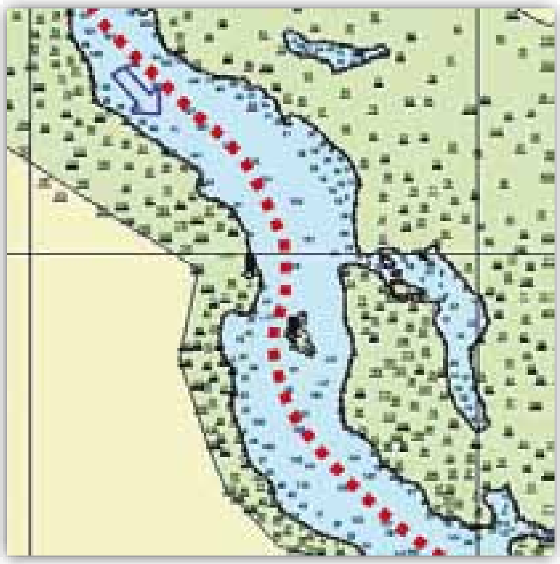
(a) Keng Thong Soum (Km 1,957)

Keng Thong Soum was another dangerous area for navigation that was identified and surveyed during the Condition Survey of Dangerous Areas for Navigation between Huay Xay and Luang Prabang (DA01). This stretch of river was described as a “twisted fast channel”.

This spot is situated approximately 2 km upstream of the Tha Deua-Pakkhone ferry.



The map excerpt above comes from the UHA atlas and shows little details of the dangerous area



The view above is an excerpt of the condition survey which was carried out at this location

Pilots report heavy turbulence and strong currents which propel vessels towards the rocky and steep river banks. The bends in this section are very sharp and downstream vessels have difficulty in steering away from the rocks.

The satellite image highlights the difficulty of this narrow bended channel. The image was taken during high waters as the left river bank (rocky platform) is completely flooded and submerged.

Figure 124: **Satellite Image of Keng Thon Soum (Km 1,957)**

(b) Keng Si Nhok (Km 1,945)

Keng Si Nhok, known as HS02 under the Condition Survey of Dangerous Areas for Navigation between Huay Xay and Luang Prabang, is situated 10 km downstream of the Tha Deua Pakkhone ferry site. This dangerous area is characterised by a prominent series of islands situated in the middle of the navigation channel, reducing its operational width to only 31 metres at chart datum. Currents are extremely strong with frequent vortexes. Keng Si Nhok is considered to be one of the most dangerous areas between Luang Prabang and Vientiane. However, ships can pass all year round due to sufficient water depths.

Most of the pilots consulted ranked Keng Si Nhok as the rapid of most concern (in terms of risk and danger) between Luang Prabang and Vientiane.

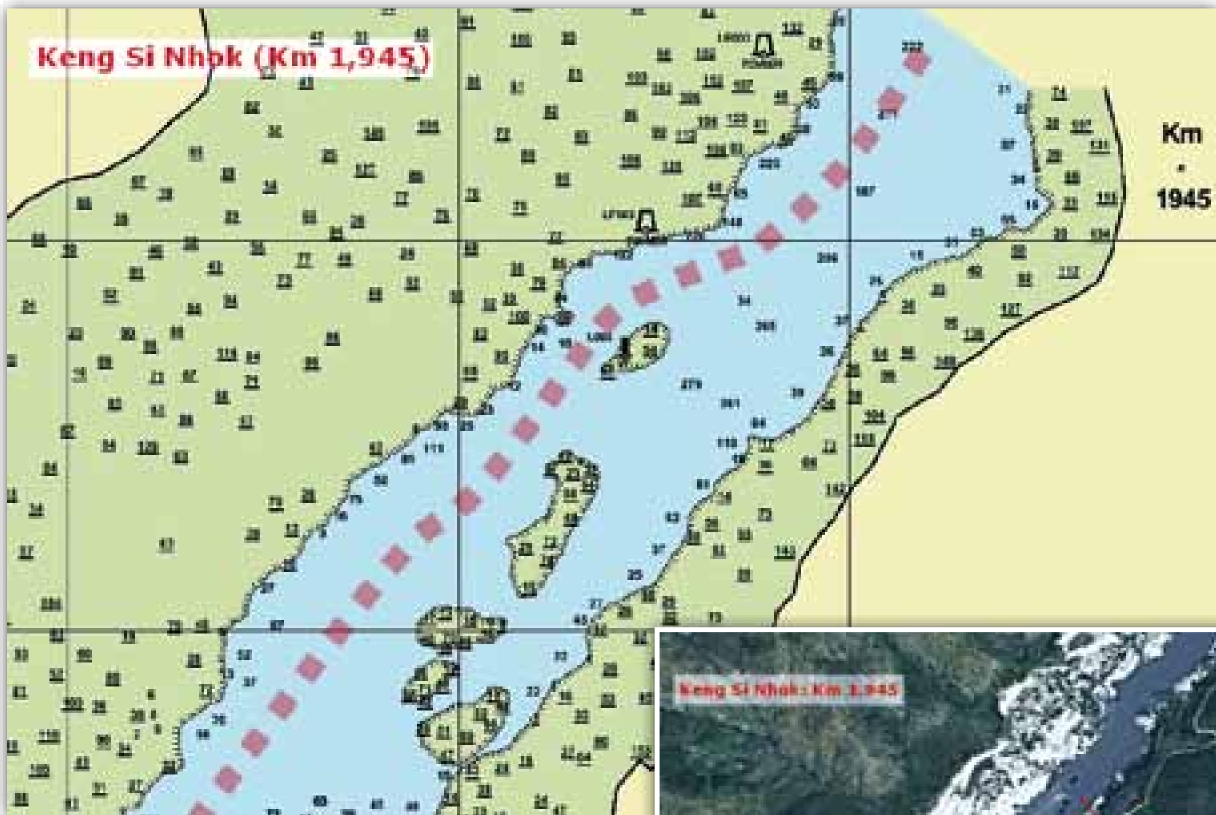
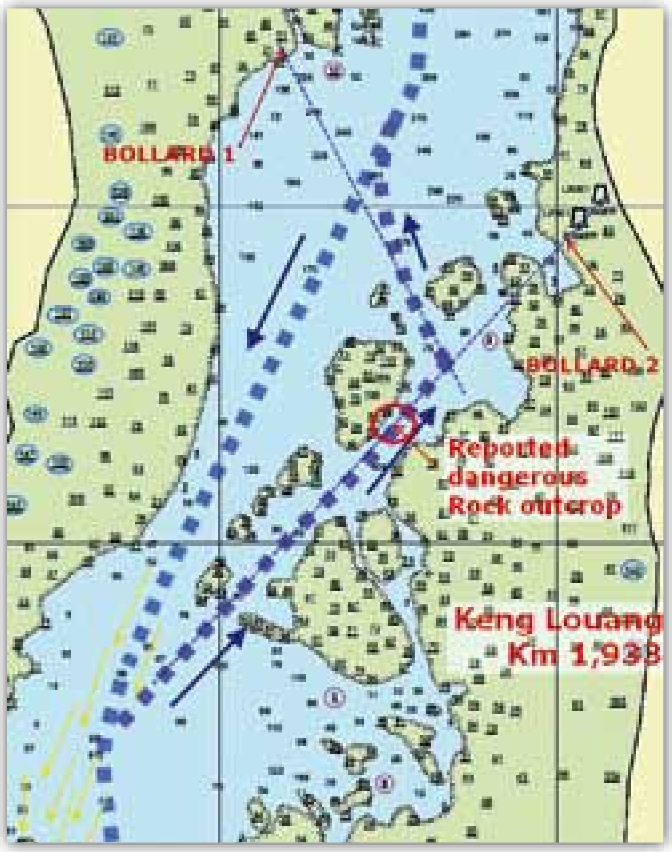


Figure 125: **Keng Louang (Km 1,933)**

(c) Keng Louang (Km 1,933)

Keng Louang, which translates as "Most Important Rapid'', was referred to as HS03 under the Condition Survey of Dangerous Areas for Navigation between Huay Xay and Luang Prabang. The rapid has been fitted with two bollards, allowing vessels with insufficient engine power to be winched up the rapid. As a result of the winching process, the course taken by vessels travelling upstream is different from the "downstream channel." However, both channels are considered very dangerous and complex.

The "upstream channel" at its narrowest point is only 20 metres in width. The major difficulty in this rapid is a hidden, partially submerged rock outcrop adjacent to the largest island. This submerged rock has already caused substantial damage to a number of vessels and pilots consulted have requested the immediate removal of this obstacle to prevent further incidents. During the low-water season, there is insufficient water depth in the ''upstream channel'' and the currents are too strong for vessels to pass in this direction. Vessels with limited horsepower have to be pulled up by cables from the two bollards which have been installed. In addition to the primary concern of submerged rocks and fast flowing currents, the upstream section also features a bend with a radius of at most 100 m which further complicates traversal of the rapid. The upstream channel is used only during the low-water season. Once the island separating the upstream channel from the downstream channel is submerged all vessels take the downstream channel.



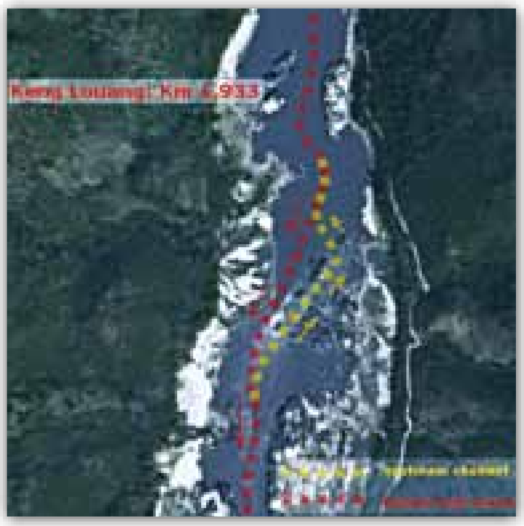
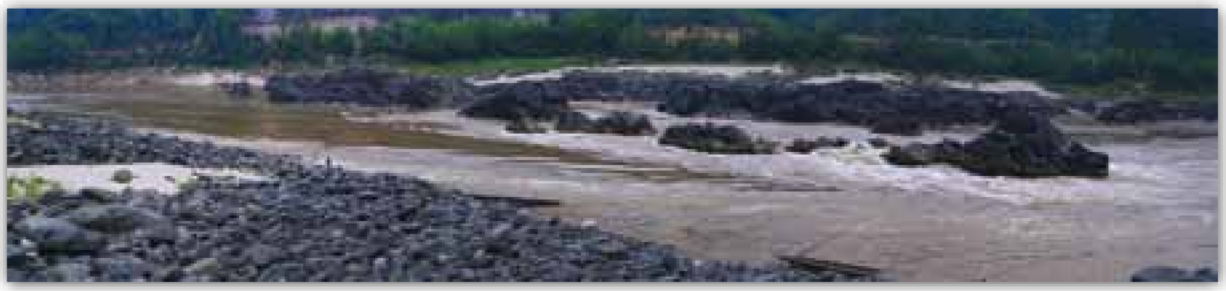


Figure 126: **Keng Louang (Km 1,933)**

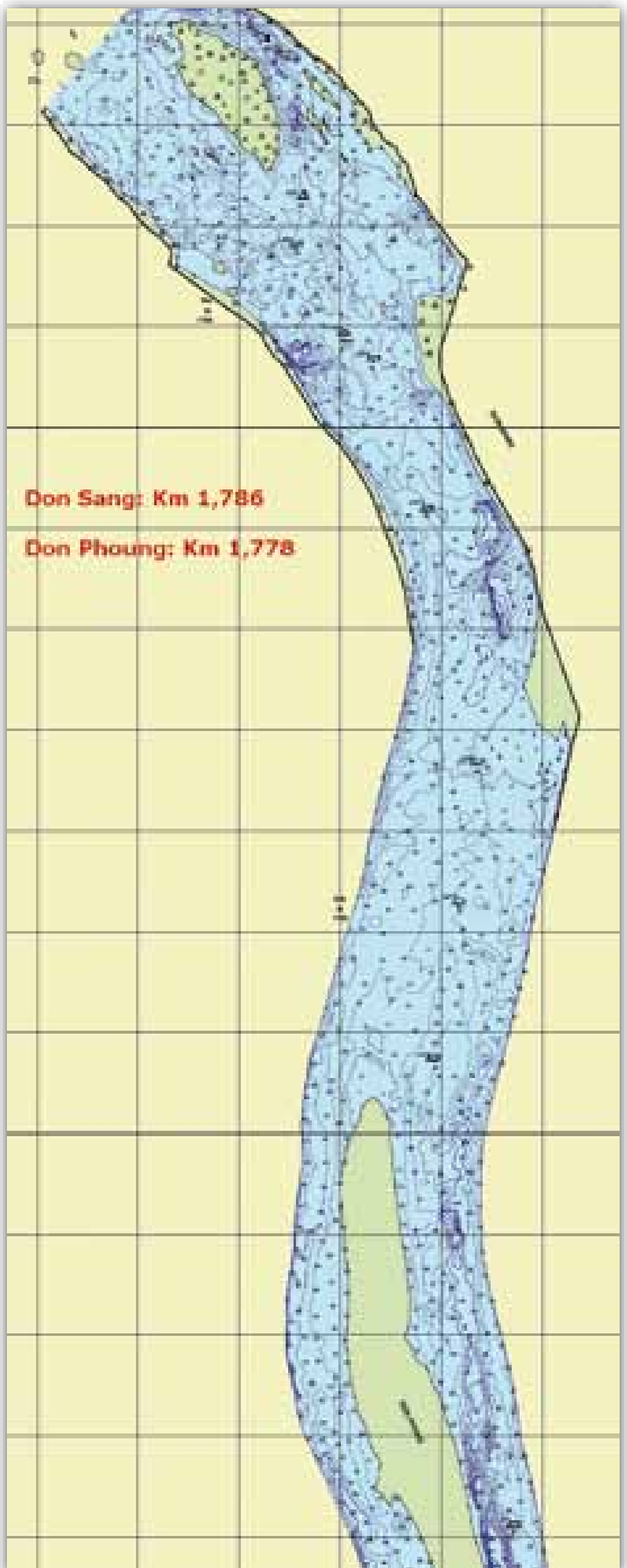


Panoramic view from Keng Louang, showing the funnel-shaped strong current in the downstream channel. The downstream rocky peninsula, right in the picture, does not seem to be too big a problem for shipping. This rapid shows a great level of difference (waterhead) often exceeding 75 cm.

(d) Don Sang - Don Phung (Km 1,786 - Km 1,778): distance = 8 km

Pilots consider the Don Sang to Don Phung section to be very difficult to navigate due to the limited water depth. The river bottom here is sandy although there are a few scattered rock outcrops.

In addition to the limited depth in this region, the channel is highly dynamic. Pilots report that the channel can require repeated surveying as often as every week. Vessels must often wait in this area until a small boat is able to verify the channel by testing the depth with bamboo poles. Only once this process has completed may a vessel safely pass in the dry season. The survey methodology is not sufficient to verify the channel width along the entire stretch.



Despite these limitations, there is no major risk of spills or environmental damage posed by this difficult area. The most severe outcome of an incident in this area would likely be a cargo vessel carrying dangerous goods becoming stranded on a sandbank, which should not result in a spillage.

Figure 127: **Don Sang – Dong Phung (Km 1,786) to (Km 1,778)**

(e) Keng Chan (Km 1,655)

Keng Chan was surveyed during the Condition Survey of Dangerous Areas for Navigation between Luang Prabang and Pakse (HS-08). Although the location is officially designated as Km 1,655, the rapid stretches cover several kilometres. An additional area in this stretch was designated HS-08A during the condition survey. Waters in this narrow channel are very turbulent, with strong currents, frequent sideways currents and tricky bends.

Pilots report that once vessels have entered the rapid, they are committed to progressing to the end of the rapid, as there is no area to safely hold or manoeuvre to reverse course. Larger vessels headed upstream often require as much as 20 minutes to traverse the dangerous area. Attempting to pass oncoming vessels is extremely difficult and dangerous. Pilots often call each other by telephone to arrange the sequence of vessels moving through the rapid, with priority given to downstream vessels due to the shorter time it takes these boats to pass the rapid. Information on approaching vessels is also conveyed by passing speedboat pilots.

This is an extremely long and dangerous rapid that covers a much larger distance than that considered during the earlier condition surveys.

Figure 128:
Keng Chan (Km 1,655)

(f) Keng Mai (Km 1,752)

This dangerous area was also surveyed during the Condition Survey of Dangerous Areas for Navigation between Huay Xay and Luang Prabang (HS06). Here again, the risk of environmental damage from an accident is not that high, although the pilots reported a rocky river bed and some outcrops of rock on the left bank adjacent to the deep scour. There are very shallow areas up and downstream of the deep trench. Boats often have to stop here in the dry season if there is insufficient water available for them to pass.

Small boats are also used here to employ the bamboo pole method to identify the channel, similar to the approach used between Don Sang and Don Phung. Anecdotal evidence from the pilots suggests that more accidents have occurred here than Keng Si Nhok despite the relatively benign appearance of the waterway.

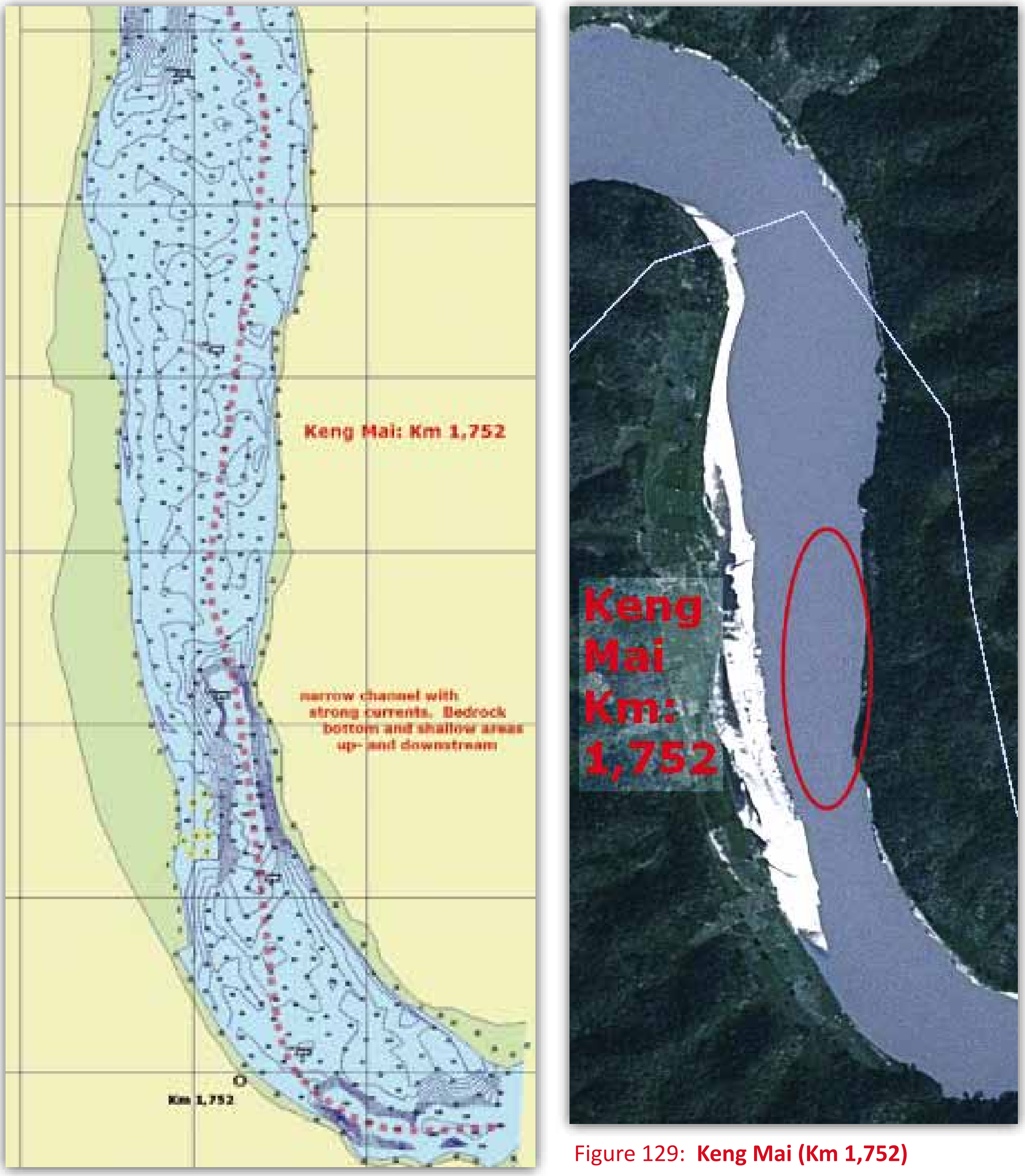


Figure 129: **Keng Mai (Km 1,752)**

The frequency and severity of dangerous rapids on this stretch result in the waterway risk assessment for the section Luang Prabang - Pak Lay - Vientiane being determined as ''red'' during both water- level conditions for both the waterway geometrics and hydraulics. Although some of the hazards are situated upstream from Vientiane, they are not considered a threat with regard to the “location of the hazard'' assessment. This classification is due to the fact that navigation in this section is presently limited in size and tonnage. The degree of possible pollution due to spillage of dangerous goods actually transported or potentially being transported (there are none for the time being) is minimal in regard to the ''location of the hazard'' and has therefore been assessed as ''green'' during both water-level conditions.

Table 47: **Waterway Assessment Luang Prabang - Pak Lay - Vientiane**

LUANG PRABANG - PAK LAY - VIENTIANE		
	Low water	High water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.3.1.6 Section Vientiane (Km 1,585) - Savannakhet (Km 1,126): distance = 459 km

(a) Keng Sadok (Km 1,370)

Keng Sadok was not considered as a ''dangerous area'' under the Condition Survey of Dangerous Areas for Navigation between Luang Prabang and Pakse.

This location has a sharp bend with severe constraints to manoeuvrability due to the narrow channel. Pilots must endeavour to slalom their vessels through the obstacles. Many islands and several scattered rock outcrops hinder navigation here. There are no aids to navigation installed to provide guidance to pilots. During high-water levels, vessels tend close to the right bank (Thailand) where the water is deep enough and the bank provides a visual reference of vessel position.

The only serious problem is that the navigation channel has to be known to avoid hitting rocks and rocky islands. On a scale of 1 (easy) to 10 (very difficult) this hazard is quoted 5 to 6.

Figure 130: **Keng Sadok (Km 1,370)**

(b) Keng Ka Phouang (Km 1,157)

Keng Ka Phouang was surveyed during the Condition Survey of Dangerous Areas for Navigation between Luang Prabang and Pakse (HS 12). This area has a large number of rock outcrops and scattered islands, in a wide variety of sizes. The majority of these obstacles are submerged during high-water conditions, making navigation here extremely treacherous.

This dangerous area is very interesting as the navigation channel marked by the old French channel markers has sections that require vessels to proceed in a direction that is almost perpendicular to the current. For vessels travelling in a downstream direction, this section requires great skill and a suitably designed vessel with sufficient engine power to pass safely. The strength of the current here means that it is essential for the vessel to choose the correct entry point to the rapid as this sets it up to make the correct manoeuvres in the perpendicular sections. If an incorrect initial course is taken, the vessel will be unable to prevent being driven onto the rocks by the current here.

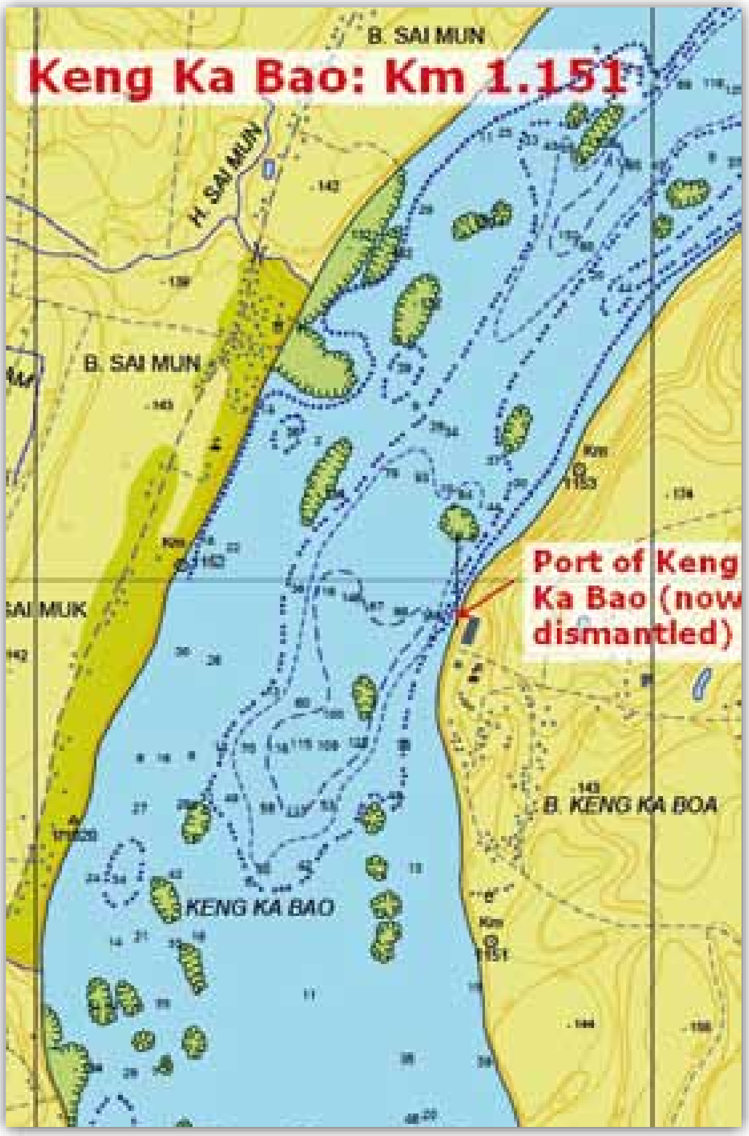
All pilots consulted agreed that this section should only be attempted by highly experienced pilots. Great precision is required by vessels making this turn. If the turn is taken too early, the vessel will impact the old French marker. If the turn is taken too late, the vessel will be driven onto the rocks downstream. Evidence of the difficulty involved in this manoeuvre could be seen in the area through vessel impact damage to the French marker T016, which had clearly been impacted by vessels that had misjudged the turn.

The map overlay shows the condition survey which was carried out in HS-12 relative to the Updated Hydrographic Atlas and recent satellite imagery. There is good correlation with the atlas but this is unable to be shown on the satellite imagery which was taken during high-water levels.

(c) Keng Ka Bao (Km 1,151)

Keng Ka Bao is a shallow rapid situated just downstream of the former port of Keng Ka Bao (at Km 1,151.9) that was originally used as the port for Savannakhet but was dismantled a number of years ago. Prior to the completion of National Road 13, the waterway was the only route available for regular cargo or passenger transport between the capital of Vientiane and Savannakhet. Keng Ka Bao also marks the start of National Road 9 to Viet Nam. The port facilities at the site are now abandoned and the warehouse (N = 16° 48’ 54.58”, E = 104° 44’ 47.54”) is being used for other purposes.

Rapids here were surveyed under the Condition Survey of Dangerous Areas for Navigation between Luang Prabang and Pakse (HS 13). Identifying the correct route through the hundreds of scattered rock outcrops and small islands in this stretch is quite difficult as no obvious route immediately presents itself. Aids to navigation once provided a guide to skippers here, but these have all now been destroyed by the impact of vessels or floating debris (large trees and other detritus), making this stretch challenging to those unfamiliar with the correct route. In addition to the lack of a clear course, the river bottom here is quite rocky and the close proximity of this site to the cities of Savannakhet and Mukdahan presents an additional risk factor.



Dangers in this area have now been exacerbated by the debris created by the destroyed channel markers which are usually submerged near the navigation channel itself, close to their original locations. The lack of durability of these channel markers can be explained by the absence of bedrock in this area, which is required to form a solid foundation into which to anchor the markers.

The waterway risk assessment for the waterway geometrics and hydraulics in the section from Vientiane to Savannakhet has been classed as ''yellow'' during low-water level conditions as a result of the aforementioned conditions. During high-water conditions the waterway geometrics assessment is elevated to ''green'' as the main obstacles for navigation are mitigated by increased water depths.

Table 48: **Waterway Assessment Vientiane- Savannakhet**

VIENTIANE - SAVANNAKHET		
	Low water	**High water**
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.3.1.7 Section Savannakhet (Km 1,126) – Pakse (Km 869): distance = 257 km

This section is known as the "Saravane area" situated on the "Saravana Plateau".

(a) Keng Khem Ma Rat (Km 1,038)

Keng Khem Ma Rat was surveyed under the Condition Survey of Dangerous Areas for Navigation between Luang Prabang and Pakse (HS15) and is detailed in the images below. This stretch contains a series of short sections that are dangerous to navigation. During periods of low water, these sections feature calm water running through canyons with vertical walls of between four and five metres in height. The calmness of this area during the dry season is contrasted with the extremely violent and turbulent waters found here during the wet season. Hazardous waters found here are caused by the submerged canyon topography. Two pictures below show the seasonal variation with the canyons visible in the Updated Hydrographic Atlas illustration, but completely submerged in the satellite imagery. During the dry season, the channel follows a zigzag course in order to avoid rock outcrops and the steep rocky river banks.

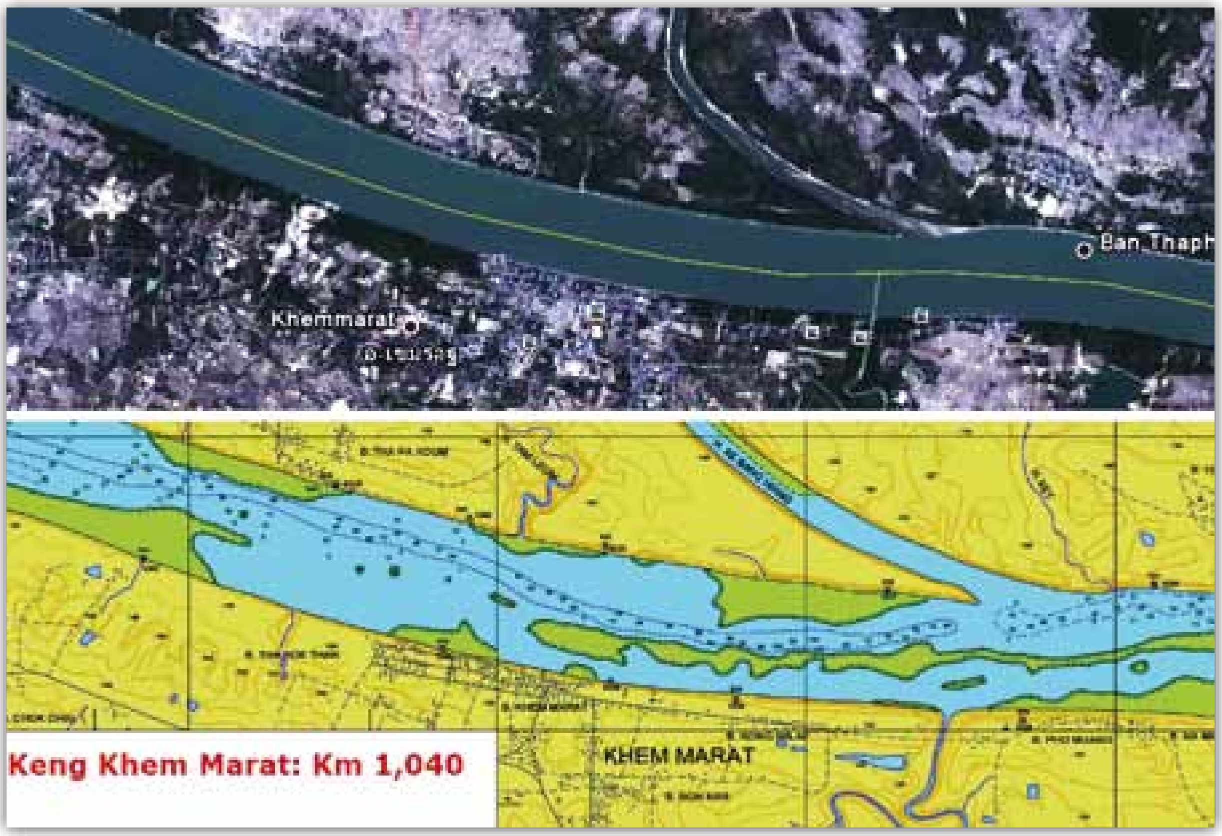


Figure 131: **Keng Khem Marat (Km 1,040)**

Only a few of the old French channel markers remain in good condition. Most of the old markers are damaged or destroyed from impacting vessels or floating debris and have now added to the dangers in this stretch.

The Saravane area is known for its shaky and turbulent currents during high-water season, often creating a number of confusing choices between various channels in the river, most of them unmarked and therefore highly uncertain. There is very little navigation in this section and no cargo vessels. Several dangerous areas in this region are well known and documented in the Condition Survey of Dangerous Areas for Navigation between Luang Prabang and Pakse. None of them have been physically surveyed as they appear to be ''safe'' during low-water conditions (gentle current and smooth water surface). During high-water level conditions, these dangerous areas are extremely tricky for navigation with shaky and turbulent water surfaces and as a result entirely unsafe for navigation. Keng Na Pha Nieng Thay (Km 989) and Keng Soum Soa (Km 983) are two such stretches, as well as:

(b) Keng Ma Vo (Km 974)

Keng Ma Vo translates as ''Crazy Dog''. This dangerous area is typical of the geography of the Saravane region and clearly demonstrates the canyon-shaped walls and the smooth water surface during low-water levels. During high-water levels, the river breaks out of its canyon-shaped river banks, hiding the actual location of the channel and creating enormous whirlpools and heavy turbulence.

The pictures below show the canyon-shaped walls of Keng Ma Vo between which the waters are relatively calm and quiet during the low-water season. At this time, the visibility restrictions through the bends are the only real safety hazard. Having said this, the radius of the downstream bend of Keng Ma Vo at Km 972-971 is quite large at an estimated 650-700 metres.

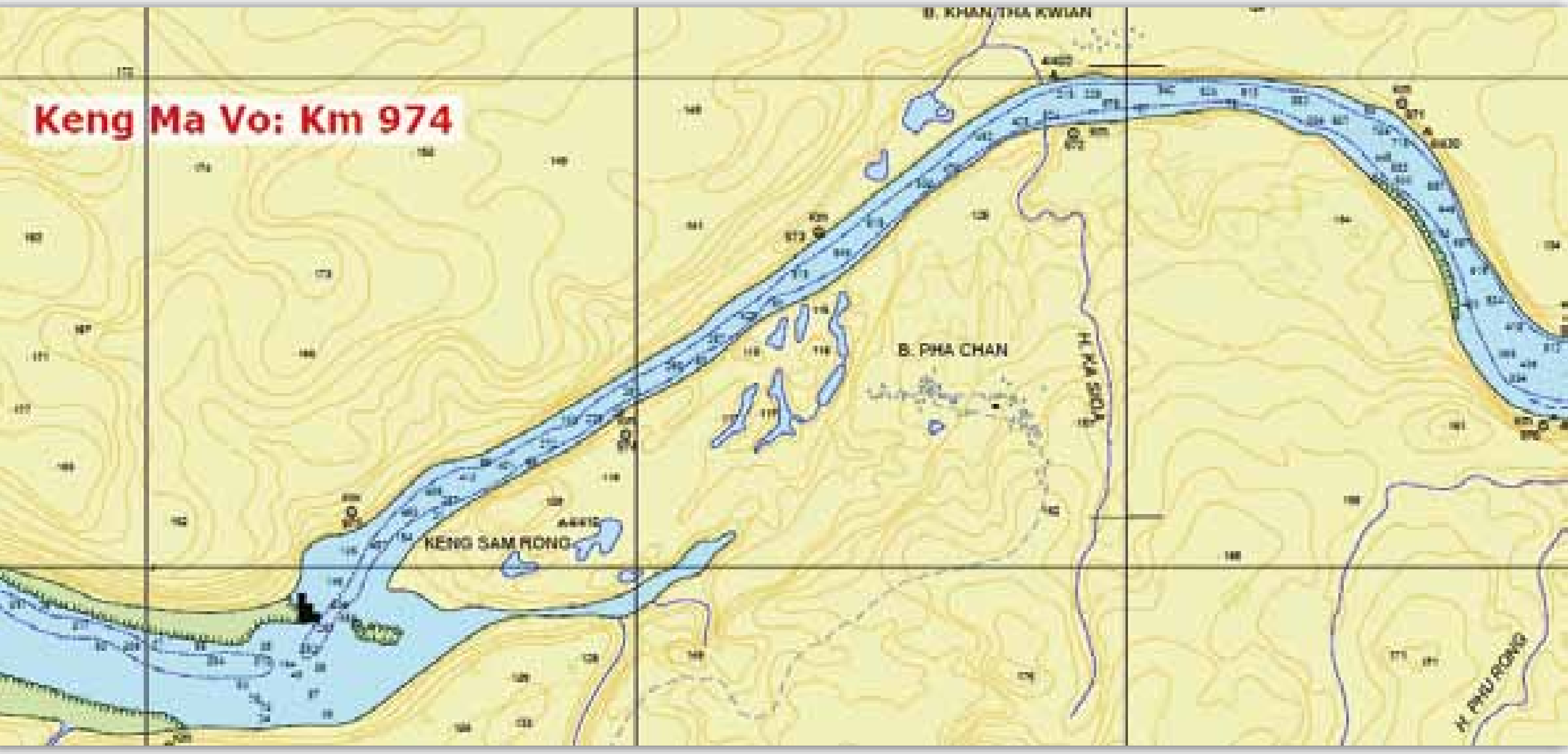


Figure 132: **Keng Ma Vo (Km 974)**

The aerial imagery here illustrates the narrowness of the canyon during the low-water period. The photographs below serve to illustrate both the height of the canyon walls during the low-water period as well as the limited visibility caused by curves in the river.

Figure 133: **Waterway Conditions at Keng Ma Vo (Km 974)**

During the low-water season, the waterway risk assessment for the section Savannakhet - Pakse is ''yellow'' for both waterway geometrics and hydraulics. This assessment is due to the limited visibility and narrow channel at this time of year. Due to the extreme level of hazard caused by Keng Khem Ma Rat, and to a lesser extent at Keng Ma Vo, both of the aforementioned assessments are elevated to "red" for the high-water season. There are no proximate conditions contributing to location of the hazard, nor are there any man-made conditions so these categories have both been assessed as "green" year-round.

Table 49: **Waterway Assessment Savannakhet –Pakse**

SAVANNAKHET - PAKSE		
	Low water	High water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.3.1.8 Section Pakse (Km 869) – Khone Falls (Km 721): distance = 148 km

Downstream from Pakse, there is very little navigation by larger vessels with the exception of some cross-river ferries. This is an extremely difficult section which is almost inaccessible for any cargo vessel of sizeable dimensions. It also incorporates a highly sensitive environmental area and the Siphandone region, which is one of the most popular eco-tourism destinations in Lao PDR. Despite the limitations to major vessels, many smaller passenger boats ply this section carrying tourists to many of the small islands in this river archipelago.

In terms of navigational risk management, this area is considered to be completely unsuitable for larger vessel navigation and transport of dangerous cargoes. There is also minimal impetus for major navigation in this area as the proximity to the Khone Falls results in a physical barrier to navigation. This barrier is illustrated in the composite map shown here.

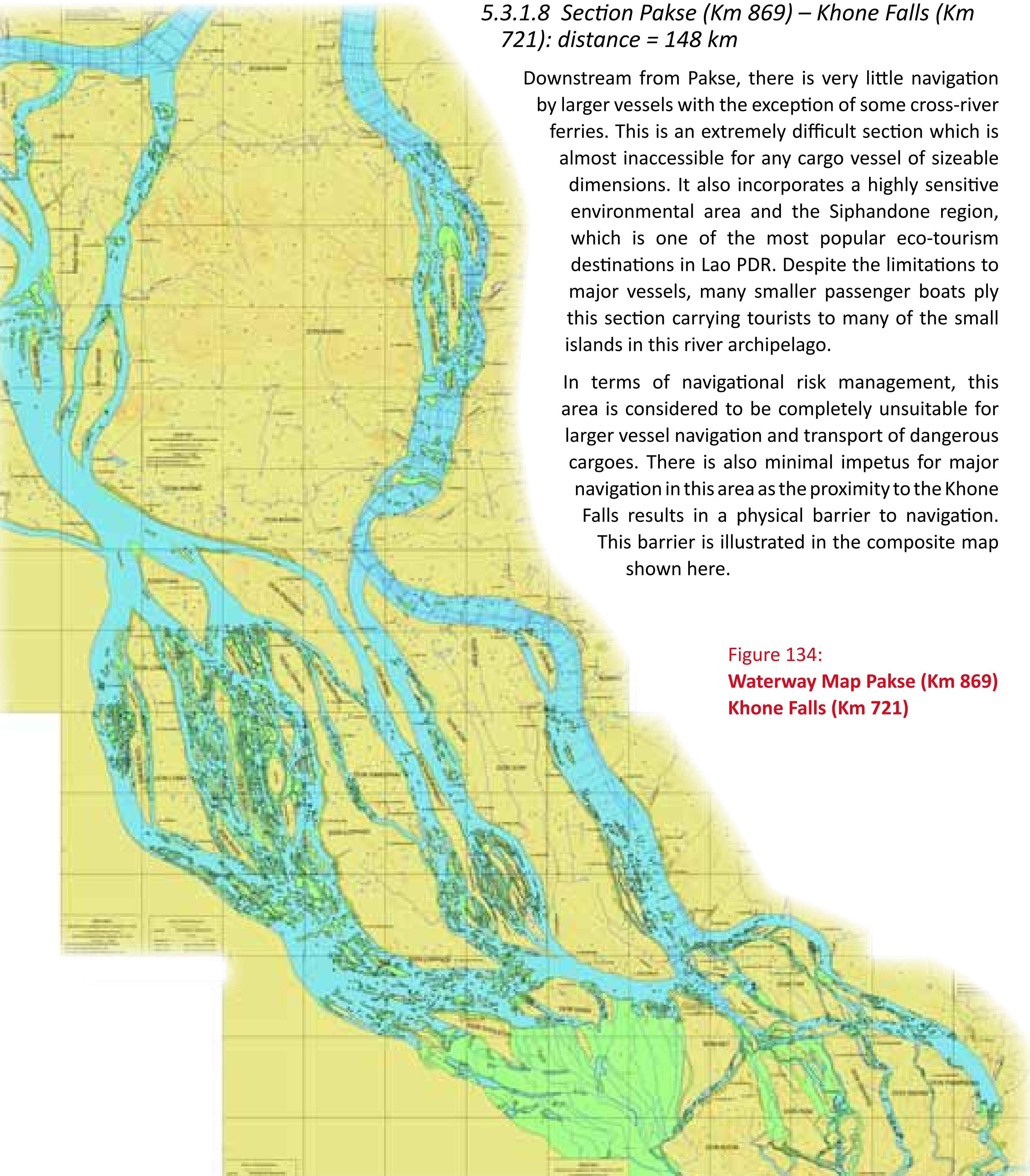


Figure 134:
Waterway Map Pakse (Km 869) Khone Falls (Km 721)

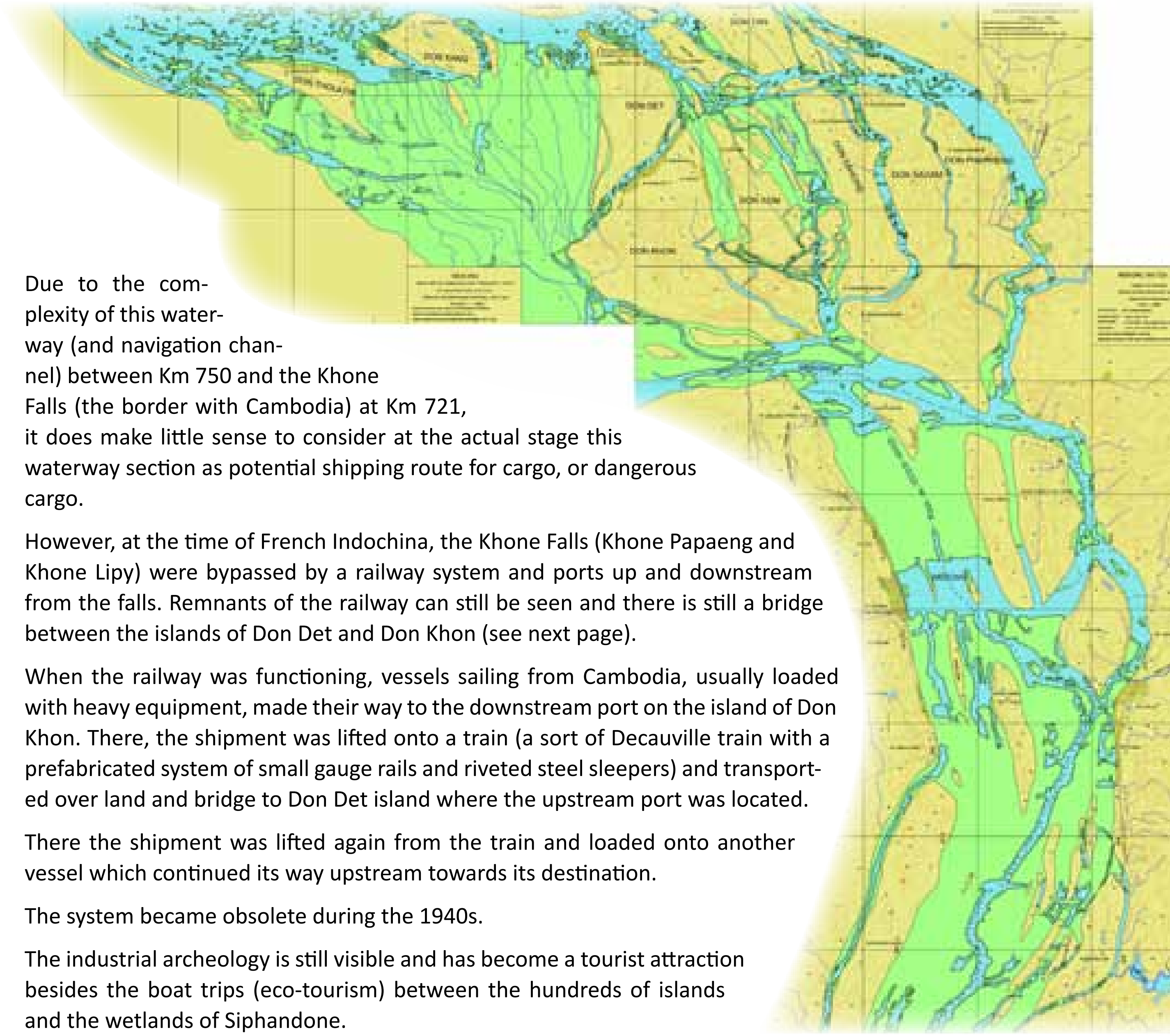


Figure 135:
Navigation Channel at Khone Falls (Km 750) to (Km 721)

Due to the complexity of this waterway (and navigation channel) between Km 750 and the Khone Falls (the border with Cambodia) at Km 721, it does make little sense to consider at the actual stage this waterway section as potential shipping route for cargo, or dangerous cargo.

However, at the time of French Indochina, the Khone Falls (Khone Papaeng and Khone Lipy) were bypassed by a railway system and ports up and downstream from the falls. Remnants of the railway can still be seen and there is still a bridge between the islands of Don Det and Don Khon (see next page).

When the railway was functioning, vessels sailing from Cambodia, usually loaded with heavy equipment, made their way to the downstream port on the island of Don Khon. There, the shipment was lifted onto a train (a sort of Decauville train with a prefabricated system of small gauge rails and riveted steel sleepers) and transported over land and bridge to Don Det island where the upstream port was located.

There the shipment was lifted again from the train and loaded onto another vessel which continued its way upstream towards its destination.

The system became obsolete during the 1940s.

The industrial archeology is still visible and has become a tourist attraction besides the boat trips (eco-tourism) between the hundreds of islands and the wetlands of Siphandone.

Commercial shipping no longer exists. The navigation channel is scattered with islands, sand banks and rock outcrops and there are virtually no aids to navigation.

This multimodal link, constructed by the French in 1893 (the year that Laos was added to French Indochina), consisted of a 7 km narrow-gauge track (initially 600 mm Decauville but later widened to 1 m) and a 170-metre bridge linking the two ports.

The presence of the Irrawaddy dolphin (*Orcaella brevirostris)*, a highly endangered species whose numbers have dropped from about 30 individuals in 1993 to about 10 today, is another environmental concern which rules out shipping of dangerous cargo.

Concrete structure to hoist cargo between the train and at vessels at the upstream port on Don Deth

Local port and arch-bridge between the islands of Don Deth and Don Khon

Remnants of a narrow-gauge stream train which linked the two ports

Collapsed French markers indicating the navigation channel towards the downstream port at Don Khon

Lyphy falls where all navigation stops

Navigation is impossible at Khone Phapaeng

The waterway risk assessment for the section Pakse – Khone Falls is “red” during both water-level conditions, not only for the waterway geometrics but particularly for the location of the hazard. The Siphandone wetlands and the highly sensitive and protected Irrawaddy dolphins turn this section into an impossible waterway suitable for the transport of dangerous cargo.

Moreover, the crippled navigational aids make navigation in this area extremely tricky given the complexity of the waterway system and the labyrinth of canals, waterways, islands, sand banks and rock outcrops, hidden or not.

Table 50: **Waterway Assessment Pakse - Khone Falls**

PAKSE – KHONE FALLS		
	Low water	High water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.3.2 Cambodia

Three waterway sections were included in Cambodia, each with their own navigation particulars:

1. Mekong between the border with Lao PDR (Khone Falls) and Kompong Cham;
2. Mekong between Kompong Cham and the border with Viet Nam, virtually accessible to seagoing vessels; and
3. Tonle Sap between Chaktomuk on the Tonle Sap River in Phnom Penh and the port of Chhong Kneas on the Tonle Sap Lake in Siem Reap.

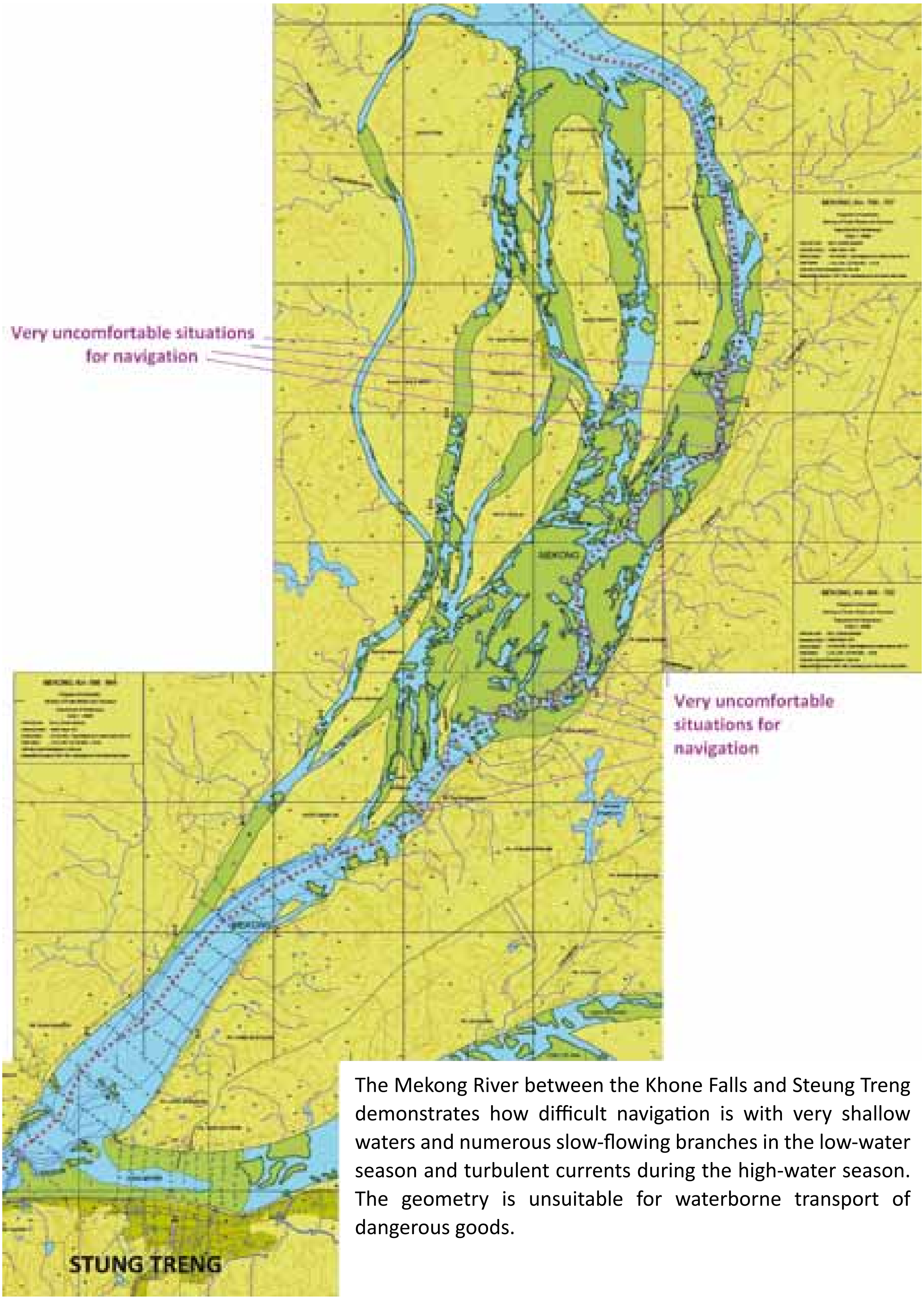
Sections 1 and 2 below are based on a desktop study and Section 3 was the subject of extensive consultations with pilots and waterway users between Phnom Penh and Chhong Kneas.

Between the Border with Lao PDR (Khone Falls) and Kompong Cham

5.3.2.1 Section Khone Falls (Km 721) – Steung Treng (Km 684): distance = 37 km

Local passenger transport is most significant in this section. The river remains tricky and with rocky outcrops and shallow, narrow, sharp bends. An excerpt of the navigation channel (dotted red 238 line) just upstream of the confluence between Mekong mainstream and Sesan tributary demonstrates the dangerous navigation conditions on this section.

Just downstream the Khone Phapaeng falls, there is an area where the critically endangered Irrawaddy dolphin (*Orcaella brevirostris)* is found. It is a popular site for eco-tourism and although a dolphin conservation project has been set up, numbers continue to decline.



The Mekong River between the Khone Falls and Steung Treng demonstrates how difficult navigation is with very shallow waters and numerous slow-flowing branches in the low-water season and turbulent currents during the high-water season. The geometry is unsuitable for waterborne transport of dangerous goods.

Figure 136: **Waterway Map Khone Falls - Steung Treng**

The risk assessment analysis of this river section is very similar to the section upstream from the Khone Falls to Pakse in Lao PDR. The geometry is unsuitable (also during high-water levels), waterway hydraulics during high-water level are turbulent, old French channel markers can be obstacles for navigation and the environmental aspect (location of the hazard) of the channel passing through wetlands and a dolphin conservation area result in the assessment below.

Table 51: **Waterway Assessment Khone Falls - Steung Treng**

KHONE FALLS – STEUNG TRENG		
	Low water	High water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.3.2.2 Section Steung Treng (Km 684) – Kratie (Km 561): distance = 123 km

The river section between Steung Treng and Kratie is very large and the channel very small. The section is scattered with hundreds of islands and shoals and there is an abundance of old French Channel markers, most of them in a good condition.

Bends are often very small in radius and unsafe from strong side currents. Once away from the channel, the situation becomes even more dangerous. Some locations are important dolphin habitats and shipping is required to reduce speed.

Navigation is very difficult and requires skill from the pilots. At low-water levels, most of the views are obstructed by the low vegetation growing on the sandbanks and the rocky outcrops. They are flooded during the high-water level and safety conditions are even more dangerous as the channel is lost (old French markers flooded) in these wide river stretches.

The multiple shoals and sand banks in this section make navigation difficult

Currents are often strong and the old French channel markers have suffered from multiple impacts

The excerpt here next from the UHA Atlas underlines the similarity with upstream sections and the difficult navigation conditions in the channel.

Several places in the channel have an S-shape, requiring vessels to make two 180-degrees U-turns to avoid rocky outcrops and islands.

Figure 137: **French Channel Markers Near Steung Treng**

There several old French channel markers, some of which have collapsed or are heavily damaged from vessel impacts and floating debris.

During the dry season, the river bed becomes a wetland. Dense vegetation obstructs the view of the channel and it requires good skills from pilots to align vessels in the right position for tackling the next ''gate'' (one red and one green beacon or channel marker in line with each other).

Currents are often strong and some rapids in this section produce heavy turbulence and strong currents, making navigation difficult.

This river section has the same risk analysis grid as for the upstream and downstream sections: geometry "red" during both of seasons, hydraulics "yellow" in both seasons) and the location "red'', due to the wetlands and the dolphin conservation area also "red”.

Table 52: **Waterway Assessment Steung Treng – Kratie**

STEUNG TRENG – KRATIE		
	Low water	High water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.3.2.3 Section Kratie (Km 561) – Kampong Cham (Km 448): distance = 113 km

In terms of risks, this section is much better than previous sections but plagued with shoals and unstable sand banks. Groundings are frequent, although pilots know very well their shipping route. Some of the shoals have, according to the UHA Atlas, not even one metre of water depth below chart datum. These places usually occur when the river has an important branch, very wide and with slow currents (little vertical gradient). The other branch is usually not navigable and mostly dry in the dry season.

A first shoal is encountered at Km 550 on the western arm of the Mekong. The eastern arm is not navigable.

In the adjacent map, all water depths of less than 1 metre have been highlighted by an orange circle. At Km 550, the river is 1,250 metres wide, while the eastern arm is 850 meters wide (very shallow and, according to the UHA Atlas, completely dry during the dry season). It is hard to believe that the full low-water discharge which is still some 1,250 m^3/sec (measured at Kratie [Km 561]) has to pass through this small wet section, roughly estimated at [415 m wide x 0.8 m avg deep =] 332 m^2. This would result in a corresponding speed of the current of 3.78m^3/sec (average). The eastern channel takes no discharge in low-water periods.

Current speeds of over 3m/sec have a scouring effect (deepening moveable river beds) but this is not confirmed by the shoal which is located in sand and silt.

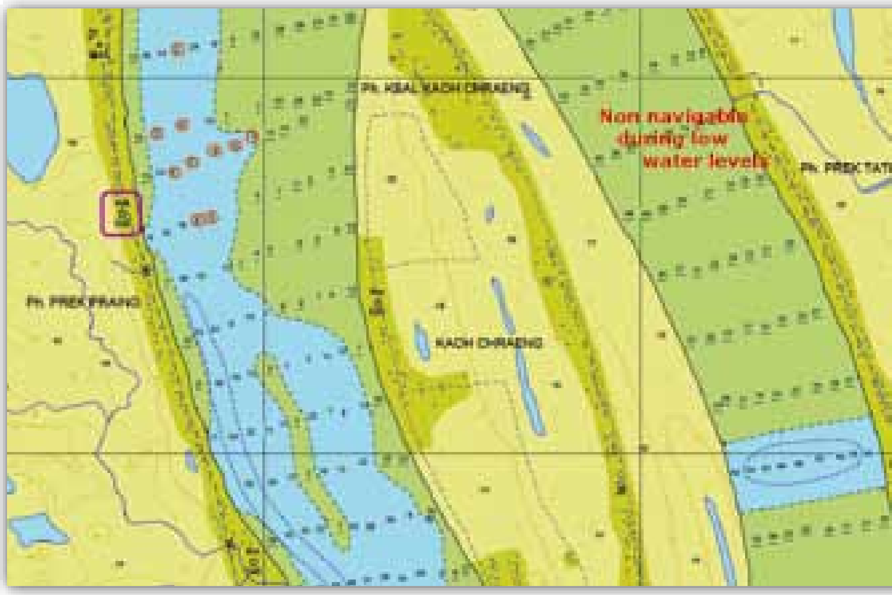


Figure 138: **Shoal Near Kratie (Km 550)**

Figure 139: **Strong Current Near Kratie (Km 561)**

An even more dangerous situation exists further downstream between Km 523 and 525. Here the river (monsoon-bed) is 1,260 metre wide but big parts are dry during the wet season. At least four sections have been identified in the UHA Atlas where the water depth does not reach even 1 metre below chart datum, increasing the risks of grounding and accidents.

At Km 496, a third shoal is a problem to navigation. The channel shifts here from the right bank (upstream) to the left bank (downstream) and this phenomenon always lead to shallow sand bars in the shifting area.

Figure 140: **Strong Currents Between Km 523 and Km 525**

The river is generally wide with a smooth flow. There are few rapids but quite a few shoals and sand banks.

Riverbanks are steep and erodible with severe erosion taking place every year after the annual flood

In this section, channel geometry presents some problems only during the dry season (yellow), while hydraulics pose no problem. There are a few wetlands of lesser importance.

Table 53: **Waterway Assessment Kratie – Kampong Cham**

KRATIE – KAMPONG CHAM		
	Low water	High water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

The Mekong between Kampong Cham and the Viet Nam border

5.3.2.4 Section Kampong Cham (Km 448) – Phnom Penh (Km 348): distance = 100 km

This section used to be sailed by seagoing vessels transporting rubber from Tonle Bet. In 1991, the last wooden pier able to accommodate seagoing vessels along the Mekong (for loading rubber and rubber wood) collapsed and maritime navigation stopped.

This waterway has recently been equipped with day and night navigational aids and safety has improved a lot. There are only a few spots along this river section which do not have sufficient depth for seagoing vessels going upriver to Kampong Cham. Even inland vessels struggle through these areas and groundings are often reported.

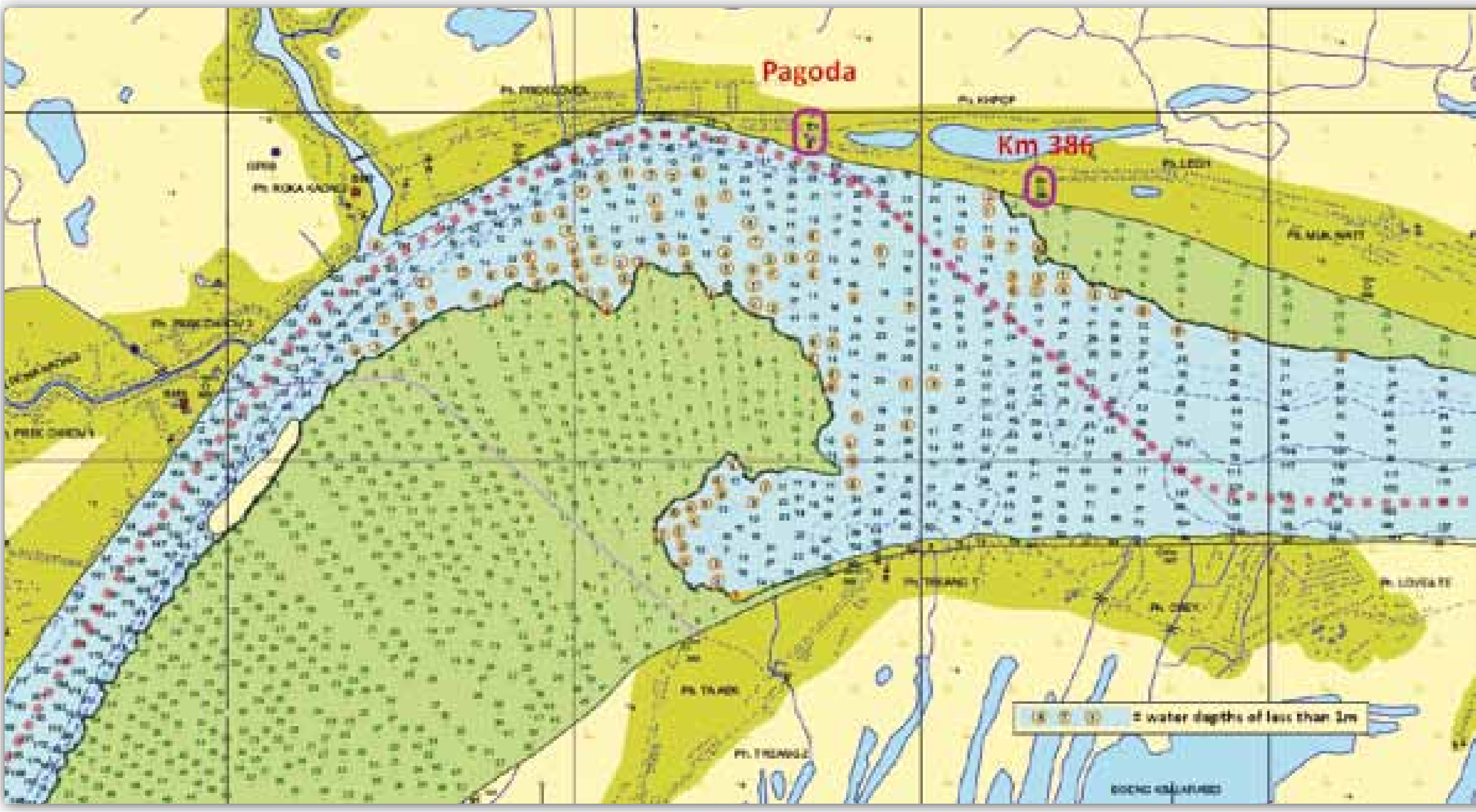


Figure 141: **Navigation Channel (Km 386)**

The area around Km 386 was dangerous to seagoing vessels for many years, and the pilots had to choose carefully the correct channel during low-water season. Even now, the inland vessels struggle at this location and continuous hydrographic surveys are needed to determine the unstable channel shifting from the left bank over the sandbar to the right bank. Pilots are in communication with each other and receive instructions to avoid grounding. In the UHA map excerpt on the previous page, an update after detailed hydrographic surveys, all water depths of less than 1 metre have been highlighted by an orange circle. The channel, which shifts from the left to the right bank, is guided by a temple on the right bank. This visual aid has worked over the last couple of years, despite the sandbar in the middle moving over the years.

At this particular place, the river is up to 3,110 metres wide. Consequently, the current is slow and the sediment abundant. The left arm around the smaller island at Km 382 (see picture) is dry and not navigable for most of the year. Some more shoals and shallow places in the river can be found downstream.

Another aspect which influences directly the safety of navigation and the transport of dangerous goods is the great number of ferries crossing the river. Most of these ferries are not meeting basic safety standards and often heavily loaded with vehicles, trucks and people.

The bridge at Kampong Cham does not have air-clearance indication for shipping

The Mekong downstream from Kampong Cham is broad, gentle and deep

River banks are often steep and subject to erosion during the annual flood season

Luxury passenger vessels sail between Phnom Penh and Kampong Cham

The bridge at Kampong Cham has no air-clearance indication for shipping

The Mekong downstream Kampong Cham: broad and gentle deep river

Ferry transporting vehicles across the Mekong

Dredging obstructs the navigation channels

Further downstream towards Phnom Penh, almost two thirds of the channel is blocked by a sand-dredging operation on the right bank. It is not known whether the floating pipe is illuminated at night. There are no buoys indicating this activity in the middle of the river. Monitoring and enforcement by authorities is limited by resources and budgets.

The risk assessment of this section in terms of geometry is ''green'' during both seasons but the man-made obstacles (ferries and dredgers) make the location of the hazard "yellow" in both seasons. The environmental risk of the water intake, being just upstream from Phnom Penh, could be considered ''yellow'' during low discharges.

Table 54: **Waterway Assessment Kampong Cham - Phnom Penh**

KAMPONG CHAM – PHNOM PENH		
	Low water	**High water**
Waterway Geometrics	green	green
Waterway Hydraulics	green	green
Location of the hazard	yellow	yellow
Man-made conditions	yellow	green

5.3.2.5 *Section Phnom Penh (Km 348) – Cambodia-Viet Nam Border (Km 251): distance = 97 Km*

This river section has received the highest attention from the Phnom Penh Autonomous Port (PPAP) under whose authority this river stretch falls. It is the backbone for the international and cross-border shipping bound for the port of Phnom Penh and the safety of the waterway is of the highest importance.

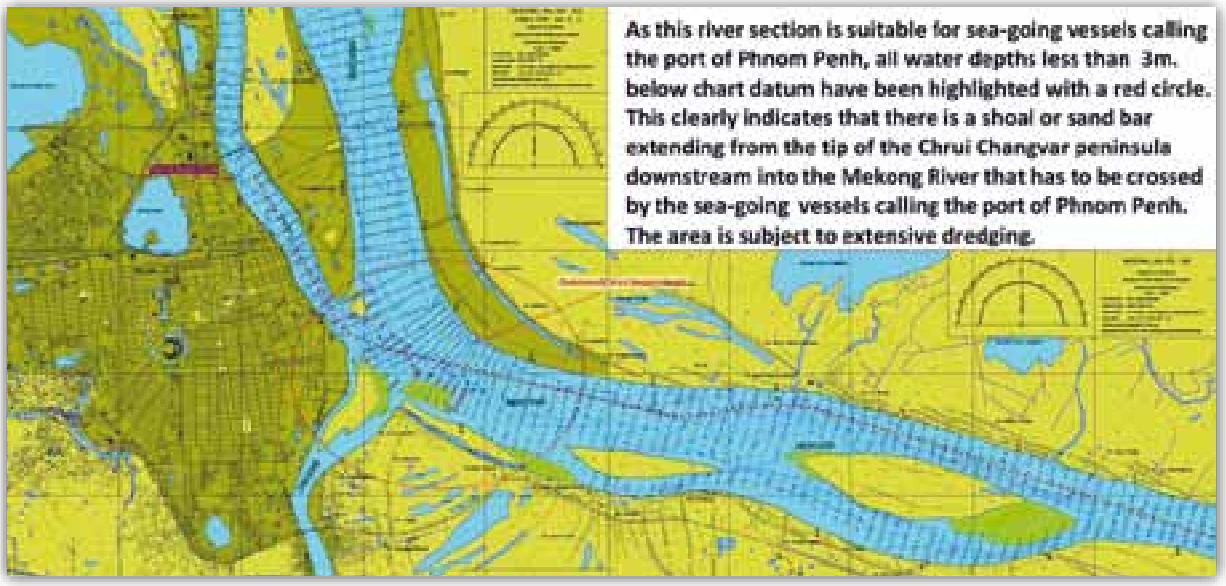
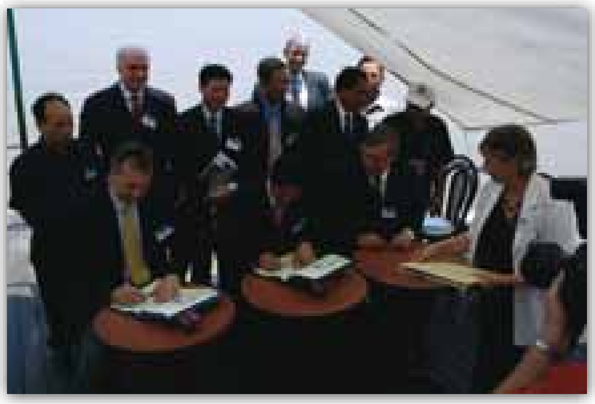


Figure 142: **Navigation Channel at Phnom Penh (Km 348)**

The waterway is generally good with only a few dangerous places, the first being Chaktomuk in front of the Royal Palace, where the four branches of the river meet. A second port for Phnom Penh is being built some 25 km downstream from Chaktomuk. One of the reasons for the new port is the extensive dredging that had to be carried out every year to ensure access to the port all year round. The Chaktomuk area is a very complex hydraulic system where currents change direction according to the time of the year. For decades, sand deposits just downstream from the southern tip of the Chruoy Changvar peninsula have obstructed water entering the Tonle Sap from the Mekong in the wet season. The MRC has a number of extensive studies related to this complex hydraulic situation and little can be done in river training works to maintain a deep channel between the Tonle Sap entrance and the downstream of the Mekong unless continuous dredging is undertaken.

Further downstream, the river is clear of all obstacles and an adequate aids to navigation system has been installed by by the MRC. This river section is suitable for both day and night navigation. The busy ferry site at Neak Luong (Km 293) will have less traffic once a bridge is completed.



On 5 April 2007 the first buoy was laid in the Mekong River in the Chaktomuk area. The ceremony was attended by numerous high-ranking officials including HE Mr Sun Chanthol, Cambodian Minister of Public Works and Transport, and HE Mr Jan Matthysen, the Ambassador of Belgium. MRC Chief Executive Dr Olivier Cogels also attended along with senior transport officials from Cambodia and Viet Nam.

The risk assessment for this river section looks good. All fields are "green" during both water-level conditions, even though this section is used by seagoing vessels for which the potential risk to the environment is higher.

Table 55: **Waterway Assessment Phnom Penh-Viet Nam Border**

PHNOM PENH – BORDER VIET NAM		
	Low water	High water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

The Tonle Sap between Chaktomuk on the Tonle Sap River in Phnom Penh and the Port of Chhong Kneas on the Tonle Sap Lake in Siem Reap

5.3.2.6 Section Phnom Penh (Km 0) – Kampong Chhnang (Km 99): distance = 99 Km

In this section and further upstream to Chnok Trou, day-and-night navigation is possible. The navigation channel doesn't show any particular obstacle which might endanger shipping activities. Most of the hazards are from wooden piles and old mooring facilities are broken and/or obsolete. The upper parts no longer exist but the lower submerged parts constitute a real danger. They are used for fixing fishing nets or for mooring fishing vessels.

Figure 143: **Sharp Bend in the Tonle Sap River**

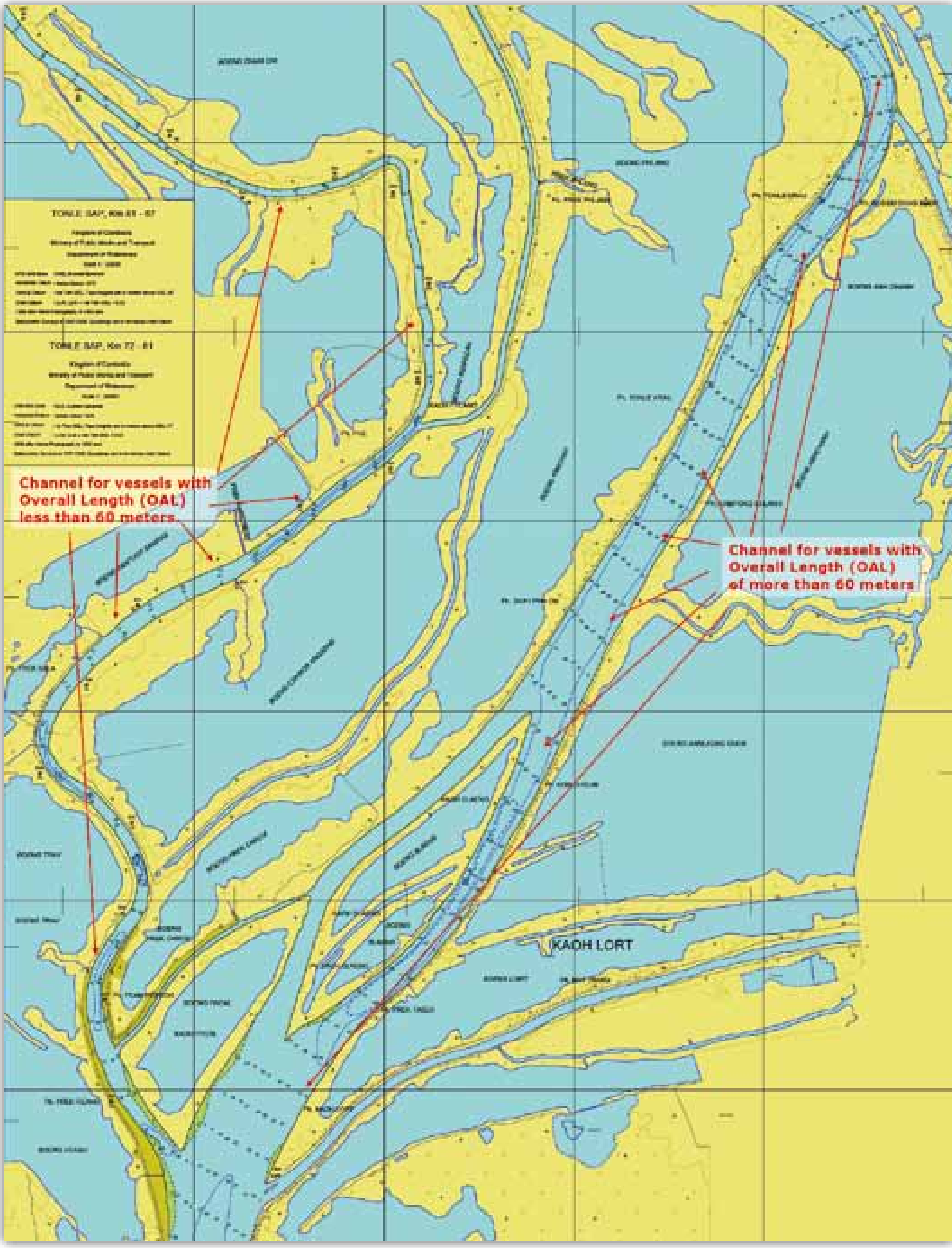


Figure 144: **Watrerway Map at Chnok Trou**

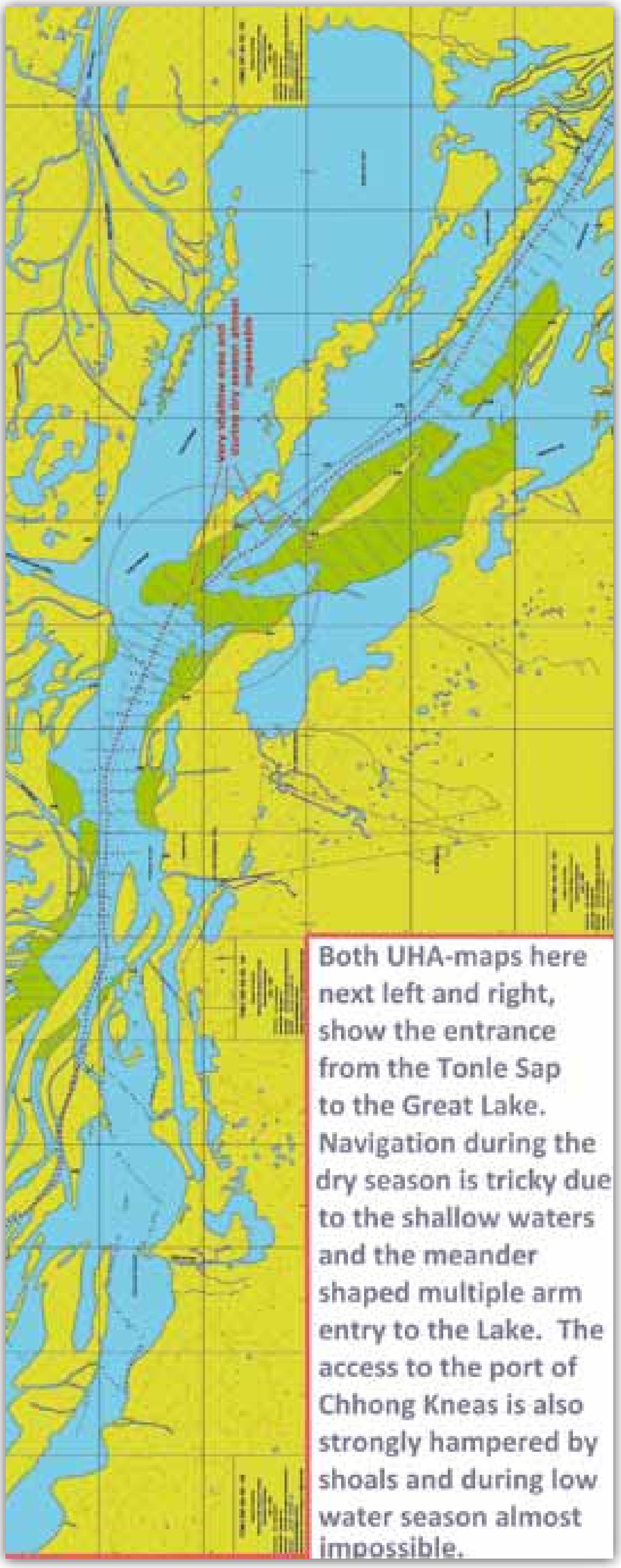


Figure 145: **UHA Map of Chhong Kneas**

From Km 69 on, there are two channels which access the Tonle Sap Lake, one for smaller vessels with overall length of less than 60 metres and another for bigger vessels. The smaller channel, which seems to be the one preferred by skippers, shows one particular sharp bend (curvature not more than 185 metres) at Km 82.3. Vessels move very slowly until they have enough visibility of oncoming vessels. Many near-collisions have occurred at this place.

This channel is rather shallow there is not enough depth during a certain period of the year. When water levels are high, air clearance under the bridges is not clear.

Pilots report that there is no significant cargo transport in this section. A small tanker transports petroleum between Phnom Penh and Chhong Kneas during high-water level conditions.

5.3.2.7 Kampong Chhnang (Km 99) – Chhong Kneas (Km 149 + approx 55 km): distance = 104 km

This stretch does not represent any significant hindrance to navigation during high-water levels. During the dry season, however, the water depths are minimal and not sufficient to let any vessel with draft over 0.80 m pass. Shipping to Chhong Kneas is not possible for the entire dry season.

With rising waters and the current flowing towards the Tonle Sap Lake in the wet season, the environmental aspect becomes very significant as any pollution will end up in the lake.

The entry to the Chhong Kneas port is a problem. Accessibility defines when shipping to Chhong Kneas has to stop, rather than the shallows at Chnok Trou. The access channel is shallow and muddy, and totally inaccessible for vessels of sizeable tonnage.

The risk assessment grid for both of the sections Phnom Penh - Kampong Chhnang and Kampong Chhnang - Chhong Kneas are as follows:

Table 56: **Assessment Phnom Penh – Kampong Chhnang**

PHNOM PENH – KAMPONG CHHNANG		
	Rising water	**Falling water**
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

Table 57: **Waterway Assessment Kampong Chhnang - Chhong Kneas**

KAMPONG CHHNANG – CHHONG KNEAS		
	Rising water	**Falling water**
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

In both of the above grids, difference has been made between "rising waters" (when the current reverses and flows upstream from Phnom Penh towards the Tonle Sap Lake) and "falling waters" (when the current flows downstream towards the sea as the lake empties). The direction of the current has a huge impact on the environmental risk in the first section Phnom Penh – Kampong Chhnang during the filling of the lake and the second section (between Kampong Chhnang, Chnok Trou and the entire lake) all year round.

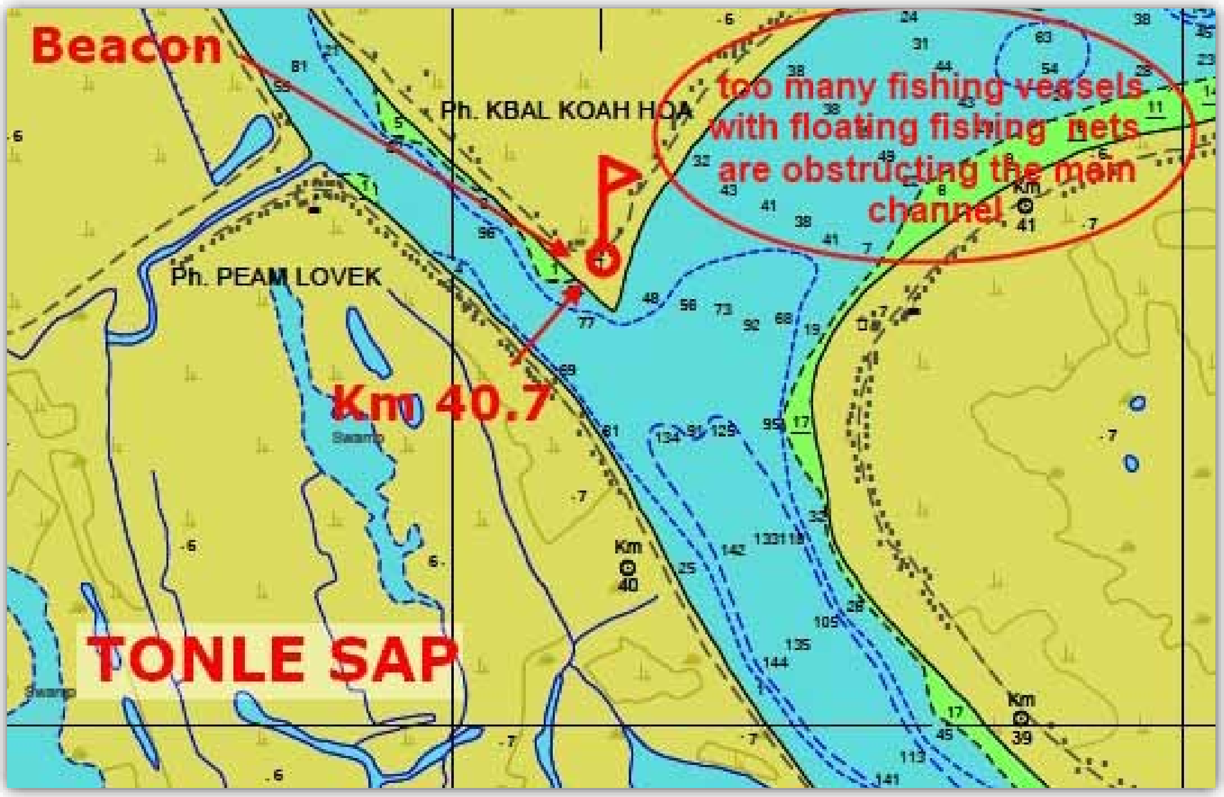


Figure 146: **Fishing Vessels Obstructing the Navigation Channel at Entrance to Tonle Sap Lake**

Between Phnom Penh and Chnok Trou, the smaller navigation channel for vessels with an overall length of 60 metres is on the right bank (the western channel) while the larger and deeper channel is on the left bank (eastern channel) and has many obstructions from fishing activities. Both channels are marked by beacons (day and night navigation). When water levels become low to very low, vessels often have no other choice than to take the deeper channel which in many places is conflicting with the fishing community's interests. Navigation in this deeper channel has become almost impossible and some sections have completely been closed for navigation.

Google Earth view of the first split at Km 40.7 from Phnom Penh where ships and other vessels choose their channel in accordance with their overall length.

Google Earth view and UHA map excerpt from the second split at Km 69.5

5.3.3 Viet Nam

The waterways in the Mekong Delta consist of two major systems. The first, the Mekong mainstream (Tieng Giang) between the border with Cambodia and the deep sea buoy at Cua Tien in the mainstream estuary, was long the main and only shipping route for seagoing vessels calling on Phnom Penh. The river is accessible for vessels up to 5,000 DWT. Major ports along this shipping route are My Tho, Vinh Long, Sa Dec, Hong Ngu and Tan Chau.

The second is the Mekong mainstream down to the entrance of the Vam Nao Pass then the Bassac River which is an alternative, and perhaps better, shipping route to Phnom Penh. Major ports along this shipping route are Can Tho and Long Xuyen. Upstream from Can Tho are numerous petroleum ports on the right bank. The Bassac River and Vam Nao Pass have been opened for seagoing vessels bound for Phnom Penh in a bilateral Navigation agreement brokered by the MRC in 2009. With the exception of Cua Hao in the Bassac estuary, this shipping route would be better. The entrance to the estuary entrance is, however, and unstable and shallow. Many studies have been conducted to improve the entrance channel. The most recent is a spectacular short-cut canal (Quan Chanh Bo) which would bypass the estuary and link the deep channel of the Bassac directly with the sea, out of the sediment cone of the Bassac.

The risk assessment of these two river systems is mainly based on the assessment of ''navigation, traffic, communication, man-mad obstacles etc'' and the ''location of the hazard'' (environmental aspect) as the waterway geometrics and hydraulics are good to excellent everywhere.

The Mekong Delta in Viet Nam has an estimated 90 percent of all traffic on the Mekong between the Golden Triangle and the South China Sea, which underlines the importance of the risk assessment based on the current levels of navigation, traffic density, communications and man-made obstacles on the waterway.

The Mekong Mainstream

5.3.3.1 Section Deep Sea Buoy (Km 0) – My Tho (Km 74): 74 km

This section, which is managed by VINAMARINE as a maritime channel, does not present any particular problem, apart from the extremely busy navigation activities in front of My Tho. All sorts of vessels mingle with each other day and night. Navigation is difficult for seagoing vessels since ferries are continuously crossing more or less perpendicular to the direction of long-haul navigation.

There is little or no difference between the high and low-water situations given the tidal influence.

Figure 147: **Maritime channel near My Tho**

Further downstream towards the river mouth, high waves and strong winds can be a danger for smaller vessels approaching the estuary, while fixed and floating fishing nets can seriously obstruct the waterway.

Regarding the legalisation of the fishing nets inside the navigation channels, Viet Nam has the following arrangements regarding permits to be issued:

(a) if fishing grounds are within the channels, VIWA permits are required;

(b) if fishing grounds are outside the channels, permits are issued by local Fisheries Departments.

In recent years, agencies such as the waterway traffic police, waterway traffic inspectors, inland waterway port authority and people's committees have strengthened inspection and law enforcement by making more police reports on violations.

However, inland waterway inspectors and port authority inspectors are not allowed to levy fines. Only inland waterway police can levy fines but the fines are still very low and the results rather modest.

Moreover, inspections are insufficient due to the lack of resources and equipment and limited authority of the relevant line agencies. Fines imposed are too low compared to the degree of violations. The actual resources are just enough to focus on major IWT routes and national routes. The local domestic transport system is not paid proper attention and a number of small accidents are reported.

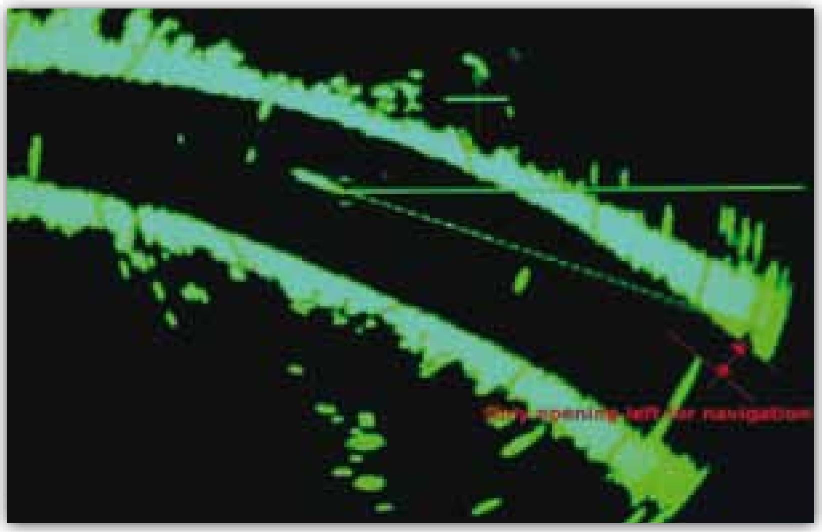


Figure 148: **Radar screen image of navigation on the Mekong River**

The risk assessment grid for the section Deep Sea Buoy (Km 0) - My Tho is as follows for both water levels (making little difference nearby the river mouth as the tidal wave is higher than the flood wave):

Table 58: **Waterway Assessment Deep Sea Buoy – My Tho**

DEEP SEA BUOY – MY THO		
	Low water	High water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

The only problem stems from the busy navigation condition on the Mekong in front of My Tho which is why the "man-made conditions" field is yellow.

5.3.3.2 *My Tho (Km 74) – Tan Chau (Km 236): distance = 162 km*

There is no major obstacle for navigation in this 162 km long section. The channel is well marked, relatively straight and deep and river bends are gentle. Even the My Thuan bridge does not constitute any hindrance to navigation: there is good visibility and currents are affordable. Some complain that the channel downstream from My Thuan bridge is unstable. But this has so far not been an obstacle in any way to safe shipping.

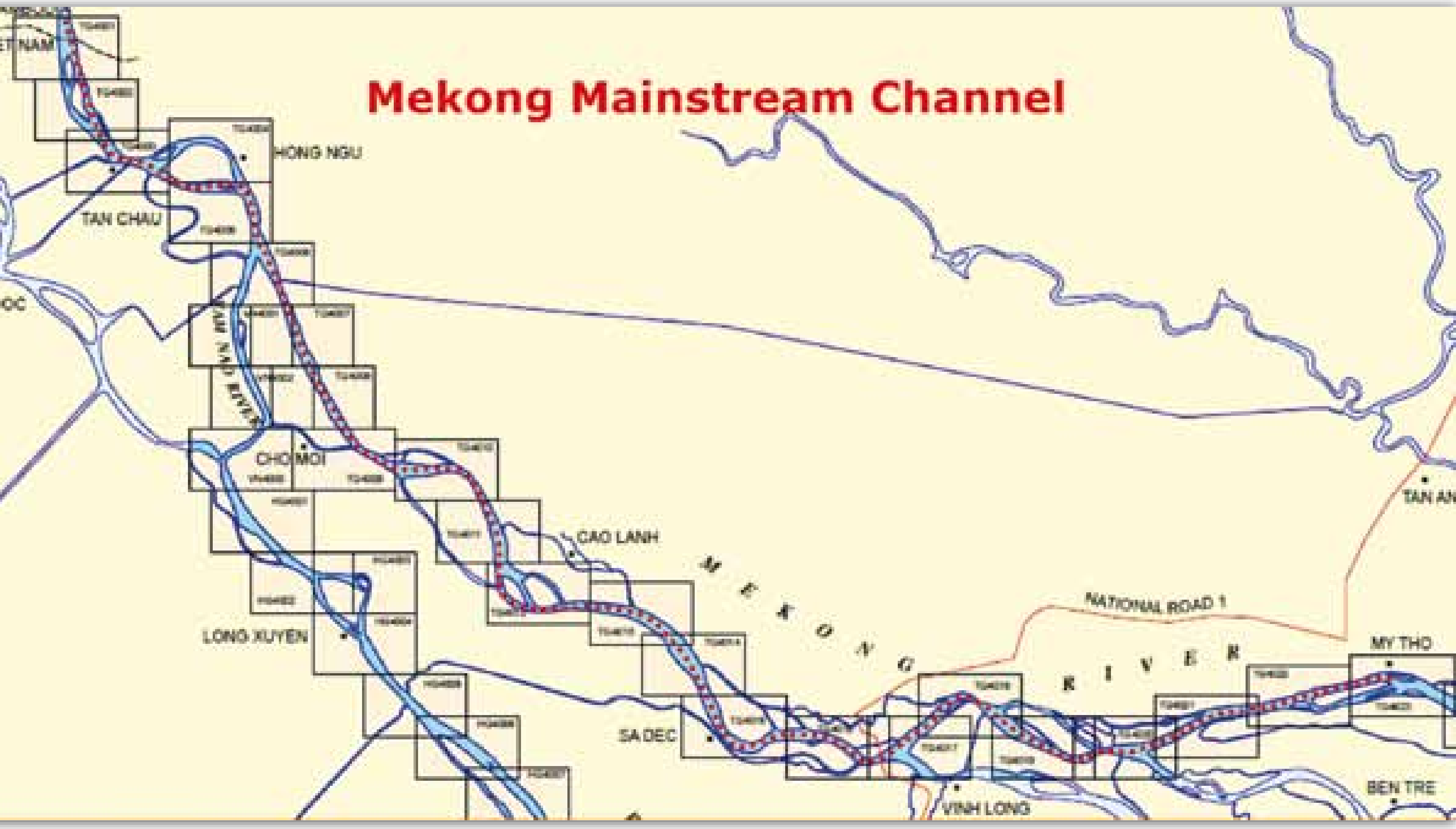


Figure 149: **Mekong Mainstream Channel Near Tan Chau**

However, in order to keep the channel updated, buoys are relocated at regular intervals following hydrographic surveys. It is mainly the green buoys that have to be relocated towards the middle of the river. For a long time, there was no updating of the hydrography. But the recent UHA update from the MRC has solved the problem and VIWA is keeping a close eye on the situation.

The navigation problem in My Tho continues upstream: a busy waterway with lots of vessels of all kinds and limited adherence to navigation rules except the seagoing vessels with experienced pilots onboard. Pilotage is compulsory for other nation flagged vessels. For Vietnamese-flagged vessels, the captains must have a certificate to show they are fully acquainted with the waterway. All pilots and captains from seagoing vessels strictly adhere to the safety regulations.

Figure 150: **Unstable Channel Near Entrance of Co Chien River**

Once upstream from My Tho, there are no maritime aids to navigation (installed by VINAMARINE). All navigational aids along the river upstream of My Tho are for inland navigation (under VIWA's responsibility).

There are also no aids-to-navigation for day and night navigation. In 2004, a project was set up by the World Bank to install navigational aids for seagoing vessels between Sa Dec and My Tho. After installation, no maintenance was carried out due to lack of funding. There were also serious complaints about the insufficient light intensity of the buoy lights. After inspection, it was advised that night navigation between Sa Dec and My Tho should be stopped.

Conflicts between fishermen and crewmembers have been reported. Drifting nets are particularly dangerous when they get caught in a rudder or propeller. Sand dredgers pose another problem, with barges grouped around dredgers blocking major parts of the navigation channel and/or obstructing visibility. The regulation of sand dredging is complex in Viet Nam and requires further investigation.

Under current rules, construction work on inland waterway channel corridors can only be carried out with VIWA approval. This is also the case for sand mining and any form of sand dredging.

However, there is serious encroachment on channel corridors of many inland waterways, especially in the Mekong Delta, from sand mining, fish farming, floating villages, illegal floating markets and waterfront restaurants.

This situation is the result of a lack of local planning and coordination with waterway transport development plans. Further consultation is required with waterway users and local people to ensure inland waterborne transport is promoted and balanced with people's livelihoods and other sectors, notably tourism and fisheries including aquaculture.

Sand dredging and sand mining in the Mekong Delta in Viet Nam can seriously hinder normal navigation. The business involves hundreds of vessels and other pieces of floating equipment. While dredging areas are usually indicated by yellow "danger" buoys both upstream and downstream, it not clear if such operations are taking place in authorized areas.

Solar panels from buoys (left) are supposed to recharge batteries during the day. But they are often stained by bird droppings and no longer working. The “safe water” buoy (right) seems to be a favourite gathering place for birds.

VIWA has proposed some solutions to deal with violations related to channel corridor protection:

(a) Civil Works

In the case of housing violations, localities and communities should prepare urban plans with residential layouts, especially in densely-populated areas along rivers and in urban areas. Urban planning must encourage and support people to move to new housing. At the same time, there should be an uncompromising approach towards civil construction to protect the channel corridors.

(b) Fishing and Aquaculture

Fishing and fish farming within the protected channel corridor need to be defined and arranged in accordance with the relevant management units of inland waterways. Fishing and fish farming must arrange for signals as prescribed and signs have to be clearly visible. When the channel corridor changes, the management units of inland waterways require all fishing equipment and aquaculture installations to be relocated or reduced. To prevent infringements or violations of regulations protecting channel corridors from fishing vessel owners, fish farmers or owners of fixed fishing nets, the inland waterways management units needs to:

- determine and prepare the layout for fishing and fish farming based on the actual situation of channel corridors and the needs of fishermen;

- require owners to commit to being responsible for installing signals on vessels, not change location or move vessels without the agreement of the inland waterways management unit in the area and, at management's request, relocate or reduce their farms under agreements signed by owners and local government witnesses; and
- prepare notices to request farm owners to move or reduce farms when the channel corridor changes.

(c) Floating Markets

Floating markets are traditional activities of people along rivers, especially those along the rivers and canals in the Mekong Delta in Viet Nam such as Cai Rang Floating Market in Can Tho River and Phung Hiep Floating Market on the Quan Lo River.

To prevent floating markets from affecting traffic safety, activities should be confined to certain areas determined by marks and proper aids to navigation in consultation with local people. Relevant agencies need to be able to handle violations properly.

(d) Construction Works

Construction works in protected channel corridors must strictly and fully follow the rules and regulations of the management for inland waterway system. This applies during the periods before, during and after construction. Implementing a project requires agreement of inland waterway management authorities and a plan to ensure traffic safety. Safety concerns need to prevail during the design, bidding and construction phases. After completion, the site has to be cleaned and all obstacles removed. The entire file has to be submitted to the inland waterway management authorities.

(e) State Management over Protected Channel Corridors

- Define the boundary lines of the navigation channels and the protected channel corridors in relation to other water-resources areas in large rivers;
- Marking the protected channels corridors.

The navigation channel for seagoing vessels between Sa Dec and Tan Chau is now taking the southern channel around the island in Hong Ngu district.

The number of buoys and their position in the remaining stretches between My Tho and Tan Chau (162 km) appears to be sufficient.

Since there is no major factor threatening the safety of navigation in this section My Tho – Tan Chau, the risk assessment grid can be estimated as follows for both water levels:

Table 59: **Waterway Assessment My Tho – Tan Chau**

MY THO – TAN CHAU		
	Low water	**High water**
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.3.3.3 Tan Chau (Km 236) – Cambodia-Viet Nam (Km 251): distance = 15 km

This 15 km short stretch has a couple of big islands and the channel is reportedly not sufficiently marked. Buoys are usually at a visual distance from each other, which is approximately 1.5 miles. In this stretch, the buoys are distanced between 3.0 and 3.5 miles from each other, creating a certain unease for navigation. The channel is reportedly not stable and is said to shift easily.

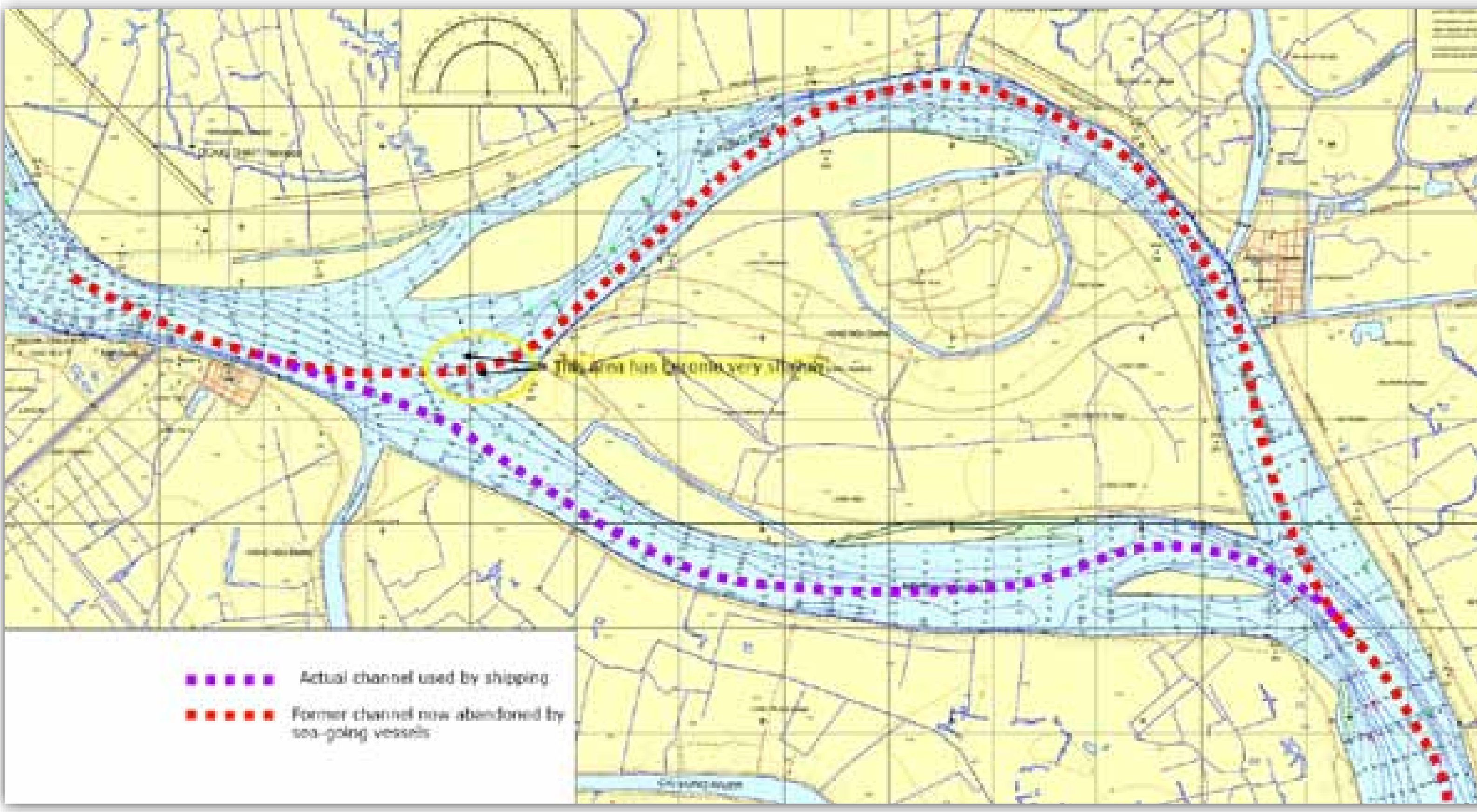


Figure 151: **Navigation Channel Near Tan Chau**

This short stretch neverthless does not result in a high risk evaluation for navigation including seagoing vessels and the overall assessment of is "green" for both water level conditions:

Table 60: **Tan Chau - Cambodia-Viet Nam Border**

TAN CHAU – CAMBODIA-VIET-NAM BORDER		
	Low water	High water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

The Bassac River and the Vam Nao Pass

5.3.3.4 Bassac River Mouth (Km 0) – Can Tho (Km 109): distance 109 km

The Bassac River (Song Hau) estuary has been extensively studied to improve navigation. Proposals have ranged from "dynamic dredging" to creating a new channel via the Tan Chan Bo Canal.

Existing conditions for entry to the estuary are extremely tricky, heavily depending on the tidal window. Furthermore, the channel is not stable and buoys have to be relocated every six months. Extensive year-round hydrographic surveys confirm that the channel is not stable and that its position is unreliable.

Despite being unstable, the risks of groundings are not considered high although the location of the estuary may make vessels susceptible to winds, heavy waves and even typhoons.

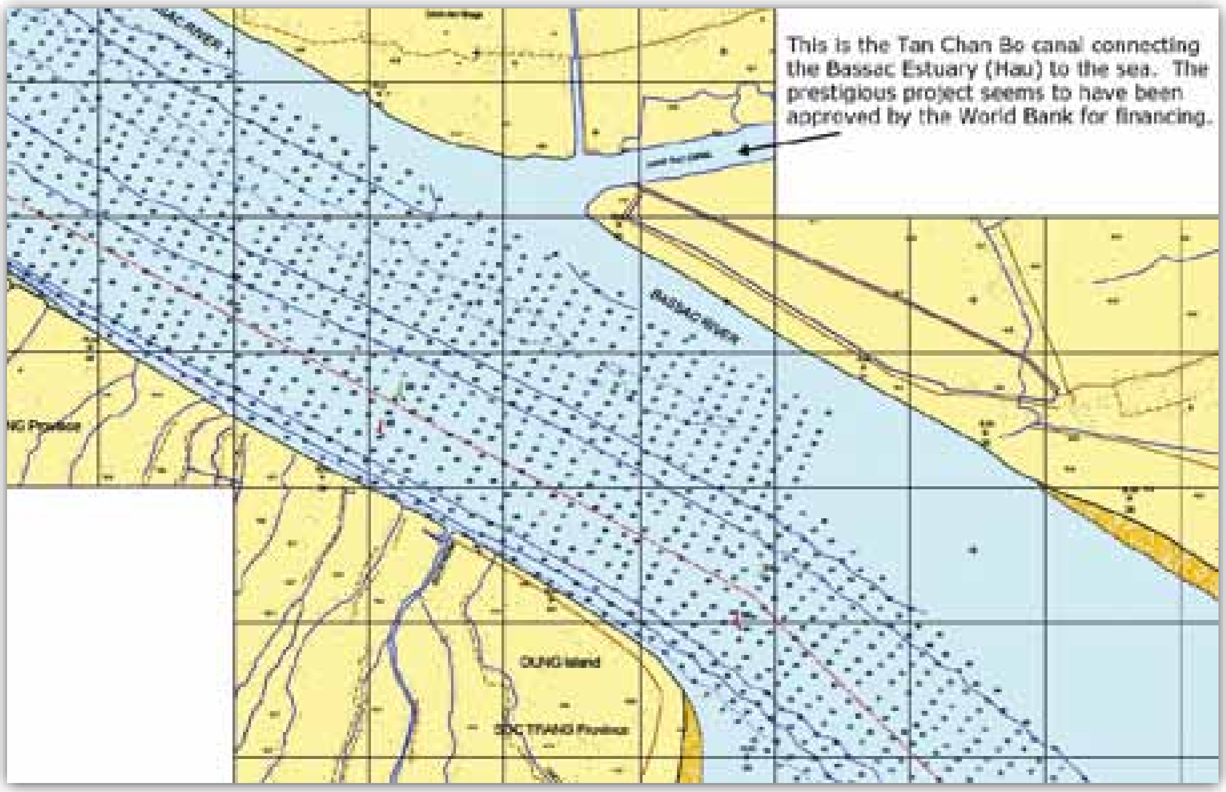


Figure 152: **Quan Chanh Bo Canal**

Figure 153: **Entrance of the Bassac River (Song Hau)**

The risk assessment for this section does not show any particular problem with the exception of the entrance of the Bassac River (Song Hau) from the South China Sea. Stranded vessels on shoals and sand banks can be heavily exposed by waves and currents, as the sea can be very rough in this area.

Table 61: **Waterway Assessment Bassac River: River Mouth (Hau)- Can Tho**

BASSAC RIVER: RIVER MOUTH (HAU) – CAN THO		
	Low water	High water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.3.3.5 *Section Can Tho (Km 129) – Long Xuyen (Km 162): distance = 33 km*

The management of the waterway downstream from the O Mon River mouth belongs to VINAMARINE while upstream belongs to VIWA. The O Mon River mouth is situated at Km 126 of the left bank of the Bassac River. Between here and Can Tho, there are many petroleum ports downstream, each with their own maritime port infrastructure (usually jetties).

Day and night navigation is safe in this section. Navigational aids are satisfactory. Between Rach Soi Hau Giang Canal (Km 153 of the right bank) and O Mon River (Km 126), day and night aids to navigation for seagoing vessels has been installed by VIWA and fully satisfies seagoing vessels.

Upstream from the port of Can Tho, the waterway is quite busy with many vessels and barges (some of which are big sand barges) anchored in the middle of the waterway. The situation for navigation is somewhat confusing as the navigational aids appear lost in the flotilla.

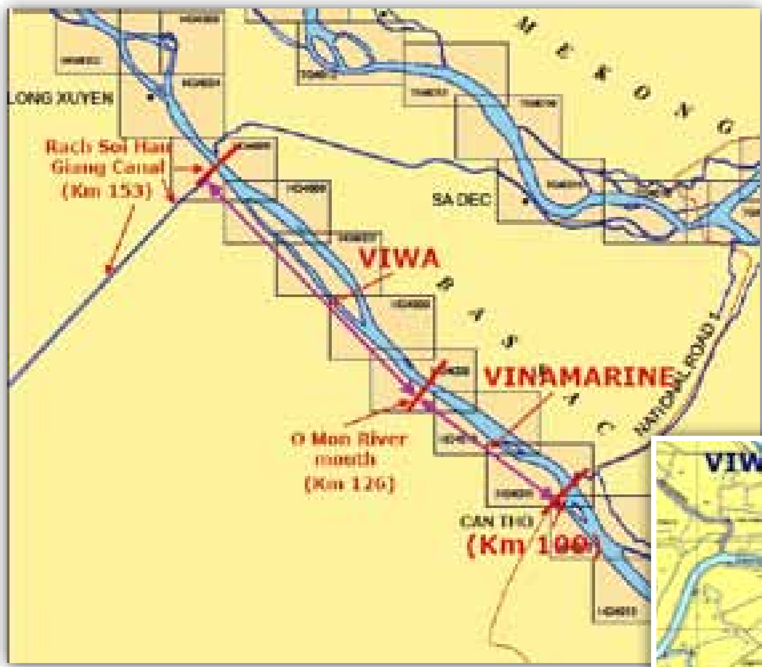


Figure 154: **O Mon River Near the Entrance to the Bassac River**

Clusters of floating equipment, vessels and barges hamper navigation and obstruct the view.

There are many ports and terminals on the right bank of the river between the O Mon River mouth and Can Tho. Most activities, however, are mid-channel.

This buoy seems lost between anchored vessels and barges

A multitude of vessels, both sailing and anchored, obstructs the view of navigational aids

The risk assessment for this section during all seasons is in every aspect green:

Table 62: **Waterway Assessment Bassac River: Can Tho – Long Xuyen**

BASSAC RIVER: CAN THO – LONG XUYEN		
	Low water	**High water**
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.3.3.6 Long Xuyen (Km 162) – Mekong Mainstream (Km 216): distance = 54 km

Upstream from Long Xuyen is the densely-populated island of Ong Ho, previously connected to the electrical grid of the Mekong Delta by a low-level high-tension line about 15 metres above the highest high-water line. Sea-going vessels therefore had to use the narrow northern channel at Km 165.5, which was less deep and had a sharp bend with low visibility and strong side currents.

Since the high-tension line has been replaced by a submarine cable, seagoing vessels now use the more comfortable southern channel.

However, the connection of the Bassac River to the Vam Nao Pass at Km 187.5 has a very sharp bend where strong currents have created a scour hole more than 41 metres deep. The Cambodian Navigation Master Plan has even suggested widening the curve by dredging some seven million cubic metres. The concave riverbank is, however, so densely populated that this may never be realised.

The UHA map excerpt on the next page shows the entire Vam Nao Pass, linking the Mekong mainstream with the Bassac River. There is some confusion about the nomenclature of the river arms but it is increasingly accepted that there are two Mekong River arms between Km 216 (the most northern connection with the link to the Vam Nao Pass) and Km 195, being the reconnection of both Mekong River arms.

The Vam Nao Pass, which is only 6 Km long, is a natural link between the two major Mekong River branches, Mekong mainstream and the Bassac River. Both are important distributaries of floodwaters to the

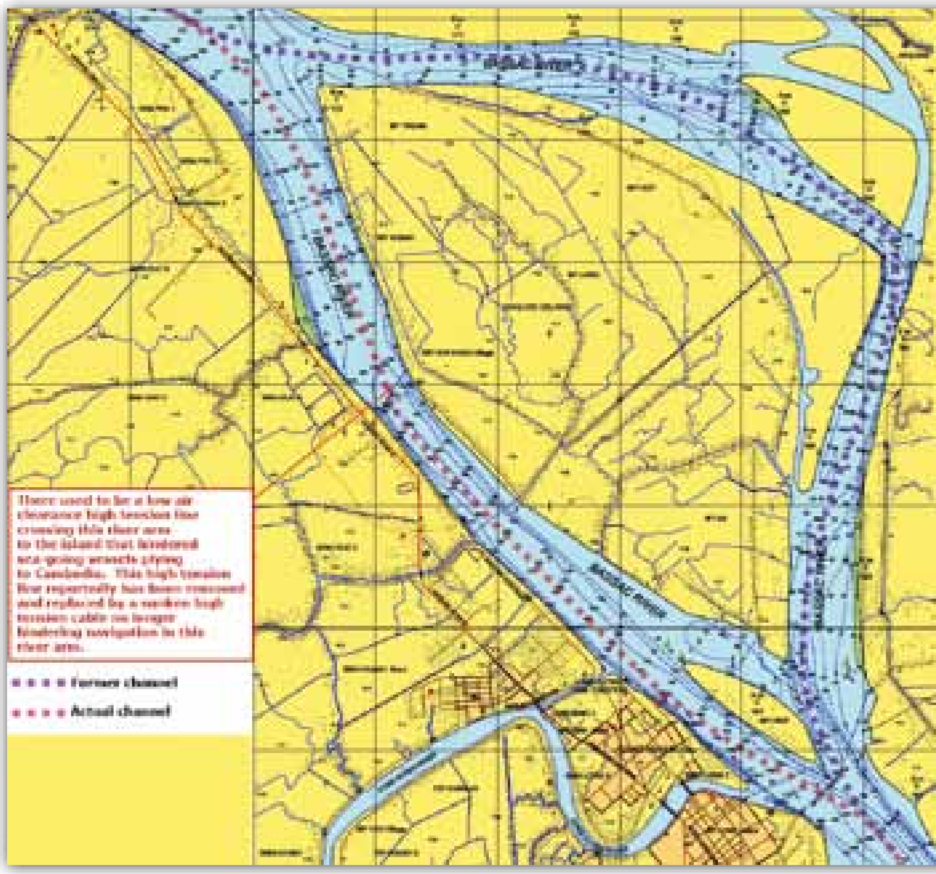


Figure 155: **Sharp Bend (Km 165.5)**

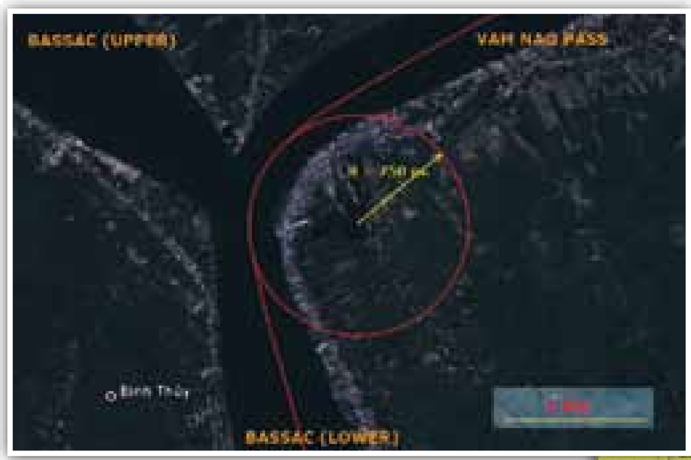


Figure 156: Vam Nao Pass

sea although the Mekong mainstream takes the major part downstream from Phnom Penh (80 percent versus 20 percent for the Bassac). At the Vam Nao Pass, however, a substantial redistribution of the total discharge takes place. A huge amount of water flows through the Vam Nao Pass to flush the Bassac River and the distribution is about 50-50 downstream from the split of the Vam Nao pass.

The risk assessment for this section during all seasons is in every aspect green, with the exception of the intersection between the Vam Nao Pass and the Bassac River, where the currents during high water levels are extremely strong.

Table 63: **Waterway Assessment Long Xuyen – Vam Nao – Mekong Mainstream**

LONG XUYEN – VAM NAO – MEKONG MAINSTREAM		
	Low water	High water
Waterway Geometrics		
Waterway Hydraulics		
Location of the hazard		
Man-made conditions		

5.4 SUMMARY OF THE RISK ASSESSMENT OF THE ENTIRE LOWER MEKONG RIVER

Table 64: **Summary of Risk Analysis for Low-Water Level Situation**

Low-Water Level Situation			Low water level	Waterway geometrics: sharp curves, rocky bottom (bedrock) and river banks, submerged obstacles like hidden rocks, vessel wrecks, big boulders, etc., narrow channels not allowing the crossing of two vessels or overtaking, high bottom gradients with hidden thresholds, etc.	Hydraulics of the waterflow strong funnel-shaped currents, strong turbulent currents, water upsurges, whirlpools, side currents from tributaries or side channels, etc.	Location of the hazard upstream from important water intakes, upstream from big cities, upstream from important wetlands, Tonle Sap and entrance of the Great Lake during flood season, upstream from special zones with protected species, etc.	Navigation, traffic, communication, man-made obstacles, etc. traffic density and presence of high-speed vessels, fishing nets across the river, dredging vessels and pontoons or moored barges in the channel, bad or no communication between vessels and shore, bad or no communication between vessels, damaged aids to navigation (beacons) or misplaced buoys, busy ferry crossings obstructing long-haul traffic, piers and causeways from ports and/or terminals, absence or limited information on existing water levels and traffic density, low-tension high voltage cables, etc.
Golden Triangle	2,373	Chiang Saen	2,364				
Chiang Saen	2,364	Chiang Khong/Huay Xay	2,314				
Chiang Khong/Huay Xay	2,314	Pak Beng	2,172				
Pak Beng	2,172	Luang Prabang	2,010				
Luang Prabang	2,010	Pak Lay - Vientiane	1,585				
Vientiane	1,585	Savannakhet	1,126				
Savannakhet	1,126	Pakse	869				
Pakse	869	Khone Falls	721				
Khone Falls	721	Steung Treng	684				
Steung Treng	684	Kratie	561				
Kratie	561	Kompong Cham	448				
Kompong Cham	448	Phnom Penh	348				
Phnom Penh	348	Border Viet-Nam	251				
Border Viet-Nam	251	Tan Chau	236				
Tan Chau	236	My Tho	74				
My Tho	74	Deep Sea Buoy					
Mekong-Vam Nao Intersection	216(*)	Long Xuyen	162				
Long Xuyen	162	Can Tho	109				
Can Tho	109	Deep Sea Buoy	-				
Phnom Penh	-	Kompong Chhnang	99				
Kompong Chhnang	99	Chhong Kneas	204				

216(*) = km distance along the Mekong mainstream

Table 64: **Summary of Risk Analysis for High-Water Level situation (continued)**

High-Water Level Situation			High water level	Waterway geometrics: sharp curves, rocky bottom (bedrock) and river banks, submerged obstacles like hidden rocks, vessel wrecks, big boulders, etc., narrow channels not allowing the crossing of two vessels or overtaking, high bottom gradients with hidden thresholds, etc.	Hydraulics of the waterflow: Strong funnel-shaped currents, strong turbulent currents, water upsruges, whirlpools, side currents from tributaries or side channels, etc.	Location of the hazard: upstream from important water intakes, upstream from big cities, upstream from important wetlands, Tonle Sap and entrance of the Great Lake during flood season, upstream from special zones with protected species, etc.	Navigation, traffic, communication, man-made obstacles, etc.: traffic density and presence of high-speed vessels, fishing nets across the river, dredging vessels and pontoons or moored barges in the channel, bad or no communication between vessels and shore, bad or no communication between vessels, damaged aids to navigation (beacons) or misplaced buoys, busy ferry crossings obstructing long-haul traffic, piers and causeways from ports and/or terminals, absence or limited information on existing water levels and traffic density, low-tension high voltage cables, etc.
Golden Triangle	2,373	Chiang Saen	2,364				
Chiang Saen	2,364	Chiang Khong/Huay Xay	2,314				
Chiang Khong/Huay Xay	2,314	Pak Beng	2,172				
Pak Beng	2,172	Luang Prabang	2,010				
Luang Prabang	2,010	Pak Lay - Vientiane	1,585				
Vientiane	1,585	Savannakhet	1,126				
Savannakhet	1,126	Pakse	869				
Pakse	869	Khone Falls	721				
Khone Falls	721	Steung Treng	684				
Steung Treng	684	Kratie	561				
Kratie	561	Kompong Cham	448				
Kompong Cham	448	Phnom Penh	348				
Phnom Penh	348	Border Viet-Nam	251				
Border Viet-Nam	251	Tan Chau	236				
Tan Chau	236	My Tho	74				
My Tho	74	Deep Sea Buoy					
Mekong-Vam Nao intersection	216(*)	Long Xuyen	162				
Long Xuyen	162	Can Tho	109				
Can Tho	109	Deep Sea Buoy	-				
Phnom Penh	-	Kompong Chhnang	99				
Kompong Chhnang	99	Chhong Kneas	204				

216(*) = km distance along the Mekong mainstream

The following page shows the graphic representation of the summary of the risk analysis for waterways under low-water and high-water conditions. The proportional representation of the length of each stretch shows better the total importance of the suitability of the Mekong River in terms of transport of dangerous cargoes.

Table 65: **Summary of the Risk Analysis of Waterways by Distance**

Km	Start	Km	End	Km	LOW WATER SITUATION	HIGH WATER SITUATION	
9	Golden Triangle	2,373	Chiang Saen	2,364			Very difficult section for the transport of dangerous cargo along the waterway
50	Chiang Saen	2,364	Chiang Khong/Huay Xay	2,314			
142	Chiang Khong/Huay Xay	2,314	Pak Beng	2,172			
162	Pak Beng	2,172	Luang Prabang	2,010			
425	Luang Prabang	2,010	Pak Lay - Vientiane	1,585			
459	Vientiane	1,585	Savannakhet	1,126			
257	Savannakhet	1,126	Pakse	869			
148	Pakse	869	Khone Falls	721			
37	Khone Falls	721	Steung Treng	684			
123	Steung Treng	684	Kratie	561			
113	Kratie	561	Kompong Cham	448			More comfortable section for transport of dangerous cargo along the waterway
100	Kompong Cham	448	Phnom Penh	348			
97	Phnom Penh	348	Border Viet-Nam	251			
15	Border Viet-Nam	251	Tan Chau	236			
162	Tan Chau	236	My Tho	74			
74	My Tho	74	Deep Sea Buoy				
54	Mekong-Vam Nao Intersection	216(*)	Long Xuyen	162			
53	Long Xuyen	162	Can Tho	109			
109	Can Tho	109	Deep Sea Buoy	-			
(99)	Phnom Penh	-	Kompong Chhnang	99			
(105)	Kompong Chhnang	99	Chhong Kneas	204			

Two distinctive sections become clearly visible in the graph above. Strictly relating to waterway characteristics, the upper stretches of the Mekong starting say, from the Golden Triangle down to Kratie in Cambodia, have nothing much to offer in terms of safe navigation and are not waterways recommended for the transport of dangerous goods. This can be "partly" explained by the average river gradient between the Golden Triangle and Kratie, being approximately 10 times higher than between Kratie and the Sea (see chart below).

In terms of waterway characteristics, transporting dangerous cargo in the upper stretches of the Mekong is not very safe. Currents are usually strong and turbulent, with rocky outcrops, both visible and submerged, narrow channels often between cliffs and steep rocky river banks, poor visibility, whirlpools, rapids and sharp bends.

But downstream from Kratie, the river is gentler, deeper and straighter, with a smooth laminar flow, soft river banks of sand or clay and, in most of the stretches, with an adequate aids to navigation system.

It can therefore be recommended that waterborne transport of dangerous cargoes should be limited to the lower stretches of the Mekong (downstream from Kratie) and the 459 km stretch between Vientiane and Savannakhet. Running mostly parallel to the latter, however, is National Road No 13, offering door-to-door transport over land.

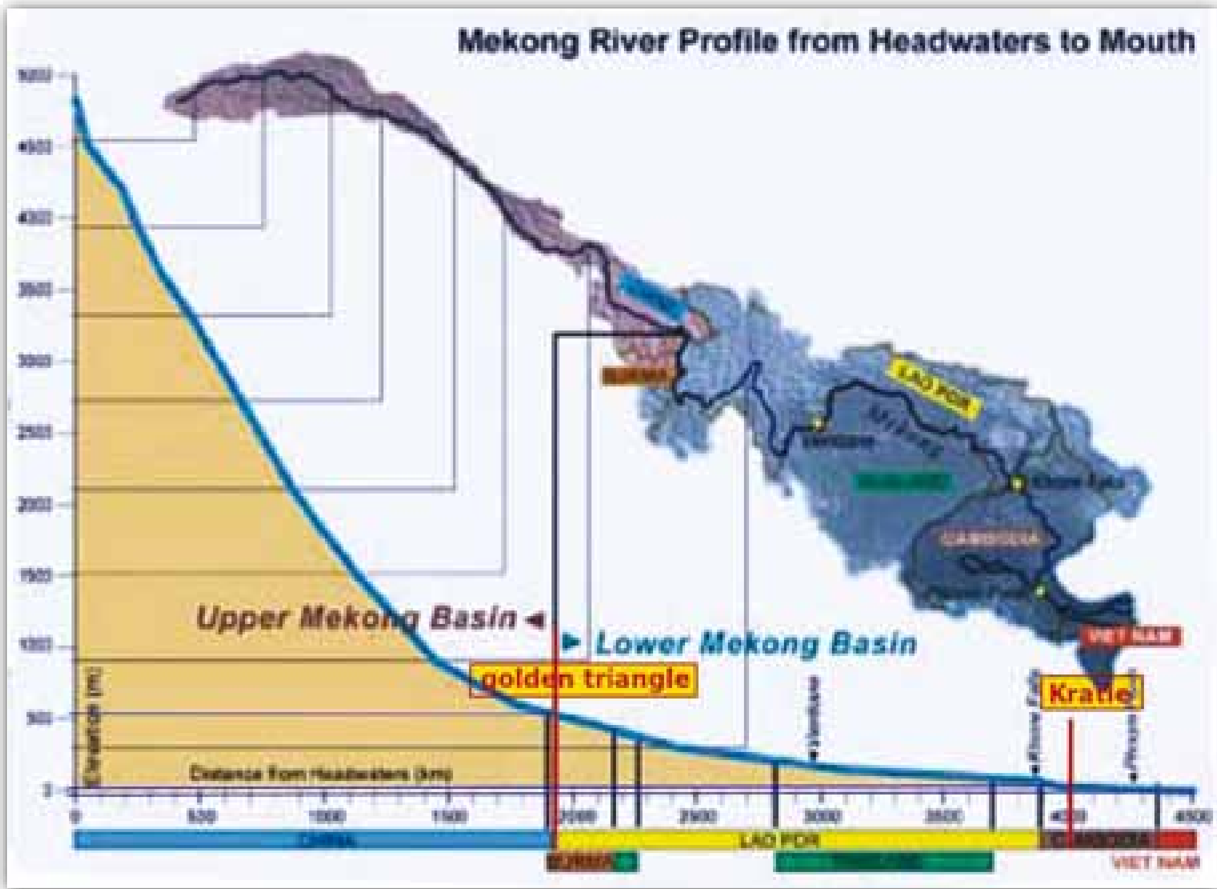


Figure 157: **Mekong River profile from Headwaters to Mouth**

On the other hand, the centre of navigation is the Mekong Delta in Viet Nam, which has a dense waterway network and seems perfectly suitable for waterborne transport of dangerous cargoes.

6. REGIONAL AND INTERNATIONAL LEGAL FRAMEWORK

6.1 INTRODUCTION

The aim of this chapter is to provide an overview and analysis of the existing legal frame works for the establishment of harmonised rules for the transportation of dangerous goods on the Mekong.

The Mekong Basin comprises six countries, namely Cambodia, Lao PDR, Thailand, Viet Nam, the People's Republic of China and Myanmar.

Cambodia, Lao PDR, Thailand, and Viet Nam are members of the Mekong River Commission (MRC). The MRC was established under the *Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin*, signed at Chiang Rai, 5 April 1995 (MRC Agreement).[51] The People's Republic of China and Myanmar, located in the Upper Basin, are dialogue partners of the MRC.

Thailand, the People's Republic of China, Myanmar and the Lao PDR are signatories to the *Agreement on Commercial Navigation on Lancang-Mekong River*, which relates to the "Upper" Mekong and was signed at Tachileik on 20 April 2000.[52]

In theory, consideration should be given to the *Convention between Siam and France relating to the Regulation of the Relations between Siam and Indochina*, signed at Bangkok, 25 August 1926, which applies to the "Middle" Mekong.[53]

Cambodia and Viet Nam are signatories to the *Agreement on Waterway Transportation*, signed at Phnom Penh, 17 December 2009. This treaty relates to the "Lower" Mekong.[54]

[51] See below, Chapter 6.3.1
[52] See below, Chapter 6.3.2
[53] See below, Chapter 6.3.3
[54] See below, Chapter 6.3.4

Below, we will recall the general international background on the transportation of dangerous goods by water. Next, we will examine the international instruments pertaining to the Mekong and the provisions concerning the carriage of dangerous goods contained in these instruments.

Existing national laws and regulations should be taken into consideration when drafting harmonised rules for the transportation of dangerous goods on the Mekong. Therefore we will inventory and briefly discuss the relevant domestic laws and regulations of the MRC Member States.

Next, we will focus on international benchmarks and further analyse the legal benchmarks as well as the national regulations on the carriage of dangerous goods. We will then elaborate on the legal bases for the establishment of harmonised rules. In the last section, we will make recommendations on rules and regulations for the transportation of dangerous goods on the Mekong.

6.2 GENERAL INTERNATIONAL BACKGROUND

6.2.1 International Convention for the Prevention of Pollution from Ships, 1973

The *International Convention for the Prevention of Pollution from Ships* (MARPOL) is the main international convention on the prevention of pollution of the marine environment. The Convention includes regulations aimed at preventing and minimising pollution from vessels – both accidental pollution and pollution from routine operations – and currently includes six technical Annexes (see also Chapter 4.4.4.1):

- Annex I-Regulations for the Prevention of Pollution by Oil;
- Annex II-Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk;
- Annex III-Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form;
- Annex IV-Prevention of Pollution by Sewage from Ships;
- Annex V-Prevention of Pollution by Garbage from Ships; and
- Annex VI-Prevention of Air Pollution from Ships.

Thailand, Cambodia, Viet Nam, the People's Republic of China and Myanmar are parties to MARPOL. Thailand, Viet Nam and Myanmar are only a party to MARPOL 73/78 (Annex I/II). Cambodia is not a party to the 1997 Protocol (Annex VI). Lao PDR is not a party to MARPOL.

Article 1 (1) of the MARPOL Convention reads:

> *The Parties to the Convention undertake to give effect to the provisions of the present Convention and those Annexes thereto by which they are bound in order to prevent the pollution of the marine environment by the discharge of harmful substances or effluent containing such substances in contravention of the Convention; and*
>
> *The MARPOL Convention applies to ships flying the flag of a Party to the Convention and to ships not entitled to fly the flag of a Party but which operate under the authority of a Party (Article 3).*

The MARPOL Convention should be taken into consideration when establishing harmonised rules for the transportation of dangerous goods on the Mekong.

6.2.2 International Convention for the Safety of Life at Sea, 1974 (SOLAS) and the International Maritime Dangerous Goods (IMDG) Code

The major international convention on the carriage of dangerous goods by sea is the *International Convention for the Safety of Life at Sea*, 1974 (SOLAS), which entered into force on 25 May 1980.

Cambodia, Thailand and Viet Nam as well as the People's Republic of China and Myanmar are parties to SOLAS. Thailand is not a party to the 1978 (Tanker Safety and Pollution Prevention) and 1988 (New Harmonised System of Surveys and Certification) Protocol, Myanmar is not a party to the 1988 Protocol. Lao PDR is not a party to SOLAS.

According to Article II, the SOLAS Convention applies to vessels entitled to fly the flag of States the Governments of which are Contracting Governments. Regulation 1 of Chapter I of the SOLAS Convention stipulates that, unless expressly provided otherwise, the regulations apply only to vessels engaged on international voyages. Regulation 2 (d) of the same chapter defines *international voyage* as a voyage from a country to which the SOLAS Convention applies to a port outside such a country, or conversely.

As all riparian states – with the exception of the Lao PDR – are parties to SOLAS, this Convention should be taken into due account when drafting harmonised rules for the transportation of dangerous goods on the Mekong.

The carriage of dangerous goods is addressed in Chapter VII of the SOLAS Convention. This chapter contains provisions for the classification, packing, marking and labelling, documentation and stowage of dangerous goods in packaged form, in solid form in bulk, and liquid chemicals and liquefied gases in bulk.

Regulation 2 (1) of Chapter VII on carriage of dangerous goods stipulates that unless expressly provided otherwise, its rules apply to the carriage of dangerous goods in packaged form in all vessels to which the regulations apply and in cargo vessels of less than 500 gross tonnage.

In order to assist the contracting states to the SOLAS Convention in issuing instructions to the vessels under their flag concerning the carriage of dangerous goods, the International Maritime Organization (IMO) has developed the *International Maritime Dangerous Goods (IMDG) Code*.

The IMDG Code – while originally designed to provide merely assistance in the implementation of the SOLAS Convention – is now binding. An amendment to Chapter VII of the SOLAS Convention, which was adopted in May 2002, makes the IMDG Code mandatory as of 1 January 2004 for all countries which have ratified the SOLAS Convention.

Some of the instruments relating to navigation on the Mekong expressly refer to the IMDG Code. This is the case for the *Rules on Water Transport Administration on the Lancang-Mekong River* (Article 17)[55] as well as for the *Agreement on Waterway Transportation* (Article 2 [15]).[56]

As a result, the IMDG Code must be taken into due consideration when drafting harmonised rules for the transportation of dangerous goods on the Mekong.

[55] See below, Chapter 6.3.2

[56] See below, Chapter 6.3.4

6.2.3 ILO Code of Practice on Safety and Health in Ports, 2003

The *Code of Practice on Safety and Health in Ports* was drafted by the Internal Labour Organisation (ILO). The Code replaces both the second edition of the *ILO Code of Practice on Safety and Health in Dock Work* (1977) and the *ILO Guide to Safety and Health in Dock Work* (1976). The text was adopted by a Meeting of Experts held in Geneva from 8 to 17 December 2003.

The Code is not a legally binding instrument. It is not intended to replace national laws and regulations. The practical recommendations in this Code are intended to provide guidance to ILO constituents and to those responsible for or involved in the management, operation, maintenance and development of ports.

The Code is not limited to international trade and is equally applicable to domestic operations, including those on inland waterways (Section 1.2.1).

The Code has a chapter on dangerous goods (Chapter 8). In this chapter, reference is made to the IMDG Code. It is noted that while the IMDG Code is intended mainly for precautions to be taken for sea voyage, its provisions can also be applied in shore-side terminals and the *Code of Practice on Safety and Health in Ports* recommends that it be so used (Section 8.1.4.15).

The ILO *Code of Practice on Safety and Health in Ports* could be taken into consideration when establishing harmonised rules for the transportation of dangerous goods on the Mekong.

6.2.4 IMO Revised Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas, 2006

The *Revised Recommendations on the Safe Transport of Dangerous Cargoes and Related Activities in Port Areas* were approved by the Maritime Safety Committee of the International Maritime Organization (IMO) at its eighty-second session (29 November to 8 December 2006). The Recommendations are aligned with the provisions of the IMDG Code.

The Recommendations are intended to set out a standard framework within which legal requirements can be prepared by governments to ensure the safe transport and handling of dangerous cargoes in port areas.

These recommendations could act as an additional inspiration for the drafting of harmonised rules for the transportation of dangerous goods on the Mekong.

6.2.5 Other Relevant International Instruments

The following can be categorised as maritime instruments:

- *International Bulk Chemical Code* and the *Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk*;
- *International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* and earlier codes, the *Gas Carrier Code* and the *Code for Existing Ships Carrying Liquefied Gases in Bulk*;
- *International Code for the Safe Carriage of Packaged Irradiated Nuclear Fuel, Plutonium and High-Level Radioactive Wastes onboard Ships* (INF Code);
- *International Maritime Solid Bulk Cargoes* (IMSBC) Code;
- International Convention on the Establishment of an International Fund for the Compensation for Oil Pollution Damage;

- International Convention on the Control of Harmful Anti-Fouling Systems on Ships; and
- International Convention for the Control and Management of Ship's Ballast Water and Sediments.
- *Hague/ Hague-Visby Rules*;
- *Hamburg Rules*;
- *Rotterdam Rules*; and
- *HNS Convention*.

The United Nations Recommendations on the transport of dangerous goods apply to both maritime and inland waterway transport.

The *International Safety Guide for Inland Navigation Tank-barges and Terminals* can be categorized as an instrument applying to inland waterway transport.

6.3 INTERNATIONAL INSTRUMENTS PERTAINING TO THE MEKONG

6.3.1 Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin (MRC Agreement)

Cambodia, Lao PDR, Thailand and Viet Nam are parties to the *Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin*, signed at Chiang Rai, 5 April 1995 (MRC Agreement).

The MRC Agreement is the basic convention under which the Mekong River Commission (MRC) has been established and still functions today.

Under this Agreement, the parties first and foremost agree:

> *[t]o cooperate in all fields of sustainable development, utilization, management and conservation of the water and related resources of the Mekong River Basin, including, but not limited to irrigation, hydro-power, navigation, flood control, fisheries, timber floating, recreation and tourism, in a manner to optimize the multiple-use and mutual benefits of all riparians and to minimize the harmful effects that might result from natural occurrences and man-made activities (Art. 1)*.

The MRC Agreement does not contain specific provisions on dangerous goods. However, some provision of the Agreement might be of interest to the present study.

Article 9 of the MRC Agreement for instance reads:

> *On the basis of equality of right, freedom of navigation shall be accorded throughout the mainstream of the Mekong River without regard to the territorial boundaries, for transportation and communication to promote regional cooperation and to satisfactorily implement projects under this Agreement. The Mekong River shall be kept free from obstructions, measures, conduct and actions that might directly or indirectly impair navigability, interfere with this right or permanently make it more difficult. Navigational uses are not assured any priority over other uses, but will be incorporated into any mainstream project*.

> Riparians may issue regulations for the portions of the Mekong River within their territories, particularly in sanitary, customs and immigration matters, police and general security (emphasis added).

According to this Article, the riparian countries – Cambodia, Lao PDR, Thailand and Viet Nam – may issue regulations, particularly in sanitary, customs and immigration matters, police and general security.

The concepts of "police and general security" are not defined in the MRC Agreement. It can be argued that the notion of "general security" encompasses measures on the transportation on the Mekong of explosives, ammunition or similar dangerous cargoes that might be considered a potential threat to security. The notion of "police" is even broader and can be interpreted as comprising all measures aimed at the preservation of public order.

More importantly, the Article under discussion contains the word "particularly". This indicates that riparians may also issue regulations on other matters, not specifically mentioned in Article 9 of the Agreement, such as the transportation of dangerous goods.

Remarkably, Article 9 of the MRC Agreement empowers each riparian state to unilaterally issue national regulations for its own stretch of the river. It should be noted that the regime of international rivers in Europe provides for the establishment of regulations on navigation *by common consent* among the riparians, but this principle does not appear to prevail worldwide.[57]

Article 11 of the MRC Agreement stipulates:

> *The institutional framework for cooperation in the Mekong River Basin under this Agreement shall be called the Mekong River Commission and shall, for the purpose of the exercise of its functions, enjoy the status of an international body, including entering into agreements and obligations with the donor or international community.*

According to Article 18 of the Agreement, the functions of the Council of the Mekong River Commission are:

a. *To make policies and decisions and provide other necessary guidance concerning the promotion, support, cooperation and coordination in joint activities and projects in a constructive and mutually beneficial manner for the sustainable development, utilization, conservation and management of the Mekong River Basin waters and related resources, and protection of the environment and aquatic conditions in the Basin as provided for under this Agreement;*

b. *To decide any other policy-making matters and make decisions necessary to successfully implement this Agreement, including but not limited to approval of the Rules of Procedures of the Joint Committee under Article 25, Rules of Water Utilization and Inter-Basin Diversions proposed by the Joint Committee under Article 26, and the basin development plan and major component projects/programmes; to establish guidelines for financial and technical assistance of development projects and programmes; and if considered necessary, to invite the donors to coordinate their support through a Donor Consultative Group; and*

c. *To entertain, address and resolve issues, differences and disputes referred to it by any Council member, the Joint Committee, or any member State on matters arising under this Agreement.*

[57] Art. CVIII of the 1815 Vienna Final Act provides: "The Powers whose states are separated or crossed by the same navigable river, engage to regulate, *by common consent*, all that regards its navigation. For this purpose they will name Commissioners, who shall assemble, at latest, within six months after the termination of the Congress, and who shall adopt as the basis of their proceedings, the principles established by the following Articles" (emphasis added). For a detailed discussion, see Vitanyi, B, *The International Regime of River Navigation*, Alphen aan den Rijn, Sijthoff & Noordhoff, 1979, 219 *et seq*.

The latter provision of the MRC Agreement offers a legal basis for the MRC Council to "make policies and decisions" relating to, *inter alia*, the "utilization" of the Mekong River Basin as well as for the "protection of the environment". Furthermore, the MRC Council is empowered to "decide" on any "other policy-making matters" and "make decisions necessary to successfully implement [the MRC] Agreement".

At first sight, the inter-relation between Article 18 on the decision-making powers of the Council on the one hand and the above mentioned Article 9 on national regulatory powers in the field of navigation is unclear. In our view, regulatory bodies of the Riparian States may enact national regulations on the transportation of dangerous goods on the basis of Article 9, while the MRC Council may on the basis of Article 18 also take an initiative for the establishment of harmonised rules on this matter. However, Article 18 does not seem to empower the MRC Council to adopt directly applicable regulations. In other words, if the MRC Council would adopt harmonised regulations, these would subsequently have to be "transposed" into national regulations by the competent national authorities of the Riparian States.[58]

6.3.2 Agreement on Commercial Navigation on Lancang-Mekong River between P.R. China, Lao PDR, Myanmar and Thailand

The Agreement on Commercial Navigation on Lancang-Mekong River, signed at Tachileik on 20 April 2000, forms the legal basis of the opening of the Upper Mekong for international navigation (the Agreement is briefly introduced in Chapter 3.3.2). The Parties to this Agreement are People's Republic of China, Lao PDR, Myanmar and Thailand.

Article 17 of the Agreement reads:

> *For the safety of life, health and the protection of the environment the carriage under this Agreement of hazardous materials such as toxic chemicals, explosives and radioactive material shall be prohibited. However, the carriage of some other types and categories of dangerous goods and the safety measures thereof may be agreed upon by consultation among the Contracting Parties.*

In other words, the Agreement prohibits the carriage of toxic chemicals, explosives and radioactive material on the Upper Mekong. The carriage of other types and categories of dangerous goods is only allowed when agreed upon among the Contracting Parties.

Article 8 of the Agreement stipulates:

> *Vessels and their crewmembers and passengers of one Contracting Party, during their stay and passage through the territory of another Contracting Party, shall respect the common navigation rules and the laws and regulations of the country of that Contracting Party, in particular, customs and immigrations, environment protection and ecology balance and other laws and regulations concerning public order and security.*
>
> *The Contracting Parties shall give due publicity to all such laws and regulations.*

This Article clearly distinguishes between "common" navigation rules jointly adopted by the Riparian States and national laws and regulations.

[58] Interestingly, under a 2005 Treaty between the Netherlands and Flanders the Permanent Commission for the Supervision of Navigation of the River Scheldt has been granted the power to enact directly applicable regulations without any intervention by national regulatory authorities.

Article 21 of the Agreement reads:

With a view to promoting the objectives of this Agreement and to resolving problems which may arise from its implementation, representatives of the Contracting Parties shall hold meetings at least once a year alternately in the country of the Contracting Parties or whenever necessary upon request by any Contracting Party to consult and to promote cooperation in the following matters, inter alia:

a. the maintenance and improvement of the navigability of the river;

b. measure to increase safety for navigation and protection of environment;

c. exchange of information on navigation channels, obstacles and obstructions relating to navigation safety;

d. improvement and expansion of port facilities;

e. cooperation and coordination in the customs, immigration and other related matters;

f. for the purpose of safe and smooth navigation, especially in dry season, to cooperate to a possible extent in the provision of water flow and the relevant data;

g. cooperation in improvement of telecommunication network for the foregoing purposes;

h. formulation and improvement of relevant common rules and regulations for the effective implementation of this Agreement; and

i. other matters arising from the interpretation and application of this Agreement.

Article 21 of the Agreement stipulates that the Contracting Parties will hold meetings to consult and to promote cooperation on, *inter alia*, the formulation and improvement of relevant common rules and regulations for the effective implementation of the Agreement.

The wording of Article 21 appears sufficiently broad in order to serve as a legal basis for the adoption by the Contracting Parties of harmonised rules for transportation of dangerous goods on the Upper Mekong. However, the Agreement does not contain an express legal basis for the adoption of directly applicable "common" regulations without the subsequent intervention of competent national regulatory authorities. Whether the "common" regulations are considered directly applicable in practice remains to be seen investigated.

In practice, the Agreement was supplemented[59] by the following six technical annexes (see also Chapter 4.4.4.1)[60]:

- *Regulations on Safe Navigation of Vessels on the Lancang-Mekong River*;
- *Rules on Water Transport Administration on the Lancang-Mekong River*;
- *Guidelines on the Maintenance and Improvement of the Navigability of the Lancang-Mekong River*;
- *Regulations on the Investigation and Handling of Waterborne Traffic Accidents on the Lancang-Mekong River*;
- *Regulations on Management of Search & Rescue, Salvage and Wreck Removal on the Lancang-Mekong River;* and
- *Technical Regulations of Surveys of Commercial Ships on the Lancang-Mekong River*.

[59] A communication from the Government of Thailand mentions that the regulations were "issued under the Agreement on Commercial Navigation on Lancang-Mekong River", see: http://www.thaigov.go.th/webold/news/cab/44/cab6feb01.htm, consulted on 25 October 2011.

[60] Economic and Social Commission for Asia and the Pacific, Manual on Modernization of Inland Water Transport for integration within a multimodal transport system, New York, United Nations Publications, 2004, 86.

Article 1 of the *Regulation on Safe Navigation of Vessels on the Lancang-Mekong River* reads:

> *These regulations are formulated with a view to jointly strengthening the traffic control on the Lancang-Mekong River, maintaining the order of waterborne traffic and ensuring the safety of vessels in accordance with the Agreement on Commercial Navigation on the Lancang-Mekong River concluded among the Governments of the People's Republic of China, the Lao People's Democratic Republic, the Union of Myanmar and the Kingdom of Thailand.*

The five other regulations and guidelines contain a similar provision.

Article 2 of the *Regulation on Safe Navigation of Vessels on the Lancang-Mekong River* reads:

> *These Regulations are applicable to all vessels sailing, berthing or conducting operations on the section of the Lancang-Mekong River between Simao in P.R. China and Luang Prabang in Lao PDR.*

The five other regulations and guidelines contain a similar provision.

Some Regulations contain provisions on their implementation by the Contracting Parties. Article 3 of the *Regulations on Management of Search & Rescue, Salvage and Wreck Removal on the Lancang-Mekong River* for instance stipulates:

> *The competent authorities of the Contracting Parties are responsible for implementing these Regulations in respect of coordinating, organizing and commanding search & rescue and salvage of persons and vessels in distress as well as management operations on wreck removal.*

Furthermore, some of the regulations and guidelines contain specific provisions on dangerous goods. These provisions shall be highlighted below.

Article 25 of the *Regulations on Safe Navigation of Vessels on the Lancang-Mekong River* stipulates:

> *During berthing, loading and unloading or navigating, a vessel carrying dangerous goods shall, in addition to exhibiting signals as generally prescribed, exhibit an all-round red light at the mast yard at night and the International Code Flag "B" in the day time.*

Article 16 of the Rules on *Water Transport Administration on the Lancang-Mekong River* reads:

> *For the safety of life, health and the protection of environment, the carriage of dangerous goods such as explosives, poisonous and infectious substances [and] radioactive materials shall be prohibited.*

Article 17 of these Rules stipulates:

> *The protection requirements for each packaging group and each type of package as required in the carriage of dangerous goods shall be in compliance with the provisions for packaging type, packing method, specifications and performance tests in [the] IMDG Code.*
>
> *The proper shipping name of the goods shall be displayed on the package of dangerous goods and the name used shall be in compliance with the individual schedules of dangerous*

goods in [the] IMDG Code. Labels and marks as required by the provisions of [the] IMDG Code shall be adhered on the evident place of the package either by pasting, printing or fastening.

The UN number of the dangerous goods contained shall also be displayed on their packages.

The documents used for the transport of dangerous goods shall meet the requirements stipulated in [the] IMDG Code.

Article 18 of the Rules reads:

Vessels carrying dangerous goods shall comply with relevant technical requirements for the carriage of dangerous goods.

When carrying dangerous goods onboard vessels, precautions shall be made to ensure the normal use of the safety facilities and unimpeded pass of the pass ways.

Article 19 of the Rules stipulates:

Passenger vessels, cargo and passenger vessels and vessels other than steel construction shall not be allowed to carry dangerous goods.

Finally, Article 20 of the Rules reads:

The loading and carriage of ruptured and leaked packages and contaminated dangerous goods shall be prohibited.

The *Guidelines on the Maintenance and Improvement of the Navigability of the Lancang-Mekong River*, the *Regulations on the Investigation and Handling of Waterborne Traffic Accidents on the Lancang-Mekong River* and the *Regulations on Management of Search & Rescue, Salvage and Wreck Removal on the Lancang-Mekong River* do not contain provisions pertaining to dangerous goods.

Article 33 of the *Technical Regulations of Surveys of Commercial Ships on the Lancang-Mekong River* stipulates that the vessel intended for carrying dangerous goods must be equipped with an additional all-round red light.

The rules and regulations mentioned above – which apply only to the Upper Mekong – should be taken into consideration when establishing harmonised rules for the transportation of dangerous goods on the Mekong. As we have seen, the *Rules on Water Transport Administration on the Lancang-Mekong River* contain provisions on the carriage of dangerous goods. These provisions refer to the IMDG Code.

6.3.3 *Convention between Siam and France relating to the Regulation of the Relations between Siam and Indochina*

There is currently no updated and harmonised legal regime for navigation on the stretch of the Mekong between Luang Prabang and the Khone Falls.

However, the *Convention between Siam and France relating to the Regulation of the Relations between Siam and Indochina*, signed at Bangkok, 25 August 1926 appears still to be in force between Lao PDR and Thailand.[61]

[61] See also the summary of the regional meeting to establish a legal framework for cross border navigation between the Lao PDR and Thailand on the stretch downstream of Luang Prabang, held at Vientiane on 27 October 2010.

The 1926 Convention does not contain provisions on dangerous goods.

Under this Convention, a "Franco-Siamese Permanent High Commission of the Mekong'' was established which functioned fairly effectively[62] from 1928 until the beginning of World War II[63] and encountered further political difficulties as from 1954.[64] The Commission elaborated a number of common regulations.[65]

The status of the common regulations of the Franco-Siamese Permanent High Commission of the Mekong remains to be ascertained. Furthermore, we were unable to access the text of all regulations. However, it seems unlikely that these regulations contain up-to-date provisions relating to dangerous goods. In any case, it appears that the Commission had no regulatory powers and did not have the power to establish binding rules. From the wording of Article 10 of the Convention,[66] it follows that the Commission was only charged with the preparation of rules.

6.3.4 Agreement on Waterway Transportation between Cambodia and Viet Nam

The *Agreement on Waterway Transportation*, signed at Phnom Penh, 17 December 2009, was concluded by Cambodia and Viet Nam and relates to the Lower Mekong Basin (the Agreement is briefly introduced in Chapter 3.3.2). The Agreement replaces the Agreement on Waterway Transportation, signed at Hanoi, 13 December 1998.

The purpose of the Agreement is to establish a legal framework for the effective implementation of freedom of navigation in the Mekong River system, thereby implementing Article 9 of the MRC Agreement as well as to create favourable conditions for transit and cross-border navigation within the regulated waterways (Art. 1).

The term *dangerous goods* within the context of the Agreement is defined in Article 2 (15). This definition reads:

> *'Dangerous goods' means goods classified in the IMDG Code or in any other relevant IMO publication as dangerous for carriage by sea, and any other substance or goods the properties of which might be dangerous if that substance or those goods were carried by*

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62 Halbertsma, H.G., "Legal aspects of the Mekong River System", *NILR* 1987, (25), 33.

63 Wheeler, V.M., "Co-operation for Development in the Lower Mekong Basin", *American Journal of International Law* 1970, Vol. 64, No. 3, (594), 605 footnote 41.

64 Dinh, N.Q., "L'internationalisation du Mékong", *Annuaire français de droit international* 1962, (91), 108.

65 See further Dinh, N.Q., "L'internationalisation du Mékong", o.c., 101-102 and Kesavankutty Menon, P., *The Lower Mekong River Basin: An Enquiry into the International Legal Problems of the Development Programme of the Lower Mekong Committee,* diss., New York University, School of Law, 1970, 81.

66 Article 10 stipulates:

There shall be a "Permanent Franco-Siamese High Commission for the Mekong" consisting of an equal number of Siamese and Indo-Chinese officials.

In addition to the powers granted it under Articles 2, 3, 5, 6 and 9 of the present Convention, it shall be the duty of the Permanent Franco-Siamese Commission for the Mekong to superintend in general the execution of the various special agreements concerning the frontier region and to study all questions arising through the application of the new system in this region ; in particular, it shall give its opinion if any disputes arise concerning the river frontier line. It may also propose such solutions as might, in its opinion, secure the friendly settlement of questions connected with rights of cultivation carried on, as circumstances allow, by the nationals of the two countries in land situated in the bed of the river. In no case shall these proposals be adopted until the common consent of the two Governments concerned has been obtained in writing.

It shall also be the duty of the Permanent Franco-Siamese High Commission for the Mekong to supply the two Governments concerned with all useful information and to prepare all the rules required to ensure the most satisfactory degree of cooperation in the policing of navigation and the maintenance of health and security in the frontier region. These rules may provide for the punishment of offenders and shall be put into force simultaneously by the two Governments concerned, when both Governments have reached an agreement regarding them. Siam and Indo-China shall negotiate, as soon as possible, an agreement for the creation and constitution of the Permanent Franco-Siamese High Commission for the Mekong which shall, on the lines laid down in the present Article, define the Commission's organisation and method of working.

> *sea, and includes empty receptacles, residues in empty tanks or cargo holds which have been used previously for the carriage of dangerous goods unless such receptacles, empty tanks or cargo holds have been cleaned and dried, purged, gas freed or ventilated as appropriate or in the case of radioactive materials have been both cleaned and adequately closed; but the expression shall not include goods forming part of the equipment or stores of the ship in which they are carried.*

Some other provisions of the Agreement also refer to dangerous goods.

Article 15 of the Agreement, which deals with documents and permits for inland waterway vessels, stipulates that Cross-Border Transportation Permits are classified into three categories. One of these three categories – the so-called "special category" – relates to permits for vessels carrying dangerous goods, with a maximum validity of 60 days.

Article 18 of the Agreement, which contains provision on pilotage, stipulates that pilotage is compulsory for, *inter alia*, vessels engaged in cross-border transportation carrying dangerous goods.

Article 20 of the Agreement, on criminal jurisdiction, provides in its fifth paragraph that the provisions of this article do not prejudice the rights of the Competent Authorities in the enforcement of the applicable laws and regulations relating to customs, public health and control measures over the safety of vessels and ports, the protection of human life, security of goods, immigration as well as the transportation of dangerous goods and environmental pollution, provided that such measures take due consideration of freedom of navigation as guaranteed by the Agreement.

These provisions should be taken into consideration when drafting harmonised rules for transportation of dangerous goods on the Mekong.

Article 12 (1) of the Agreement reads:

> *The laws, rules and regulations under which freedom of navigation shall be exercised, including on immigration, customs, health, veterinary and phytological matters, shall, with a view to an improvement of navigational conditions, be harmonised through joint decision-making. Proposals for harmonised rules and regulations shall be made by the Mekong Navigation Facilitation Committee and submitted for approval to the Contracting Parties.*

Accordingly, the Agreement provides a mechanism for the harmonisation of national laws, rules and regulation through joint decision making. A proposal for such harmonised rules must be made by the Mekong Navigation Facilitation Committee (MNFC) and has to be submitted to the Contracting Parties

Article 16 of the Agreement provides, *inter alia*:

1. *The laws and regulations on immigration, customs, health, veterinary and phytological matters and environment shall be enacted by the Contracting Parties.*
2. *The laws and regulations referred to under paragraph (1) shall conform to applicable international conventions and generally accepted international practice.*

Article 32 of the Agreement mentions the harmonisation of regulations as one of the basic duties of the Mekong Navigation Facilitation Committee:

> The Mekong Navigation Facilitation Committee is charged with:

a. *ensuring the smooth implementation of the present Agreement and actively contributing to the realisation of its objectives;*

b. *improving and harmonising the regulations and other conditions under which freedom of navigation is exercised;*

c. *promoting and intensifying the cooperation between the Contracting Parties in all matters related to navigation in the Mekong river system and related activities; and*

d. *obtaining compliance with the provisions of the present Agreement (emphasis added).*

Article 33 of the Agreement continues:

1. *With a view to the harmonisation of laws, rules and regulations and the facilitation of navigation within the Mekong river system, the Mekong Navigation Facilitation Committee shall make proposals for the adoption and, if need be, the revision by the Contracting Parties of:*

[…]

f. *rules and regulations on the transportation of dangerous goods;*

[…]

2. *The implementing regulations referred to in paragraph (1) shall conform to the present Agreement, other applicable international conventions and generally accepted international standards.*

[…]

In other words, Article 33 (1) of the Agreement specifically instructs the MNFC to make proposals for the adoption by the Contracting Parties of rules and regulations on the transportation of dangerous goods. Pursuant to the provision at hand, harmonised rules on the carriage, handling and storage of dangerous goods can be adopted by the Governments of Cambodia and Viet Nam, upon a proposal from the MNFC. Any harmonised rules adopted within the MNFC can never be considered directly applicable. Such harmonised rules are merely proposals for subsequent national lawmaking.

Article 33 (2) of the Agreement furthermore provides that the implementing regulations should conform to generally accepted international standards.[67]

Article 34 (1) of the Agreement stipulates that the MNFC consists of an Executive Council, a Board, Working Groups and a Waterway Transportation Consultative Group. According to Article 34 (2) the MNFC Executive Council has the power to establish and adopt implementing regulations under the Agreement "subject to prior or subsequent approval by the respective Governments, which shall be requested in due time".

[67] With regard to these international standards, see above, Chapter 6.2

6.4 NATIONAL LAWS AND REGULATIONS

6.4.1 Inventory of National Instruments in Cambodia

When drafting harmonised rules for the transportation of dangerous goods on the Mekong, existing national laws and regulations should be taken into consideration as well.

The following Cambodian laws and regulations are relevant to the carriage of dangerous goods by inland navigation.

A first relevant instrument is the *Constitution of the Kingdom of Cambodia*. Article 58 of the Constitution with regard to control, use and management of *i.e.* rivers, canals, streams and lakes stipulates:

> *State property comprises land, underground mineral resources, mountains, sea, undersea, continental shelf, coastline, airspace, islands, rivers, canals, streams, lakes, forests, natural resources, economic and cultural centres, bases for national defence and other buildings determined as State property.*
>
> *The control, use and management of State properties shall be determined by law.*

A second relevant instrument is the *Decree of 28 October 1988*, "referring to Contract and Other Liabilities". This Decree does not contain specific provisions on the transport of dangerous goods. However, Article 83 of the Decree contains a definition of the term carrier contract, which reads:

> *A contract for carriage is a contract whereby a person who is a carrier undertakes to transport passengers, luggage* [sic] *or goods from one place to another for a fee determined by an agreement of the parties or a fee determined by the state.*

A third relevant instrument is the *Sub-Decree on Water Pollution Control* of 6 April 1999. Article 3 (i) of this Decree defines hazardous substances and reads:

> *Hazardous substances refers to any substances that cause danger to living organisms, damage or break down any object or buildings or adversely impact and damage the environment. The types of hazardous substances are listed in the Annex 1 of this sub-decree.*

Article 8 of the Sub-Decree stipulates:

> *The disposal of solid waste or any garbage or hazardous substances into public water areas or into public drainage system shall be strictly prohibited.*
>
> *The storage or disposal of solid waste or any garbage and hazardous substances that lead to the pollution of water of the public water areas shall be strictly prohibited.*

Cambodia is preparing a national instrument to regulate transport over inland waterways. The draft law on inland waterway transportation contains an interesting provision concerning the transport of dangerous goods. Article 61 of the draft law reads:

> [...]
>
> *The carriage of dangerous goods shall be permitted by the competent authorities. The technical details for the carriage of dangerous goods by inland waterways ship shall be determined by the declaration of the minister in charge of public works and transport.*
>
> [...]

The current status of the *Draft Law on Inland Waterway Transportation* is unknown.

On 30 June 2011 a draft of the "*Prakas on Technical [sic] for carriage of dangerous goods by inland waterway in the Kingdom of Cambodia*" was presented (the Prakas is briefly introduced in Chapter 3.3.3.1). The wording of the *Prakas* is not always clear. The aim of the *Prakas* is laid down in Article 1:

> *This Prakas shall aim to determine technical [sic] for carriage, loading and unloading of dangerous goods in the inland waterway of the Kingdom of Cambodia.*

Article 2 of the draft *Prakas* stipulates:

> *The purpose of this Prakas shall be determined as follows:*
>
> *To protect human life, animals, damage of public and private properties during carrying of dangerous goods in the inland waterway of the Kingdom of Cambodia.*
>
> *To prevent the carriage of dangerous goods without technical procedure.*
>
> *To maintain good order, security and environmental prevention pollution in the inland waterway.*

Article 3 of the draft *Prakas* reads:

> *The scopes of this Prakas shall be applied as follows:*
>
> *Any means of commercial inland waterway transport which is carried dangerous goods in the Kingdom of Cambodia, except vessels in properties of Ministry of Defense and Ministry of Interior.*
>
> *Person who runs businesses or other services which involving of carrying of dangerous goods.*
>
> *Shipowners of all kinds of ship, mobile floating barges, ports, and landing stages.*

Article 4 of the draft *Prakas* divides the dangerous goods into classes following the IMDG Code classification.

Article 5 of the draft *Prakas* stipulates:

> *Carriage of dangerous goods in the inland waterway shall be applied to European Agreement concerning the international carriage of dangerous goods by inland waterway ADN.*

Article 9 of the draft *Prakas* obliges all vessels carrying dangerous goods to have a dangerous goods manifest, an example of which can be found in annex to the draft *Prakas*.

The current status of this draft *Prakas* is unknown.

It is furthermore reported that the following relevant circulars are currently being prepared by the Inland Waterway Transport Department of the Ministry of Public Works and Transport (MPWT) (see also Chapter 4.3.2.3):

- *Circular on Waste Management from Ships in Inland Waters;*
- *Circular on Dangerous Goods Transportation Technique on Inland Waterways;*
- *Circular on the License for Barges and Ships;*

- *Circular on Protection and Prevention of Traffic Accidents along Inland Waterways;*
- *Circular on Management of Means of Waterway Transport*.

The Cambodian laws, decrees and sub-decrees on environmental protection, natural resources management, protected areas and land-use planning are listed in Chapter 7.2.1. In the same chapter, reference is made to the 1999 *Sub-Decree on the Environmental Impact Assessment Process, the Decree on Water Pollution Control, the Sub-Decree on Solid Waste Management and the Sub-Decree on Air Pollution, Vibration and Noise Disturbance*.

In addition, reference can also be made to the following instruments which are discussed elsewhere in this volume:

- *Prakas on the Formation of Private Port Management Commission* (see Chapter 3.3.3.1);
- *Sub-Decree No. 218 of 24 December 2008 on the Establishment of Cambodian Maritime Institute (CMI)* (see Chapter 3.3.3.1);
- *Law on Fire Prevention and Firefighting of 2001 and its implementing decree and circulars* (see Chapter 3.3.4.1).

6.4.2 Inventory of National instruments in Lao PDR

The following laws of the Lao PDR contain provisions which are relevant to the transportation of dangerous goods by inland waterways.

A first relevant instrument is the *Law on Water and Water Resources* of 11 October 1996. According to Article 1, the Law determines the necessary principles, regulations, and measures relating to the administration, exploitation, use and development of water and water resources in the Lao PDR, in order to preserve the sustainability of water and water resources, to ensure that water is available in the volume and quality necessary for the people's living requirements, to promote agriculture, forestry, and industry, to develop the national economy, and to ensure that no damage is caused to the environment.

Article 42 of the Law contains provisions on preventing polluted water and waste water and reads:

> *Polluted water is water which is not clean or water which has been used, which can be reused after being recycled. Waste water is water which has been used and which has dirty substances in it or has chemicals mixed in it so as to cause it to lose its characteristics as water, being dangerous to the environment.*
>
> *Individuals, legal entities or organisations must adhere to regulations regarding the prevention of waste water.*
>
> *It is prohibited to undertake any activity that may cause damage to water or water resources, the environment, animals, and the living condition of the people; it is prohibited to dump or discharge waste of any kind into water sources so as to create polluted water or waste water containing pollutants or waste in excess of the discharge standard.*
>
> *Polluted water, waste water, and waste that exceed the discharge standard must first be treated before they may be dumped or discharged into water sources; this includes: water from plants, factories, abattoirs, hospitals, and others.*

> *Should any individual discover any act referred to above, he must report it to the village administrative authorities or to a responsible agency for timely resolution.*

A second relevant instrument is the *Land Transport Law* of 12 April 1997. According to Article 1, the *Land Transport Law* has the function of "determining the regime for the administration, organisation, and operation of the domestic, international and cross-border transport of goods and of passengers in order to efficiently and safely expand travel and distribution of goods, using the country's potential in respect of its geographical location at the centre of countries in the region to contribute to socio-economic development and international cooperation".

Article 2 of the Law defines land transport as "the transport of goods, passengers, materials, commodities, and animals via roads by means of various types of vehicles and motorised mechanisms, including tractors carrying goods, passengers and animals, and automobiles ranging from three-wheeled vehicles to all types of automobiles, including different types of trucks". As such, the Law does not apply to transportation by waterways.

Nevertheless, Article 23 of the Law contains an interesting provision on dangerous goods which reads:

> *Transport of Dangerous Materials.*
>
> *The transport of dangerous materials, such as: chemical materials, flammable materials, explosive materials, whether by transport enterprise, specialised transport or personal transport, must receive approval from the Ministry of Communication, Transport, Post and Construction in coordination with concerned sectors and must strictly comply with the regulations regarding the transport of dangerous materials.*

It is not clear what is meant by the above mentioned "regulations regarding the transport of dangerous materials".

Other relevant instruments include the *Draft Rule on Safety of the Port*, *the Draft Rule on Dry Port*, the *Draft Regulation on Handling and Storage of Dangerous Goods* and the *Draft Rule on Inland Waterway Transportation of Dangerous Goods* (see also Chapter 3.3.6.1). At this stage, these instruments are only available in Lao.

In addition, reference can be made to the following regulations, guidelines, technical standards and notifications that currently apply to inland waterway transportation in Lao PDR (already presented in Chapter 4.3.5.1):

- *Guideline on River Traffic Regulation No. 219/MCTPC* of 19 April 2000;
- *Guideline on River Transport Regulation No. 104/MCTPC* of 12 January 2000;
- *Guideline on Request for Ship Building Permission No. 1442/MCTPC* of 26 January 1996;
- *Notification for Operating of Passenger Speed Boat No. 1663/MCTPC* of 1 June 1997;
- *Standard of Technical Inspection for Ship and Ferry No. 0030/Transport Section* of 8 January 1996;
- *Regulation on transport business establishment, forwarders and maintenance services owned by state, group of people, state-private, private and individual No. 1423/CTPC* of 22 June 1996;
- *Regulation on Truck and Transport Boat Association No. 1414/CTPC* of 22 July 1996.

Furthermore, reference can be made to the relevant environmental legislation, which will be further discussed in Chapter 7.2.2.1 and which includes the following instruments:

- *Environmental Protection Law No. 02/99/NA* of 3 April 1999;
- *Forestry Law* of 2005;
- *National Heritage Law* of 2005;
- *Land Law* of 1997;
- *Decree on the Environment Protection Fund No. 146/PM* of 6 June 2005;
- *Environmental Assessment Decree* of 16 February 2010;
- *EIA Regulation for Hydropower Development Sector* of 2001;
- *EIA Regulation for Road Development Sector* of 2003;
- *EIA Regulation for Industry Sectors* of 2005,
- *National Environmental Standard, No. 2734/PMO, WREA* of 7 December 2009.

6.4.3 Inventory of National Instruments in Thailand

The following Thai laws and regulations contain provisions which are relevant to the carriage of dangerous goods by inland waterway.

The *Navigation in Thai Waters Act* of 1913, as amended in 1992, contains several provisions on the carriage of dangerous goods. The wording of the Act is not always clear, presumably due to the translation into English.

Section 189 of the *Navigation in Thai Waters Act* stipulates:

> *The Harbor Master with the approval of the Minister of Communication shall have power to announce in the Government Gazette to classify the things and the thing that may cause danger.*

Section 190 of the Act reads:

> *The Minister of Communication shall have power to issue the Ministerial Regulations prescribing the rules and means concerning the packing, storing, classifying, providing and showing the sign, preparing the necessary document, and transshipment the things that may cause danger during transportation under this chapter.*
>
> *Such Ministerial Regulations shall become effect upon their publication in the Government Gazette.*

Section 191 of the Act reads:

> *The transshipment of anything that may cause danger from vessel to vessel, transferring from vessel to land, or transferring from land to vessel. The master or the representative of vessel must inform the harbour Master least 24 hours before transferring, and do not transfer until receive the permission from the Harbor Master.*
>
> *The Harbor Master with the approval of the Minister of Communication shall have power to announce in the Government Gazette to except the what type of vessel or what type of transferring that is not in force of provision under paragraph one.*

Section 192 of the Act reads:

The Harbor Master with the approval of the Minister of Communication shall have power to announce in the Government Gazette, what type of vessel that carry things that may cause danger must fly the flag or show the sign or give any warning as prescribed.

Section 193 of the Act stipulates:

The sending of things that may cause danger by ship, the sender must prepare the sticker showing clearly the dangerous condition of that things on the box, and notify by letter concerning the dangerous condition of that things including the name and address of sender tot the master for information while of before bringing that things to the vessel.

Section 194 of the Act reads:

The master must check carefully, do not allow to bring the thing that may cause danger to vessel with the offense to the Ministerial Regulation issued under Section 190. In case of any doubt concerning the hiding the thing that may cause danger to a vessel, the master may deny to receive that box, except the owner or the possessor allow to open that box for inspection.

Section 195 of the Act stipulates:

Any person offending against any of the provisions of Section 192 or Section 194 paragraph one shall be punished with imprisonment not exceeding three months or with a fine not exceeding then thousand Bath or both.

Section 196 of the Act reads:

Any person offending against any of the provisions of Section 190, Section 191 or Section 193 paragraph two shall be punished with an imprisonment not exceeding six months or with a fine not exceeding twenty thousand Bath or both.

A second relevant instrument is the *Hazardous Substance Act* of 29 March 1992, as amended. This Act (which is briefly referred to in Chapter 3.3.5.1) establishes a Hazardous Substance Committee (Sec. 6) and contains provisions on duties and civil liabilities (Chapter 3) and penalties (Chapter 4). The *Hazardous Substance Act* does not contain specific provisions on the transportation of dangerous goods.

The Marine Department of the Thai government issued several notifications on the carriage of dangerous goods by inland waterways.

A first relevant notification of the Marine Department is Notification no. 353/2529 of 15 December 1986 which concerns the classification of dangerous substances and articles (see also Chapters 3.3.5.1 and 7.2.1.1). Thailand – as a party to the SOLAS convention – follows the IMDG Code classification of dangerous goods, which is duplicated in the notification.

A second relevant notification of the Marine Department is Notification no. 411/2543 of 22 December 2000 concerning safety measures for the loading/discharging of oil and chemicals (see also Chapters 3.3.5.1 and 7.2.1.1). This notification reads:

1. *The owner or operator of port loading/discharging oil or chemicals shall develop an action*

plan for the prevention and response of marine pollution caused by oil or chemical spillage in accordance with the Marine Department's guidelines. Such plan shall be approved by the Marine Department before implemented.

The Marine Department's Working Group shall finish consideration of the action plan within 60 days since the day receiving the submission. If the consideration prolongs beyond such period, it shall be deemed that the action plan has been approved by the Marine Department.

If the Marine Department notifies the submitting port owner or operator of its disapproval for subsequent revision/improvement of the action plan. The Marine Department's Working Group shall finish consideration of the revised action plan within 30 days since the day receiving the revised action plan. If the consideration prolongs beyond such period, it shall be deemed that the revised action plan has been approved by the Marine Department.

2. *Preparation of appliances/equipment for emergency response:*

   2.1 *The owner or operator of port loading/discharging oil products shall always maintain all appliances/equipment necessary for the oil spill response in accordance with the action plan for the prevention and response of marine pollution caused by oil spill approved by the Marine Department. Such appliances/equipment must be ready for use at all times, particularly during the loading/discharging of oil products.*

   2.2 *In case certain chemicals are needed for oil spill response, chemicals certified by national authorities or international organizations shall be used subject to prior approval by the Marine Department.*

   2.3 *The owner or operator of port loading/discharging chemicals shall always maintain all appliances/equipment necessary for the response of chemical spillage or fire in accordance with the action plan for the prevention and response of marine pollution caused by chemicals approved by the Marine Department. Such appliances/equipment must be ready for use at all times, particularly during the loading/discharging of chemicals.*

3. *Before the loading/discharging of oil and chemicals, the Harbour Master and Ship Master shall carry out a joint inspection between the ship and port by using a Ship/Shore Safety Check List as recommended by the International Safety Guide for Oil Tankers and Terminals.*

   The port owner or operator shall maintain the Ship/Shore Safety Check List for the purpose of inspection not less than 3 months. If there is any legal dispute, the Ship/Shore Safety Check List shall be kept until the dispute is legally settled.

   In case of the ship-to-ship loading/discharging of oil or chemicals, the Masters of both ships shall carry out a joint inspection of safety of both vessels before the loading/discharging commences. The joint inspection will be carried out in accordance with the Ship to Ship Transfer Guide developed by the International Chamber of Shipping and the oil Companies International Marine Forum. The Masters of both ships shall maintain the joint inspection report for verification not less than 3 months. If there is any legal dispute, the joint inspection report shall be kept until the dispute is legally settled.

A third relevant notification is *Notification No. 412/2543* also of 22 December 2000 (see also Chapters 3.3.5.1 and 7.2.1.1). This notification contains guidelines for the action plan for combatting marine pollution at ports where dangerous goods are loaded/discharged.

The *Safety Measures for Transportation of Petroleum Products on Mekong River (Thailand)* constitute another relevant instrument (see also Chapters 3.3.5.1 and 7.2.1.1). These Safety Measures have been developed with a view to serving as a guideline for management and control to ensure safe transportation. They also provide a guideline for a response to unexpected incidents of oil spills. In addition, they contain provisions on the compensation of operational expenses and damages caused by marine pollution as a result of oil spill.

Reference can furthermore be made to the following instruments which are already presented above:

- *Port Authority of Thailand Act* (B.E. 2494) as amended in B.E. 2543 (see Chapter 3.3.5.1);
- *Ship Survey Regulation Act* (B.E. 2534) (see Chapter 4.3.4.1);
- *Thai Vessel Act* (B.E. 2481) (see Chapter 4.3.4.1).

Moreover, a number of legal instruments deal with environmental issues and will be further discussed below (see Chapter 7.2.3.1). These instruments include:

- *Enhancement and Conservation of the National Environmental Quality Act* (B.E. 2535);
- *Public Health Act* (B.E. 2535);
- *Fishery Act* (B.E. 2496);
- *Factories Act* (B.E. 2535);
- *Public Cleansing Act* (B.E. 2535);
- *Industrial Estate Authority of Thailand Act* (B.E. 2522);
- *Land Transportation Act* (B.E. 2522);
- *Industrial Products Standards Act* (B.E. 2511);
- *Petrol Act* (B.E. 2521);
- *Land Traffic Act* (B.E. 2535);
- *Highway Act* (B.E. 2535);
- *Building Control Act* (B.E. 2522);
- *Energy Conservation Promotion Act* (B.E. 2535);
- *Official Information Act* (B.E. 2540).

6.4.4 Inventory of National Instruments in Viet Nam

The following Vietnamese laws and regulations contain provisions that are relevant to the carriage of dangerous goods by inland navigation.

A first relevant instrument is the *Decree No. 40-CP on Ensuring Navigation Orders and Safety on Inland Waterways* by the government dated 5 July 1996. Article 31 (2) of this Decree stipulates:

> *The passenger transport means must not carry toxic, explosive, inflammable and other dangerous substances which affect the health and life of passengers.*

Article 32 of this Decree reads:

> *A means of transport carrying toxic goods, explosive and other dangerous substances must get permission from the competent State agency and must be marked with a special sign as prescribed. It must strictly observe the prescriptions on the prevention and fight against toxicity, fires and explosions.*

A second relevant instrument is the *Regulation on Inland Waterway Cargo Transportation, Handling, Consignment and Preservation*. This Regulation was issued together with *Decision 1895/1999/QD-BGVTV* of 30 July 1999 promulgating the regulation on inland waterway cargo transportation, handling, consignment and preservations. Article 1 of the Regulation reads:

> [...]
>
> *The transportation, handling, consignment and preservation of dangerous goods shall comply with separate regulations.*

This provision probably refers to *Decree No. 29/2005/ND-CP* of 10 March 2005, which will be discussed below.

A third relevant instrument is the *Law No. 23/2004/QH11* of 15 June 2004 on Inland Waterway Navigation. Article 1 defines the scope of the Law and reads:

> *This Law provides for inland waterway navigation activities; conditions to ensure safety for inland waterway navigation infrastructures, vessels and people participating in inland waterway navigation and transport.*

Article 2 of the Law stipulates:

> *This Law applies to organizations and individuals involved in inland waterway navigation activities.*
>
> *In cases where international agreements which the Socialist Republic of Vietnam has signed or acceded to contain provisions different from those of this Law, the provisions of such international agreements shall apply.*

Article 95 of the Law contains provisions on transport of dangerous cargoes and stipulates:

1. *Vessels engaged in the transport of dangerous cargoes must be permitted by competent State agencies and have unique codes. Transporters must strictly observe regulations on prevention and control of hazards, fires and explosions; must have plans on coping with oil-spill incidents when transporting petrol and oil.*
2. *The Government shall prescribe the list of dangerous goods and the transport of dangerous goods on inland waterways.*

The list of dangerous goods as mentioned in Article 95 (2) of *Law No. 23/2004/QH11* is laid down in *Decree No. 29/2005/ND-CP* of 10 March 2005 promulgating the list of dangerous goods and the inland waterway transportation thereof (the Decree is briefly touched upon in Chapter 3.3.4.1).

This Decree only concerns the transportation of dangerous goods on inland waterways, but excludes transportation of dangerous goods on inland waterways in service of armed forces' defence and security purposes (Art. 1).

Article 2 (1) of the Decree stipulates:

> *This Decree applies to domestic as well as foreign organizations and individuals engaged in the transportation of dangerous goods on inland waterways.*

Article 2 (2) of the Decree reads:

In cases where the international agreements which the Socialist Republic of Vietnam has signed or acceded to contain provisions different from those of this Decree, the provisions of such international agreements shall apply.

Article 3 of the Decree contains definitions and reads:

1. *Dangerous substances mean substances or compounds in a gaseous, liquid or solid form which may cause harms to human life and health, environment, safety or national security.*
2. *Dangerous goods mean those containing dangerous substances which may cause harms to human life and health, environment, safety or national security when being transported on inland waterways.*

[...]

The second chapter of the Decree provides a classification and a list of dangerous goods. This classification is similar to that of the IMDG Code. Dangerous goods are divided into 9 different classes and divisions:

Class 1: Explosives

Division 1.1 : Explosives

Division 1.2: Industrial explosive materials

Class 2: Flammable or Toxic Gases

Division 2.1: Flammable gases. identification numbers of a group of two or three

Division 2.2: Toxic gases

Class 3: Flammable Liquids

Class 4: Flammable Solids

Division 4.1: Flammable solids, self-active

Division 4.2: Substances pran'e to self combustibility

Division 4.3: Substances which on contact with water emit flammable gases

Class 5: Oxidizing Substances

Division 5.1: Oxidizing substances

Division 5.2: Organic peroxides

Class 6: Toxic or Infectious Substances

Division 6.1: Toxic substances

Division 6.2: Infectious substances

Class 7: Radioactive Substances

Class 8: Corrosives

Class 9: Other Dangerous Substances and Goods

The second chapter of the Decree also deals with rules on packaging, labels and symbols (Art. 6) and with responsibilities to formulate, amend and supplement regulations on dangerous goods (Art. 7).

The third chapter of the Decree contains provisions on the transportation of dangerous goods. In this chapter rules are laid down concerning “conditions on persons involved in transportation of dangerous goods” (Art. 8), “loading and unloading of dangerous goods” (Art. 9), “conditions on vessels carrying dangerous goods” (Art. 10), “responsibilities of dangerous goods carriers” (Art. 11), “responsibilities of shipmasters and vessel operators” (Art. 12), “responsibilities of dangerous goods transportations hirers” (Art. 13), “responsibilities of local People’s Committees” (Art. 14), “competence to grant dangerous goods transportation permits” (Art. 15) and “contents of, procedures and time limits for granting dangerous goods transportation permits” (Art. 16).

Chapter Four of the Decree contains provisions on the inspection, examination and handling of violations. Chapter Five contains implementation provisions.

A following relevant instrument is the Decree of 19 October 2009 on multimodal transport, which holds several provisions concerning the liability of the consignor when transporting dangerous goods through a multimodal transport mode.

Article 25 of the Decree concerns the liability to provide information on goods:

1. The consignor or his/her representative shall accurately provide the multimodal transport operator with the following information on the goods:

   a) Particulars relating to the goods for insertion in the multimodal transport document:

   - The general nature, marks, number, weight, volume and quality of the goods; and

   - The apparent condition of the goods.

   b) Papers related to the goods as provided for by law or agreed in the trading contract.

2. In addition to the liabilities mentioned in Clause 1 of this Article, the consignor or his/her representative that hands over dangerous goods to the multimodal transport operator for carriage shall:

   a) Supply the multimodal transport operator with necessary documents and instructions on the danger of the goods and, if necessary, the precautions to be taken;

   b) Mark or label dangerous goods in accordance with treaties or current national law; and

   c) Appoint escorts, if it is so required for dangerous goods.

Article 26 (2) of the Decree, which deals with liability for the loss of goods, stipulates:

When the consignor or his/her representative fails to comply with the provisions of Clause 2, Article 25 of this Decree and the multimodal transport operator has no way to know the particulars and danger of such goods, the consignor shall indemnify the multimodal transport operator against any loss resulting from the carriage of such goods, even they may be unloaded, destroyed or rendered innocuous by the multimodal transport operator, as the circumstances may require, if dangerous goods become an actual danger to life or property.

A number of instruments that apply to inland waterway ports and landing stages were already dealt with in Chapter 3.3.4.1 and include the following decision and circulars:

- *Decision No. 27/2008/QD-BGTVT* of 4 December 2008 regulating the responsibilities and authorities of VIWA;
- *Circular No. 25/2010/TT-BGTVT* of 31 August 2010 regulating the implementation of inland waterway ports and landing stages;
- *Circular No. 34/2010/TT-BGTVT* of 8 November 2010 regulating the operation of the Port Authority (port state control) systems; and
- *Circular No. 101/2008/TT-BTC* of 11 November 2008 regulating the implementation for fee, charge and fine collection of inland waterway ports and landing stages.

Reference can furthermore be made to the following instruments that relate to maritime transport and that were discussed in Chapter 4.3.3.3:

- *Maritime Code of Viet Nam*;
- *Decree 30/CP on Activities of People and Foreign Navigation Facilities in Viet Nam's Waters* of 29 January 1980;
- *Decree No. 13/CP on Regulation on the Management of Maritime Shipping at Seaports and in the Maritime Navigable Zones of Viet Nam* of 25 February 1994;
- *Decree on the Tasks of Viet Nam's Marine Police including the Task of Marine Environment Protection* of 28 March 1998 ;
- *Decree No. 160/2003/ND-CP on Administering Maritime Activities at Vietnamese Ports and Maritime Waters* of 18 December 2003.

In Chapter 4.3.3.4, the following instruments that regulate inland waterway transportation were briefly presented:

- *Circular No. 20/2011/TT-BGTVT* on the rules for management of passenger transport;
- *Circular No. 21/2011/TT-BGTVT* on the rules for registration of inland vessels;
- *Decision No. 25/QD-BGTVT* on the rules for registry of inland vessels;
- *Decision No. 33/2004/QD* on the rules for management of cargo transport;
- *Decision No. 34/2011/QD* on the rules for inland waterway port authority); and
- *Circular No. 14/2011/ TT-BGTVT* on the rules for crew members on inland waterways).

In addition, the following two legal instruments that were presented in Chapter 4.3.3.4 contain standards for vessels carrying dangerous goods:

- *Decision No. 28/2004/QD-BGTVT*; and
- *Decree No. 125/2005/ND-CP*.

Furthermore, reference can be made to *Decision No. 63/2000/QD-Ttg* of 7 June 2000 and *Decision No. 129/2001/QD-Ttg* of August 2001, discussed in Chapter 4.3.3.6, which both regulate the response to oil incidents.

The environmental legislation, which will be further discussed in Chapter 7.2.4.1, includes the following legal instruments:

- *Law on Protection of the Environment* of 1994;
- *Water Law* of 20 May 1998;
- *Decree 80/CP/2006* on environmental impact assessment, pollution, disaster control and monitoring (amended and supplemented by *Decree No. 21/2008/ND*);
- *Decree 117/2009/ND-CP* on increased violation for environmental pollution;
- *Decree No. 120/2008/ND-CP* on regulations for river basin management of 1 December 2008;
- *Circular No. 04/2008/TT-BTNMT* on certification and inspection of environmental protection schemes;
- *Circular No. 05/2008/TT-BTNMT* on Strategic Environmental Assessment (SEA), EIA and environmental protection commitment;
- *Decision No. 2242/QD/KHKT-PC* by the Minister of Transport on regulation of environmental protection in the transport sector of 12 September 1997;
- *Decision No. 32/2004/QD-BGTVT* of the Minister of Transport on the organisation and operation of ports of 21 December 2004;
- *Industry Standard 22 TCN264* on rules to prevent river pollution caused by vessels, 2006.

The specific legal instruments related to environmental impact assessment, which will be further dealt with in Chapter 7.2.4.2 include:

- *Circular 490/1998/TT-BKHCMT* which requires the submission of an EIA report and provides guidance on the EIA process;
- *Decree No. 143/2004/ND-CP* which describes the appraisal process for EIA's;
- *Circular No. 08/2006 TT-BTNMT* which provides further guidance on strategic environmental assessment, EIA and environmental protection commitment;
- *Decree No. 21/2008/ND-CP*;
- *Decree No. 80/2006/ND-CP*.

Finally, reference can be made to *Decree 117/2009/ND – CP* which provides for guidelines for handling law violations in the field of environmental protection (see further below, Chapter 7.2.4.3).

6.5 INTERNATIONAL BENCHMARKS

In this section, we will analyse a number of agreements and regulations concerning the carriage of dangerous goods on international waterways. In Europe, there is a tendency towards harmonisation, with an important role for the *European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN)*. In the United States, the transportation of dangerous goods on inland waterways is regulated by federal law and regulations concerning transportation. Both legal regimes will be discussed below.

The instruments presented below can be used as a benchmark for the drafting of harmonised rules for the transportation of dangerous goods on the Mekong.

6.5.1 European Inland Waterways

6.5.1.1 Rules of Safety for the Transportation of Dangerous Goods on the Rhine

Since the 19th century (1838), the Central Commission for the Navigation of the Rhine (CCNR) has drawn up specific rules for the transportation of dangerous goods on the Rhine (cannon powder, explosives, poisonous and corrosive substances, etc.)[68].

In 1972, the CCNR adopted the *Rules of Safety for the Transportation of Dangerous Goods on the Rhine* (ADNR), which were regularly updated.

The ADNR was drafted upon the model of the European Agreement concerning the international *Carriage of Dangerous Goods by Road* (ADR), adopted in 1957 under the aegis of the United Nations Economic Commission for Europe (UNECE).

A new version of the ADNR came into force on 1 January 1995. In a bid to harmonise international regulations, the CCNR amended the ADNR to reflect the amendments made to ADR, as well as to the regulations concerning the international carriage of dangerous goods by rail (RID) and to the IMDG Code.

6.5.1.2 European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways

In the mid 90s, European States felt the need for a Europe-wide harmonisation in the field of international carriage of dangerous goods by inland waterways. The UNECE, which comprises 56 European Member States, was viewed as the better venue to achieve this goal. Following a proposal by the CCNR, and with the active participation thereof, the UNECE transformed a previously non-binding resolution into an international agreement akin to the ADR. The *European Agreement concerning International Carriage of Dangerous Goods by Inland Waterway* (ADN) was signed on May 26, 2000 in Geneva and entered into force on February 29, 2008. The ADN consists of an Agreement and annexed Regulations, the content of which is identical to the ADNR.

The Regulations annexed to this agreement were based on the terms of the ADNR. The CCNR decided that following a period of transition the ADN regulation would supersede the ADNR. This took effect on 1 January 2011.

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[68] See http://www.ccr-zkr.org/12020400-en.html

According to the Preamble of the ADN, the aim of the Contracting Parties is to establish by joint agreement uniform principles and rules, for the purpose of:

- increasing the safety of international carriage of dangerous goods by inland waterways;
- contributing effectively to the protection of the environment, by preventing any pollution resulting from accidents or incidents during such carriage; and
- facilitating transport operations and promoting international trade.

Article 1 of the ADN defines the scope of the Agreement. It reads:

1. *This Agreement shall apply to the international carriage of dangerous goods by vessels on inland waterways;*
2. *This Agreement shall not apply to the carriage of dangerous goods by seagoing vessels on maritime waterways forming part of inland waterways; and*
3. *This Agreement shall not apply to the carriage of dangerous goods by warships or auxiliary warships or to other vessels belonging to or operated by a State, provided such vessels are used by the State exclusively for governmental and non-commercial purposes. However, each Contracting Party shall, by taking appropriate measures which do not impair the operations or operational capacity of such vessels belonging to or operated by it, ensure that such vessels are operated in a manner compatible with this Agreement, where it is reasonable in practice to do so.*

The ADN does not apply to the carriage of dangerous goods by seagoing vessels on maritime waterways forming part of inland waterways, as this type of transport is covered by the IMDG Code.

According to Article 2 (1) of the ADN, the Regulations annexed to the Agreement form an integral part thereof. These annexed Regulations include (a) provisions concerning the international carriage of dangerous goods by inland waterways (b) requirements and procedures concerning inspections, the issue of certificates of approval, recognition of classification societies, derogations, special authorizations, monitoring, training and examination of experts (c) general transitional provisions and (d) supplementary transitional provisions applicable to specific inland waterways (Art. 2 [2]).

Article 3 of the ADN contains definitions:

For the purposes of this Agreement:

a. *"vessel" means an inland waterway or seagoing vessel;*

b. *"dangerous goods" means substances and articles the international carriage of which is prohibited by, or authorized only on certain conditions by, the annexed Regulations;*

c. *"international carriage of dangerous goods" means any carriage of dangerous goods performed by a vessel on inland waterways on the territory of at least two Contracting Parties;*

d. *"inland waterways" means the navigable inland waterways including maritime waterways on the territory of a Contracting Party open to the navigation of vessels under national law;*

e. *"maritime waterways" means inland waterways linked to the sea, basically used for the traffic of seagoing vessels and designated as such under national law;*

f. "recognized classification society" means a classification society which is in conformity with the annexed Regulations and recognized, in accordance with the procedures laid down in these Regulations, by the competent authority of the Contracting Party where the certificate is issued;

g. "competent authority" means the authority or the body designated or recognized as such in each Contracting Party and in each specific case in connection with these provisions;

h. "inspection body" means a body nominated or recognised by the Contracting Party for the purpose of inspecting vessels according to the procedures laid down in the annexed Regulations.

Article 6 of the ADN stipulates that each Contracting Party retains the right to regulate or prohibit the entry of dangerous goods into its territory for reasons other than safety during carriage.

Article 10 of the ADN stipulates:

Contracting Parties

1. Member States of the Economic Commission for Europe whose territory contains inland waterways, other than those forming a coastal route, which form part of the network of inland waterways of international importance as defined in the *European Agreement on Main Inland Waterways of International Importance (AGN)* may become Contracting Parties to this Agreement:

   a. by signing it definitively;

   b. by depositing an instrument of ratification, acceptance or approval after signing it subject to ratification, acceptance or approval; and

   c. by depositing an instrument of accession.

2. The Agreement shall be open for signature until 31 May 2001 at the Office of the Executive Secretary of the Economic Commission for Europe, Geneva. Thereafter, it shall be open for accession.

3. The instruments of ratification, acceptance, approval or accession shall be deposited with the Secretary General of the United Nations.

Article 17 of the ADN establishes an Administrative Committee. This Committee shall consider the implementation of the ADN, any amendments proposed thereto and measures to secure uniformity in the interpretation and application thereof. The Contracting Parties are members of the Administrative Committee. The Committee may decide that the States referred to in Article 10, paragraph 1 of the Agreement which are not Contracting Parties, any other Member State of the Economic Commission for Europe or of the United Nations or representatives of international intergovernmental or nongovernmental organizations may, for questions which interest them, attend the sessions of the Committee as observers (Art. 17 [2]).

Article 18 of the ADN establishes a Safety Committee. This Committee shall consider all proposals for the amendment of the Regulations annexed to the Agreement, particularly as regards safety of navigation in relation to the construction, equipment and crews of vessels.

The annexed Regulations, which run to more than 500 pages, have the following structure:

Part 1: General provisions;

Part 2: Classification;

Part 3: Dangerous goods list, special provisions and exemptions related to limited and excepted quantities;

Part 4: Provisions concerning the use of packagings, tanks and bulk cargo transport units;

Part 5: Consignment procedures;

Part 6: Requirements for the construction and testing of packagings (including IBCS and large packagings), tanks and bulk cargo transport units;

Part 7: Requirements concerning loading, carriage, unloading and handling of cargo;

Part 8: Provisions for vessels crews, equipment, operation and documentation; and

Part 9: Rules for construction.

6.5.1.3 *Directive 2008/68/EC of the European Parliament and of the Council of 24 September 2008 on the Inland Transport of Dangerous Goods*

In the mid 90s, the European Union set out uniform regulations for the transport of dangerous goods by road[69] and by rail[70], which provided for the application of the ADR and RID rules. In 2008, these directives were repealed and replaced by *Directive 2008/68/EC* of the European Parliament and of the Council of 24 September 2008 on the inland transport of dangerous goods. This directive also lays down provisions in relation to inland waterways.

The Preamble of the Directive recalls that the majority of Member States are contracting parties to the *European Agreement concerning the International Carriage of Dangerous Goods by Road* (ADR), subject to the *Regulations concerning the International Carriage of Dangerous Goods by Rail* (RID) and, in so far as is relevant, contracting parties to the *European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways* (ADN).

The Preamble furthermore recalls that the ADR, RID and ADN lay down uniform rules for the safe international transport of dangerous goods. According to the Preamble such rules should also be extended to national transport in order to harmonise across the Community the conditions under which dangerous goods are transported and to ensure the proper functioning of the common transport market.

The scope of the Directive is defined in its Article 1, the first paragraph of which reads:

> *This Directive shall apply to the transport of dangerous goods by road, by rail or by inland waterway within or between Member States, including the activities of loading and unloading, the transfer to or from another mode of transport and the stops necessitated by the circumstances of the transport.*
>
> *It shall not apply to the transport of dangerous goods:*

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[69] Council Directive 94/55/EC of 21 November 1994 on the approximation of the laws of the Member States with regard to the transport of dangerous goods by road.

[70] Council Directive 96/49/EC of 23 July 1996 on the approximation of the laws of the Member States with regard to the transport of dangerous goods by rail.

a. *by vehicles, wagons or vessels belonging to or under the responsibility of the armed forces;*

b. *by seagoing vessels on maritime waterways forming part of inland waterways;*

c. *by ferries only crossing an inland waterway or harbour; or*

d. *wholly performed within the perimeter of an enclosed area.*

Article 2 of the Directive contains definitions. 'ADN' is defined as the *European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways*, concluded at Geneva on 26 May 2000, as amended (Art. 2 [3]). 'Vessel' is defined as any inland waterway or seagoing vessel.

Article 3 of the Directive contains general provisions.

It reads:

1. Without prejudice to Article 6, dangerous goods shall not be transported in so far as this is prohibited by Annex I, Section I.1, Annex II, Section II.1, or Annex III, Section III.1.
2. Without prejudice to the general rules on market access or the rules generally applicable to the transport of goods, the transport of dangerous goods shall be authorised, subject to compliance with the conditions laid down in Annex I, Section I.1, Annex II, Section II.1, and Annex III, Section III.1.

Annex III of the Directive relates to transport by inland waterway.

It reads:

III. 1 ADN

Annexed Regulations to the ADN, as applicable with effect from 1 July 2009, as well as Articles 3(f), 3(h), 8(1), 8(3) of the ADN, it being understood that "contracting party" is replaced by "Member State" as appropriate.

III. 2 Additional transitional provisions

1. *Member States may maintain restrictions on the transport of substances containing dioxins and furans applicable on 30 June 2009.*
2. *Certificates, in accordance with Annex III, Section III.1 (8.1), issued before or during the transitional period referred to in Article 7(2) shall be valid until 30 June 2016, unless a shorter period of validity is indicated in the certificate itself.*

III. 3 National derogations

[none listed]

Article 4 of the Directive contains provisions on the transport of dangerous goods between EU Member States and third countries.

The Article stipulates:

The transport of dangerous goods between Member States and third countries shall be authorised in so far as it complies with the requirements of the ADR, RID or ADN, unless otherwise indicated in the Annexes.

Article 5 of the Directive contains provisions on restrictions on grounds of transport safety.

Article 5 (1) stipulates:

> *Member States may on grounds of transport safety apply more stringent provisions, with the exception of construction requirements, concerning the national transport of dangerous goods by vehicles, wagons and inland waterway vessels registered or put into circulation within their territory.*

Following this Directive, all Member States of the European Union are bound by the regulations provided in the ADN Agreement. Nevertheless, according to Article 6 of the Directive, some derogations are possible.

Article 6 stipulates:

1. *Member States may authorise the use of languages other than those provided for in the Annexes for transport operations performed within their territories.*
2. a. *Provided that safety is not compromised, Member States may request derogations from Annex I, Section I. 1, Annex II, Section II. 1, and Annex III, Section III. 1, for the transport within their territories of small quantities of certain dangerous goods, with the exception of substances having a medium or high level of radioactivity, provided that the conditions for such transport are no more stringent than the conditions set out in those Annexes.*

   b. *Provided that safety is not compromised, Member States may also request derogations from Annex I, Section I. 1, Annex II, Section II. 1, and Annex III, Section III. 1, for the transport of dangerous goods within their territory in the case of:*

      i) *local transport over short distances; or*

      ii) *local transport by rail on particular designated routes, forming part of a defined industrial process and being closely controlled under clearly specified conditions.*

   The Commission shall examine in each case whether the conditions laid down in subparagraphs (a) and (b) have been met and shall decide, in accordance with the procedure referred to in Article 9(2), whether to authorise the derogation and to add it to the list of national derogations set out in Annex I, Section I. 3, Annex II, Section II. 3, or Annex III, Section III. 3.

   […]

Article 10 of the Directive stipulates that EU Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive by 30 June 2009 at the latest.

6.5.1.4 The Sava River Basin

The Sava is a river in Southeast Europe, a right side tributary of the Danube river at Belgrade. The Sava is 947 kilometres long and flows through Slovenia, Croatia, along the northern border of Bosnia and Herzegovina, and through Serbia.

In 2005 the International Sava River Basin Commission (ISRBC) was established. This Commission is in charge of the implementation of the *Framework Agreement on the Sava River Basin* (FASRB).

On 8 June 2000, the Sava River Basin Commission adopted *Rules for the Transport of Dangerous goods on the Inland Waterways on the Sava River Basin.*[71]

[71] Decision 12/10 of the ISRBC

The scope of these Rules is laid down in Article 1, which reads:

1. *These Rules shall apply to the transport of dangerous goods on the inland waterways on the Sava River from the river kilometre 0.00 to Brežice, on the Kolubara River from the river kilometre 0.00 to the river kilometre 5.00, on the Drina River from the river kilometre 0.00 to the river kilometre 15.00, on the Bosna River from the river kilometre 0.00 to the river kilometre 5.00, on the Vrbas River from the river kilometre 0.00 to the river kilometre 3.00, on the Una River from the river kilometre 0.00 to the river kilometre 15.00 and on the Kupa River from the river kilometre 0.00 to the river kilometre 5.00, including the activities of loading and unloading, the transfer to or from another mode of transport and the stops necessitated by the circumstances of the transport.*
2. *These Rules shall not apply to the transport of dangerous goods:*
   a. *by vessels belonging to or under responsibility of the armed forces*
   b. *by ferries only crossing waterway or port; or*
   c. *wholly performed within the perimeter of an enclosed area.*
3. *Parties may lay down specific safety requirements for the national and international transport of dangerous goods within their territory as regards the transport of dangerous goods by vessels not covered by these Rules. They shall inform the International Sava River Basin Commission (hereinafter the Sava Commission) of such provisions and their justification.*
4. *The Sava Commission shall inform the other Parties accordingly.*
5. *Parties may regulate or prohibit, strictly for reasons other than safety during transport, the transport of dangerous goods within their territory.*

Article 2 of the Rules contains definitions. It reads:

For the purpose of these Rules:

a. *'ADN' means the* European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways*, concluded at Geneva on 26 May 2000, as amended;*
b. *'vessel' means any inland waterway vessel; and*
c. *'Party' means Party to the* Framework Agreement on the Sava River Basin*.*

Article 3 of the Rules refers to the ADN.

The Article stipulates:

On the waterways mentioned under the Article 1, paragraph 1, Annexed Regulations to the ADN, as applicable with effect from 1 January 2011, as well as Articles 3(f), 3(h), 8(1), 8(3) of the ADN, it being understood that 'contracting party' is replaced by 'Party' as appropriate, shall be applied for the transport of the dangerous goods.

It should be noted that only Serbia and Croatia are Parties to the ADN. Bosnia, Herzegovina and Slovenia are not. On the strength of Article 3, the ADN applies to the waterways identified in Article 1, which include waterways in Bosnia, Herzegovina and Slovenia.

Article 5 of the Rules stipulates that Parties may, on grounds of transport safety, apply more stringent provisions, with the exception of construction requirements, concerning the national transport of dangerous goods by vessels registered or put into circulation within their territory.

Article 6 of the Rules contains provisions on derogations, akin to those of Article 6 of *EU Directive 2008/68* on the inland transport of dangerous goods.

It reads:

1. *Member States may authorize the use of languages other than those provided for in Article 3 for transport operations performed within their territories.*
2. *Provided that safety is not compromised, Parties may request derogations from Article 3, for the transport within their territories in the case of :*
   a. *small quantities of certain dangerous goods, with the exception of substances having a medium or high level of radioactivity, provided that the conditions for such transport are no more stringent than the conditions set out in Article 3;*
   b. *local transport over short distances;*

   The Sava Commission shall examine in each case whether the conditions laid down in subparagraphs (a) and (b) have been met and shall decide whether to authorize the derogation and to add it to the list of national derogations.
3. *Derogations under paragraph 2 shall be valid for a period not exceeding six years from the date of authorization, such period to be fixed in the authorization decision. Derogations shall be applied without discrimination.*
4. *If a Party requests the extension of an authorization for derogation, the Sava Commission shall review the derogation in question. If no amendment to Article 3, affecting the subject matter of the derogation has been adopted, the Sava Commission shall renew the authorization for a further period not exceeding six years from the date of authorization, such period to be fixed in the authorisation decision. If an amendment to Article 3, affecting the subject matter of the derogation has been adopted, the Sava Commission may:*

   a. declare the derogation obsolete and remove it from the relevant list of derogations;

   b. *limit the scope of the authorization and amend the relevant list of derogations accordingly; and*

   c. *renew the authorization for a further period not exceeding six years from the date of authorization, such period to be fixed in the authorization decision.*
5. *Every Party may, exceptionally and provided that safety is not compromised, issue individual authorizations to carry out transport operations of dangerous goods within its territory, which are prohibited by this Rules, or to carry out such operations under conditions different from those laid down in this Rules, provided that those transport operations are clearly defined and limited in time.*

6.5.2 Inland Waterways of the United States

6.5.2.1 United States Code

Transportation of dangerous goods on inland waterways in the United States is regulated by federal law and regulations. The federal law is published in the *Code of Laws of the United States of America*. The Code is a compilation and codification of the general and permanent federal laws of the United States. It is published every six years by the Office of the Law Revision Counsel of the House of Representatives.[72]

Title 49 of the US Code deals with transportation. Chapter 51 of Subtitle III (General and Intermodal Programmes) contains provisions on the transportation of hazardous material.

Section 5101 of Chapter 51 stipulates:

The purpose of this chapter is to protect against the risks to life, property, and the environment that are inherent in the transportation of hazardous material in intrastate, interstate, and foreign commerce.

Section 5102 (13) provides for a definition of transportation, which reads:

"transports" or "transportation" means the movement of property and loading, unloading, or storage incidental to the movement.

The transportation of dangerous goods on inland waterways falls within the scope of this law.

Section 5103 (a) stipulates:

The Secretary of Transportation shall designate material (including an explosive, radioactive material, etiologic agent, flammable or combustible liquid or solid, poison, oxidising or corrosive material, and compressed gas) or a group or class of material as hazardous when the Secretary decides that transporting the material in commerce in a particular amount and form may pose an unreasonable risk to health and safety or property.

The federal legislation on transportation of dangerous goods contains provisions on a wide diversity of subjects. The legislation has the following structure:

Sec. 5104: Representation and tampering

Sec. 5105: Transporting certain highly radioactive material

Sec. 5106: Handling criteria

Sec. 5107: Hazmat employee training requirements and grants

Sec. 5108: Registration

Sec. 5109: Motor carrier safety permits

Sec. 5110: Shipping papers and disclosure

[Sec. 5111: Repealed]

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72 Article 9 of the MRC Agreement reads: *On the basis of equality of right, freedom of navigation shall be accorded throughout the mainstream of the Mekong River without regard to the territorial boundaries, for transportation and communication to promote regional cooperation and to satisfactorily implement projects under this Agreement. The Mekong River shall be kept free from obstructions, measures, conduct and actions that might directly or indirectly impair navigability, interfere with this right or permanently make it more difficult. Navigational uses are not assured any priority over other uses, but will be incorporated into any mainstream project. Riparians may issue regulations for the portions of the Mekong River within their territories, particularly in sanitary, customs and immigration matters, police and general security* (underlining added).

Sec. 5112: Highway routing of hazardous material

Sec. 5113: Unsatisfactory safety rating

Sec. 5114: Air transportation of ionizing radiation material

Sec. 5115: Training curriculum for the public sector

Sec. 5116: Planning and training grants, monitoring, and review

Sec. 5117: Special permits and exclusions

[Sec. 5118: Repealed]

Sec. 5119: Uniform forms and procedures

Sec. 5120: International uniformity of standards and requirements

Sec. 5121: Administrative

Sec. 5122: Enforcement

Sec. 5123: Civil penalty

Sec. 5124: Criminal penalty

Sec. 5125: Preemption

Sec. 5126: Relationship to other laws

Sec. 5127: Judicial review

Sec. 5128: Authorization of appropriations

6.5.2.2 Code of Federal Regulations

The *Code of Federal Regulations* (CFR) is the codification of the general and permanent rules and regulations published in the Federal Register by the executive departments and agencies of the Federal Government of the United States. The CFR is published by the Office of the Federal Register, an agency of the National Archives and Records Administration.

Title 49 of the CFR deals with transportation. Chapter I of Subtitle B on Other Regulations Relating to Transportation contains the regulations of the Pipeline and Hazardous Materials Safety Administration of the Department of Transport.

Subchapter C contains the hazardous materials regulations. Part 176 of the Subchapter C contains the provisions on the carriage of dangerous goods by vessel. Paragraph 176.5 defines the scope of these provisions.

It reads:

a. Except as provided in paragraph (b) of this section, this subchapter applies to each domestic or foreign vessel when in the navigable waters of the United States, regardless of its character, tonnage, size, or service, and whether self-propelled or not, whether arriving or departing, underway, moored, anchored, aground, or while in dry dock.

b. This subchapter does not apply to:

   i) A public vessel not engaged in commercial service;

   ii) A vessel constructed or converted for the principal purpose of carrying flammable or combustible liquid cargo in bulk in its own tanks, when only carrying these liquid cargoes;

iii) A vessel of 15 gross tonnes or smaller when not engaged in carrying passengers for hire;

iv) A vessel used exclusively for pleasure;

v) A vessel of 500 gross tonnes or smaller when engaged in fisheries;

vi) A tug or towing vessel, except when towing another vessel having Class 1 (explosive) materials, Class 3 (flammable liquids), or Division 2.1 (flammable gas) materials, in which case the owner/operator of the tug or towing vessel shall make such provisions to guard against and extinguish fire as the Coast Guard may prescribe;

vii) A cable vessel, dredge, elevator vessel, fireboat, icebreaker, pile driver, pilot boat, welding vessel, salvage vessel, or wrecking vessel; or

viii) A foreign vessel transiting the territorial sea of the United States without entering the internal waters of the United States, if all hazardous materials being carried onboard are being carried in accordance with the requirements of the IMDG Code (IBR, see §171.7 of this subchapter).

[...]

Part 176 of the Subchapter C on the carriage of dangerous goods by vessel has the following structure:

Subpart A	:	General
Subpart B	:	General Operating Requirements
Subpart C	:	General Handling and Stowage
Subpart D	:	General Segregation Requirements
Subpart E	:	Special Requirements for Transport Vehicles Loaded With Hazardous Materials and Transported onboard Ferry Vessels
Subpart F	:	Special Requirements for Barges
Subpart G	:	Detailed Requirements for Class 1 (Explosive) Materials
Subpart H	:	Detailed Requirements for Class 2 (Compressed Gas) Materials
Subpart I	:	Detailed Requirements for Class 3 (Flammable) and Combustible Liquid Materials
Subpart J	:	Detailed Requirements for Class 4 (Flammable Solids), Class 5 (Oxidizers and Organic Peroxides), and Division 1.5 Materials
Subpart K	:	[Reserved]
Subpart L	:	Detailed Requirements for Division 2.3 (Poisonous Gas) and Division 6.1 (Poisonous) Materials
Subpart M	:	Detailed Requirements for Radioactive Materials
Subpart N	:	Detailed Requirements for Class 8 (Corrosive Materials) Materials
Subpart O	:	Detailed Requirements for Cotton and Vegetable Fibers, Motor Vehicles, and Asbestos

The legal regime of the inland waterways of the United States of America will be included in the international benchmarking analysis in Chapter 6.

6.6 INTERNATIONAL BENCHMARKING ANALYSIS

The table presented below provides an overview of the subjects dealt with by the international instruments pertaining to the Mekong – in particular the *Agreement on Commercial Navigation on Lancang-Mekong River*, signed at Tachileik, 20 April 2000, and the technical annexes that supplement it–and by the national laws and regulations pertaining to the transport of dangerous goods which were enacted or prepared by the Riparian States of the Mekong River Basin, as well as by the international benchmarking instruments discussed above.

This table allows the reader (1) to identify the subjects covered by the current legal regime pertaining to transport of dangerous goods on the Mekong, (2) to compare the available legal rules with the international benchmarking instruments, and (3) to identify gaps in the rules for waterborne transportation on the Mekong.

With regard to Cambodia, both the existing legislation and the legislation in preparation are presented in the table below.

The table does not include information on Lao PDR, as no English translation of the relevant instruments is available.

The column pertaining to the United States combines the provisions of the *United States Code* and the *Code of Federal Regulations*.

Table 66: **Current Legal Regime in the Upper Mekong, Member Countries Compared to ADN Code and Sava Rules.**

SUBJECT	Upper Mekong	Cambodia		Lao PDR	Thailand	Viet Nam	ADN Agreement	Sava Rules	United States
		Existing law	Law in preparation						
Scope and applicability	X		X				X	X	X
Definitions		X	X			X	X	X	X
Units of measurements			X			X	X	X	
Training			X			X	X	X	X
Safety obligations	X		X				X	X	X
Special rules, derogations			X				X	X	
Transitional measures			X				X	X	
Compliance			X				X	X	X
Transport restrictions	X		X		X		X	X	X
Security provisions	X		X				X	X	X
Classification societies			X				X	X	
Certificate of approval			X				X	X	X
Classification			X		X	X	X	X	X
Dangerous goods list	X		X			X	X	X	X

Table 67: **Current legal regime in the Upper Mekong, Member Countries compared to ADN Code and Sava Rules**

SUBJECT	Upper Mekong	Cambodia		Lao PDR	Thailand	Viet Nam	ADN Agreement	Sava Rules	United States
		Existing law	Law in preparation						
Dangerous goods packed in limited quantities			X				X	X	
Dangerous goods packed in excepted quantities			X				X	X	
Consignment procedures - general			X				X	X	
Marking and labelling	X		X		X	X	X	X	
Placarding			X		X	X	X	X	
Documentation			X				X	X	X
Construction and testing of packaging			X				X	X	
Loading, carriage, unloading and handling of dangerous goods for dry cargo vessels			X			X	X	X	X
Loading, carriage, unloading and handling of dangerous goods for tank vessels			X		X	X	X	X	X
General requirements for vessels and equipment	X		X			X	X	X	X
Requirements concerning training of crew			X			X	X	X	X
Miscellaneous requirements for crew			X				X	X	
Documents			X				X	X	X
Rules for construction of dry cargo vessels			X				X	X	X
Rules for construction of tank vessels			X				X	X	X
Enforcement						X			X
Penalties					X				X
Permits		X				X			X
Uniform forms and procedures									X
Segregation						X	X	X	X
Regulatory authority			X		X	X			X

The above comparison of the legal regime pertaining to transport of dangerous goods on the Mekong with the international benchmarks reveals that – with the exception of the Cambodian law in preparation – the current regime is imperfect with important gaps and major differences between the riparian countries.

The current legal regime does not contain provisions on, *inter alia*, dangerous goods packed in limited quantities, the construction and testing of packaging, the training of crews (with the exception of Viet Nam, however), the construction of vessels and the segregation of dangerous goods (again with the exception of Viet Nam).

6.7 LEGAL BASES FOR THE ESTABLISHMENT OF HARMONISED RULES

The existing national rules and regulations and treaties on navigation on the Mekong River contain different mechanisms for the harmonisation of regulations, including on the transportation of dangerous goods. No available treaty covers the Mekong in its entire length (‘Upper’, ‘Middle’ and ‘Lower’ Mekong).

The 1995 MRC Agreement confirms the power of each Riparian State to adopt national regulations for its own stretch of the river. The MRC Council may take an initiative to harmonise such regulations. However, such harmonised rules must subsequently be transposed into national regulations.

According to Article 9 of the MRC Agreement, the riparian countries – Cambodia, Lao PDR, Thailand, and Viet Nam – may issue regulations, particularly in sanitary, customs and immigration matters, police and general security for the portions of the Mekong River within their territories.

The concepts of "police and general security" are not defined in the MRC Agreement. It can be argued that the notion of "general security" encompasses measures on the transportation on the Mekong of explosives, ammunition or similar dangerous cargoes that may be considered a potential threat to security. The notion of "police" is even broader and can be interpreted as comprising all measures aimed at the preservation of public order.

More importantly, the Article under discussion contains the word "particularly". This indicates that Riparian States may also issue regulations on other matters, not expressly mentioned in Article 9 of the Agreement, such as the transportation of dangerous goods.

In practice, and as presented in Chapter 6.4, the riparian countries have in the past adopted national laws and regulations on transportation of dangerous goods, although it must be stressed that the current legal regime is imperfect with important gaps and major differences between the riparian countries.

The possible advantages of using the existing national laws and regulations as a basis for harmonisation are that the new rules and regulations would be in line with existing concepts and rules and that enforcement would be facilitated. However, such an approach would require more preparatory legal work, consultation and negotiations. In this regard, it can be noted that the Vietnamese rules are well developed but are probably also too complicated to be used as a basis for the establishment of harmonised rules and regulations.

On the other hand, Article 18 of the MRC Agreement[73] offers a legal basis for the MRC Council to "make policies and decisions" relating to, inter alia, the "utilisation" of the Mekong River Basin as well as for

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[73] Article 18 of the MRC Agreement reads:

The functions of the Council are:

A. To make policies and decisions and provide other necessary guidance concerning the promotion, support, cooperation and coordination in joint activities and projects in a constructive and mutually beneficial manner for the sustainable development, utilization, conservation and management of the Mekong River Basin waters and related resources, and protection of the environment and aquatic conditions in the Basin as provided for under this Agreement;

B. To decide any other policy-making matters and make decisions necessary to successfully implement this Agreement, including but not limited to approval of the Rules of Procedures of the Joint Committee under Article 25, Rules of Water Utilization and Inter-Basin Diversions proposed by the Joint Committee under Article 26, and the basin development plan and major component projects/programmes; to establish guidelines for financial and technical assistance of development projects and programs; and if considered necessary, to invite the donors to coordinate their support through a Donor Consultative Group; and,

C. To entertain, address and resolve issues, differences and disputes referred to it by any Council member, the Joint Committee, or any member State on matters arising under this Agreement.

the "protection of the environment". Furthermore, the MRC Council is empowered to "decide" on any "other policy-making matters" and "make decisions necessary to successfully implement [the MRC] Agreement".

It could be envisaged that the MRC Council would – on the basis of Article 18 of the MRC Agreement and inspired by, for instance, the ADN Agreement – take the initiative and propose a set of rules on the transportation of dangerous goods on the Mekong that have to be implemented by the riparian countries. Furthermore, some leeway could be given to the riparian states when transposing the rules into national regulations. This would give the riparian states the opportunity to adapt the rules to local circumstances as well as to existing national laws and regulations. Moreover, this is likely to facilitate the enforcement of the rules.

The quadripartite *Agreement on Commercial Navigation on Lancang-Mekong River* contains a mechanism for the establishment by the Riparian States of "common" rules on the transportation of dangerous goods on the Upper Mekong. It remains to be seen whether such common rules should be regarded as directly applicable without any further intervention of national regulatory bodies.

In theory, consideration should be given to the *Convention between Siam and France relating to the Regulation of the Relations between Siam and Indochina*, signed at Bangkok, 25 August 1926, which applies to the 'Middle' Mekong. The Convention contains a mechanism for the preparation of harmonised rules which is however no longer operational today.

Concerning the Lower Mekong, the 2009 *Agreement on Waterway Transportation* specifically instructs the Mekong Navigation Facilitation Committee to make proposals for the adoption by the Contracting Parties of harmonised rules and regulations on the transportation of dangerous goods.

If a harmonisation of rules on the transportation of dangerous goods for the entire course of the Mekong ('Upper', 'Middle' and 'Lower' Mekong) is considered useful, an alternative option would be to establish harmonised rules for the transportation of dangerous goods on the Mekong under a separate international treaty or a treaty 'ad hoc'.

6.8 INTERIM CONCLUSIONS

A brief international benchmarking analysis reveals that the current legal regime pertaining to transport of dangerous goods on the Mekong is imperfect, with important gaps and major differences between the riparian countries. Important aspects of the transportation of dangerous goods by inland waterways such as, *inter alia*, dangerous goods packed in limited quantities, the construction and testing of packaging, the training of crews (with the exception of Viet Nam, however), the construction of vessels and the segregation of dangerous goods (again with the exception of Viet Nam), are not covered by the current regime.

As a result, it would appear that there is a case for the establishment of comprehensive, harmonised and up-to-date legal rules on the transportation of dangerous goods on the Mekong.

In Europe, a general tendency towards harmonisation of rules on the transportation of dangerous goods by inland waterways has emerged, with a key role for the *European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways* (ADN).

The ADN was drafted by the United Nations Economic Commission for Europe (UNECE), in close cooperation with the Central Commission for the Navigation of the Rhine (CCNR). Currently, 17 countries are party to the ADN.[74]

[74] Bulgaria, Croatia, Czech Republic, France, Germany, Hungary, Luxembourg, Poland, Netherlands, Republic of Moldova, Romania, Russian Federation, Serbia, Slovakia, Switzerland, Ukraine.

The preamble of the ADN recalls the aim of the Contracting Parties, which is to establish by joint agreement uniform principles and rules, for the purpose of:

- increasing the safety of international carriage of dangerous goods by inland waterways;
- contributing effectively to the protection of the environment, by preventing any pollution resulting from accidents or incidents during such carriage; and
- facilitating transport operations and promoting international trade.

These policy objectives appear to have relevance to the Mekong River Basin as well.

Furthermore, following *Directive 2008/68/EC* of the European Parliament and of the Council of 24 September 2008 on the inland transport of dangerous goods, all EU Member States are now bound by the regulations provided in the ADN Agreement.

The example of the Sava River Basin likewise illustrates the importance of the ADN. The Sava flows through Slovenia, Croatia, along the northern border of Bosnia and Herzegovina, and through Serbia. Only Serbia and Croatia are party to the ADN. Bosnia, Herzegovina and Slovenia are not. However, on the strength of Article 3 of the *Rules for the Transport of Dangerous goods on the Inland Waterways on the Sava River Basin*, adopted by the Sava River Basin Commission, the ADN also applies to waterways in Bosnia, Herzegovina and Slovenia.

In Southeast Asia, Cambodia is close to adopting rules on transport of dangerous goods by inland waterways that explicitly refer to the ADN. Article 5 of the draft "*Prakas on Technical [sic] for carriage of dangerous goods by inland waterway in the Kingdom of Cambodia*" stipulates:

> *Carriage of dangerous goods in the inland waterway shall be applied to European Agreement concerning the international carriage of dangerous goods by inland waterway ADN.*

In the light of the above, it could be envisaged to use the ADN as a basis for harmonised rules for the transportation of dangerous goods on the Mekong.

7. ENVIRONMENT

7.1 OVERVIEW

There is currently very limited research on the environmental impacts of waterway transport on the Mekong River, particularly in relation to dangerous goods, oil spill pollution, sand mining, dredging and construction of ports and waterway infrastructure. This chapter will focus on the carriage, handling and storage of dangerous goods and the potential impacts of oil spill pollution, solid and liquid wastes and the mechanisms the Member Countries have implemented to prevent control and monitor water pollution. The chapter will also identify the important wetlands in the Mekong Basin, evaluate the water quality threats and describe the existing water quality monitoring (WQM).

Although the Mekong River is widely used for transportation purposes, so far little expertise appears to be available on the management of spills from navigation. As navigation spills might endanger the Mekong River resources, risks from spills should be limited and their impacts should be minimised taking into account the ecological value and economic uses of the Mekong River on which many people depend for their survival.

7.1.1 Lower Mekong Basin

The Mekong River is the longest river in Southeast Asia, the twelfth longest in the world, and the tenth largest by discharge. It rises on the Tibetan Plateau and flows southward through China, Myanmar, Lao PDR, Thailand, Cambodia and Viet Nam, where it discharges into the South China Sea. The catchment of the river, which has an area of 795,000 km^2, is functionally divided into two: the Upper Mekong Basin (that flows southwards through China, where it is called the Lancang River), and the Lower Mekong Basin, which includes parts of the Lao PDR, Thailand, Cambodia and Viet Nam (Figure 158).[75] The river forms the border between the Lao PDR and Myanmar in the transition zone between the upper and lower basins.

[75] Lazarus, K., P. Dubeau, C. Bambaradeniya, R. Friend, L. Sylavong, 2006. An Uncertain Future: Biodiversity and Livelihoods along the Mekong River in Northern Lao PDR, IUCN, Bangkok, Thailand and Gland, Switzerland.

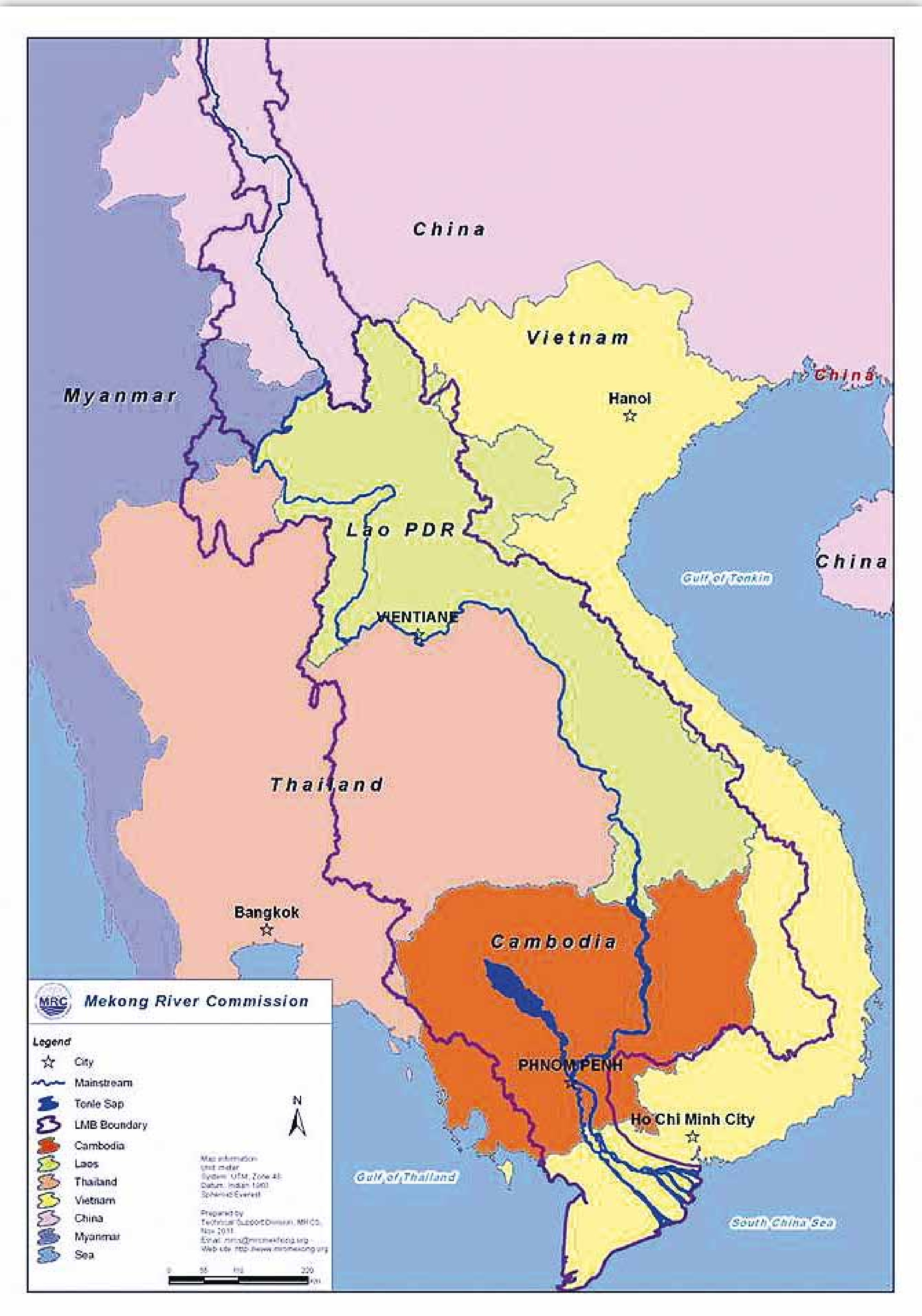


Figure 158: **Map of the Mekong Basin**

7.1.2 Important Wetlands

The Mekong River is second only to the Amazon in terms of biodiversity importance, and is the most productive inland fishery in the world. Wetlands play a vital role in the livelihoods of local people and the socio-economic development of the region. Their use for rice cultivation and freshwater capture fisheries provides the staples of people's diets throughout the region, as well as a major source of export revenue. Accelerating economic development, population growth and changed consumption patterns of the basin's population are placing the health of wetland ecosystems and their ability to sustain the livelihoods of a growing population is at risk.[76]

According to the Ramsar Convention (one of the broadest and most widely used definitions), wetlands are "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six metres". The LMB contains rich and extensive areas of wetlands. The Mekong River and its numerous tributaries, backwaters, lakes and swamps support many unique ecosystems, such as deep pools, a plain of reeds and mangrove forests.

There are a considerable numbers of shallow lakes, ponds and swamp wetlands in the Mekong River Basin, filled with rainwater or floodwater, either on a seasonal basis or perennially. Wetlands are intimately linked to the ecological balance and socio-economic development in the Mekong River Basin, as they provide major habitats for fish, birds, wildlife and are an important protein source for riparian populations. In 2000, the MRC identified 87 important wetlands and four Ramsar sites in the LMB (see Figure 159).

In Lao PDR and Thailand, there are important wetlands and floodplains that are at risk from the transport of cargo and petroleum products from Chiang Saen, Thailand, to the People's Republic of China and Myanmar. Downstream from Phnom Penh, there is significant transport of dangerous goods and many important wetlands and agricultural land in both Cambodia and Viet Nam. There are many important wetlands in Cambodia around the Tonle Sap Lake, which is at risk from passenger transport and the operation of floating fuel terminals. The National Working Groups in the Member Countries were asked to select the most important wetlands in respect to the transport of the dangerous goods along the Mekong River. A questionnaire also determined areas where shipping activities could be restricted to protect the natural resources of the Mekong River.

[76] MRC 2010. "State of the Basin Report 2010". Mekong River Commission, Vientiane, Lao PDR

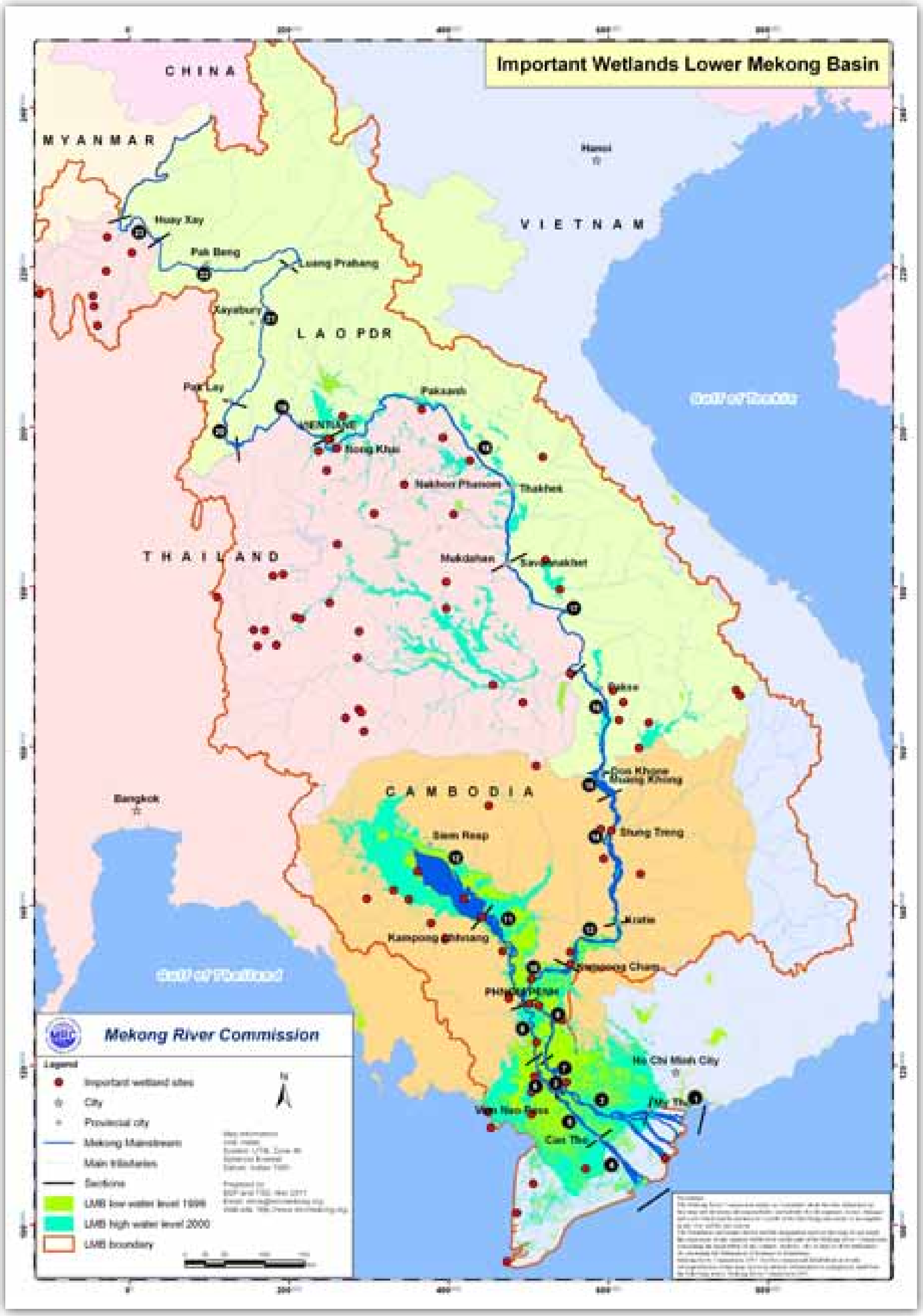


Figure 159: **Important Wetlands in the Lower Mekong Basin**

7.1.2.1 Cambodia

Important wetland systems along the Mekong River and its tributaries have been identified, and several projects and related activities have been carried out. Some important projects are being implemented to protect and conserve these areas in relation to socio-economic development. Some related environmental studies revealed concerns about negative impacts to Cambodian wetlands resulting from rapid and unplanned urbanisation and industrialisation in the LMB and pollution from point and non-point sources (industrial sector, agriculture, mining, households, navigation, and erosion). However, there is currently limited available data and water pollution analysis to determine the sources of pollution. The important wetlands identified in Cambodia are listed below..

Table 68: **Important Wetland Sites in Cambodia**

Name of site	Importance	Area (ha)	Province	Types	Key biodiversity information
Middle stretches of the Mekong north of Steung Treng (Figure 162)	Ramsar site Refuge for rare fish, dolphins and birds.	14,600	Steung Treng	Flooded forest	Important breeding and feeding habitat for rare species of fish and globally threatened wetland-dependent birds
Middle stretches of the Mekong River between Kratie and Steung Treng towns	Rich biodiversity	33,808	Steung Treng-Kratie	Braided channels, islands and sandbars, flooded forest and channel woodland; deep pools, rocky rapids and turbulent stretches.	Variety of habitats supporting a wide range of aquatic species as well as water birds and mammals
Prek Toal	Core zone of Tonle Sap Biosphere Reserve	39,879	Battambang	Flooded forest	Supports internationally important colonies of a number of globally threatened water birds
Boeung Chhma, associated river and floodplains	Ramsar Site High biodiversity	28,000	Kompong Thom	Seasonally flooded forest and swamp	Supports a large variety of plant, fish and water bird species, many of which are listed as rare, vulnerable or endangered
Bassac Marshes	Potential Ramsar Site	52,316	Kandal	Seasonally inundated shrub and vegetation.	Of great importance to water birds

Source: Adapted from Vathana 2003

Tonle Sap Lake

The Tonle Sap Lake has been classified as a Biosphere Reserve, enjoying the highest level of international protection typically reserved for biodiversity hot spots of global significance. The Tonle Sap ecosystem consists of the Tonle Sap Lake and the Tonle Sap River, and also includes the extensive floodplains that surround the lake and river within the boundaries defined by the average upper flood levels. There are three main elements in the ecosystem. The feature at its centre is the Tonle Sap Lake, which is a shallow, turbid tropical lowland lake covering an area of about 2,500 km^2. The dry-season maximum depth of the lake is less than 1 meter. The size of the lake varies between 160 km long and 35 km wide at its widest point during the low-water time and 300 km in length and more than 100 km in width in some places at the height of the flooding.[77]

The flooding is an annually recurring event and the extent varies from year to year. During the wet season, rainwater in the catchment of the ecosystem is held in the lake by the rising water levels in the Mekong that prevent it from further draining. Shortly afterwards, the Mekong reaches heights that reverse the flow of water in the Tonle Sap River, pushing large volumes of Mekong water up into the ecosystem, resulting in extensive flooding. This creates a floodplain lake ecosystem with an area of up to 15,000 km^2.

Pollution is a threat to the Tonle Sap ecosystem, and is mostly related to human settlements on the lake and its vicinity. Fertilisers, particularly organic pesticides, are found and are expected to become a bigger problem as agricultural production increases. Floating fuel stations and vessels operating in or near the ecosystem pose a threat to water quality and ecosystem services. Navigation between Kompong Cham to Steung Treng should be restricted to preserve important habitats and aquatic biodiversity.

7.1.2.2 Lao PDR

Figure 160: **Flooded Forest in Steung Treng, Cambodia**

[77] MASTER PLAN FOR WATERBORNE TRANSPORT ON THE MEKONG RIVER SYSTEM IN CAMBODIA MP03 'Environmental safeguarding mechanism' November 2006.

There are several globally significant sites for biodiversity conservation in Thailand and Lao PDR. Segments of the upper Mekong form part of the Indo-China Biodiversity Hotspot. Two important bird areas designated by Birdlife International are located along the upper Mekong stretch, including the river channel from Xieng Kok to Ban Bo in Lao PDR and to Chiang Saen in Thailand. The important wetlands in Lao PDR are listed below.

Table 69: **Important Wetland Sites in Lao PDR**

Name of site	Importance	Area (ha)	Province	Types	Key biodiversity information
Siphandone Wetland	High biodiversity	6,000	Champassak	Perennial wetlands, seasonal river channels, rapids and waterfalls and seasonal flooded forest	At least 205 species of fish recorded; critical to the life cycle of migratory fish species and habitat for the Irrawaddy dolphin *(Orcaella brevirostris)*
Xe Champhone Wetland (Figure 163)	High biodiversity	2,000	Attapeu and Champassak	Freshwater lakes and ponds, freshwater marsh, seasonally flooded grassland	Critically important fish-ing breeding and spawning grounds
Bong Nong Ngom	High biodiversity Potential Ramsar site	1,000	Champassak	Freshwater marshes and seasonally flooded forest	Rich fish fauna; important for a wide variety of water birds

Source: Adapted from Phittayaphone 2003

7.1.2.3 Thailand

Figure 161: **Xe Champhone Wetland, Savannakhet Province, Lao PDR**

A Ramsar wetland of international importance is located in the Chiang Saen area, on the floodplain of the upper Mekong River. The Nong Bong Kai Non-Hunting Area (4.34 km^2) in Chiang Rai province is a small lake (also known as Chiang Saen) surrounded by mountains and low hills in the extreme north of the country, adjacent to Lao PDR and Myanmar. The area is of major importance for both local and migratory birds (Figure 162). Another Ramsar wetland of international importance is the Bung Khong Long Non-Hunting Area in Nong Khai Province. This is one of the largest lakes in northeast Thailand and supports a number of vulnerable and endangered fish and bird species. The area is a vital food source and spawning ground for the important subsistence fishing industry in Nong Khai province. The important wetlands in Thailand are listed below in Table 70.

Table 70: **Important Wetland Sites in Thailand**

Name of site	Importance	Area (ha)	Province	Types	Key biodiversity information
Nong Bong Khai non-hunting area	Ramsar site	434	Chiang Rai	Riverine plain, seasonal and intermittent marsh	Includes 121 species of birds (57 residents) including 53 water birds and 13 species of fish
Bung Kong Long non-hunting area	Ramsar site	2,214	Nong Khai	Permanent natural water reservoir	Includes 64 fish species (31 of economic importance)

Source: Adapted from Choowaew 2003

Figure 162: **Nong Bong Kai, Chiang Rai, Thailand**

7.1.2.4 Viet Nam

The most important wetlands and protected areas in relation to transport of dangerous goods in the Mekong Delta are listed below.

Table 71: **Important Wetland Sites in Viet Nam**

Name of site	Importance	Area (ha)	Province	Types	Key biodiversity information
Tram Chim National Park (Figure 165)	National Park	7,588	Dong Thap	*Melaleuca* swamp, seasonally inundated grassland, lotus swamp	Created in 1998 to protect several rare birds. Plain of Reeds is an important site for conservation of wild rice.
U Minh Thuong National Park	National Park	8,154	Kien Giang	Peat land, *Melaleuca* forest, swamp, grassland and open water, waterways	Supports one of the largest breeding colonies of water birds in the Mekong Delta, 187 bird species confirmed, high diversity of flora and fauna
U Minh Ha National Park	National Park	8,286	Ca Mau	Peat land, *Melaleuca* forest, grassland and open water, waterways.	High abundance and species richness of water birds, habitat for endangered mammals
Mui Ca Mau National Park (Figure 166)	National park UNESCO Bio-sphere	41,862	Ca Mau	Sub-tidal and tidal coastal wetlands: mud flat, mangrove swamp, shrimp ponds	Excellent habitat for migrating shore birds, 93 species of birds from 38 families listed, including 7 species in the IUCN Red List

Source: Adapted from Thinh 2003

Figure 163: **Tram Chim, Dong Thap, Viet Nam**

The mangrove forests in the Mui Ca Mau National Park and coastal areas in the Mekong Delta are very important areas for biodiversity.

Figure 164: **Mui Ca Mau, Ca Mau Viet Nam**

7.1.2.5 Wetland Classifications

The MRC wetland classification system has defined four priority levels of wetlands in the LMB. The priority levels are described below.

Table 72: **Priority Level Wetlands**

Priority Level	Wetland Type
1	Wetlands, marshes and swamps
2	Shrubs and bush land
3	Agriculture, aquaculture and man-made wetlands
4	Waterfalls and river banks.

Both Priority Level 1 and Level 2 provide important ecological functions. Socio-economic development and navigation should be restricted in these areas. The classifications and locations of the wetlands in the LMB in respect to the ports, terminals and ferry crossings included in the risk analysis is shown in Figure 165.

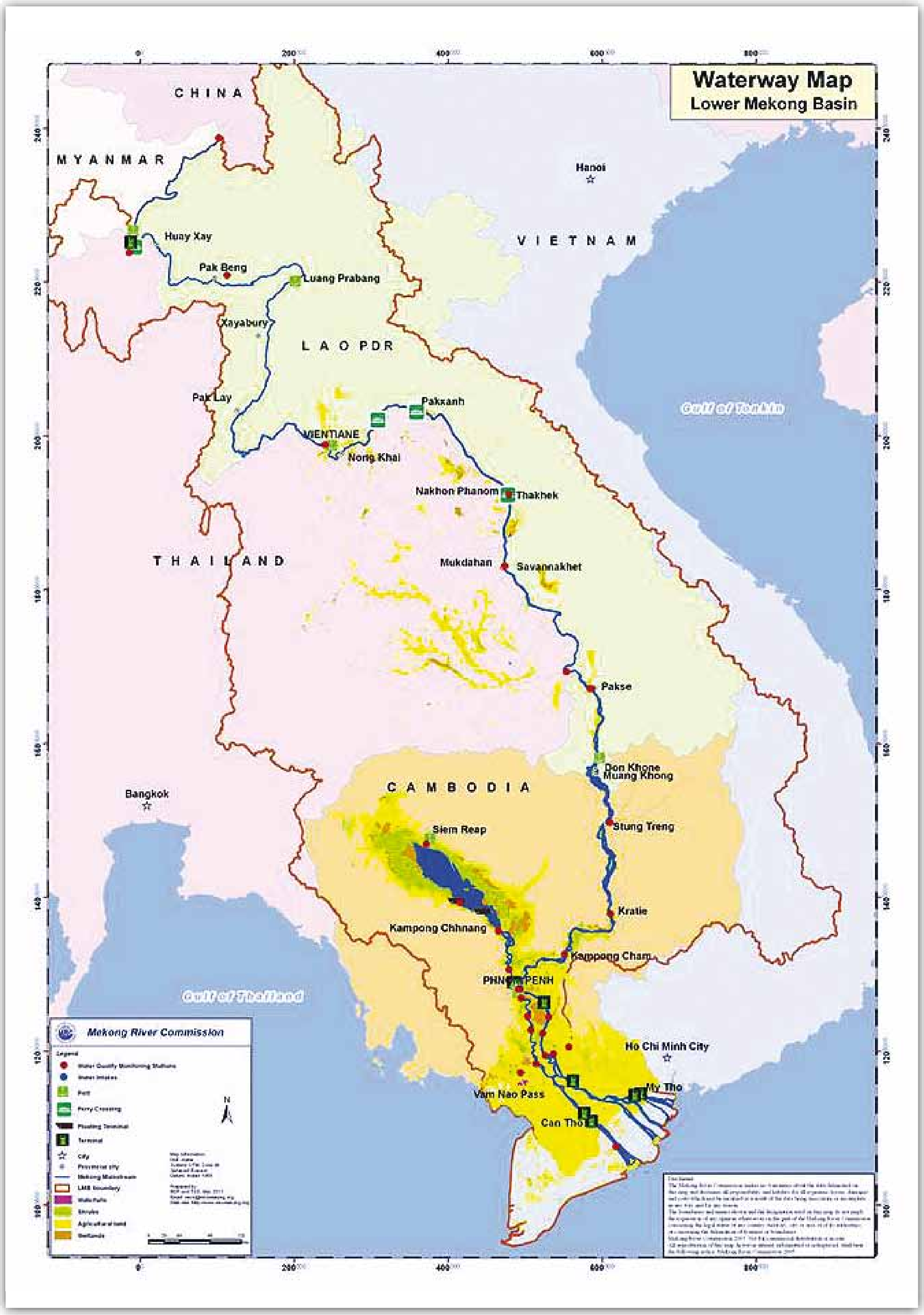


Figure 165: **Priority Level Wetlands in the Lower Mekong Basin**

There is significant transport of dangerous goods between Cambodia and Viet Nam. Figure 165 shows that there are a number of petroleum terminals located in Cambodia and Viet Nam that are close to priority Level 1 and 2 wetlands and Level 3 agricultural land. The domestic transport of dangerous goods in Cambodia occurs from Phnom Penh to the Tonle Sap Lake. Floating fuel terminals are surrounded by Priority Level 1 and 2 wetlands and Level 3 agricultural land. The domestic transport of dangerous goods in Viet Nam is close to agricultural land, mangrove forests and the coastline of the Mekong Delta. Figure 165 indicates the locations of 17 permanent water-quality monitoring stations on the Mekong River.

7.1.3 Water Quality Monitoring

The water resources of the Mekong River provide livelihoods for most of the 60 million people who live in the Lower Mekong Basin. These livelihoods to a large extent depend on the environmental health of the Mekong River and its tributaries remaining in good condition. Water quality is a key determinant of environmental health.

7.1.3.1 Cambodia

The Ministry of Environment (MoE) is fully responsible for water-quality monitoring and environmental monitoring in industrial premises along the Mekong River and throughout the country. In the case of inspection at serious environmental pollution sources and/or areas, the MoE will do an inspection either in cooperation with concerned ministries/institutions or itself, depending on whether the case is urgent or normal.

A specific water-quality standard has not been developed to measure the potential impacts from navigation activities. However, several national standards of the *Sub-Decree on Water Pollution Control* can be applied including:

(i) effluent standard for pollution sources discharging wastewater to public water areas or sewers;

(ii) water quality standard in public water areas for bio-diversity conservation; and

(iii) water quality standard in public water areas for public health protection.

Water quality samples are taken monthly taken and analysed by the Ministry of Water Resources and Meteorology (MoWRAM) and by MoE only at the Phnom Penh Port. MoWRAM also conducts water sampling at designated stations in above-mentioned water sources under the MRC Water Quality Monitoring Network.

7.1.3.2 Lao PDR

In Lao PDR, the water quality parameters and guidelines are outlined in the *National Environmental Quality Standard No: 2734/PMO-WREA,* December 2009*,* which includes the following:

(i) drinking Water Quality Standards;

(ii) groundwater Quality Standards; and

(iii) surface Water Quality Standards.

Monitoring of water quality is not undertaken for specific locations in relation to navigation activities and port developments. Socio-economic development projects such as mining and hydropower are required to do self monitoring and report to the Water Resources and Environment Agency (WREA). iWREA and line agencies are responsible for monitoring tributaries and canals. The MRC Water Quality Monitoring Network monitors water quality in the Mekong River.

7.1.3.3 *Thailand*

Water quality monitoring in Thailand is undertaken by the Pollution Control Department (PCD) under the Ministry on Natural Resources and Environment (MONRE). The PCD has developed the following water quality standards:

(i) surface water quality standards;

(ii) effluent standards; and

(iii) groundwater standards.

The PCD uses a number of parameters for water quality monitoring in Thailand. There is water quality data and extensive monitoring for the Chao Phraya River and other tributaries. No specific water quality monitoring data is available for the Mekong River at Chiang Saen Port and surrounding areas.

7.1.3.4 *Viet Nam*

The Ministry of Natural Resources and Environment (MONRE) is responsible for water quality monitoring. Provincial centres for environmental monitoring have been established in Can Tho, Kien Giang, Hau Giang and Ca Mau provinces in the Mekong Delta. Viet Nam has established environmental standards, including standards on sampling and sample preservation, analysis methods and standards on quality of air, surface water, groundwater, soils, emission standards and wastewater standards. The water quality standards include:

(i) QCVN 08:2008 / BTNMT - National Technical Regulations for Surface Water Quality;

(ii) QCVN 09:2008 / BTNMT - National Technical Regulations on Groundwater Quality;

(iii) QCVN 10:2008 / BTNMT - National Technical Regulations on Coastal Water Quality; and

(iv) QCVN 14:2008 / BTNMT - National Technical Regulations on Waste Water Quality.

In the Mekong Delta, there are 34 groundwater monitoring stations located near ports, petroleum terminals and refuelling sites. Water quality is decreasing, impacting on agricultural land and aquatic biodiversity, affecting the economic livelihoods of people in the Mekong Delta.

7.1.3.5 *MRC Water Quality Monitoring Network*

In April 1995, the MRC Member Countries signed the *Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin* (the Mekong Agreement) which empowers the Mekong River Commission (MRC) and its secretariat (MRCS) to monitor water quality in the Mekong River. Under this agreement, water quality is specific to Article 3 (Environmental Protection), Article 7 (Prevention and Cessation of Harmful Effects) and to Article 10 (Emergency Situations). The MRC has monitored the water quality of the river since the mid-1980s, although monitoring of the Cambodian stretch of the Mekong began only in 1993. The MRC has established a Water Quality Monitoring Network (WQMN) with the purpose of providing timely data and information on the status and changes in water quality of the Mekong River Basin.[78]

The WQMN was reviewed and updated in 2008 and 2009. The programme includes water quality monitoring for 87 permanent stations of which 55 are primary stations and 32 are secondary stations on the mainstream and important tributaries of the Mekong River (Figure 166).

[78] The Mekong River Report Card on Water Quality (2000–2006) Volume I, September 2008 Mekong River Commission, Vientiane

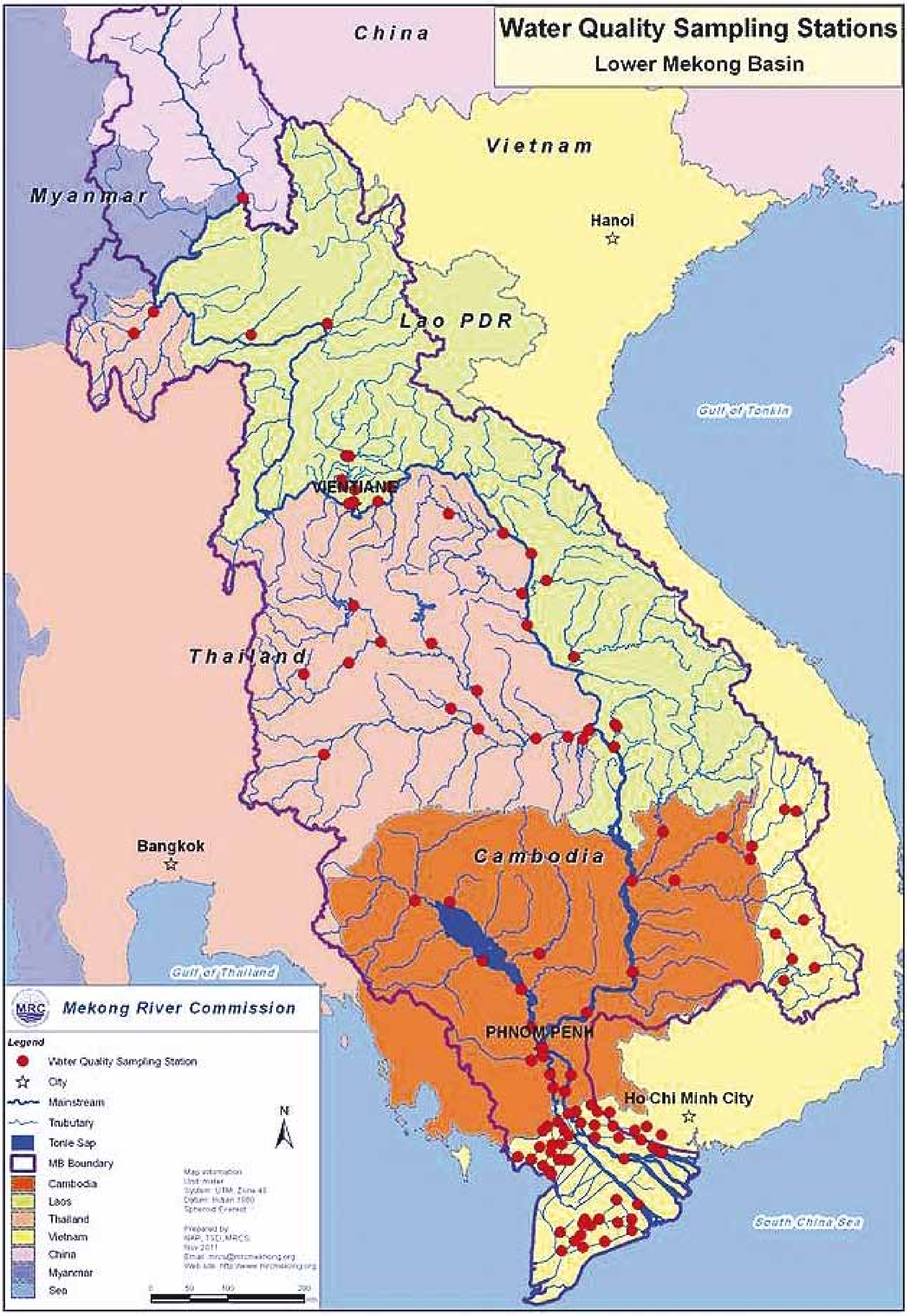


Figure 166: **Water Quality Monitoring Stations in the LMB**

The parameters the MRC monitors are the conventional physio-chemical measures that are employed by similar programmes worldwide. Table 73 describes the list of parameters measured by the WQMN and published by the MRC in *The Mekong River Report Card on Water Quality (2000-2006)*.

Table 73: **List of WQMN Parameters Measured Every Two Months (2009)**

Temperature	Total Nitrite and Nitrate	Dissolved Oxygen
Conductivity	Ammonium	Chemical Oxygen Demand
Total Suspended Solids	Total Nitrogen	Faecal Coliforms
pH	Total Phosphorus	

Four parameters and their guideline values were selected to assess to assess the "human impact" on water quality in the Mekong River. These are Dissolved Oxygen (DO), Ammonium (NH4), Chemical Oxygen Demand and Total Phosphorous (TP). Table 74 provides the guideline values of the water quality parameters used.

Table 74: **Water Quality Parameters Used in the Classification System for the "Human Impact" on Water Quality.**

Parameter	Units	Value	Parameter	Units	Value
Dissolved Oxygen	mg/l	≥ 6	Chemical Oxygen Demand	mg/l	< 4
Ammonium	mg/l	< 0.05	Total Phosphorus	mg/l	< 0.08

If the measured value for each parameter is within the guideline value on a sample day, it is given a rating of 2; if not the rating is 0. The Water Quality Index (WQI) is calculated using a formula including all four parameters. A rating system was developed to determine the "human impact" on water quality at specified locations within the Mekong River Basin.

Table 75: **Rating System for "Human Impact" on Water Quality**

Class	Rating Score
A - No impact	10 ≥ A ≥ 9.5
B – Slight Impact	9.5 > B ≥ 8.5
C - Impact	8.5 >C ≥ 7
D – Severe Impact	D < 7

The degree of the impact of human activities on the water quality at 17 mainstream monitoring stations from 2000-2008 ranged from "no impact" to "severe" as shown in Table 76.

Table 76: **Water Quality Class of Mekong Mainstream Stations for the "Human Impact" on Water Quality 2000 - 2008**

No	Station Name	Country	CLASS								
			2000	2001	2002	2003	2004	2005	2006	2007	2008
1	Houa Khong	Lao PDR	ND	ND	ND	ND	B	C	B	B	B
2	Chiang Saen	Thailand	B	B	B	C	D	C	C	B	C
3	Luang Prabang	Lao PDR	B	B	B	C	C	C	B	C	C
4	Vientiane	Lao PDR	B	C	B	C	B	C	B	C	C
5	Nakhon Phanom	Thailand	C	B	B	B	D	C	D	C	D
6	Savannakhet	Lao PDR	ND	B	B	B	B	C	C	C	C
7	Khong Chiam	Thailand	C	B	B	C	D	B	C	B	C
8	Pakse	Lao PDR	B	B	B	B	C	B	B	B	B
9	Steung Treng	Cambodia	ND	ND	ND	ND	ND	C	B	B	B
10	Kratie	Cambodia	B	A	A	A	A	C	B	B	B
11	Kompong Cham	Cambodia	B	C	B	A	A	B	B	B	A
12	Chrouy Changvar	Cambodia	B	B	A	A	A	B	B	C	B
13	Neak Luong	Cambodia	B	B	A	A	B	C	C	C	B
14	Kaam Samnor	Cambodia	ND	ND	ND	ND	ND	C	B	B	C
15	Tan Chau	Viet Nam	C	B	C	B	B	D	D	C	D
16	My Thuan	Viet Nam	B	B	C	C	C	C	D	D	D
17	My Tho	Viet Nam	ND	B	C	B	D	C	D	D	D

ND: No Data

The potential human impacts on Mekong water quality are assessed by the WQI for Human Impact and four key water quality parameters. The monitoring found that water quality in the uppermost part of the LMB reflects lower human impacts than the downstream part of LMB. From the Chrouy Changvar station in Cambodia downstream to the Mekong Delta reflects higher human impacts.

The WQMN provides good information on the status and trends of the selected parameters and WQI. While it can generate diagnostic and prescriptive information on certain kinds of threats, it cannot deal comprehensively with the impacts (real or anticipated) of present and proposed issues of land use and socio-economic development. This type of traditional monitoring focuses mainly on water chemistry and does not monitor ecological effects that are now the primary determinant of "environment effects" in modern water-quality programmes.[79]

[79] MRC 2008b. An Assessment of Water quality in the Lower Mekong Basin, MRC Technical paper No. 19, Mekong River Commission, Vientiane.

The MRC is very aware that the conventional data collected under its water-quality monitoring programme, while useful for conventional issues such as organic pollution, eutrophication and salinity, does not allow for the identification of "hot-spots" where inorganic or organic contaminants may be present or the level of risk that may be associated with contaminants. There is currently limited data on the changes in water-quality conditions caused by development and other human activities. The National Working Group was asked to identify additional water quality monitoring undertaken in the Member Countries in relation to the transportation of dangerous goods along the Mekong River.

7.1.4 Water Quality Threats in the Lower Mekong Basin

As the livelihoods of most of the 60 million people who live in the Lower Mekong Basin (LMB) wholly or partly depend on aquatic resources, the environmental health of the river is a major concern to the governments of the countries in the basin. Poor water quality can result from natural processes, but may often be related to human activities. The development and production of synthetic chemicals used in industry and agriculture has profound effects on water quality. Water quality is one of the key factors affecting the environmental health of the Mekong river system.[80] Increased urbanisation, population growth, and increased rates of consumption have to led to further resource extraction (e.g. mining and forestry), materials processing (e.g. pulp and paper mills), hydropower, navigation and port developments which present threats to water quality. Further to the WQMN, the MRC has undertaken diagnostic studies to determine human impacts on water quality. *An Assessment of Water Quality in the Lower Mekong Basin* outlines the main threats to water quality.

7.1.4.1 Urban Development

The large cities of Vientiane in Lao PDR, Phnom Penh in Cambodia and Can Tho in Viet Nam lie along the Mekong and Bassac River and are home to significant number of people with about 500,00 in Vientiane, 1.3 million in Can Tho and 1.7 million in Phnom Penh. The population density in these cities results in increasing municipal wastewater discharge to the Mekong River. Elevated concentrations of phosphorous, nitrogen and COD, and lower dissolved oxygen (DO) in the Mekong Delta have been detected due to high population and intensive agriculture.[81]

7.1.4.2 Industry

The development of water resources of the Mekong River has accelerated particularly in the hydropower and agricultural sectors. Navigation has also increased considerably in the Upper Mekong between Thailand and the People's Republic of China and from Cambodia to Viet Nam. The scale of industrial development in the LMB is relatively low. Industrial development has the potential to increase pressure on aquatic resources substantially in the future. The MRC has reported that industrial water pollution has been concentrated around specific industrial contaminants and downstream from major urban areas. At present, limited information is available on industrial discharges or run-off from industrial sites.

There is limited data and specific information on the role of industry in water pollution of the mainstreams of the Mekong and Bassac rivers. The MRC reported that in 2003 and 2004, the full suite of industrial contaminants was below detection level in water samples. Analysis of these same contaminants in bottom sediment found that a small number of sites in the downstream component showed minor effects of industrial contamination.[82] Toxic chemicals in the environment include heavy metals and some organic compounds. These persistent pollutants cause specific problems in aquatic environ-

80 MRC (2010) “State of the Basin Report 2010”. Mekong River Commission, Vientiane, Lao PDR.

81 MRC (2008b) An Assessment of Water quality in the Lower Mekong Basin, MRC Technical paper No. 19

82 MRC (2007a) Diagnostic Study of the Lower Mekong Basin. MRC Technical Paper No. 15

ments as they are often accumulated into the food chains. Like persistent organic pollutants, the data about heavy metals and other trace elements is currently limited for the Mekong River.

7.1.4.3 Tourism

There is no hard evidence in the case studies that tourism has generally brought about large-scale deterioration in the water and related resources of the LMB. However, in urban centres dependent primarily on large-scale tourism, air pollution from traffic and construction, and inadequate disposal of wastewater, sewage, solid waste and garbage have led to the pollution of wells, rivers and streams. Fuel discharges from boats, and waste matter from restaurants, guesthouses and other facilities catering to tourist demand pollute rivers, streams and wetlands. Tourist services and passenger transport is increasing in the LMB so will require further monitoring.[83]

7.1.4.4 Navigation

There are a number of petroleum terminals, inland and maritime ports in Cambodia and Viet Nam which contribute industrial wastewater, solid and liquid wastes from vessel and port operations which may carry harmful substances with potentially negative impacts on the Mekong water quality and aquatic ecosystems. Industrial waste, oil spills and hazardous wastes are emerging threats from the carriage, handling and storage of dangerous goods which need to be addressed through regional action plans and environmental management and monitoring systems.

There have been numerous efforts over the years, under the MRC Environment Programme and WQMN, to identify significant basin-wide issues and threats to water quality. Some pollution "hot-spots" have been identified by the MRC that link to local sources of pollution. Somewhat elevated levels of heavy metals and trace elements in the water have been found in areas with significant vessel traffic and/or with high population densities mainly in downstream areas of Phnom Penh and in the Mekong Delta, but also in the border areas between China and Lao PDR. Although further water quality monitoring needs to be undertaken, at present, it can be reasonably inferred that the stations with higher total heavy metal concentrations are located in areas with significant vessel traffic and/or with high population densities (see Table 77).

Table 77: **Pollution Hotspots in the Lower Mekong Basin**

Location of Monitoring Station	Potential pollution source
Lao-Chinese border (LS3)	Commercial shipping between Thailand and China
Luang Prabang (LS4)	Large volume of tourist vessel traffic
Vientiane (LS5)	High population density
Kratie (CP15)	Medium volume of vessel traffic for tourism and transportation
Prek Kdam - Tonle Sap River (CP17)	Vessel traffic and some industrial activities;
Koh Khel, Bassac (CS18) and Neak Luong, Mekong (CS19)	Downstream from Phnom Penh
Tan Chau, Mekong (VP20)	High population density in the Mekong Delta
Chau Doc, Bassac (VS21)	High population density in the Mekong Delta

Source: MRC 'An Assessment of Water Quality in the Mekong Basin' Technical Paper No.19.

[83] MRC (2010) An assessment of environmental impacts of tourism in the Lower Mekong Basin

The concentrations of heavy metals recorded in 2003 showed that sites at the Lao-Chinese border (LS3) and Neak Luong (CS19) have elevated levels. The station at Neak Luong may be affected by the Tonle Sap River as the Prek Kdam (CP17) station, which is located on the Tonle Sap, shows the highest level of total heavy metals. The second highest concentration of total heavy metals is observed at Chau Doc (VS21), on the Bassac River. Koh Khel (CS18), also on the Bassac, has higher levels of heavy metals. Both sites are downstream from Phnom Penh.[84]

It is unknown whether elevated levels of pollutants at sites downstream from Phnom Penh are local factors or the result of urban, industrial development or navigation. The most significant areas for navigation in the LMB is characterised in Table 78 below.

Table 78: **Most significant Navigation in the Lower Mekong Basin**

Navigation Activities	Traffic Density
PR of China to Chiang Saen, Thailand	Low to Medium-Level Transport of Dangerous Goods and Cargo
Huay Xay to Luang Prabang, Lao PDR	Passenger Transport
Siphandone, Lao PDR	Passenger Transport
Kratie to Steung Treng, Cambodia	Passenger Transport
Phnom Penh to Chhong Kneas (Tonle Sap), Cambodia	Passenger Transport
Phnom Penh to Kompong Chhnang (Tonle Sap)	Low-Level Transport of Dangerous Goods
Phnom Penh, Cambodia to Viet Nam	Medium to High-Level Transport of Dangerous Goods and Cargo
Mekong Delta, Viet Nam	High-Level Transport of Dangerous Goods, Cargo and Passengers

Figure 167 below indicates the pollution hotspots in relation to the transport of dangerous goods, cargo and passengers in the LMB.

[84] An Assessment of Water Quality in the Mekong Basin, Technical Paper No. 19, MRC, 2008

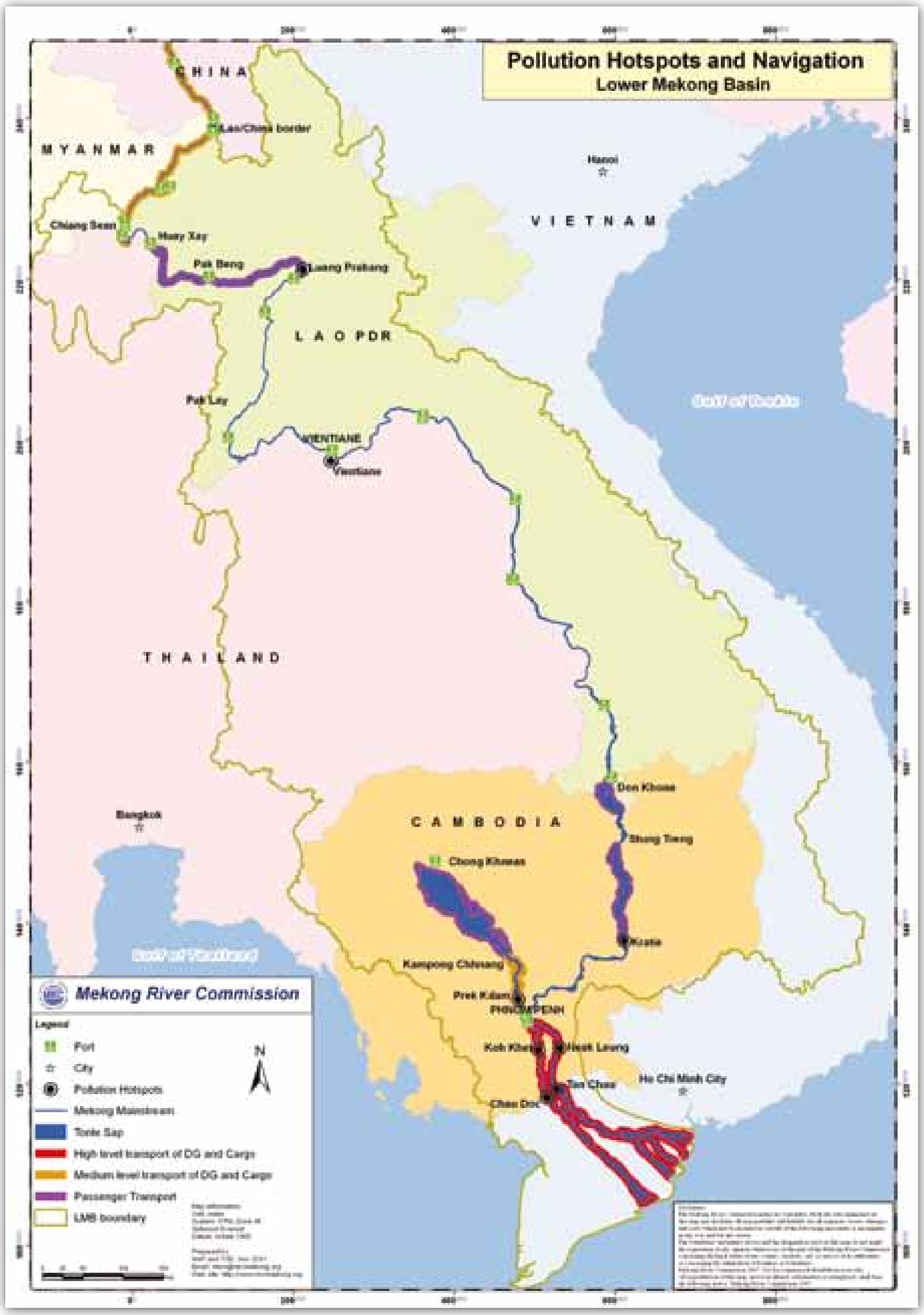


Figure 167: **Pollution Hotspots and Main Navigation Activities in the LMB**

7.1.5 Trans-Boundary Pollution

The Mekong Basin is an international river basin covering six countries. Trans-boundary water quality is, therefore, a key concern of the four MRC Member Countries as well as Myanmar and the People's Republic of China.

7.1.5.1 *Trans-Boundary Areas in the Lower Mekong Basin*

The MRC Diagnostic Study of the Lower Mekong Basin identified five main trans-boundary areas in relation to notification and emergency response procedures for water quality incidents:

1. People's Republic of China/Lao PDR

   In 2004, a boundary station at Houa Khong (Lao PDR) was established to monitor the boundary between the Upper and Lower Mekong Basin.

2. Lao PDR/Myanmar

   This short section of the Mekong is in remote, sparsely populated regions of both countries. At this time, there is no reason to expect any significant problems in this section. It is, however, a reach of increasing barge traffic between China and Thailand.

3. Thailand/Lao PDR (at the Mekong River)

   Thailand and the Lao PDR have similar concerns over sediment erosion and transport on the Mekong, nutrient pollution from riparian cities, towns and villages along the mainstream, the potential for contaminants from developing industrial areas (especially on the Thai side), agricultural chemicals and salinity from the Khorat Plateau of Thailand.

4. Lao PDR/Cambodia

   No particular issues have been raised over water quality at this order, other than concerns by Cambodia over possible dioxins/furans from the Lao PDR/Viet Nam border area sprayed with Agent Orange during the American War.

5. Cambodia/Viet Nam

   There is concern over the possibility that industrial contaminants from the city of Phnom Penh will be transported downstream.

7.1.5.2 *Procedures for Water Quality*

The MRC Environment Programme has established technical working groups in Member Countries to establish Procedures for Water Quality. Technical guidelines supporting the procedures are:

- Chapter 1: Technical Guidelines for Protection of Human Health;
- Chapter 2: Technical Guidelines for Protection of Aquatic Life;
- Chapter 3: Technical Guidelines For Water Quality Emergency Response and Management; and

- Chapter 4; Cooperation Framework for Implementing the PWQ.

The Risk Analysis project relates to Chapter 3 Technical Guidelines for Water Quality Emergency Response and Management, the objectives of the guidelines are to:

- ensure a timely and effective cooperation among the Member Countries in responding to water quality emergency incidents; and
- reduce the extent of trans-boundary water pollution incidents and to mitigate their negative effects

Chapter 3 (Technical Guidelines for Water Quality Emergency Response and Management) aims at ensuring timely and effective cooperation among Member Countries in response to water quality emergency incidents. The process includes 10 steps of three stages, namely preparation, operation and post-evaluation of incidents. Different substances from industrial, agricultural, mining, and navigation activities potentially causing water quality emergency incidents in the Mekong Basin would be reviewed. The probability of incidents occurring and the level of damage on aquatic and wetland ecosystems would be predicted based on hydrological, hydraulic and water quality modelling. These results would provide Member Countries with information for early warning and timely notification and response.

7.1.6 Potential Environmental Impacts of Inland Waterborne Transport

The Risk Analysis considered the potential environment impacts associated with the carriage, handling and storage of dangerous goods at ports, petroleum terminals, ferry crossings and onboard vessels. The scope of this study did not include the environmental impacts of dredging and maintaining the navigation channel, sand mining or measuring the atmospheric emissions from vessels and port activities.

7.1.6.1 Ports and Terminals

As determined from the Risk Analysis, there are a number of inland ports, terminals and ferry crossings in the Member Countries. Potential environmental impacts from the storage and handling of dangerous goods are:

- increased risk of spillages from storage tanks and facilities;
- increased risks of spillages and pollution during loading and discharging operations;
- increased risk of spillages during bunkering activities;
- solid and liquid wastes and hazardous materials;
- contamination of soil and groundwater;
- potential for land contamination in vicinity of refuelling areas;
- run-off from ports, petroleum terminals, ferry crossings and refuelling areas; and
- wastewater discharged from ports and petroleum terminals.

Inland ports, petroleum terminals and ferry crossings can also be significant sources of water pollution from industrial effluents, sewage, and inadequate waste disposal and run off from port and petroleum areas. As determined in the chapter on ports and terminals, none of the selected ports, terminals and ferry crossings had adequate measures in place to contain pollution within the boundaries of the site. Furthermore, many of the ports/terminals are subject to seasonal flooding and heavy rains during the wet season which increases the amount of run-off and potential pollutants discharged to the Mekong River.

7.1.6.2 Vessels

As determined from the Risk Analysis, the main types of dangerous goods transported on the Mekong River are diesel, gasoline, kerosene and liquid petroleum gas (LPG). The main risks associated with the transport of dangerous good in relation to vessels include:

- increased pollution from passing shipping;
- increased risk of spillages and pollution from shipping accidents;
- spills and intentional discharge of substances containing oil, heavy metals and pesticides;
- waste and waste water disposal;
- vessel discharges and spills; including discharges such as oily ballast, bilge water, anti-fouling paints and sewage;
- loss or damage to habitats and species due to an increase in disturbance and pollution; and
- health and safety risks for existing waterway users.

Discharging of untreated or inefficiently treated oily bilge water together with other oil spills is a significant environmental problem of shipping. The main environmental risks of shipping accidents are leakages and spills of cargo oil or fuel oil and discharges of dangerous goods. The risks of harmful outcomes and even catastrophes are real, since accidents take place in inland waterways where prevention measures are not always readily available.

7.1.6.3 Solid Wastes

Water pollution from industrial sources has been identified in the LMB, especially in the cities of Vientiane and Phnom Penh and the Mekong Delta. Generally, treatment of industrial wastewater is limited and handling and disposal of industrial hazardous waste are insufficient. Control of industrial wastewater is not enforced or monitored by national line agencies. So far, industrial water pollution is mainly concentrated around factories and downstream from major urban areas.[85]

Solid waste can be classified into different types, depending on their source. Household waste is generally classified as municipal waste, industrial waste as hazardous waste. The term "solid waste" means any garbage, refuse, or sludge from a waste-treatment plant or water-supply treatment plant. Studies have focussed on the public health impacts of increased urbanisation and limited municipal waste management plans in developing countries. Direct dumping of untreated wastes into rivers can alter the aquatic habitats and harm native plants and animals. Uncontrolled disposal of wastes can cause contamination to groundwater and direct dumping to rivers can impact both surface and groundwater quality. Reducing the environmental health of the river, groundwater and soil can, in turn, generate public health implications for people depending on the water resources and living nearby waste facilities or illegal dumping of wastes.[86]

The operations of ports, terminals and vessels have the potential to generate both domestic and hazardous wastes. Currently, industrial and municipal waste management plans in the Member Countries are limited, increasing the risks to both the environment and public health. It was determined that a number of ports and terminals did not have adequate wastewater treatment plants and there are no provisions of onshore waste disposal facilities for vessels. Workers in ports/terminals and onboard vessels, riparian populations living nearby operations, water intakes (drinking) and the tourism and fisheries sectors are at risk from adverse environmental and public health impacts associated with inadequate management of hazardous wastes.

[85] http://www.unep.or.jp/Ietc/Publications/spc/Solid_Waste_Management

[86] MRC technical Paper No. 28 Mekong River Commission, Vientiane. 68 pp

Further analysis will be required to determine the composition of both the industrial and municipal waste generated along the Mekong River and the existing waste management plans and facilities. Measures will also be needed to avoid pollution due to surface water run-off, drainage, and contamination by organic matter and minerals from wastewater.

7.1.7 Potential Environmental Impacts of Oil Spill Pollution

Water pollution or damage caused by the operation of inland vessels, ports and terminals pose a threat to the aquatic environment. As determined in the chapters on ports and terminals and vessels, there is significant transport and storage of petroleum products in the LMB and some of the ports, petroleum terminals and vessels have limited capacity to prevent and respond to oil spill pollution. Once oil or liquid chemicals have been spilled, they cannot be completely contained and recovered. Whatever means are deployed to combat navigation spills, some product will always escape recovery, remain in the aquatic environment and migrate away from the spill site. As even very low concentrations of oil or liquid chemicals might exert some detrimental effects on the aquatic environment, the highest priority should be given to prevention of accidental and operational spills. This section will describe the potential impacts of oil spill pollution.

7.1.7.1 Oil Spills in Inland Waterways

Most literature relates to the impacts of marine oil spills. However, oil spills in inland waters are highly likely to contaminate water supplies, affecting aquatic ecosystems and riparian populations. Offshore facilities and vessels are the major sources of spills in the marine environment, whereas fixed facilities and vessels are the major sources of spills for inland waters. Studies have determined that oils spilled into inland waters are more likely to be lighter-weight crude oils and refined products such as gasoline and diesel.[87]

7.1.7.2 Types of Oil

When determining the impacts of oil spill pollution, it is important to consider oil categories and types (Table 79).

Table 79: **Oil Type and Category**

Oil Category	Oil Types Included
Crude oils	Crude oil
Heavy oils	Heavy fuel oil, intermediate fuel oil, Bunker C, No.6 fuel oil, No.5 fuel oil, asphalt.
Light oils	Diesel, mineral oil, motor oil, low-sulphur marine gas oil, lubricating oil, hydraulic oil, bilge slops, waste oils
Gasoline	Various grades of gasoline
Jet fuel	Kerosene
Non-petroleum oils	Bio-diesel, animal fat, vegetable oil, volatile organic distillate

An Oil Spill Risk Assessment conducted in the US state of Washington[88] considered important characteristics of oil spill pollution in an aquatic environment including persistence, acute toxicity and mechanical injury score which are defined as follows:

[87] Walker, Ann, H., Janet H. Kucklick, Alexis E. Steen, and David Fritz (1995) Oil spill chemicals in freshwater environments. Proceedings of the 1995 Oil Spill Conference. American Petroleum Institute.

[88] French McCay, D., J. J. Rowe, *et al.* (2004) "Estimation of potential impacts and natural resource damages of oil." Journal of Hazardous Materials 107(1-2): 11-25

- **Persistence** - the length of time the spilled oil is known to (or likely to) persist in a variety of habitat types;
- **Acute toxicity** - the degree to which oil is capable of causing adverse effects on fish, invertebrate and aquatic organisms after short-term exposure (hours to days);
- **Mechanical injury score** - related to density and impacts caused by coating, fouling or clogging of organisms and their appendages and apertures, such that movements and behaviours are inhibited; heavy oils receive higher scores; and
- **Persistence scores** - indicate the approximate length of time the spilled oil is known to (or likely to) persist in a variety of habitat types (Table 80).

Table 80**: Persistence scores**

Score	Persistence
5	5-10 years or more
4	2-5 years
3	1-2 years
2	1 month to 1 year
1	Days to weeks

This information was used to determine the effect scores by the type and category of oils (Table 81).

Table 81: **Effect Scores by Oil Type**

Oil category	Acute Toxicity	Mechanical injury	Persistence
Crude oils	0.9	3.6	5
Heavy oils	2.3	5.0	5
Light oils	2.3	3.2	2
Gasoline	5.0	1.0	1
Jet fuel	1.4	2.4	1
Non-petroleum oils	1.4	2,4	1

Impacts of oils spills are highest for heavy fuels, followed by crude oil; lower for light oils and gasoline and lowest for jet fuel and non-petroleum oils. Studies of oils spills have found the following:

- More persistent and viscous oils (heavy oils) cause more impacts to birds, mammals and shorelines than lighter oils;
- Spills of light oils (diesel) and crude oil cause higher impacts in the water column (on fish, shellfish and plankton) than equal volume spills of heavy fuels or gasoline, because heavy fuels are not easily entrained into the water column (requiring high turbulence to do so), and gasoline is much more volatile and so results in lower water column toxicity than the light fuels and crude oils; and
- Impacts vary considerably and primarily by the sensitivity of the environment and the distribution of organisms in different aquatic habitats.

Another threat to the environment is caused by the operational discharges of bilge oil, heavy oils and lubricants, as well as organic substances (mainly polycyclic aromatic hydrocarbons (PAH)) and wastes. Heavy oils and hazardous wastes can be released during operations at ports and terminals and fuel trucks are a common source of oil spill pollution in inland waterways.[89]

The main types of oil transported along the Mekong River are gasoline, diesel and Jet fuel. There is also the domestic transport of intermediate fuel oil in Cambodia and Viet Nam which requires further investigation. Generally the risks to environment and safety of gasoline, diesel and heavy oils are summarised below (Table 82).

Table 82: **Risks of Diesel, Gasoline and Heavy Oils**

Type	Environment	Safety	Fire
Diesel	The risks for the environment are mainly related to the certain toxic compounds dissolving in the water column and droplets of hydrocarbon being dispersed.	It is advisable to wear apparel to prevent contact with the skin and possibly inhalation of vapours.	At ambient temperatures, the risks of fire and explosion for response personnel are relatively limited, due to the product's low volatility (flash point higher than 50°C).
Gasoline	Gasoline is naturally rich in aromatic compounds, molecules which are recognised for their solubility and toxicity, the hydrocarbon content in the water column will be significant. In turbid waters, these molecules will become combined with matter in suspension and will then settle. Furthermore, most additives present in gasoline products are also toxic.	The risks generated by a significant petrol spill are particularly important for response personnel. They are linked to the production, by the petrol slick, of toxic and above all extremely flammable vapours. Gasoline is comprised of relatively high proportions of toxic and volatile hydrocarbons, such as benzene, which is known to cause cancer in humans and hexane, which can affect the nervous system. It is advisable to wear Personal Protective Equipment (PPE) suitable for hydrocarbons to prevent contact with the skin and possibly inhalation of vapours.	The flash point of this type of product is lower than ambient temperature and the risks of fire and explosion are therefore high.
Heavy Oils	Fuel oils are slightly toxic for the environment, as light compounds are present in small proportions. However, due to their high viscosity, they have a significant impact on the shoreline, flora and fauna by smothering.	The risks of these products for humans are mainly linked to toxicity by contact. During clean-up operations, the main means of exposure is contact with the skin and mucous membranes. It is therefore essential to avoid all contact by wearing PPEs suitable for hydrocarbons.	Certain heavy oils which have a low flash point can present serious risks of fire or even explosion

Adapted: CEDRE Response to Small-Scale Pollution in Ports and Harbours[90]

[89] http://www.environmental-research.com/erc_papers/ERC_paper_19.pdf

[90] Operational Guide. Cedre: 2007, 49p

7.1.7.3 Oil Spill Risk Assessment

An oil spill risk assessment and pollution modelling was not undertaken in this phase of the project for the Mekong River. Spill probability analyses oil type, spill volume and geographic location of the spill. The Mekong River system has a number of different aquatic environments: fast-flowing stretches, deep pools, important wetlands, the Tonle Sap Lake and estuaries in the Mekong Delta.

The locations of all potential spill sites and an estimation of the type and size of the potential spills have to be known. The perception of risk might be based on the level of shipping traffic, navigational hazards, types of traffic, size of vessels, types of oil and chemicals handled and the location of petroleum, terminals, oil terminals and bunkering activities. Specific sensitivities in the port surroundings and along frequently navigated parts of the Mekong River should be identified as well. All areas likely to be adversely affected by an oils spill that are environmentally-sensitive (e.g. important wetlands, habitats) or commercially-sensitive (e.g. water intakes, fisheries) should be listed and described.

7.1.7.4 Potential for Oil Spills

Some of the hazardous substances handled in the Mekong Basin are oil components. The risk and impacts of oil spills are largely associated with navigation activities. Modelling and assessing oils spills are therefore an important activity in safeguarding the Mekong River environment. The potential for oil spills was evaluated for the ports, terminals and floating refuelling stations in the Risk Analysis for Thailand and Lao PDR (Table 83) and for Cambodia and Viet Nam (Table 84). Firstly, types of oil were represented:

1. diesel;
2. gasoline;
3. heavy oils; and
4. jet fuel (kerosene).

The potential magnitude of oil spills was based on the "Thailand National Oil Response Plan" which has the following tiers for oil spills pollution:

1. Tier 1 - small spill not exceeding 20 tonnes which may occur from oil-transfer activities at ports and terminals;
2. Tier 2 - medium spill with a size range of 20 -1,000 tonnes; and
3. Tier 3 - major spill exceeding 1,000 tonnes which may be caused by a severe accident.

The location of the spill was depicted based on the following:

1. Priority Level Wetlands 1 and 2 (Important wetlands, swamps, marsh shrubs and bush);
2. Priority Level Wetlands 3 and 4 (Agricultural land, man-made wetlands and waterfalls);
3. riparian populations, (located nearby to densely populated areas); and
4. trans-boundary areas (may cause trans-boundary pollution).

Table 83: **Potential Oil Spills for Thailand and Lao PDR**

SITES	TYPE OF OIL				POTENTIAL OIL SPILL			LOCATION			
THAILAND	Diesel	Gasoline	Heavy Oils	Jet Fuel (Kerosene)	Tier 1 Small Spill	Tier 2 Medium Spill	Tier 3 Major Spill	Priority Level Wetlands 1 and 2	Priority Level Wetlands 3 and 4	High population density	Trans-boundary areas
Chiang Saen Port	■	■	■		■						■
Keawalee Terminal	■	■	■		■	■					■
Chiang Khong Ferry Crossing	■	■	■		■						■
Bungkhan Ferry Crossing	■	■	■		■						■
Nakhon Phanom Ferry Crossing	■	■	■		■						■
LAO PDR	Diesel	Gasoline	Heavy Oils	Jet Fuel (Kerosene)	Tier 1 Small Spill	Tier 2 Medium Spill	Tier 3 Major Spill	Priority Level Wetlands 1 and 2	Priority Level Wetlands 3 and 4	High population density	Trans-boundary areas
Huay Xay Ferry Crossing	■	■	■		■						■
Luang Prabang Ports	■	■	■		■						
Km 4 State Port, Vientiane	■	■	■		■	■				■	■
Pakxanh Ferry Crossing	■	■	■		■						■
Nakasang Passenger Port	■	■	■		■			■			■

Currently, there are no large-storage terminals operating on the Mekong River in Lao PDR and Thailand so there is no potential for major spills. The maximum size of the vessels is 300 tonnes so there is no potential for major oil spills arising from vessel accidents.

Table 84: **Oil Spill Potential for Cambodia and Viet Nam**

SITES	TYPE OF OIL				POTENTIAL OIL SPILL			LOCATION			
CAMBODIA	Diesel	Gasoline	Heavy Oils	Jet Fuel (Kerosene)	Tier 1 Small Spill	Tier 2 Medium Spill	Tier 3 Major Spill	Priority Level Wetlands 1 and 2	Priority Level Wetlands 3 and 4	High population density	Trans-boundary areas
Phnom Penh Port	■	■	■		■	■				■	
Petroleum Terminal 1	■	■	■		■	■	■			■	
Petroleum Terminal 2	■	■	■	■	■	■	■			■	
Petroleum Terminal 3	■	■	■	■	■	■	■		■		
Krakor Floating Terminal	■	■	■		■	■		■	■	■	
Chnok Trou Re-Fuelling	■	■	■		■			■	■	■	
Chhong Kneas Floating Terminal	■	■	■		■	■		■	■	■	
VIET NAM	Diesel	Gasoline	Heavy Oils	Jet Fuel (Kerosene)	Tier 1 Small Spill	Tier 2 Medium Spill	Tier 3 Major Spill	Priority Level Wetlands 1 and 2	Priority Level Wetlands 3 and 4	High population density	Trans-boundary areas
Tay Nam Bo Petroleum Terminal	■	■	■	■	■	■	■		■	■	
Binh Duc Petroleum Terminal	■	■	■	■	■	■	■		■	■	
Quang Trung Petroleum Terminal	■	■	■	■	■	■	■		■	■	
Dong Thap Petroleum Terminal	■	■	■	■	■	■	■		■	■	

The potential for major oil spills is higher in Cambodia and Viet Nam due to the magnitude of operations. The terminals are also operated close to riparian populations and agricultural land. The floating terminals on the Tonle Sap Lake in Cambodia pose threats to Level 1 and 2 priority wetlands and riparian populations. The above is only an indication for the potential for oil spills and does not take into account the existing level of safety and environmental protection measures in place.

Further pollution modelling and scenarios need to be developed to determine the environmental impacts of oil spill pollution. The potential for trans-boundary pollution from terminals and vessels operating in Cambodia to Viet Nam also requires further investigation. The maximum size of tankers operating in Cambodia is 1,500 tonnes. The oil spill potential in the Mekong, Bassac and Tonle Sap Rivers also requires further investigation and modelling. The following section examines the legal framework in the Member Countries for environmental protection, impact assessments and monitoring.

7.2 LEGAL FRAMEWORK

The National Working Group in each of the Member Countries comprised an environmental expert (from the Cambodian Ministry of Environment, the Lao Ministry of Water Resources Environment Administration and the Thai and Vietnamese Ministries of Natural Resources and Environment). These experts were required to collect data and provided information related to:

- environmental protection and environmental impact assessment legislation;
- international conventions adopted by the Member Countries;
- institutions and line agencies responsible for compliance and enforcement;
- water quality monitoring and procedures; and
- important wetlands, vulnerable habitats and culturally significant areas.

The results of a questionnaire were combined with information from the MRC Environment Programme (EP) to determine the legal and institutional framework in the MRC Member Countries in relation to the transport of dangerous goods and more generally industrial and socio-economic development in each of the Member Countries.

7.2.1 Cambodia

7.2.1.1 National Legislation

The Royal Government of Cambodia has implemented laws, royal decrees and sub-decrees for environmental protection, natural resources management, protected areas and land-use planning (Table 85).

Table 85: **Inventory of Environmental Legislation in Cambodia**

Laws
Law on Land Use Planning, Urbanization and Construction, 1994
Law on Environmental Protection and Natural Resources Management, 1996
Law on Water Resources Management, 2007
Law on Natural Protected Areas, 2008
Royal Decrees
Royal Decree on the Creation and Designation of Protected Areas, 1993
Royal Decree on the Establishment of Protected Cultural Zones in Siem Reap
Royal Decree on the Establishment and Management of Tonle Sap Biosphere Reserve, 2001
Sub-Decrees
Sub-Decree on Standards and Management of Agricultural Materials, 1998
Sub-Decree on the Environmental Impact Assessment Process, 1999
Sub-Decree on Solid Waste Management, 1999
Sub-Decree on Water Pollution Control, 1999
Sub-Decree on Air Pollution, Vibration and Noise Disturbance, 2000
Sub-Decree on Management Ozone Depletion Substances, 2005
Sub-Decree on Classification and Labelling of Chemicals, 2007
Rules, Regulations and Guidelines

Table 85: **Inventory of Environmental Legislation in Cambodia (continued)**

Sub-Decrees
Prakas on the Provision of Roles and Responsibilities to Provincial and Municipal Environmental Department to carry out the Sub-Decree on Water Pollution Control and Solid Waste Management, 1999
Guideline on the Boosting of Implementation of Sub-Decree on Water Pollution Control, 1999
Guideline on the Boosting of Implementation of Sub-Decree on Solid Waste Management, 1999
Guideline on Hazardous Waste Management in Factories, 2000
Guidance on Sludge Management at Factories, Manufacturers and Companies, 2000
Announcement on Water Pollution Control at Pollution Sources throughout the Country, 2001
Inter-ministries Prakas (MoI and MoE) on Solid and Garbage Management in the Kingdom of Cambodia, 2003
Guidance on Solid Waste Management at factories, manufacturers and companies, 2003
Prakas on Halting the Sale, Distribution and Burning of Industrial Solid Wastes, 2003
Prakas on Management and Control of Use, Importation, Exportation and Distribution of Chemical Substances in the Industrial Sector, 2004

The MoE is fully responsible for the implementation of and ensuring compliance with environmental laws, rules and regulations and standards in close collaboration and coordination with concerned ministries and local authorities. The Ministry of Water Resources and Meteorology (MoWRAM) is responsible for implementing the above laws in relation to water resources management and water quality monitoring.

There have not been any studies along the Mekong River in Cambodia to identify the impacts of the environmental and socio-economic benefits resulting from navigation, port development and petroleum terminals. A specific strategy aiming at reducing the negative impacts resulting from the ports, petroleum terminals and navigation activities has not yet been developed. The *Law on Environmental Protection and Natural Resources Management; Sub-Decree on Water Pollution Control; Sub-Decree on Solid Waste Management; Sub-Decree on EIA Process;* and *Sub-Decree on Air Pollution and Noise Disturbance* are all legal instruments that can used to minimise any negative impacts to the environment and public health.

7.2.1.2 Environmental Impact Assessment

The *Law on Natural Protected Areas* was enacted in 2008 and aims to ensure the management and conservation of biodiversity as well as to ensure the sustainable use of natural resources in the natural protected areas (Article 1). The following legal instruments related to EIA:

i) *Law on Environmental Protection and Natural Resources Management*; and

ii) *Sub-Decree on EIA Process.*

Environmental impact assessment (EIA) has been applied to all development/investment projects in the natural protected areas in order to minimise serious environmental and social impacts (Article 44). The MoE is fully responsible for assessing and reviewing the EIA prior to submission to the Royal Government for approval. The EIA is reviewed in consultation with key stakeholders and relevant Ministries at both national and sub-national levels and local communities.

Environmental Management Plan (EMP) included in the *Sub-Decree on EIA Process* 1999 is a key tool to protect the environment and natural resources against any harmful impacts and pressures from various development projects (proposed and existing). Under Article 23 and 26 of the *Sub-Decree on EIA Process,* environmental management plans (EMP) must be submitted to the MoE – this is the responsibility operators of ports, vessels and petroleum terminals for reviewing and approval. However, the MoE does not have EMPs for all the existing petroleum terminals and ports along the Mekong River. The requirement of emergency-response plans from ports, petroleum terminals has not yet been taken into account by the MoE, except the requirement of environmental management plans.

7.2.1.3 Pollution Control

A specific water-pollution prevention programme has not yet been developed and communicated to key stakeholders at national and sub-national levels. The pollution prevention programme is included in the Environmental Strategic Plan (2009 – 2014). The MoE is responsible for reducing environmental pollution and implementing environmental legislation in relation to pollution control, monitoring and EIAs. This requires strengthened cooperation and consultation with concerned ministries, local authorities, and private sector and industry groups.

In serious cases of environmental pollution, the MoE shall conduct inspections, take actions and report to concerned ministries and institutions as indicated in the following legislation:

- *Decree on Water Pollution Control* (Article 32);
- *Sub-Decree on Solid Waste Management* (Article 26); and
- *Sub-Decree on Air Pollution, Vibration and Noise Disturbance* (Article 31).

Based on the environmental legislation, several processes can be taken to determine the source of pollution. Firstly, after identifying type and scope of environmental pollution, the MoE will advise in writing to the pollution source's owner to improve the situation (to stop pollution by various means). Secondly, if such pollution still occurs, the MoE shall apply environmental legislation to fine the owner of the source of the pollution and can temporarily stop operations which caused the pollution until the situation improves. Thirdly, in cases where the owner of the source of pollution violates the second procedure, all relevant activities will be completely stopped and the owner taken to court. However, some environmental legislation pertains to various industry sectors and therefore the relevant ministries and institutions should ensure compliance with environmental legislation to accomplish strategic plans, programmes and activities.

7.2.1.4 Water Quality Threats

The National Working Group determined possible threats to water quality from the transport of dangerous goods in Cambodia. The floating fuel terminals and refuelling stations at Chnok Trou and Kompong Chhnang province on the Tonle Sap are possible threats to water quality and biodiversity resulting from disposals of solid and liquid wastes into the waterways. In addition, water quality and people in this area are exposed to high risks from oil spills, fires and explosions.

The transport of dangerous goods and navigation should be restricted in the Mekong River between Kompong Cham and Steung Treng provinces to protect important habitats and wetlands. These areas provide habitats and migration for rare and endangered species of the Mekong River including the Irrawaddy dolphin (*Orcaella brevirostris*). Navigation in these areas should be clearly identified to avoid any potential damage to wetland habitats of rare and endangered species.

7.2.2 Lao PDR

7.2.2.1 National Legislation

The *Environmental Protection Law* specifies necessary principles, rules and measures for managing, monitoring, restoring and protecting the environment in order to protect public, natural resources and biodiversity, and to ensure the sustainable socioeconomic development of Lao PDR (Table 86).

Table 86: **Inventory of Environmental Legislation in Lao PDR**

Laws
Environmental Protection Law, No: 02/99/NA, date 3 April 1999
Forestry Law, 2005 (Biodiversity Protection and Conservation)
National Heritage Law, 2005,
Land Law, 1997
Decrees
Decree on the Environment Protection Fund No: 146/PM, date 6 June 2005
Regulations and Standards
EIA Regulation for Hydropower Development Sector, introduced in 2001,
EIA Regulation for Road Development Sector, introduced in 2003,
EIA Regulation for Industry Sectors, introduced in 2005,
National Environmental Standard, No: 2734/PMO, WREA, date 7 December 2009
Environmental Impact Assessment No: 112/PM, date 6 February 2010
National Policy and Strategies
National Environmental Strategy for year 2020
National Strategy on Environment Education and Awareness to the year 2020

The following national ministries and line agencies are responsible for environmental protection, water resources, transport and the industrial sector in Lao PDR:

- Water Resources and Environmental Administration (WREA);
- Pollution Control Division (PDR);
- Department Environmental Social Impact Assessment (ESIA);
- Ministry of Public Work and Transport (Waste Management); and
- Ministry of Industry and Commerce (Industry Waste).

7.2.2.2 Environmental Impact Assessments

Environmental audit and environmental risk assessment measures been introduced to identify issues in environmental protection and compliance is required with the following:

- *Environmental Impact Assessment Decree No: 112/PM*, dated 16 February 2010 (Environmental Management Plan); and
- *Agreement on the National Environmental Standards No: 2734/PMO-WREA*, dated 7 December 2009

In Lao PDR, there are only small cargo and passenger ports and no petroleum terminals on the Mekong River so no ports, petroleum terminals or shipping companies have been required to submit Environmental Management Plans (EMPs) to the Government (WREA) and relevant line agencies. For other sectors, hydropower, mining, agriculture and infrastructure projects are required to submit EMPs to WREA and line agencies for review and monitoring. In the future, proposed petroleum and port developments or the expansion or rehabilitation of existing facilities will need to comply with *Regulation No: 679/PMO-WREA* List of Project Developments to ensure Initial Environment Examination (IEE) and Environment Impact Assessment (EIA) are conducted.

7.2.2.3 Pollution and Waste Control

There are no adequate waste disposal strategies for solid and liquid wastes at ports and ferry crossings or for vessels. Currently, WREA is drafting the *National Strategy of Waste Management and Chemical Management*. There are no future plans for development of storage and waste treatment facilities along the Mekong River. WREA and line agencies conduct training and information for monitoring and environmental awareness to reduce environmental impacts on local communities but not directly with port authorities, ferry crossings and vessel operators.

7.2.3 Thailand

7.2.3.1 National Legislation

The Ministry of Natural Resources and Environment (MONRE) in Thailand is responsible for legislation governing environmental rules and regulation. The Pollution Control Department (PCD) and Office of Natural Resources and Environmental Policy and Planning (ONEP) are responsible for maintaining the following Acts and Standards in relation to the environment, public health, hazardous substances and industry (Table 87). The PCD is responsible for the implementation of the (NEQA 1992) *Pollution Prevention and Mitigation Policy* in accordance with the *Policy and Perspective Plan for Enhancement and Conservation of the National Environmental Quality 1997-2016*. According to the *Constitution of the Kingdom of Thailand (*B.E. 2550, or 2007), environmental management is different from the previous constitutions. This law provides the public right to participate in the prevention and elimination of any action that causes deterioration of natural resources and pollution of the environment, clearly in Sections 57, 66, 67, 73, 85 and 290.

Table 87: **Inventory of Environmental Legislation in Thailand**

Act
Hazardous Substance Act, B.E. 2535
Enhancement and Conservation of the National Environmental Quality Act, B.E. 2535
Navigational in Thai Waters Act, B.E. 2456
Public Health Act, B.E. 2535
Fishery Act, B.E. 2496
Factories Act, B.E. 2535
Public Cleansing Act, B.E. 2535 (1992)
Standards
Water Quality Standards
Air Quality and Noise Standards
Soil Quality Standards

Besides the laws and standards above, there are several other acts which involve the PCD such as the:

- *Industrial Estate Authority of Thailand Act*, B.E. 2522 (1979);
- *Land Transportation Act*, B.E. 2522 (1979);
- *Industrial Products Standards,* B.E. 2511 (1968);
- *The Petrol Act*, B.E. 2521 (1978);
- *Land Traffic Act*, B.E. 2535 (1992);
- *Highway Act*, B.E. 2535 (1992);
- *Building Control Act*, B.E. 2522 (1979) and B.E. 2535 (1992)
- *Energy Conservation Promotion Act*, B.E. 2535 (1992) and
- *Official Information Act*, B.E. 2540 (1997).

The Industrial Works Department (IWD) is also responsible for the safe operation of the petroleum and other industrial sectors. The Thailand Marine Department (MD) is responsible for ensuing compliance with the acts and standards related to navigation, transportation of petroleum products and safety measures in Thailand. The standards and MD announcements that relate to transportation of dangerous goods are shown below in Table 88.

Table 88: **Marine Department Standards for Transportation of Petroleum Products**

Act
Navigational in Thai Waters Act, B.E. 2456
Marine Department Standards
Marine Department Announcement Announcement 411/2542 on Measure on Safety discharge and loading of petroleum and chemical product
Marine Department Announcement Announcement 412/2542 on Guideline on action plan and pollution elimination for handling of dangerous goods in port
Marine Department Announcement 353/2529 on Classification of Dangerous Goods (issued in accordance with IMDG Code of SOLAS 1974)
Safety measure for handling of Petroleum Product in Mekong River (issued under the Agreement on Commercial Navigation on Lancang-Mekong River)

7.2.3.2 Environmental Impact Assessments

Agriculture is the main industrial sector along the Mekong River and there is navigation between Chiang Saen and China through Chiang Saen Port. Chiang Saen Port II is currently under construction. Apart from these main ports and the development of sawmills there are only small passenger ports and ferry crossings in Thailand. There are currently no petroleum terminals or storage tanks on the Mekong River in Thailand. Fuel is transferred directly from truck to vessels. EIAs are only required for ports above 500 gross registered tonnage (GRT) and hydropower dams along the Mekong River.

ONEP are responsible for ensuring that an EIA and an Environmental Impact Statement (EIS) is prepared prior to the development of ports above 500 GRT. The PCD are responsible for consultation with local community and the MD for port operators and shipping companies.

7.2.4 Viet Nam

7.2.4.1 National Legislation

The Ministry of Natural Resources and Environment (MONRE) in Viet Nam are responsible for the following National legislation (Table 89). The legal framework in Viet Nam is Laws, Decrees, Circulars, Decision and Industry Standards.

Table 89: **Inventory of Environmental Legislation in Viet Nam**

Act
Law on Protection of the Environment, 1994
Law on Inland Waterway Navigation (No. 23/2004/QH11 of 15 June 2004) and specific regulations on environmental protection (Articles 7, 8, 71 and 72)
Water Law, 20 May 1998
Decrees
Decree 80/CP/2006 on environmental impact assessment, pollution, disaster control and monitoring.
Decree No. 21/2008/ND-CP amending and supplementing *Decree 80/CP/2006*
Decree 117/2009/ND-CP on increased violation for environmental pollution
Decree No. 120/2008/ND-CP on regulations for river basin management, 1 December 2008
Circulars
Circular No. 04/2008/TT-BTNMT on certification and inspection of environmental protection schemes
Circular No. 05/2008/TT-BTNMT on Strategic Environmental Assessment (SEA), EIA and environmental protection commitment.
Decisions
Decision No. 2242/QD/KHKT-PC, by the Minister of Transport Regulation of environmental protection in the transport sector, 12 September 1997
Decision No. 32/2004/QD-BGTVT of the Minister of Transport on the organization and operation of ports, 21 December 2004
Standards
Industry Standard 22 TCN264 on rules to prevent river pollution caused by vessels, 2006

7.2.4.2 Environmental Impact Assessment

Specific regulations related to environmental impact assessment (EIA) are *Circular 490/1998/TT-BKHCNMT* requiring submission of EIA report and providing specific guidance on EIA process (including content of the EIA report). *Decree No. 143/2004/ND-CP* describes the appraisal process for environmental impact assessments. MONRE will be responsible for appraising and reporting to the Prime Minister for EIAs in the following specified areas;

(1) national parks;

(2) nature reserves;

(3) recognised cultural and historical sites;

(4) lands belonging to at least two localities;

(5) projects to build permanent bridges equal or greater than 1,000 m in length; and

(6) hydropower plants with capacity of 100 cm^3 or more.

Provincial Departments of Natural Resources and Environment (DONRE) are responsible for appraising and reporting to the relevant Provincial Peoples Committees for EIAs in all other areas. Technical guidelines are provided for 10 specialised industry sectors including hydropower, thermal power, urban planning, industrial zone planning, road traffic, rock exploitation, cement, brewery, textiles and dying and offshore petrol exploitation. There are no technical guidelines for development of ports and petroleum terminals.

Circular No. 08/2006 TT-BTNMT provides further guidance on strategic environmental assessment (SEA), EIA and environmental protection commitment (EPC). *Decree No. 21/2008/ND-CP* and *Decree No. 80/2006/ND-CP* further detail the implementation of important articles of the *Law on Environmental Protection* relating to EIA, including:

- elaboration and appraisal of strategic environmental assessment reports;
- elaboration, appraisal and approval of EIA reports, implementation of environmental EIA reports and specifies, other requirements for approving decisions;
- elaboration, registration and certification of environmental protection commitment (EPC) documents; and
- examination and reporting on the appraisal and approval of EIA and EPC documents.

This EIA and EPC appraisal process does not apply to projects that have been operating or were approved prior to 1 July 2006.

In November 2011, MONRE organised a national conference on strategic environmental impact assessment and environmental protection. This was the second national meeting on environmental impact assessment, aiming to share practical lessons in strategic environmental impact assessment, environmental assessment commitment of ministries, branches and localities.

The Vietnam Environment Administration (VEA) found that many proposed projects have been not been approved because they did not meet the requirements for environment protection. However, there were still loopholes in EIA regulations and many businesses do not comply with the contents of their EIA reports, especially those related to construction of environment protection projects.

The provincial DONRE stated that many businesses consider the procedures in the EIA only for obtaining building licenses and land-use certificates that are required for authorities to approve their projects and do not complete satisfactory EPC. The Industrial Safety Techniques and Environment Agency (ISTEA) under the Ministry of Industry and Trade (MOIT) attributes this to low quality of the EIA reports. It was reported that businesses and authorities also do not attach importance to following up on EIA reports or compliance with EPC. MONRE is proposing measures in the future to improve the effectiveness of EIAs and prevent negative impacts on the environment by proposed and existing projects. Measures include human resource training, promoting communications to raise awareness of EIAs and strengthening state management of EIA in ministries, agencies, and localities.[91]

7.2.4.3 Monitoring and Compliance

The Ministry of Natural Resources and Environment (MONRE) is responsible for guiding strategic environmental assessment (SEA), EIA and environmental protection commitment (EPC) in Viet Nam. *Decree 117/2009/ND – CP* provides guidelines for handling law violations in the field of environmental protection. Operators responsible for pollution can be violated for breaching environmental protection laws.

[91] http://www.qdnd.vn/qdndsite/en-US/75/72/182/155/160/165842/Default.aspx

Departments of Natural Resources and Environment (DONRE) in Viet Nam are responsible for the enforcement of environmental regulations in the provinces. In relation to transport of dangerous goods, the operators of ports, vessels and petroleum terminals are required to submit environmental management plans (EMP) to the provincial departments. The terminals are required to have a bill on the registration confirmation standard or a certificate of environmental commitment for environmental protection ECP which must be certified by the district People's Committee. Petroleum terminals must also have a certificate of eligibility by the Department of Fire Protection Police.

Under *Decision No. 1211/1999/QD-BGTVT* of May 20, 1999 petroleum stations on vessels (ships or barges) must have a Certificate of Technical Safety of Waterway Authority. It is not clear whether this is applied to floating fuel terminals in the Mekong Delta and who is responsible for inspecting the safety and environmental protection measures.

7.3 CONCLUSIONS

There are a number of important wetlands in the Mekong Basin that provide major habitats for fish, birds, wildlife and an important source of protein for riparian populations. Water quality is decreasing in the Mekong River Basin, impacting on agricultural land, important wetlands and biodiversity. Impacts to the water quality are mainly due to increased urbanization and socio-economic developments along the Mekong River, particularly in Cambodia and Viet Nam. Water pollution from point and non-point pollution sources includes agriculture, mining, households, garment and food processing and navigation. The carriage, handling and storage of dangerous goods is a potential threat to water quality due to oil spills and solid and liquid wastes generated during the operation of vessels, petroleum terminals and ports.

7.3.1 Cambodia

There is significant transport of dangerous goods between Viet Nam and Cambodia. There are 12 petroleum terminals in Cambodia located on the Mekong, Bassac and Tonle Sap Rivers. A number of the terminals are in close proximity to agricultural land, important wetlands, riparian populations and water intakes (drinking water) and, in the event of an incident, pose not only a threat to the environment but also local communities.

7.3.1.1 Important Wetlands

As defined by the MRC Environment Programme, there are a number of Level 1 and Level 2 priority level wetlands and also extensive agricultural land in Cambodia. The Tonle Sap Lake in Cambodia is a Biosphere Reserve and is a wetland of global significance. The transport of dangerous goods from Phnom Penh to the lake by domestic tankers and refuelling stations pose a major threat to water quality in the Tonle Sap Lake and stricter controls and restrictions need to be implemented. The Steung Treng RAMSAR site is another important wetland in Cambodia. Navigation between Kompong Cham and Steung Treng should also be restricted to preserve important habitats and aquatic biodiversity.

7.3.1.2 Water Quality

Industrial waste and oil spills are emerging threats from the carriage, handling and storage of dangerous goods. Elevated levels of heavy metals and other trace elements have been found in Cambodia in areas with significant vessel traffic and/or high population densities, mainly in areas downstream from Phnom Penh. The MRC is responsible for water quality monitoring in the Member Countries and determining water quality threats and pollution hotspots related with socio-economic development and urbanisation. The following water quality monitoring stations were areas of concern in Cambodia for human impacts on water quality:

- Prek Kdam, Tonle Sap River;
- Koh Kel, Bassac River; and
- Neak Luong, Mekong River.

Further water quality testing is required to confirm the exact source of water pollution so the risks can be mitigated.

7.3.1.3 Legal Framework and Compliance

The *Law on Environmental Protection*, 1996 and *Law on Water Resources Management*, 2007 are the main legislation relevant to environmental management in Cambodia. A number of Royal Decrees and Sub-Decrees have been implemented for specific areas including EIA, Waste Management and Water Pollution Control. The MOE is fully responsible for implementing and ensuring compliance with environmental legislation and MOWRAM for laws and decrees in relation to water resources management, monitoring and pollution control.

A specific strategy aiming at reducing the environmental impacts resulting from the ports, petroleum terminals and navigation activities has not been developed in Cambodia. The MOE is responsible for reducing environmental pollution and implementing legislation in relation to pollution control, monitoring and EIA. There is no process to ensure that the existing petroleum terminals comply with EIA and operators are not currently required to submit environmental management plans (EMP) to MOE. The existing petroleum terminals have not completed sufficient EMP as they were constructed prior to the implementation of EIA legislation.

There is limited enforcement and environmental monitoring as National line agencies have difficult accessing some of the private petroleum terminals. Cooperation needs to be improved between the the MPWT, MOE and MOWRAM and private industry in relation to pollution prevention, water quality monitoring, compliance with EIA and environmental awareness in the IWT sector in Cambodia.

Water quality monitoring is undertaken at the Phnom Penh Port. However, there is currently no water quality monitoring conducted in areas surrounding petroleum terminals. There is no programme to investigate soil contamination and groundwater in areas surrounding ports and petroleum terminal. Air quality, emissions and noise pollution is not measured at ports and petroleum terminals. Wastewater is not tested by national line agencies at ports and petroleum terminals. Some of the terminals do not have adequate wastewater systems and oily wastes are discharged directly to the waterways.

7.3.2 Lao PDR

There are currently no petroleum terminals operating in Lao PDR on the Mekong River, the majority of ports are small refuelling stations, passenger and cargo ports and there are significant numbers of tourist vessels from Luang Prabang. Ferry crossings are used primarily for transporting diesel, gasoline and other cargo from Thailand to Lao PDR. The acceleration of the mining sector in Lao PDR could mean in the future that toxic substances including sodium cyanide and mercury are transported along the Mekong River and its tributaries

7.3.2.1 Important Wetlands

There were two wetlands identified as significant in Lao PDR: Xe Champone, Savannakhet province and Bung Kiat Nong, Champassak province. There is currently limited navigation in these areas and the potential threats of oil spill pollution and impacts from navigation are low. There is some Level 1 and Level 2 priority wetlands and agricultural land in Lao PDR, although the agricultural sector is not as extensive as in Cambodia and Viet Nam.

7.3.2.2 Water Quality

In relation to human impacts on water quality, the main areas for concern in Lao PDR are from commercial shipping between China and Thailand, passenger transport in Luang Prabang and high population density downstream from Vientiane. The trans-boundary area of the Lao-Chinese border requires further investigation to determine sources of pollution. The main concerns in Lao PDR relate to waste management and also run-off from ports and ferry crossings.

7.3.2.3 Legal Framework and Compliance

The *Environmental Protection Law*, 1999 is the main legislation relevant to environmental management in Lao PDR. Regulations and Standards have been implemented for more specific areas including; EIA and for specific industrial sectors. The Water Resources and Environmental Administration (WREA) and its Pollution Control Division (PCD) are responsible for ensuring compliance with environmental law, regulations and standards.

As IWT in Lao PDR is relatively underdeveloped, much of the focus of WREA and PCD has been on the mining and hydropower sectors. The ports, ferry crossings and vessel operators are not required to submit environmental management plans to the WREA or PCD and have not been included in specific environmental awareness or waste management strategies.

7.3.3 Thailand

Trade in the Upper Mekong in Thailand with the People's Republic of China is increasing through Chiang Saen Port, and this is set to expand after the opening of Chiang Saen Port II in 2012. Over the last few years, cargo throughput and exports of diesel through Keawalee Terminal have increased significantly. There are no petroleum terminals or storage tanks operating in Thailand, and fuel is transferred directly from tanker truck to vessels. There are only a few vessels registered in Thailand and they are predominantly ferries. Most vessels operating in the Upper Mekong are from the People's Republic of China, Lao PDR and Myanmar. The ferry crossings in Thailand are still used for the transport of fuel tankers, construction materials and other cargo between Thailand and Lao PDR.

7.3.3.1 Important Wetlands

The two important wetlands in Thailand identified by the National Working Group are Nong Bong Kai, Chiang Rai province, and Bung Khong Long, Nong Khai province. There are also some Level 3 agricultural lands along the Mekong River in Thailand and Level 2 priority wetlands. The potential water quality threats to the wetlands at Nong Bong Kai and Bung Khong Long from increased navigation and transport of dangerous goods in the Upper Mekong is considered low.

7.3.3.2 Water Quality

Potential human impacts on water quality have been detected near the Lao-Chinese border and this may be a result of increased shipping between Thailand and the People's Republic of China. However, further investigation is required to determine the exact source of the pollution. Water-quality monitoring also detected possible human impacts in Vientiane, a stretch of the Mekong shared by Lao PDR and Thailand. The main threats to water quality in Thailand are potential oil spills at Keawalee Terminal, solid and liquid wastes, operational impacts at Chiang Saen Port, navigation accidents in the Upper Mekong and oily wastes and run-off at ferry crossings.

7.3.3.3 Legal Framework and Compliance

The *Enhancement and Conversation of the National Environmental Quality Act* (B.E. 2535) is the main environmental legislation under the constitution of Thailand. MONRE, ONEP and PCD are responsible for maintaining the environmental acts on water quality and other technical standards related to specific industry sectors. The Thai Marine Department is responsible for issuing standards and safety measures for preventing oil spill pollution, navigation in Thai waters and the safe transportation of petroleum products.

EIAs are only required in Thailand for ports above 500 GRT. An EIA was completed for Chiang Saen Port II, which is currently being built. As the port is close to the border with Lao PDR, it could not be determined if any trans-boundary impacts were considered in the EIA. Chiang Saen Port is not required to submit environmental management plans. Keawalee Terminal is a private terminal and is not required to submit any environmental management plans. No additional water-quality monitoring programmes have been established downstream from Chiang Saen Port and Keawalee Terminal. Further investigation is required to determine the environmental management plans and water-quality monitoring programmes for Chiang Saen Port II.

7.3.4 Viet Nam

7.3.4.1 Important Wetlands

The important wetlands in Viet Nam are Phu My, Kien Luong District, Plain of Reeds, Dong Thap Muoi Wetlands and Long Quyen Quadrangle. Viet Nam is working to rehabilitate some of the existing wetlands and conserve them for the future. There are extensive level 3 agricultural lands which are essential to socio-economic development in Viet Nam. The mangrove forests near the Mekong Delta also play important ecological functions and need to be protected. Due to the magnitude of the transport of dangerous goods in the Mekong Delta, the potential risks to wetlands, agricultural land, mangrove forests and riparian populations is high.

7.3.4.2 Water Quality

Water quality has been decreasing in the Mekong River in Viet Nam due to rapid urbanisation and intensive agricultural production. Industrial water pollution has been concentrated around specific industrial contaminants and downstream from major urban areas. Can Tho has a population of 1.3 million and is one the largest cities in the Mekong River system. The scale of industrial development is still relatively low in Viet Nam. However, with maritime, domestic and cross-border trade increasing, port and vessels operations have high potential to impact on water quality if not managed carefully.

The transport and storage of dangerous goods is extensive in Viet Nam. There are a number of large terminals which use domestic tankers to supply refuelling stations and industry for power generation. International tankers are used to export petroleum products to Cambodia from terminals in Ho Chi Minh City and large tankers are also used for domestic trade from Can Tho and My Tho to the western part of the delta. There is potential for major oil spills and the cumulative impacts of small operational spills from the sheer number of tankers, terminals and refuelling stations operating in the Mekong Delta should not be underestimated. The traffic intensity is very high in Viet Nam which also increases the risks of navigation accidents which may result in pollution. There are limited onshore waste disposal facilities to deal with solid and liquid wastes generated by vessels and port/terminal operations.

7.3.4.3 Legal Framework and Compliance

The main environmental legislation in Viet Nam is the *Law on Protection of the Environment (*1994) and there are a number of decrees and circulars related to EIA, pollution control and inspection of environmental protection schemes. MONRE is responsible for implementing environmental legislation and DONRE for inspections and monitoring of environmental protection and pollution control. The *Law on Inland Water Navigation* (2004) contains specific regulations on environmental protection. Operators of ports and petroleum terminals are required to submit EMP to DONRE. Registrations and inspections are carried out by VIWA for inland vessels and VINAMARINE for maritime vessels.

Viet Nam has the legal framework and resources to approve EIA and ensure compliance with EMP. However, it could not be determined whether existing terminals and refuelling stations are required to develop EMP for compliance with environmental legislation as a number of the facilities were built prior to the introduction of environmental legislation. A recent review of EIA found that there were still loopholes in the legislation and that some businesses did not comply with the contents of the EIA and had applied the procedures only for land-use certificates or building licenses and not environmental protection.

The petroleum terminals in Viet Nam have developed response plans for firefighting and other emergencies. But a number of them do not have contingency plans or sufficient equipment and resources to respond to oil spill emergencies. Environmental monitoring has not been implemented across all the oil and gas terminals to ensure continual monitoring of air, soil and water emissions. Wastewater from terminals is consistently tested by national line agencies or an external authorities to ensure compliance. The authorities have difficulty accessing some privately-operated terminals and there needs to be more awareness in the industry regarding pollution control and waste management.

7.3.5 Regional

At present, the greatest risk for the transport of dangerous goods is in the lower part of the Mekong River, downstream from Phnom Penh, Cambodia and in the Mekong Delta, Viet Nam. There are a number of petroleum terminals, refuelling stations and vessels operating between Cambodia and Viet Nam and, as identified in earlier chapters, some of the facilities and vessels have limited risk controls in relation to safety, pollution prevention and emergency response.

7.3.5.1 Potential for Oil Spills and Pollution

The impacts of oil spills are highest for heavy fuels, followed by crude oil and diesel; lower for gasoline and lowest for jet fuel (kerosene). Currently, the main types of oils carried on the Mekong River are diesel, gasoline and jet fuel. There is only limited domestic transport of heavy oils used for industry purposes in Cambodia and Viet Nam. Heavy fuels are more persistent and have the potential for more long term impacts on the environment. However, gasoline, diesel and kerosene have higher acute toxicity, pose higher risks to safety and increase the potential for fire and explosion. Wastes generated by vessels and port/terminals are heavy oils and the cumulative impacts of wastes being discharged into the environment are an area for concern. The potential for oil spills and pollution was evaluated in all the MRC Member Countries. It is important on a regional basis to understand the potential for oil spills and the type and quantity of dangerous goods stored and transported on the Mekong River.

Thailand has the potential for small operational spills and medium spills at Keawalee Terminal. Currently, the vessels operating in the Upper Mekong are 300t and will not cause a major spill. The ferry crossings carrying fuel tankers pose a risk of small operational spills and medium spills of diesel and gasoline into the Mekong River. Further investigation is required on the carriage of fertilisers and other packaged dangerous goods to minimise risks to safety and the environment.

In Lao PDR, there is limited storage and transport of dangerous goods. The ferry crossings and re-fuelling stations have the potential to cause small operational and medium oil spills. At Km 4 State Port, there are underground fuel tanks used for equipment and machinery at the site and there is potential for medium oil spills, particularly during flooding if the underground tanks are not adequately contained. The expansion of the mining industry in Lao PDR will require close monitoring to ensure dangerous goods are not carried on the Mekong River without a prior dangerous goods risk assessment and/or EIA depending on the scope of the operations.

In Cambodia, there are a number of petroleum terminals on the Mekong River system that are used to import gasoline, diesel, jet fuel and LPG from Viet Nam. These operations have the potential to cause major oil spills. The Vietnamese tankers operating in the Mekong River system are 1,000-1,500 tonnes and, if involved in a navigational accident or an operational error, there is potential to cause medium and major oil spills. The floating fuel terminals operating on the Tonle Sap Lake have the potential to cause small operational and medium oil spills. Due to possible impacts on wetlands, these require further restrictions. Further pollution modelling is required to determine the potential trans-boundary impacts of a major oil spill at a terminal or vessel operating in Cambodia.

Inland waterborne transport and the transport of dangerous goods is most developed in Viet Nam. There are numerous petroleum terminals, refuelling stations and tankers operating in the Mekong Delta. There is potential for major oil spills and small operation spills. There are limited facilities for the reception of vessels wastes in Viet Nam. Furthermore, the inland and maritime ports in Viet Nam were not included in the Risk Analysis. Further investigation is required on the type and quantities of packaged dangerous goods stored and handled at these ports.

8. CONCLUSIONS

8.1 OVERVIEW

This Risk Analysis was an extensive assessment of selected ports, terminals, vessels, waterways, legal frameworks and the environment to govern the safe transport of dangerous goods in the LMB. The potential impacts of oil spills and operational impacts of the transport of dangerous goods were carefully considered on both a regional and national basis. Conclusions have been made in relation to the scope of the project for ports/terminals, vessels, waterways, legal frameworks and the environment. This chapter provides a summary of the conclusions for the Member Countries and at the regional level in relation to the scope of the Risk Analysis. These conclusions will help to guide the recommendations in Volume II to determine the national and regional priorities for improving the transport of dangerous goods along the Mekong River.

8.1.1 Cambodia

The carriage, handling and storage of dangerous goods is significant in Cambodia. Gasoline, diesel, jet fuel and other petroleum products are imported from Viet Nam and primarily stored at 12 large petroleum terminals on the Mekong and Tonle Sap Rivers. The petroleum products are transported on inland barges from Vietnamese petroleum terminals in Ho Chi Minh City and inland terminals in the Mekong Delta. Other dangerous goods including ammonium nitrate, fertilisers and toluene are imported through Phnom Penh Port in Cambodia by cross-border transport with Vietnamese and other foreign-flagged vessels. The transport of dangerous goods and all cargo has increased and is expected to rise further with the development of Phnom Penh Port II on the Mekong River which will commence operations in 2012. The cross-border transport between Cambodia and Viet Nam and international trade has been facilitated by the *Cambodia-Viet Nam Legal Agreement on Navigation*. The MPWT is responsible for implementing the agreement and for domestic IWT in Cambodia.

Domestic transport in Cambodia is still relatively limited with passenger transport being the most prominent mode. There are currently only a few inland barges and petroleum tankers registered in Cambodia. However, tankers are still used in the high-water season to transport petroleum products from terminals on the Tonle Sap River to floating fuel stations in the Tonle Sap Lake. Domestic tankers are also used as feeders for fuel supply to industries along the Mekong River for power generation and other uses. The transport and storage of petroleum products on the Tonle Sap Lake was identified as an area of concern in relation to the waterway, water quality threats, the importance of wetlands and proximity to riparian populations. Domestic transport may increase in the future with the focus of socio-economic development on the agricultural sector and rice exports expected to rise steadily.

8.1.1.1 Ports and Terminals

Chapter 3 provides a detailed analysis of the current conditions and technical deficiencies of the ports and terminals operating in Cambodia. The standards in relation to terminals varied substantially from complying with international standards to another barely meeting minimum safety requirements for the safe operation of a petroleum terminal to prevent pollution, fire, explosion and loss of life. There is no legal framework, technical guidance or compliance monitoring by national line agencies to ensure terminals are operating safely. Some of the terminals have limited emergency response or fire and oil spill equipment to respond effectively in the event of an emergency. More coordination between emergency response authorities is required as the majority of terminals are operating in areas close to riparian populations who are at risk in the event of a major incident.

Generally, there is limited awareness of the risks associated with transport and storage of dangerous goods and subsequently poor management and controls. This was the case at both the terminals and Phnom Penh Port. The port had limited documentation for handling and storing dangerous goods and did not have adequate segregation or risk controls in place to prevent or mitigate potential incidents.

8.1.1.2 Vessels

Chapter 4 provides a detailed assessment of the technical standards of vessels operating in Cambodia. Most are foreign-flagged cargo vessels and Vietnamese petroleum tankers. There is limited capacity of national line agencies to inspect the technical conditions of vessels in cross-border trade to ensure they meet minimum safety requirements. Apart from registration of vessels, there is currently no national legislation in Cambodia for IWT or the transport of dangerous goods. A number of circulars, rules are regulations are being prepared by the MPWT on dangerous goods and waste management. It was determined that there is limited emergency response and communications and insufficient navigation equipment onboard the vessels. Management of dangerous goods needs to be improved onboard as there is currently limited awareness, documentation and risk controls in place to ensure safe transport. Not all of the tankers carrying dangerous goods have AIS transponders fitted meaning that the movements of vessels cannot be monitored effectively by port and waterway authorities.

8.1.1.3 Waterways

Chapter 5 provides an assessment of the waterway characteristics and hazards to determine the suitability of the transport of dangerous goods for designated sections along the Mekong River. Currently, the main section for the transport of dangerous goods is from Phnom Penh (Km 348) to the Viet Nam border (Km 251) and there is also domestic transport of dangerous goods from Phnom Penh (Km 0) to Kompong Chhnang (Km 99) on the Tonle Sap River. There is limited IWT on the Mekong River on the sections from Khone Falls (Km 721) to Phnom Penh (Km 348). The sections from Khone Falls (Km 721) to Steung Treng (Km 684) to Kratie (Km 561) are not suitable for the transport of dangerous goods due to waterway conditions as well as important wetlands and protected areas. On the sections Kratie (Km 561) to Kompong Cham (Km 448) to Phnom Penh (Km 348), extra precautions must be taken during the low-water season due to waterway conditions. The transport of dangerous goods should be restricted from Phnom Penh (Km 0) to Kompong Chhnang (Km 99) on the Tonle Sap River due to the importance of the Tonle Sap Lake in providing ecosystem services, food security and agricultural products. The potential impacts of an oil spill are even greater when the Tonle Sap Lake is filling during the annual flood cycle.

The MRC Navigation Programme has installed aids to navigation (day and night) system from Kompong Cham to Phnom Penh and from Phnom Penh to the Viet Nam border, including AIS between Phnom Penh and the border. There are no emergency response mechanisms along the waterway in Cambodia. To respond to oil spill pollution and navigation accidents, monitoring and communications require further improvement.

8.1.1.4 Legal Framework

Chapter 6 details the international and regional rules regulations and agreements and an inventory of national instruments in Cambodia for IWT and the transport of dangerous goods. The *Agreement on Waterway Transportation* between Cambodia and Viet Nam provides an important legal framework for cross-border and international trade and has important clauses related to dangerous goods, safety and environmental protection. The MPWT is currently formulating legislation, rules and regulations for IWT and waste management including the *Prakas for the carriage of dangerous goods by inland waterway in the Kingdom of Cambodia*. This is a positive step. However, it is important to note that the Agreement on Waterway Transportation calls for harmonised rules, regulations and standards between Cambodia and Viet Nam and this should be considered prior to implementing the *prakas*.

8.1.1.5 Environment

Chapter 7 includes information on water quality monitoring, important wetlands, potential impacts of oil spill pollution and environmental laws. There are many important wetlands, protected areas and agricultural land in Cambodia. The most important wetlands are the Boueng Chmar (Tonle Sap Lake) and Steung Treng RAMSAR sites. Human water quality impacts have been determined by monitoring stations of the MRC Water Quality Monitoring Programme downstream from Phnom Penh, the Tonle Sap River and Kratie. The pollution sources cannot be traced to IWT. However, there is some evidence of heavy metals and decreased water quality in areas with vessel traffic and port/terminal operations. The petroleum terminals in Cambodia have the potential to cause major oil spills and are located close to riparian populations and water intakes (drinking). Phnom Penh Port has the potential to cause small operational and medium spills. The floating fuel terminals on the Tonle Sap Lake have the potential to cause small operational and medium spills and require special consideration due to their proximity to Priority Level 1 and 2 wetlands.

Cambodia has established legal frameworks for environmental protection, pollution control, EIAs and water quality. The MOE and MOWRAM are responsible for implementing and ensuring compliance with environmental law, rules and regulations. The national line agencies currently have limited resources and budgets to monitor the operations of all petroleum terminals and there is difficulty accessing some private terminals. The petroleum terminals were established prior to the implementation of EIA rules and regulations and are not required to develop health safety and environmental management systems or submit EMP to the government for review. Water quality, groundwater and soil contamination has not been assessed in the vicinity of petroleum terminals and port operations.

8.1.2 Lao PDR

The transport of dangerous goods is relatively limited in Lao PDR. There are no large inland ports or petroleum terminals operating along the Mekong River. The most prominent navigation activity is passenger transport between Huay Xay and Luang Prabang in the Upper Mekong. Vessels are used to transport general cargo, mostly in the high-water season. One of the main reasons that navigation is limited is due to the dangerous conditions of the waterways. Most dangerous goods are transported by ferry crossings and include gasoline, diesel, asphalt, fertilisers and construction materials. Tanker trucks containing dangerous goods load onto ferries from Thailand to Lao PDR. Km 4 State Port Authority has fuel storage capacity for refuelling trucks, cranes and equipment onsite. There are a number of small refuelling stations along the Mekong River for cargo, passenger and small fishing and other vessels. One of the main issues identified by the Risk Analysis was the management of solid and liquid wastes and limited awareness of the risk associated with transport and storage of dangerous goods.

8.1.2.1 Ports

Chapter 3 provided a detailed analysis of the current conditions and technical deficiencies of the ports, refuelling stations and ferry crossings operating in Lao PDR. The infrastructure for the ports in Lao PDR is very basic compared to Viet Nam and Cambodia. However, it could be improved to increase the efficiency and safety of port operations. There was also limited use of mechanical and electrical equipment. The equipment that was in use was either not well maintained or not in service. Most of the priority areas in the ports and ferry crossings related to improving management, training and awareness of dangerous goods to minimise the risks of pollution and other incidents. There was limited communications and information between the ports and vessels and at ferry crossings, Limited emergency response and firefighting equipment was available in the case of an emergency. National laws are being prepared in relation to port management, safety and dangerous goods. The MPWT and WD are responsible for implementing these rules and controlling port operations.

8.1.2.2 Vessels

Chapter 4 provides a detailed assessment of the technical standards of vessels operating in Lao PDR. Their technical capacity is relatively basic with limited electrical and navigation equipment onboard. From the risk analysis, it was determined that the main priority areas related to safe management of the vessels, limited training of crewmembers and awareness of dangerous goods. There is insufficient emergency response, lifesaving, firefighting and navigation equipment to ensure safe navigation and respond effectively to emergency situations. Other issues were identified with the structural condition and maintenance of main engines and equipment onboard. There is legislation that applies to IWT in relation to the registering of inland vessels, technical inspections for ships and ferries. The MPWT is responsible for implementing rules and regulations related to IWT, with technical assistance from the WD for compliance and monitoring. Currently there are limited resources to ensuring inspections of all vessels. The MPWT is currently formulating rules and regulations for transport of dangerous goods.

8.1.2.3 Waterways

Chapter 5 provides an assessment of the waterway characteristics and hazards to determine the suitability of the transport of dangerous goods for designated sections along the Mekong River in Lao PDR. The main risks for vessels in Lao PDR relate to the physical conditions of the waterways. The navigation channel is difficult to navigate with strong currents, hidden shoals, rocky outcrops and other obstructions. The transport of dangerous goods is considered suitable between the following waterway sections in Lao PDR:

- Golden Triangle (Km 2,373) to Chiang Saen (Km 2,364);
- Vientiane (Km 1,585) to Savannakhet (Km 1,126); and
- Savannakhet (Km 1,126) to Pakse (Km 869).

The transport of dangerous goods is not suitable in the following waterway sections or requires further restrictions to be developed:

- Chiang Saen (Km 2,364) to Chiang Khong/Huay Xay (Km 2,314);
- Chiang Khong/Huay Xay (Km 2,314) to Pak Beng (Km 2,172);
- Pak Beng (Km 2,172) to Luang Prabang (Km 2,010);
- Luang Prabang (Km 2,010) to Vientiane (Km 1,585); and
- Pakse (Km 869) to Khone Falls (Km 721).

The MRC Navigation Programme has installed an aids to navigation system on selected dangerous areas from Huay Xay to Luang Prabang to Vientiane. There are no emergency response mechanisms along the waterway in Lao PDR to respond to navigation accidents.

8.1.2.4 Legal Framework

Chapter 6 details the international and regional rules regulations and agreements and an inventory of national instruments in Lao PDR for IWT and transport of dangerous goods. The *Agreement on Commercial Navigation on Lancang-Mekong River* applies to navigation between Simao, People's Republic of China, and Luang Prabang. The contracting parties are the four countries of the Upper Mekong (People's Republic of China, Lao PDR, Myanmar and Thailand). Article 17 prohibits the carriage of dangerous goods unless agreed upon by the contracting parties. The *Law on Water and Water Resources (*1996) has specific clauses to prevent water pollution and the *Land Transport Law (*1997) specifies the types of goods that can be transported for domestic, cross-border and international trade but does not include IWT. There are currently no specific laws, rules or regulations for the transport of dangerous goods along the Mekong River in Lao PDR. The MPWT is drafting the following rules and regulations:

- *Draft Rule on Safety of Port*;
- *Draft Regulations on Handling and Carriage of Dangerous Goods*; and
- *Draft Rule on Inland Waterway Transportation*.

The formulation of these rules and regulations is an important opportunity to ensure all the aspects identified in the Risk Analysis are considered prior to implementation.

8.1.2.5 Environment

Chapter 7 includes information on water quality monitoring, important wetlands, potential impacts of oil spill pollution and environmental laws in Lao PDR. In relation to human impacts on water quality, the main areas for concern in Lao PDR are from commercial shipping between China and Thailand, passenger transport in Luang Prabang and high population density downstream from Vientiane. As there are no petroleum terminals in Lao PDR, there is currently no potential for major oil spills. Small operational spills, medium spills and wastes generated from port and vessel operations are threats to water quality. There were two wetlands identified as significant in Lao PDR: Xe Champone, Savannakhet province, and Bung Kiat Nong, Champassak province. However, navigation is currently limited in these areas.

The *Environmental Protection Law* (1999) is the main legislation relevant to environmental management in Lao PDR. Regulations and standards have been implemented for more specific areas including EIAs and for specific industrial sectors. The Water Resources and Environmental Administration (WREA) and its Pollution Control Division (PCD) are responsible for ensuring compliance with environmental law, regulations and standards.

8.1.3 Thailand

The main inland navigation activity in Thailand is the export and import of general cargo to and from the People's Republic of China through Chiang Saen Port in the Upper Mekong. Cargo throughput and ship calls are increasing through Chiang Saen Port and the new Chiang Saen Port II will commence operations in May, 2012, with imports and exports set to increase even further. The transport of dangerous goods is also increasing in Thailand with the export of petroleum products through Keawalee Terminal. The privately-owned terminal is used to transfer diesel and gasoline from tanker trucks to inland barges from the People's Republic of China and Myanmar. Ferry crossings continue to be used to transport tanker trucks containing gasoline, diesel and asphalt across the Mekong River to Lao PDR. General cargo, construction materials and consumable are also carried across the Mekong River at the ferry crossings.

8.1.3.1 Ports and Terminals

Chapter 3 provides a detailed analysis of the current conditions and technical deficiencies of the ports, terminals and ferry crossings operating in Thailand. Chiang Saen Port is the main inland port and was included in the Risk Analysis as it handles a wide range of general cargo, including dangerous. There are no designated areas for dangerous goods or proper containers for storage. Dangerous goods are not labelled correctly and documentation is inadequate. There are no emergency response measures in place to deal with oil spills or navigational accidents. Keawalee Terminal is not controlled by the authorities and there are no safe working procedures, limited fire and communications equipment and no oil spill response available at the site in case of emergency. Some areas for concern at the ferry crossings are a lack of standard procedures for ferry crossing operations and an absence of waste reception facilities. No fire, emergency response or oil spill response equipment is available in case of an emergency. At all operations, there is limited training and awareness on storing and handling dangerous goods, firefighting, emergency response, waste management, accidents and environmental protection. Language differences between the barges from the People's Republic of China and Myanmar and port employees increases the risk of miscommunications and operational errors.

8.1.3.2 Vessels

Chapter 4 provides a detailed assessment of the technical standards of vessels operating in Thailand. There is only a limited number of vessels registered in Thailand for the Mekong River. Most are ferries used in ferry crossings to carry tank trucks, general cargo, construction materials, cars, motorbikes and passengers between Thailand and Lao PDR. The vessels operating through Chiang Saen Port and Keawalee Terminal are mainly from the People's Republic of China but some are from Myanmar and Lao PDR. In this regard, a Chinese tanker operating at Keawalee Terminal was included in the Risk Analysis. The tanker had limited procedures regarding bunkering, dangerous goods and tank cleaning and the system for disposing of solid and liquid waste was inadequate. The tanker had limited emergency response, firefighting, navigation and safety equipment onboard. The awareness of the crewmembers of the risks associated with the transport and handling of dangerous goods was also limited. During the consultation, it was determined that Thai authorities have limited capacity and scope to monitor and inspect the conditions of the vessels prior to loading and discharging operations. Security and monitoring of vessel location has recently become an issue following a major security incident in the Upper Mekong.

8.1.3.3 Waterways

Chapter 5 provides an assessment of the waterway characteristics and hazards to determine the suitability of the transport of dangerous goods for designated sections along the Mekong River in Lao PDR from the Golden Triangle (Km 2,373) to the Khone Falls (Km 721). Thailand shares some sections of the Mekong River with Lao PDR so the waterway assessment includes both countries. Waterway police are located along the Mekong River in Thailand. However, emergency response mechanisms to respond to oil spill pollution and navigation accidents is limited. Communications and monitoring of vessels in the Upper Mekong require further improvement.

8.1.3.4 Legal Framework

Chapter 6 details the international and regional rules regulations and agreements and an inventory of national instruments in Thailand for IWT and transport of dangerous goods. Thailand has a number of legal instruments which can be applied to the Mekong River including the *Navigation in Thai Waters Act* (1913, amended in 1992) and the Thai Marine Department has issued a number of notifications for the loading/discharging of oils and chemicals and safety measures. The TMD is responsible for issuing standards and safety measures for preventing oil spill pollution, navigation in Thai waters and the safe transportation of petroleum products. The *Safety Measures for Transportation of Petroleum Products on Mekong River* is an important guideline for ensuring environmental protection and safety in the Upper Mekong. It was found during the Risk Analysis that some of the expertise from the maritime sector and experience in the Chao Phraya River should be applied to operations on the Mekong River. The Chiang Saen Port II presents an opportunity to ensure the safety measures and existing legal framework in Thailand are applied to the new operations.

8.1.3.5 Environment

Chapter 7 includes information on water quality monitoring, important wetlands, potential impacts of oil spill pollution and environmental laws in Thailand. Potential human impacts on water quality have been detected near the Chinese border which may be a result of increased shipping between Thailand and the People's Republic of China. However, further investigation is required to determine the exact source of the pollution. The main threats to water quality in Thailand from IWT are potential medium oil spills at Keawalee Terminal, solid and liquid wastes, operational spills at Chiang Saen Port, navigation accidents in the Upper Mekong and oily wastes and run off from ferry crossings. The National Working Group identified two important wetlands in Thailand at Nong Bong Kai, Chiang Rai province, and Bung Khong Long, Nong Khai province.

MONRE, ONEP and PCD are responsible for maintaining the environmental acts for water quality, environmental protection and other technical standards related to specific industry sectors. EIA are required in Thailand only for ports above 500 GRT. An EIA was completed for the Chiang Saen Port II which is currently being constructed. Chiang Saen Port and Keawalee Terminal are not required to submit any EMP to PCD. No additional water-quality monitoring programmes have been established downstream of Chiang Saen Port and Keawalee Terminal.

8.1.4 Viet Nam

IWT is well advanced and there are a number of inland and maritime ports boosting economic growth in Viet Nam. The transport and storage of dangerous goods is extensive and there are a number of petroleum terminals which use domestic tankers to supply refuelling stations and industry for power generation. Tankers are used to export petroleum products to Cambodia from terminals in Ho Chi Minh City and large tankers are also used for domestic trade from Can Tho and My Tho to the western part of of the Mekong Delta. Due to the magnitude of the transport of dangerous goods in the Mekong Delta , the potential risks to wetlands, agricultural land, mangrove forests and riparian populations is high.

8.1.4.1 Terminals

Chapter 3 provides a detailed analysis of the current conditions and technical deficiencies of petroleum terminals operating in Viet Nam. Four main petroleum terminals in Can Tho on the Bassac River and Dong Thap and My Tho on the Mekong River were included in the Risk Analysis. The standards in relation to construction and equipment was higher than in Cambodia. However, there were still some issues relating to inspections and maintenance of critical equipment and low-cost control measures which could have been implemented to reduce risks of pollution. The petroleum terminals in Viet Nam have developed response plans for firefighting and other emergencies but a number of them do not have contingency plans or sufficient equipment and resources to respond to oil spill emergencies. There were limited onshore waste disposal facilities to deal with solid and liquid wastes generated by vessels and terminal operations. Limited awareness of the risks associated with dangerous goods and environmental protection was evident at the terminals visited. There are a number of private terminals operating in the Mekong Delta which could not be accessed for the Risk Analysis.

8.1.4.2 Vessels

Chapter 4 provides a detailed assessment of the technical standards of petroleum tankers operating in Viet Nam. There are over 2,000 tankers registered in the Mekong Delta for the domestic and cross-border transport of dangerous goods. The tankers vary in size, exploitation capacity and also in technical standards, age and structural condition. Maintenance and conditions of equipment onboard also varied. The tankers involved in cross-border transport are generally higher standard than the small tankers used for domestic supply. The traffic density is very high in Viet Nam which also increases the risks of navigation accidents which may result in pollution. Some of the vessels had limited navigation, communications, firefighting and lifesaving equipment onboard. Awareness, skills and experience in relation to the handling and transport of dangerous goods, environmental protection and waste management was also limited.

8.1.4.3 *Waterways*

Chapter 5 provides an assessment of the waterway characteristics and hazards to determine the suitability of the transport of dangerous goods for designated sections along the Mekong River, Bassac River and Vam Nao Pass in Viet Nam. All the waterways included in the assessment were deemed to be suitable for the transportation of dangerous goods. Precautions should be taken from Deep Sea Buoy (Km 0) to My Tho (Km 74) on the Mekong River due to the high traffic density. Care should also be taken at the entrance of the Bassac River (Song Hau) from the South China Sea as there are shoals, sandbars and seas are very rough in this section.

The MRC Navigation Programme had installed aids to navigation (day and night) systems in the Mekong Delta. However, the distance between some of the buoys is too great. The main waterway hazards in Viet Nam are traffic density, sand mining and aquaculture. There are no emergency response mechanisms along the Mekong River and Bassac waterways to respond to oil spill pollution or navigation accidents. The Central Rescue Centre is located in Ho Chi Minh City. The monitoring of vessels and communications requires further improvement.

8.1.4.4 *Legal Framework*

Chapter 6 details the international and regional rules regulations and agreements and an inventory of National instruments in Viet Nam for IWT and transport of dangerous goods. The *Law on Inland Water Navigation (*2004) is the main legal instrument related to IWT in Viet Nam. The Vietnamese legal system is very extensive and complicated in relation to the transport of dangerous goods. Many decrees, sub-decrees, circulars and technical standards (TCVN) stem from national laws and regulations. In regards to safety and environmental protection,there are a number of overlapping areas within different rules and regulations. There is limited guidance on how to apply and implement these laws in a practical manner. There are difficulties on how to control, implement and monitor the implementation of the rules and standards by national line agencies with limited budgets and resources. There are also overlapping responsibilities between VIWA and VINAMARINE in relation to IWT.

8.1.4.5 *Environment*

Chapter 7 includes information on water-quality monitoring, important wetlands, potential impacts of oil spill pollution and environmental laws in Viet Nam. Water quality has been decreasing in the Mekong River in Viet Nam due to rapid urbanisation and intensive agricultural production. Industrial water pollution has been concentrated around specific industrial contaminants and downstream of major urban areas.

There is potential for major oil spills from the petroleum terminals and also small operational spills from the large number of tankers, terminals and refuelling stations operating that can have a cumulative impact. The important wetlands in Viet Nam are Phu My, Kien Luong District, Plain of Reeds, Dong Thap Muoi Wetlands and Long Quyen Quadrangle. There is important agricultural land, mangrove forests and aquaculture in the Mekong Delta.

The main environmental legislation in Viet Nam is the *Law on Protection of the Environment (*1994) and there are a number of decrees and circulars related to EIA, pollution control and monitoring. MONRE is responsible for implementing environmental legislation and DONRE for inspections and monitoring of environmental protection and pollution control. It could not be determined whether existing terminals and refuelling stations are required to develop EMP for compliance with environmental legislation. Most facilities were built prior to the introduction of environmental legislation. A recent review of EIA found that they were not always adequate in relation to environmental protection.

Due to limited resources and difficulty accessing private terminals, water-quality monitoring for surface water, groundwater and possible soil contamination has not been undertaken in the vicinity of all major inland ports and petroleum terminals. More awareness and public information in the industry and among all waterways regarding pollution control and waste management is required.

8.1.5 Regional

From the Risk Analysis, it is clear that the level of navigation development varies greatly between two areas, the Upper Mekong and the Lower Mekong. In the Upper Mekong, Lao PDR and Thailand have both signed the *Mekong-Lancang Agreement on Commercial Navigation*. The Khone Falls in Lao PDR acts as a physical barrier to maritime vessels and there are many dangerous areas. In the Lower Mekong, Cambodia and Viet Nam have signed the *Agreement on Cross Border Navigation* and maritime, cross border and domestic transport is developing significantly, particularly in Viet Nam. Volume II (Recommendations) will ensure that the regional and national priorities are identified in the Member Countries and also the Lower and Upper Mekong to enhance IWT and improve the transport of dangerous goods across the Mekong Basin. There are some important regional priorities that have been identified from the Risk Analysis.

The awareness of dangerous goods, environmental protection, impacts of oils spills and safety requirements is currently limited in all of the MRC Member Countries. Public information and awareness programmes will need to be developed to raise the awareness of all waterway users.

Further investigation is required on the legal framework in the Member Countries, specifically in relation to the existing rules and regulations for IWT, transport of dangerous goods and environmental protection at the national level.

Consideration will need to be given to how national and regional rules can be harmonised in the Upper and Lower Mekong under the relevant legal agreements. Member Countries drafting rules and regulations for transporting dangerous goods should consider the regional legal agreement and existing rules and regulations. The MPWT in Cambodia is currently drafting a *prakas* for IWT and transport of dangerous goods which should consider the existing rules and regulations in Viet Nam under the *Cambodia-Vietnam Agreement on Cross Border Transport*.

The development and implementation of International instruments such as the ADN Code for transport of dangerous goods should be evaluated, taking into account the current technical capacity and socio-economic development in the Member Countries. The implementation of the ADN Code should be undertaken in a feasible and practical manner.

Viet Nam has the most extensive legal instruments for IWT. However, a full review needs to be undertaken to determine the effectiveness of the rules, decrees and circulars specifically for transport of dangerous goods. The review needs to include information on how the rules and regulations are implemented and who is responsible for monitoring and compliance.

The national line agencies in the Member Countries all had difficulties ensuring compliance with existing rules and regulations. This was often due to limited budget, resources, institutional capacity and also a lack of technical guidance to assist national line agencies in completing necessary inspections. The national line agencies also have difficulty accessing some of the private terminals and completing registrations and inspections for all the vessels.

In all Member Countries, there are limited emergency response mechanisms along the waterway to monitor inland and navigation activities and respond to security incidents, navigation accidents, oil spills and other major incidents. An early warning system, notification system and emergency response systems should be enhanced in respect to existing National Disaster Committees and ASEAN Disaster Response Preparedness.

IWT should be restricted in the areas deemed not suitable for the transport of dangerous goods, identified in Chapter 5 on Waterways, to prevent navigation accidents and pollution. If there are proposals in the future for transport of dangerous goods, then a full risk assessment must be completed including terminals, vessels, waterways and the environment.

Minimum safety requirements for navigation equipment should be established for tankers and cargo vessels transporting dangerous goods in the Mekong River system to improve waterway safety. The feasibility of establishing a vessel traffic system (VTS) should also be studied to monitor the movement of cross-border tankers and cargo vessels transporting dangerous goods.

A number of ports and petroleum terminals do not have effective emergency response planning for fires, explosions and pollution incidents. Emergency response plans should involve consultation with local communities and emergency response authorities.

The capacity of emergency response authorities needs to be improved to respond effectively to major fire and explosion incidents in collaboration with the private operators of ports and petroleum terminals and local communities. Fire and emergency drills should be performed on a planned basis and reviewed to ensure continued improvement.

Not all the ports visited had established safety, health and environment (SHE) management systems. Cambodia, Thailand and Viet Nam have all signed up to the PEMSEA *Ports Safety, Health and Safety Management Code* (PHSEM). This presents a good opportunity to apply the code to major inland ports in the Member Countries.

Some of the petroleum terminals had not established such systems and are not required to submit EMP and/or emergency response plans to the government to outline how they will prevent pollution and respond to emergency situations. Petroleum terminals can have significant impacts on environment, people and public infrastructure in the event of a major incident and require further monitoring.

The petroleum industry and shipping companies should be encouraged to protect the environment under corporate social responsibility (CSR). The petroleum industry is a lucrative business and companies should invest in safety and environmental protection to ensure a sustainable future in the Member Countries.

The potential for major oil spills is highest in Cambodia and Viet Nam due to the size of the petroleum terminals and tankers operating. Further assessment and modelling is required to determine the possible trans-boundary impacts and location of terminals to water intake (drinking) and public infrastructure.

There are currently no programmes in the Member Countries to investigate soil contamination, surface water quality and groundwater monitoring in the vicinity of ports, petroleum terminals and areas with high levels of IWT.

Heavy metals and other industrial contaminants have been detected downstream from navigation activities. However, the source of the pollution cannot be confirmed. Currently, the impacts of navigation on water quality are difficult to determine under the current MRC Water Quality Monitoring Network and water quality monitoring in the Member Countries. Further investigation is required to undertake water quality monitoring in areas with high levels of transport of dangerous goods.

It was found that a number of facilities were constructed prior to the implementation of EIA rules and regulations and are not required to submit EMP to national line agencies to ensure compliance with standards for water quality, waste water and pollution prevention. In Viet Nam, it was reported that a number of operators do not comply with EIA requirements.

Cooperation at the inter-ministerial level needs to be enhanced between Ministries of Environment, Water Resources, Transport and other industrial sectors to ensure compliance with environmental rules and regulations. A joint statement should be prepared between the ministries to promote IWT and protect the environment as in the Danube River.

Volume I- Risk Analysis is a very detailed report that describes the current situation of the transport of dangerous goods in the Member Countries and analyses the associated risks for people and the environment. This volume will be an important reference for MRC, national line agencies, development partners and the private sector for many years to come. The outcomes of the Risk Analysis were used to prepare Volume II- Recommendations which provides very clear recommendations on what must be done to improve the transport of dangerous goods for the five key components:

1. Ports and terminals;
2. Vessels;
3. Waterway safety;
4. Legal framework; and
5. Environment.

A number of challenges were identified in the Member Countries to ensure the safe management and operation of ports, terminals and vessels. These challenges will need to be taken up by the relevant ministries, line agencies, private sector and other key stakeholders to ensure the current situation is improved across the board. MRC looks forward to the opportunity to work together with Member Countries, private sectors, development partners and key stakeholders to improve the transport of dangerous goods in the LMB to:

1. Prevent pollution and environmental damage to the water resources of the Mekong River;
2. Protect the lives of workers, crewmembers and riparian communities; and
3. Enhance emergency response and effective coordination for oil spills, fires and other major accidents along the waterway.

ANNEX 1:
DANGEROUS GOODS DEFINITIONS

CLASS 1: EXPLOSIVES

- An explosive substance is a solid or liquid substance (or a mixture of substances) which is in itself capable of producing by chemical reaction such gas at such a temperature and pressure and at such a speed as to cause damage to surroundings.
- A pyrotechnic substance is a substance or a mixture of substances designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative self-sustaining exothermic chemical reaction.
- An explosive article is an article containing one or more explosive substances
- A mass explosion is one which affects almost the entire load almost instantaneously.

The six hazard divisions of Class 1 are:

Division 1.1: substances and articles which have a mass explosion hazard;

Division 1.2: substances and articles which have a projection hazard but not a mass explosion hazard;

Division 1.3: substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard;

⇨ This division comprises substances and articles which give rise to considerable radiant heat or which burn one after another, producing minor blast or projection effects or both.

Division 1.4: substances and articles which present no significant hazard;

⇨ This division comprises substances and articles which present only a small hazard in the event of ignition or initiation during transport. The effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire must not cause a virtually instantaneous explosion of almost the entire contents of the package.

Division 1.5: very insensitive substances which have a mass explosion hazard; and

⇨ This division comprises substances which have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport.

Division 1.6: extremely insensitive articles which do not have a mass explosion hazard.

⇨ This division comprises articles which contain only extremely insensitive detonation substances and which demonstrate a negligible probability of accidental initiation or propagation.

⇨ Examples: fireworks, blasting explosives (used at mine sites).

CLASS 2: GASES

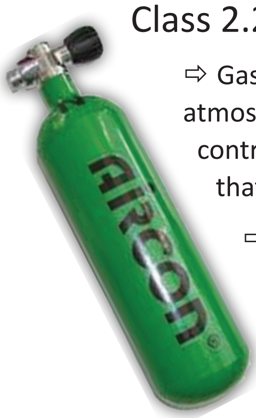
- A gas is a substance which at 50°C (122° F) has a vapour pressure greater than 300 kPa (3000 mbar or 3 bar) or which is completely gaseous at 20°C (68°F) at a standard pressure of 101.3 kPa (1013 mbar).
- This class comprises compressed gases, liquefied gases, dissolved gases, refrigerated liquefied gases and mixtures of one or more gases with one or more vapours or substances of other classes, articles charged with a gas and aerosols.

Class 2.1: Flammable Gases

⇨ Gases which at a 20°C and a standard pressure of 101.3 kPa are ignitable when in a mixture of 13% or less by volume with air or which have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit.

⇨ Examples: LPG (Liquefied Petroleum Gas), acetylene, aerosols.

Class 2.2: Non-Flammable, Non-Toxic Gases



⇨ Gases which are asphyxiant (gases which dilute or replace the oxygen normally in the atmosphere) or are oxidising (gases which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does) or any other gases that do not come under the other classes.

⇨ Examples: argon, oxygen and nitrogen

Class 2.3: Toxic Gases

⇨ Gases which are known to be so toxic or corrosive to humans as to pose a hazard to health or are presumed to be toxic or corrosive to humans because they have a LC$_{50}$[86] value equal to or less than 5,000 ml/m^3 (ppm)

⇨ Examples: chlorine and ammonia (used in swimming pools, sewage plants and refrigeration plants)

[86] LC$_{50}$ for acute toxicity on inhalation is that concentration of vapour, mist or dust which, administered by continuous inhalation to both male and female young adult albino rats for one hour, is most likely to cause death within 14 days in one half of the animals tested.

CLASS 3: FLAMMABLE LIQUIDS

- Flammable liquids are liquids, or mixtures of liquids or liquids containing solids in solution or suspension which give off a flammable vapour at or below their flashpoint (lowest temperature of the liquid at which its vapour forms an ignitable mixture with air, a flammable liquid cannot be ignited so long as its temperature remains below the flashpoint).
- This class includes liquids offered for transport at temperature at or above their flashpoint and substances transported or offered for transport at elevated temperatures in a liquid state, which give off a flammable vapour at temperature equal to or below the maximum transport temperature.
- Examples: gasoline (petrol), kerosene, ethanol, gas oil, diesel, duel

CLASS 4: FLAMMABLE SOLIDS; SUBSTANCES LIABLE TO SPONTANEOUS COMBUSTION; SUBSTANCES WHICH, IN CONTACT WITH WATER, EMIT FLAMMABLE GASES

- Substances other than those classified as explosives which, under conditions of transport, are readily combustible or may cause or contribute to a fire.

Class 4.1: Flammable Solids, Self Reactive Substances and Solid Desensitised Explosives

⇨ Solids which under conditions encountered in transport, are readily combustible or may cause or contribute to fire through friction; self-reactive substances (solids and liquids) which are liable to undergo a strongly exothermic reaction; solid desensitised explosives which may explode if not diluted sufficiently.

⇨ Examples: safety matches, dry vegetable fibres (cotton, sissal, jute, kapok), magnesium, straw, sulphur

Class 4.2: Substances Liable to Spontaneous Combustion

⇨ Substances (solids and liquids) which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air, and being then liable to catch fire.

⇨ Examples: carbon paper, oily rags, xanthates (mine sites)

Class 4.3: Substances which, in Contact with Water, Emit Flammable Gases

⇨ Substances (solids and liquids) which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

⇨ Examples: calcium, aluminium phosphide (pesticide)

CLASS 5: OXIDISING SUBSTANCES AND ORGANIC PEROXIDES

Class 5.1: Oxidising Substances

- ⇨ Substances which, while in themselves not necessarily combustible, may generally by yielding oxygen, cause or contribute to the combustion of other material.
- ⇨ Examples: ammonium Nitrate (commonly used in fertilisers), calcium hypochlorite (water treatment).

Class 5.2: Organic Peroxides

- ⇨ Organic substances which contained the bivalent -O-O- structure and may be considered derivates of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. Organic peroxides are thermally unstable substances which may undergo exothermic self-accelerating decomposition. They may have one or more of the following properties: be liable to explosive decomposition, burn rapidly, be sensitive to impact or friction or react dangerously with other substances. Some organic peroxides can cause serious injury to the eyes, even after brief contact, or will be corrosive to the skin.
- ⇨ Examples: MEKP (methyl ethyl ketone peroxide) used in the fibreglass industry.

CLASS 6: TOXIC AND INFECTIOUS SUBSTANCES

- The word “toxic” has the same meaning as “poisonous”

Class 6.1: Toxic Substances

- ⇨ These are substances liable either to cause death or serious injury or to harm human health if swallowed or inhaled, or by skin contact.
- ⇨ Examples: sodium cyanide (mine sites), arsenic

Class 6.2: Infectious Substances

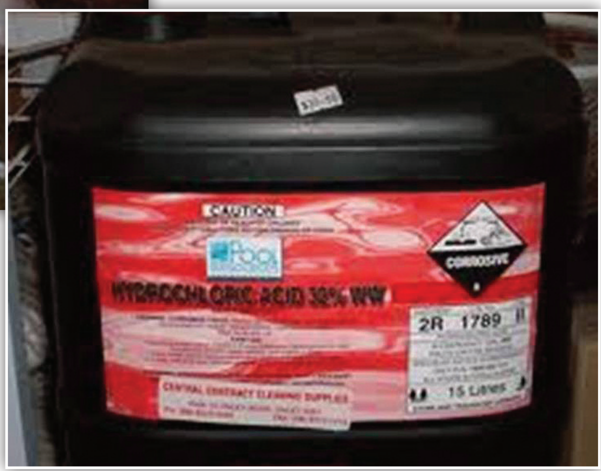
- ⇨ These are substances known or reasonably expected to contain pathogens. Pathogens are defined as microorganisms (including bacteria, viruses, parasites and fungi) and other agents such as prions, which can cause disease in humans or animals.
- ⇨ Examples: biomedical waste

CLASS 7: RADIOACTIVE MATERIAL

- Radioactive materials are any material containing radionuclides where both the activity concentrations and the total activity in the consignment exceed certain values.
- Examples: uranium, cobalt 60, plutonium.

CLASS 8: CORROSIVE SUBSTANCES

- Corrosive substances are substances which, by chemical action, will cause severe damage when in contact with living tissue or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport.
- Examples: caustic soda, hydrochloric acid



CLASS 9: MISCELLANEOUS DANGEROUS SUBSTANCES AND ARTICLES

- Miscellaneous dangerous substances and articles are substances and articles which, during transport, present a danger not covered by other classes.
- Examples: batteries containing lithium, battery-powered equipment/vehicles, containers under fumigation, first aid kits, magnetised material.

Marine Pollutants

- Marine pollutants are substances which, because of their potential to bioaccumulate in seafood or because of their high toxicity to aquatic life, are subject to the provisions of Annex III of MARPOL 73/787, as amended (*Regulations for the Prevention of Pollution by Harmful Substances carried by Sea in Packaged Form*).
- Examples: DDT and almost all pesticides.

ANNEX 2:
RISK REGISTER FOR PORTS AND TERMINALS

1. INFRA–AND SUPERSTRUCTURE

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level	Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		
1.1 Proximity to populated areas												
1101	All	Terminal close to residential area	Endangering neighbourhood in case of fire/ explosion/ toxic gas release	☐	☐	☐	☐				0	
1102	All	Trucks loaded with dangerous goods going from and to the terminal, passing dense populated areas.	Truck gets involved in accident: possible fire, explosion, release of toxic vapours, soil contamination	☐	☐	☐	☐				0	
1103	All	Open fire or hot works outside the terminal, close to tanks with jet fuel & gasoline. (UN 1202, 1203)	Sparks may ignite vapours of flammable liquids: Fire /explosion.	☐	☐	☐	☐				0	
1104	All	Open fire or hot works outside the terminal, close to tanks with substances other than petroleum products e.g.. Toluene (UN 1294)	Sparks may ignite vapours of flammable liquids. Fire /explosion.	☐	☐	☐	☐				0	
1.2 Access to port facilities												
1201	All	Access to port or terminal facilities uncontrolled, no surrounding wall (fences, no controlled gates, ...)	Intruders damage DG package: spillage, release of inflammable, explosive or toxic vapours.	☐	☐	☐	☐				0	
1202	All		Intruders steal DG package: spillage, release of inflammable, explosive or toxic vapours outside the terminal	☐	☐	☐	☐				0	
1203	All		Access from unauthorized people: eventually stealing dangerous goods, damaging dangerous goods package, hazards: see MSDS (Material Safety Data Sheet), enlarging risk of fire (for example through smoking)	☐	☐	☐	☐				0	

1.3 Tank Structure													
1301	All	Failing tank structure (ex. Tank supporting, corrosion, chemically resistant coating, ...)	Tank collapse: spillage, release of inflammable/ explosive vapours and liquid	☐	☐	☐	☐				0		
1302	All	Bad welding seams	Tank leaking: spillage, release of inflammable/ explosive vapours and liquid	☐	☐	☐	☐				0		
1.4 Cargo Pumps													
1401	Loading / Discharging	Pump blocked	Loading/ discharging interrupted	☐	☐	☐	☐				0		
1402	Loading / Discharging	Pump fails to start/ stop on demand	Loading/ discharging interrupted	☐	☐	☐	☐				0		
1403	Loading / Discharging	Pump leaking	Toxic gas release, release of inflammable or explosive vapours and liquid, pollution	☐	☐	☐	☐				0		
1404	Maintenance	No regular inspection of Cargo Pumps	Breakdown: loading/ discharging interrupted	☐	☐	☐	☐				0		
1.5 Cargo Pipes and hoses													
1501	Loading / Discharging	Cargo transfer hose is ruptured	Leaking: spillage, release of flammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1502	Loading / Discharging	Cargo pipe fractured	Leaking: spillage, release of flammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1503	Loading / Discharging	Piping subject to pressure surges (surge pressure is caused by change in fluid velocity, ex. Unplanned pump trip, rapid valve operation)	Damage to weldings, pipe fracture: spillage, pollution, commercial loss, loading/ discharging interrupted	☐	☐	☐	☐				0		
1504	Loading / Discharging	Transfer hose leaking	Spillage, release of inflammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1505	Loading / Discharging	Maximum allowable working pressure (MAWP) exceeded	Pipe fracture ,leaking: spillage, release of inflammable or explosive vapours and liquid pollution, commercial loss	☐	☐	☐	☐				0		
1506	Loading / Discharging	Safety devices not working (e.g.. Emergency Shut Down system not working)	Emergency response failure	☐	☐	☐	☐				0		
1507	Loading / Discharging	Pressure gauges not working	Operational error	☐	☐	☐	☐				0		
1508	Loading / Discharging	Safety systems manually by-passed	System integrity endangered	☐	☐	☐	☐				0		
1509	Loading / Discharging	Lines not in use not properly blinded (flange connected with all bolts tight)	Spillage, release of inflammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		

1.5 Cargo Pipes and hoses (continued)													
1510	Loading / Discharging	Gasket, seals or flange leaks	Spillage, release of inflammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1511	Management	No colour coding is used	Operational error	☐	☐	☐	☐				0		
1512	Design	Piping weldings insufficient	Pipe fracture ,leaking: spillage, release of inflammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1513	Design	Piping located in areas with high vehicle traffic should be separated from traffic flow by vehicle guards (ex. Crash posts) or earthen bearms	Pipe fracture due to contact	☐	☐	☐	☐				0		
1514	Design	Hot steam lines not insulated	Personnel injuries: burns	☐	☐	☐	☐				0		
1515	Design	Material of construction: not corrosion resistant	Pipe fracture ,leaking: spillage, release of inflammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1516	Design	Piping specifications not followed	System integrity affected	☐	☐	☐	☐				0		
1517	Maintenance	Piping not properly supported	Pipe fracture ,leaking: spillage, release of inflammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1518	Maintenance	Corrosion/erosion rates not regularly checked		☐	☐	☐	☐				0		
1519	Maintenance	No flame arrestors on vent line	Explosion / Fire	☐	☐	☐	☐				0		
1520	Maintenance	No regular pressure test	Possible Damage to cargo pipe not detected in due time	☐	☐	☐	☐				0		
1.6 Valves													
1601	Loading / Discharging	Valve blocked	Overpressure, loading/ discharging interrupted, commercial loss	☐	☐	☐	☐				0		
1602	Loading / Discharging	Valve fails to operate	Loading/ discharging interrupted, commercial loss	☐	☐	☐	☐				0		
1603	Loading / Discharging	Valve Leaking	Spillage, release of inflammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1604	Loading / Discharging	Valves not properly labelled	Operational error	☐	☐	☐	☐				0		
1605	All	Emergency valves not readily accessible	Emergency response failure	☐	☐	☐	☐				0		
1606	Design	Valve not fire rated	Emergency response failure	☐	☐	☐	☐				0		
1607	Management	Valve not marked for identification	Operational error	☐	☐	☐	☐				0		

1.6 Valves (continued)													
1608	Maintenance	Indicator lights not working	Misjudgement, misunderstanding, mistakes during cargo operations	☐	☐	☐	☐				0		
1609	Maintenance	Valve added to original system design (are there any valves added that are not on the original site plans)	Structural integrity damaged	☐	☐	☐	☐				0		
1.7 Warehouse / Sheds and other storage areas													
1701	All	Warehouses/sheds not equipped with fire fighting equipment	In case of fire/ explosion: destruction of other goods and property, spillage of DG, toxic release	☐	☐	☐	☐				0		
1702	All	Segregation of dangerous goods not according regulations	Dangerous chemical reaction of DG, fire & explosion, damage to property	☐	☐	☐	☐				0		
1703	All	Floor/surface not suited for storing DG	In case of leakage of content: contamination of the soil	☐	☐	☐	☐				0		
1.8 Cranes													
1801	Loading/discharging	Crane used beyond designed capacity (Safe Working Load (SWL) exceeded)	In case DG fall down: broken packages, release of content, after contamination with organic substances risk of fire/explosion, emission of toxic gases	☐	☐	☐	☐				0		
1802	Loading/discharging	Maximum permitted capacity not marked on crane (SWL not marked)		☐	☐	☐	☐				0		
1803	Loading/discharging	Used slings not of approved type		☐	☐	☐	☐				0		
1804	All	Cranes not been tested/inspected at regular interval		☐	☐	☐	☐				0		
1805	All	Limit/safety devices not working		☐	☐	☐	☐				0		
1806	All	Maximum load capacity of slings used less than maximum capacity of the crane		☐	☐	☐	☐				0		
1807	Loading/discharging	Cranes not certified		☐	☐	☐	☐				0		
1.9 Waste reception facilities (All kinds of ship waste)													
1901	All	No waste reception facilities available for ships	Garbage/waste deposed into the River	☐	☐	☐	☐				0		
1902	All	Capacity of waste reception facilities insufficient		☐	☐	☐	☐				0		
1903	All	Waste generated by port and cargo operations		☐	☐	☐	☐				0		

1.10 Fixed fire fighting equipment (pipes / pumps)													
11001	Incident	Pump not working	Uncontrolled extension of fire until equipment is ready for use	☐	☐	☐	☐				0		
11002	Incident	Piping not correct aligned		☐	☐	☐	☐				0		
11003	Loading / Discharging	No international shore connection available	In case of system failure no connection between shipboard fire main system and other ship or terminal.	☐	☐	☐	☐				0		
11004	Maintenance	Fire hydrant blocked	Uncontrolled extension of fire until the equipment is ready for use	☐	☐	☐	☐				0		
11005	Design	Water spray curtain not working		☐	☐	☐	☐				0		
11006	Design	Pump capacity not sufficient		☐	☐	☐	☐				0		
1.11 Portable Fire fighting equipment													
11101	Loading / Discharging	No fire fighting equipment stand-by	Time lost in case of fire, extension of the fire	☐	☐	☐	☐				0		
11102	All	Fire fighting equipment not regularly inspected / tested	Bad state, equipment missing, equipment failure	☐	☐	☐	☐				0		
11103	All	No colour code provided (Black > CO2, Blue > Dry Powder, Cream > Foam, Red > Water)	Injury, fatality, extension of fire	☐	☐	☐	☐				0		
11104	All	Legal requirements not met	Insufficient or wrong fire fighting equipment.	☐	☐	☐	☐				0		
11105	Incident	Incorrect fire fighting equipment used	Injury, fatality, extension of fire	☐	☐	☐	☐				0		
11106	Design	No fixed foam system	Fire not controllable	☐	☐	☐	☐				0		
11107	Incident	Fire fighting equipment not working	Uncontrolled extension of fire until the equipment is ready for use	☐	☐	☐	☐				0		
1.12 Fire detection equipment													
11201	Incident	Fire detection not working	Late or no response: extension of fire	☐	☐	☐	☐				0		
11202	Maintenance	Fire detection equipment not regularly tested	Bad state, equipment failure,	☐	☐	☐	☐				0		
1.13 Gas detection / Toxic material detection													
11301	Design	No gas detection / toxic material detection present	Late or no detection of gases. Depending on kind of DG (toxic gases): intoxication, suffocation, fire, explosion	☐	☐	☐	☐				0		
11302	Maintenance	Gas detection/ toxic material detection not regularly tested / calibrated	Failure or malfunctioning of detection instruments leading to late or no detection of gases. Depending on kind of DG (toxic gases): intoxication, suffocation, fire, explosion	☐	☐	☐	☐				0		

1.13 Gas detection / Toxic material detection (continued)													
11304	Loading / discharging	Gas detection/ toxic material detection not working properly	Failure or malfunctioning of detection instruments leading to late or no detection of gases. Depending on kind of DG (toxic gases): intoxication, suffocation, fire, explosion	☐	☐	☐	☐				0		
1.14 PPE / Safety Equipment / First-aid													
11401	All	No correct Personal Protective Equipment (PPE) provided	Injuries to personnel, fatality	☐	☐	☐	☐				0		
11402	All	PPE not maintained in accordance with manufacturers recommendations	Bad state of equipment, personal injuries	☐	☐	☐	☐				0		
11403	All	Emergency First-Aid facilities not provided	In case of incident: no adequate first-aid treatment to injured personnel	☐	☐	☐	☐				0		
11404	All	Safety showers not working	Serious injuries in case skin contact corrosive, irritant, toxic substances: see MSDS	☐	☐	☐	☐				0		
11405	All	Personal Protective Equipment (PPE) not inspected at regular intervals	PPE missing, bad state, not usable	☐	☐	☐	☐				0		
1.15 Emergency equipment													
11501	Emergency	No emergency equipment available	Emergency response failure	☐	☐	☐	☐				0		
11502	Emergency	Emergency equipment not sufficient	Emergency response limited	☐	☐	☐	☐				0		
11503	Spill	No spillage control equipment available	In case of spillage: increased impact of pollution	☐	☐	☐	☐				0		
11504	Spill	Spillage control equipment not sufficient		☐	☐	☐	☐				0		
11505	Emergency	No emergency control centre	No coordination, late detection of emergency situation	☐	☐	☐	☐				0		

2. MECHANICAL EQUIPMENT

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level		Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur			
2.1 Tank measurement instruments and capacity alarms													
2101	Loading / discharging	High level alarm out of order	"Tank overflow: spillage, release of inflammable or explosive vapours and liquid"	☐	☐	☐	☐				0		
2102	Loading/discharging	High level not correctly calibrated		☐	☐	☐	☐				0		
2.2 Tank Wagons													
2201	Tank Wagons containing jet fuel, gasoline	Malfunctioning meters	Tank overflow: spillage, release of flammable or explosive vapours and liquid	☐	☐	☐	☐				0		
2202		Leaking valves	Spillage, release of flammable or explosive vapours and liquid	☐	☐	☐	☐				0		
2203		Rupture of tank or welding seam		☐	☐	☐	☐				0		
2204	Tanks containing diesel or intermediate heavy fuel	Malfunctioning meters	Tank overflow: spillage, release of flammable vapours and liquid	☐	☐	☐	☐				0		
2205		Leaking valves	Spillage, release of flammable vapours and liquid	☐	☐	☐	☐				0		
2206		Rupture of tank or welding seam		☐	☐	☐	☐				0		
2.3 Tank trucks													
2301	Tanks containing jet fuel or gasoline	Leaking valves	Spillage, release of inflammable or explosive vapours and liquid	☐	☐	☐	☐				0		
2302		Rupture of tank or welding seam		☐	☐	☐	☐				0		
2303		Malfunctioning meters	Tank overflow: spillage, release of inflammable or explosive vapours and liquid	☐	☐	☐	☐				0		
2304	Tanks containing diesel or intermediate heavy fuel	Leaking valves	Spillage, release of inflammable vapours and liquid	☐	☐	☐	☐				0		
2305		Rupture of tank or welding seam		☐	☐	☐	☐				0		
2306		Malfunctioning meters	Tank overflow: spillage, release of inflammable vapours and liquid	☐	☐	☐	☐				0		
2.4 Communication means													
2401	Loading/discharging	No Walky - Talkies available	No communication, misunderstanding, mistakes	☐	☐	☐	☐				0		
2402	All	Walky-Talky not explosion proof	Ignition of explosive vapours in the area	☐	☐	☐	☐				0		
2403	Loading/discharging	Communication with control room not working	No communication, misunderstanding, mistakes	☐	☐	☐	☐				0		

2.5 Ordinary trucks / trailers													
2501	Electrical equipment	Emission of electric sparks	Ignition of explosive vapours in the area	☐	☐	☐	☐				0		
2502	Carrying inflammable dangerous goods, e.g. Toluene (UN 1294)	Packages falling from truck due to improper securing	Broken packages release toxic and inflammable/ explosive vapours and liquids	☐	☐	☐	☐				0		
2503	Carrying corrosive and toxic dangerous goods, e.g. corrosive liquid, toxic, N.O.S (UN 2922)		Broken packages release toxic and corrosive vapours and liquids	☐	☐	☐	☐				0		
2504	Carrying oxidizing agents or peroxides, e.g. ammonium nitrate (UN 1942)		Broken packages release contents, after contamination with organic substances risk of fire/explosion, emission of toxic gases	☐	☐	☐	☐				0		
2.6 Fork lift trucks / reach stackers													
2601	Electrical equipment	Emission of electric sparks	Ignition of explosive vapours in the area	☐	☐	☐	☐				**0**		
2602	Lifting of dangerous goods	Equipment used beyond rated capacity, packages fall off	Broken packages release toxic and inflammable/ explosive vapours and liquids	☐	☐	☐	☐				0		
2603		Equipment malfunction due to lacking/improper maintenance, packages fall off	Broken packages release toxic and inflammable/ explosive vapours and liquids	☐	☐	☐	☐				0		
2.7 Generators													
2701	Loading/discharging	Generator failure		☐	☐	☐	☐				0		
2702	Loading/discharging	Emergency generator failure		☐	☐	☐	☐				0		
2703	Loading/discharging	Generator overloaded	Generator shutdown, loading/ discharging interrupted	☐	☐	☐	☐				0		
2704	Loading/discharging	Generator alarm/ shutdown fails	Generator overheated, fire	☐	☐	☐	☐				0		
2705	Electric parts	Emission of electric sparks	Ignition of explosive vapours in the area	☐	☐	☐	☐				0		

3. ELECTRICITY

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level	Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		
3.1 High voltage												
3101	All	High voltage cables in dangerous areas on petroleum terminals are unprotected or badly insulated	Electric shocks, electrocution, sparks, ignition of explosive vapours, destruction of tanks, spillage of petroleum products	☐	☐	☐	☐				0	
3102	**ALL**	High voltage cables in dangerous in areas were inflammable goods are handled or stored are unprotected or badly insulated	Electric shocks, electrocution, sparks, ignition of explosive vapours, fire, spillage of products	☐	☐	☐	☐				**0**	
3.2 Cables / Cabling												
3201	Design	Not enough clearance for overhead power lines	Damage to power lines, sparks, explosion, fire, electrocution	☐	☐	☐	☐				**0**	
3202	All	Mechanical damage to cables	Sparks, explosion, fire, electrocution	☐	☐	☐	☐				0	
3203	Design	Cables not fireproof	Damage to power lines in case of fire	☐	☐	☐	☐				**0**	
3.3 Electrical equipment												
3301	All	Electrical equipment and installations do not comply with the standards recognized by the competent authority	Malfunctioning, not fireproof, overheating	☐	☐	☐	☐				**0**	
3302	Loading/discharging	Electrical equipment for use in places where potentially explosive atmosphere is present is not explosion proof	Sparks: Fire, Explosion	☐	☐	☐	☐				0	
3303	All	Electrical equipment and installations are not properly operated (e.g.. Replacing batteries in areas with flammable vapours)		☐	☐	☐	☐				**0**	
3304	Loading/discharging	Equipment not properly earthed on petroleum terminals	Static electricity, sparks: Fire, Explosion	☐	☐	☐	☐				0	
3305	All	No adequate lighting	Mistakes, wrong action, injury	☐	☐	☐	☐				**0**	
3.4 Circuit breakers												
3401	Design	Breakers not adequate for circuit protection	Overload, overheated, fire	☐	☐	☐	☐				**0**	
3402	Cargo operations	Breakers not working	Malfunction, overload, overheated, fire	☐	☐	☐	☐				0	

4. OPERATIONS

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level	Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		
4.1 Receiving / Delivering of liquid bulk												
4101	Loading/discharging	No procedures for receiving/handling dangerous goods / procedures not up to date	Mistakes, wrong action, time lost	☐	☐	☐	☐				0	
4102	Loading/discharging	Operating procedures not followed	Time lost, mistakes, wrong action, loading/ discharging interrupted	☐	☐	☐	☐				0	
4103	Loading/discharging	Proper start-up procedures not available		☐	☐	☐	☐				0	
4104	Loading/discharging	No supervision during operations	Misjudgement, mistakes, wrong action	☐	☐	☐	☐				0	
4.2 Storage of liquid bulk												
4201	Design	Tank separation not according standards (Ex. distance between storage tanks insufficient)	In case of fire (depending on kind of dangerous goods): fire, explosion, release of toxic gas	☐	☐	☐	☐				0	
4202	Design	No existing or sufficient area to contain spills	In case of tank rupture: pollution	☐	☐	☐	☐				0	
4203	Maintenance	Tank rupture due to internal corrosion	Pollution, (toxic) vapour release, fire/ explosion	☐	☐	☐	☐				0	
4.3 Receiving / Delivering of dry bulk												
4301	Loading/discharging	Operating procedures not followed	Time lost, mistakes, wrong action, loading/ discharging interrupted	☐	☐	☐	☐				0	
4302	All	No personnel safety measures taken	Injuries, fatality	☐	☐	☐	☐				0	
4.4 Storage of dry bulk												
4401	Loading/discharging	No personnel safety measures taken	Injuries	☐	☐	☐	☐				0	
4.5 Receiving / Delivering of packaged dangerous goods												
4501	Loading/discharging	Operating procedures not followed	Time lost, mistakes, wrong action, loading/ discharging interrupted	☐	☐	☐	☐				0	
4502	Loading/discharging	Packaged DG falling or damaged during handling by forklift, crane, …	Broken packages, possible release of inflammable liquid, explosive vapours, spillage of liquid.	☐	☐	☐	☐				0	

4.6 Storage and segregation of packaged dangerous goods													
4601	Storage	Incompatible materials not segregated	In case of contamination, depending on kind of dangerous goods: see MSDS, fire, explosion, release of toxic vapour	☐	☐	☐	☐				0		
4602	Storage	Package damaged	Depending on kind of dangerous good: see MSDS, injuries, fire, explosion, release of toxic gas, pollution								0		
4602	Storage	Hazardous reaction due to contamination		☐	☐	☐	☐				0		
4603	Storage	No proper containers being used	Containers affected, spillage of dangerous good, depending on kind of dangerous good: see MSDS, injuries, fire, explosion, pollution	☐	☐	☐	☐				0		
4604	Storage	No safety procedures for storing DG	Wrong handling: injury, fatality	☐	☐	☐	☐				0		
4605	Storage	Surface not suitable for storing packed DG	In case of damaged packaging: pollution	☐	☐	☐	☐				0		
4.7 Monitoring / Control of stored cargo													
4701	All	No DG register	No knowledge of location/ quantity and nature of DG. Wrong response in case of emergency	☐	☐	☐	☐				0		
4702	All	DG register not up to date		☐	☐	☐	☐				0		
4703	All	MSDS not available	Properties of stored DG unknown: wrong response in case of emergency	☐	☐	☐	☐				0		

5. MAINTENANCE

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level		Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur			
5.1 Maintenance of equipment													
5101	Maintenance	No proper maintenance material available	Bad state of equipment, malfunctioning, out of order, commercial loss	☐	☐	☐	☐				0		
5102	Maintenance	Equipment not inspected as scheduled		☐	☐	☐	☐				0		
5103	Maintenance	Improper maintenance performed		☐	☐	☐	☐				0		
5104	Maintenance	No maintenance system in place		☐	☐	☐	☐				0		
5105	Maintenance	Maintenance performed with the wrong materials or parts		☐	☐	☐	☐				0		
5106	Maintenance	No procedures for opening process equipment/piping	Incorrect action, wrong sequence of actions, personal injury	☐	☐	☐	☐				0		
5.2 Hot work													
5201	Maintenance	Hot work permit not used	Wrong or lack of precautionary measures, sparks: depending on kind of dangerous good (see MSDS) : fire, explosion, injuries or fatality	☐	☐	☐	☐				0		
5202		Welding (sparks)	Depending on kind of dangerous good (see MSDS) : fire, explosion, personal injury	☐	☐	☐	☐				0		

6. HUMAN ELEMENTS

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level		Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur			
6.1 Working hours / systems													
6101	All	Operator works long hours, no shift system	Fatigue: physical and mental exhaustion, resulting in diminished reaction, alertness and concentration								0		
6.2 Education													
6201	All	Operator does not understand / know the hazards of the process	Underestimation, misjudgement, wrong action, wrong handling								0		
6202	All	No education corresponding to job requirements	Wrong execution of the job								0		
6.3 Experience													
6301	All	New operating staff not properly trained	Uncertainty, mistakes, error								0		
6302	Loading/discharging	No procedures in place to ensure operators perform a task as required	Cargo operation interrupted: overflow, personal injury, property damage, Maximum allowable Working pressure exceeded (MAWP), ...								0		
6303		No training for operators to complete task	Uncertainty, mistakes, error								0		
6304		Operator makes an incorrect reading	Misjudgement, wrong or no action								0		
6305	All	Operator not provided with supervision	Uncertainty, mistakes, error,								0		
6.4 Training													
6401	All	No correct Personal Protective Equipment (PPE) used	Injuries								0		
6402		No correct training courses provided for workers	Underestimation, uncertainty, misjudgement								0		
6403		Special training for handling DG not provided	Underestimation, uncertainty, misjudgement, wrong handling of DG								0		
6404		No refresher training provided	No update, decreasing alertness								0		
6405		No regular emergency drills conducted	Ineffective emergency response, chaos, confusion, panic, wrong action								0		

6.5 Communication / information													
6501	All	Accidents / hazards not communicated	No hazard identification, no implementation of control measures, no adjustment of existing measures, no adjustment of working procedures	☐	☐	☐	☐				0		
6502		No records of Accidents / Hazards	No hazard identification, no implementation of control measures, no adjustment of working procedures	☐	☐	☐	☐				0		
6503		Accidents / Hazards not reported	No risk analysis, no additional corrective measures, no adjustment of existing measures	☐	☐	☐	☐				0		
6504		Language difference between terminal operator and vessel crew	Misunderstanding, mistakes, errors in working orders, …	☐	☐	☐	☐				0		

7. MANAGEMENT - REGULATIONS

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level	Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		
7.1 Safety & Quality												
7101	Safety & Quality management	No or limited safety, environmental quality procedures for the port/terminal operations	Work performance ineffective, difficulties in executing the job, higher risk for mistakes, commercial loss, increased risk of accidents	☐	☐	☐	☐				0	
7102	Safety & Quality management	Improper or inadequate procedures are in use		☐	☐	☐	☐				0	
7103	Safety & Quality management	No safety and health adviser	New hazards not identified, existing measures not evaluated. Measures to improve safety and health not up to date, no check on effectiveness of existing measures or regulations	☐	☐	☐	☐				0	
7104	Safety & Quality management	No safety & health committee	New hazards not identified, existing measures not evaluated. Measures to improve safety and health not up to date, no check on effectiveness of existing measures or regulations	☐	☐	☐	☐				0	
7.2 Inspection of terminal												
7201	Inspections	Improper/ inadequate inspections are performed	Misjudgement of existing situation, deficiencies overlooked, commercial loss, increased risk of accidents	☐	☐	☐	☐				0	
7.3 Authority Control												
7301	Authority Regulation making	No regulation	Basic, elementary requirements regarding ports/ terminals, not fulfilled	☐	☐	☐	☐				0	
7.4 Terminal Policy												
7401	Terminal policy, management	No policy, bad management	Short term profit. Low quality standards. No respect for safety of terminal operators, other property or the environment	☐	☐	☐	☐				0	

7.5 Security													
7501	All	No ISPS (International Ship and Port Facility Security) code in use	Reduced security at port facilities	☐	☐	☐	☐				0		
7.6 Emergency Response													
7601	Emergency	No measures in place to deal with dangerous cargo spillage (Emergency Response Plan)	Emergency response failure	☐	☐	☐	☐				0		
7602	All	No Emergency response drills	No experience, no efficiency, no activity sequence, chaos, panic in case of emergency. Not used to deal with emergency situations.	☐	☐	☐	☐				0		
7603	All	No or inadequate Emergency response Equipment	In case of Emergency: Terminal safety endangered, not possible to minimize hazards to human health and the environment from fires, explosions, spills or other accidents.	☐	☐	☐	☐				0		
7.7 Training													
7701	All	Terminal personnel not properly trained on handling DG	Misjudgement of hazards when handling DG, increased risk of accidents / personal injury	☐	☐	☐	☐				0		
7702	All	First aid	No skill, no knowledge, no experience	☐	☐	☐	☐				0		
7703	All	Fire fighting equipment	No update, no knowledge refresh	☐	☐	☐	☐				0		
7704	All	Emergency procedures		☐	☐	☐	☐				0		
7705	All	Accident prevention		☐	☐	☐	☐				0		
7706	All	Marine pollution prevention		☐	☐	☐	☐				0		
7707	All	Environmental protection		☐	☐	☐	☐				0		
7708	All	Ship waste Management		☐	☐	☐	☐				0		
7709	All	No refreshment courses for terminal personnel handling DG		☐	☐	☐	☐				0		
7.8 Law Enforcement													
7801	Authority regulation control	No control	Basic, elementary requirements regarding vessel ports / terminals not fulfilled, use of substandard terminals	☐	☐	☐	☐				0		

7.9 Authority Control													
7901	Authority Regulation making	No regulation	Basic, elementary requirements regarding terminals not fulfilled	☐	☐	☐	☐				0		
7902	Regulations	Operator is not aware of National Regulations	Increased risk of accidents	☐	☐	☐	☐				0		
7.10 No checklist regarding: see column possible hazards (items to be checked prior to start the work activity)													
71001	Loading/ discharging	Loading/ discharging	Wrong PPE, wrong sequence, wrong or no action, underestimation, actions and situations overlooked	☐	☐	☐	☐				0		
71002	Transfer of cargo	Cargo Transfer		☐	☐	☐	☐				0		
71003	Bunkering	Bunkering		☐	☐	☐	☐				0		
71004	All	Maintenance		☐	☐	☐	☐				0		
71005	All	Safety items		☐	☐	☐	☐				0		
7.11 General Management													
71101	All	No management system in use	Work executed in ineffective way, wrong procedures, higher risk on accidents, time lost, money spilled, commercial loss	☐	☐	☐	☐				**0**		
71102	All	No approved code of practice available	Work executed in ineffective way, wrong procedures, higher risk on accidents, time lost, money spilled, commercial loss, increased risk of accidents	☐	☐	☐	☐				**0**		
71103	All	No management concerning dangerous goods	Endangering port facilities/workers, environment, due to negligence, unawareness	☐	☐	☐	☐				**0**		
7.12 Waste Management													
71201	All	No solid waste management (garbage, maintenance residues)	Solid waste is disposed of directly into the River: pollution	☐	☐	☐	☐				**0**		
71202	All	No Liquid waste management (Bilge water, wash water, sewage & liquid residues containing oil or chemicals)	Liquid waste is disposed directly into the River: pollution	☐	☐	☐	☐				**0**		
7.13 Drugs & Alcohol													
71301	All	No drug and alcohol policy	Drug use and alcohol abuse, decreasing alertness, misjudgement, bad response, decreased reaction ability	☐	☐	☐	☐				**0**		

8. GLOBAL EVENTS

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level	Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		
8.1 Global Events												
8101	All	Flooding	Restricted or no port access, restricted or difficult work execution.	☐	☐	☐	☐				0	
8102	All	Lightning	Sudden electrical discharge striking cranes, vent masts or other high structures. Increased risk of fire / explosion	☐	☐	☐	☐				0	
8103	All	Mud slide	Restricted or no port access, restricted or difficult work execution.	☐	☐	☐	☐				0	
8104	All	Heavy and prolonged rain storms		☐	☐	☐	☐				0	
8105	All	Cyclone	All port operations to be ceased. Damage to port infrastructure.	☐	☐	☐	☐				0	
8106	All	High Winds	Port operations restricted. Damage to port infrastructure.	☐	☐	☐	☐				0	
8107	All	Tsunami or tidal wave	All port operations to be ceased. Damage to port infrastructure.	☐	☐	☐	☐				0	
8108	All	Earthquake	Damage to port infrastructure, increased risk of fire/ explosion. Damage to tank farms, increased risk of pollution	☐	☐	☐	☐				0	

ANNEX 3:
RISK REGISTER FOR VESSELS

1. MECHANICAL

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level	Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		
1.1 Main Engine												
1101	Navigation/ Engine Room	Limited systems for inspection and maintenance	Oil leaks, fuel leaks, malfunction	☐	☐	☐	☐				0	
1102	Navigation/ Engine Room	Main Engine used on maximum power for long period, insufficient cooling, insufficient inspection, bad quality fuel used	Overheating: fire, increased risk for explosion	☐	☐	☐	☐				0	
1103	Navigation/ Engine Room	Engine breakdown	Vessel not under control eventual grounding, collision, sinking	☐	☐	☐	☐				0	
1.2 Steering Gear												
1201	Navigation/ Steering gear room	Poor maintenance steering pump	Oil leaks, eventual loss of steering	☐	☐	☐	☐				0	
1202	Navigation	Chain break	Loss of steering (eventual grounding, collision)	☐	☐	☐	☐				0	
1.3 Generator												
1301	Navigation	Poor, irregular maintenance	Oil leaks, Fuel leaks, generator malfunctioning	☐	☐	☐	☐				0	
1302	Navigation	Black out	Vessel not under control eventual grounding, collision, sinking	☐	☐	☐	☐				0	
1303	Loading / Discharging	Poor, irregular maintenance	Oil leaks, Fuel leaks, increased risk of fire / explosion. Cargo operations to be ceased, commercial loss	☐	☐	☐	☐				0	
1304	Loading / Discharging	Black out	Loading/ Discharging interrupted, cargo operations delayed, commercial loss	☐	☐	☐	☐				0	
1.4 Cargo Pump												
1401	Pump room, Loading/ Discharging	Cargo pump in pump room: limited inspections and limited maintenance	Loading/ Discharging interrupted, cargo operations delayed, commercial loss	☐	☐	☐	☐				0	
1402	Pump room, Loading/ Discharging/ Sailing	Cargo pump in pump room is leaking	Toxic or flammable gas accumulation, possible fire/ explosion	☐	☐	☐	☐				0	

1.3 Generator (continued)														
1403	Deck, Loading/ Discharging	Cargo pump on deck: limited inspections and limited maintenance	Loading/ Discharging interrupted, cargo operations delayed, commercial loss	☐	☐	☐	☐				0		
1404	Deck, Loading/ Discharging	Cargo pump on deck is leaking	Toxic or flammable gas accumulation on deck, possible fire/ explosion, pollution	☐	☐	☐	☐				0		
1405	Maintenance	No regular checks for normal "wear and tear" of cargo pump (e.g. cavitation)	Breakdown: loading/ discharging interrupted	☐	☐	☐	☐				0		
1.5 Cargo pipes and hoses														
1501	Pump room, Loading/ Discharging/ Sailing	Structural damage to cargo pipes in pump room: rust spots, steel thickness affected (corroded)	Possible leaks or eventual pipe fracture, risk of toxic gas accumulation, fire /explosion	☐	☐	☐	☐				0		
1502	Deck, Loading/ Discharging	Structural damage to cargo pipes on deck: rust spots, steel thickness affected (corroded)	Possible leaks or eventual pipe fracture. Toxic or flammable gas accumulation on deck, possible fire/ explosion, pollution	☐	☐	☐	☐				0		
1503	Loading / Discharging/ Bunkering	Cargo hose used for loading or discharging is ruptured	Leaking: spillage release of flammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1504	Loading / Discharging	Irregular pressure in cargo pipes during loading or discharging (pressure in pipes going fast up and down)	Damage to weldings, pipe fracture: spillage, pollution, commercial loss, loading discharging interrupted	☐	☐	☐	☐				0		
1505	Loading / Discharging	Maximum Allowable Working Pressure exceeded (MAWP)	Pipe fracture ,leaking: spillage, release of inflammable or explosive vapours and liquid pollution, commercial loss	☐	☐	☐	☐				0		
1506	Loading / Discharging	Pressure gauge not working	Operational error	☐	☐	☐	☐				0		
1507	Loading / Discharging	Lines not in use: flanges not fully bolted, not properly blinded (closed with blind flange)	Spillage, release of inflammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1508	Loading / Discharging	Tank cover gasket missing, tank openings not properly sealed		☐	☐	☐	☐				0		
1509	Loading / Discharging	Safety devices not working (e.g.. Emergency Shut Down system not working, pressure relief valves not working, ...)	Emergency response failure	☐	☐	☐	☐				0		
1510	Loading / Discharging	Safety systems manually by-passed	System integrity endangered	☐	☐	☐	☐						
1511	Loading / Discharging	Piping not grounded	Static electricity can lead to explosion	☐	☐	☐	☐				0		

1.5 Cargo pipes and hoses (continued)													
1512	Ship's Design	Piping welds insufficient	Pipe fracture ,leaking: spillage, release of inflammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1513	Ship's Design	Pipelines not properly supported	Pipe fracture ,leaking: spillage, release of inflammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				0		
1514	Ship's Design	Material used for the ship's construction (cargo pipes, tanks) is not corrosion resistant (will affect steel thickness in future)		☐	☐	☐	☐				0		
1515	Ship's Design	Ship is constructed with hot steam lines which are not insulated	Personnel injuries: burns	☐	☐	☐	☐				0		
1516	Ship's Design	Ship is constructed with vent lines without flame arrestors	Explosion / fire	☐	☐	☐	☐				0		
1517	Maintenance	Pressure relief valves not regularly tested	Overpressure, damage to equipment	☐	☐	☐	☐				0		
1518	Management	No colour coding: cargo pipes, ventilation lines, fresh water pipes, steam lines,.. should be in different colours to avoid errors or to avoid confusion	Operational error	☐	☐	☐	☐				0		
1.6 Cargo Valves													
1601	Loading / Discharging	Valve blocked	Overpressure, loading/ discharging interrupted, commercial loss	☐	☐	☐	☐				0		
1602	Loading / Discharging	Valve fails to operate	Loading/ discharging interrupted, commercial loss	☐	☐	☐	☐				**0**		
1603	Loading / Discharging	Valve Leaking	Spillage, release of inflammable or explosive vapours and liquid, pollution, commercial loss	☐	☐	☐	☐				**0**		
1604	Loading / Discharging	Valves not properly labeled	Operational error	☐	☐	☐	☐				**0**		
1605	All	Emergency valves not readily accessible	Emergency response failure	☐	☐	☐	☐				**0**		
1606	Design	Valve not fire rated	Emergency response failure	☐	☐	☐	☐				**0**		
1607	Management	Valve not marked for identification	Operational error	☐	☐	☐	☐				**0**		
1608	Maintenance	Indicator lights not working	Misjudgment, misunderstanding, mistakes during cargo operations	☐	☐	☐	☐				**0**		

1.7 Tank Measurement													
1609	Maintenance	Valve added to original system design	Structural integrity damaged	☐	☐	☐	☐				**0**		
1701	Loading / Discharging	Instruments not working	Tank overflow: spillage, release of inflammable or explosive vapours and liquid	☐	☐	☐	☐				**0**		
1.8 Tank Capacity Alarm, High Level Alarm													
1801	Loading / Discharging	High Level Alarm out of order	Tank overflow: spillage, release of inflammable or explosive vapours and liquid	☐	☐	☐	☐				**0**		

2. STRUCTURAL HAZARDS RELATED TO THE CONSTRUCTION OF THE VESSEL

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level	Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		
2.1 Single Hull												
2101	Navigation	Grounding, contact or collision	Can eventually lead to Loss of Watertight Integrity (LOWI): Sinking, pollution, drowning	☐	☐	☐	☐				0	
2.2 Condition of cargo and ballast tanks												
2201	All	Rusted (insufficient steel thickness)	Leaking, contamination of cargo/ballast	☐	☐	☐	☐				0	
2.3 Tank Structure												
2301	Ship's Design	Bad welding seams, weldings corroded	Tank leaking: spillage, release of inflammable/ explosive vapours and liquid in adjacent spaces	☐	☐	☐	☐				0	
2.4 Slop Tank												
2401	Ship's Design	Lack of sloptank (tank on deck, used to collect the residues of the cargo remaining in the cargotanks, after discharging)	No means of collecting tank residues. Can eventually lead to pollution	☐	☐	☐	☐				0	
2402	Maintenance	Sloptank on deck is rusted/ bad state	Possible leaking can eventually lead to pollution, release of flammable vapours and toxic vapours	☐	☐	☐	☐				0	
2.5 Sewage treatment plant												
2501	Ship's Design	No sewage treatment plant (plant + Storage Tank)	Possible disposal of sewage into the River	☐	☐	☐	☐				0	
2502	All	No sewage disposal procedures	Incorrect disposal of sewage	☐	☐	☐	☐				0	
2.6 Spill Belt/ Gutter bar												
2601	Ship's Design	Lack of spill belt/ plate	In case of cargo spillage on deck: immediate release into the River (pollution)	☐	☐	☐	☐				0	
2.7 Drip Tray												
2701	Loading/discharging	Lack of drip tray	When connecting or disconnecting cargo hose: cargo spillage on deck (pollution)	☐	☐	☐	☐				0	
2702	Loading/discharging	Rusted/ bad state		☐	☐	☐	☐				0	
2.8 Bulwarks / fences												
2801	Ship's Design	No bulwark / fence	Personal injury, fatality (falling over board)	☐	☐	☐	☐				0	

2.9 Navigation Equipment													
2901	Navigation	No radar available during bad visibility, heavy rain or showers	Unable to spot traffic and navigation marks can lead to collision, contact	☐	☐	☐	☐				0		
2902	Navigation	No VHF	No communication with other traffic, no interactions between vessel and VTS (Vessel Traffic Services)	☐	☐	☐	☐				0		
2903	Navigation	No Echo-sounder, shallow water	Present keel clearance unknown	☐	☐	☐	☐				0		
2904	Navigation	No Navigation Charts	No information on waterways (obstructions, available water depth, navigation aids, ...)	☐	☐	☐	☐				0		
2905	Navigation	No GPS	Exact position unknown	☐	☐	☐	☐				0		
2906	Navigation	No Fog Horn available in bad visibility	Not able to give sound signals in order to warn other vessels	☐	☐	☐	☐				0		

3. ELECTRICITY: HAZARDS RELATED TO ELECTRICAL INSTALLATIONS

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level		Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur			
3.1 High Voltage													
3101	All	Lack of warnings, signs	Electrocution, Electric shock	☐	☐	☐	☐				0		
3102	All	Easy accessible		☐	☐	☐	☐				0		
3103	All	Unprotected installation (open installation, not protected by fireproof box)	Fire, Electrocution, Electric shock	☐	☐	☐	☐				0		
3104	All	No or insufficient insulation	Sparks: Fire, Explosion	☐	☐	☐	☐				0		
3.2 Cables													
3201	All	Mechanical damage to cables	Sparks, explosion, fire, electrocution	☐	☐	☐	☐				0		
3202	All	No or insufficient insulation	Electrocution, Electric shock, Fire	☐	☐	☐	☐				0		
3.3 Electrical equipment not grounded													
3301	All	Electrical equipment not earthed (deck lights, pumps..etc)	Sparks: Fire, Explosion	☐	☐	☐	☐				0		
3.4 Open Lights													
3401	All	Open light on deck and in pumproom	In case of cargo leakage or explosive vapour accumulation, sparks can lead to Fire, Explosion	☐	☐	☐	☐				0		
3.5 Equipment not Explosion proof													
3501	All	Walkie-Talkie, GSM, Torches and other equipment not Explosion Proof.	In case of cargo leakage or explosive vapour accumulation, sparks can lead to Fire, Explosion	☐	☐	☐	☐				0		

4. PHYSICAL HAZARDS RELATED TO THE WORKING ENVIRONMENT AND CONDITIONS

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level	Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		
4.1 Noise												
4101	Ship's design	Continuous high noise level	Stress, fatigue, loss of concentration, damage to hearing, neglect ion of alarms ,neglect ion of important sounds	☐	☐	☐	☐				0	
4102	Working with machinery	Excessive noise from operations		☐	☐	☐	☐					
4.2 Vibration												
4201	Ship's design	Long lasting vibration	Stress, fatigue, loss of concentration, health problems. Damage to equipment and vessels structure	☐	☐	☐	☐				0	
4.3 Cargo Stowage												
4301	Stowage	Badly stowed cargo: DG are not segregated	In case of contamination, depending on kind of dangerous goods: see MSDS, fire, explosion, release of toxic vapours	☐	☐	☐	☐				0	
4302	Loading / Discharging	No procedures exists for the handling of packaged DG (damage to package of DG due to improper handling)	Release of DG in cargo hold, can lead to fire / explosion, toxic vapours	☐	☐	☐	☐				0	
4.4 Cargo Lashing												
4401	Navigation	Cargo is not lashed sufficiently	Damage to cargo and vessel when cargo shifts. Possible stability loss eventually leading to capsizing	☐	☐	☐	☐				0	
4.5 Confined Spaces												
4501	Management	Confined spaces have not been identified on board (crew is unaware of the existence of confined or enclosed spaces)	Crewmembers unaware of the dangers of entering enclosed spaces. No prevention measures taken before entering enclosed spaces, possible suffocation, fatality	☐	☐	☐	☐				0	
4502	Entering enclosed spaces	Lack of oxygen, (Toxic) vapours	Suffocation, fatality	☐	☐	☐	☐				0	
4.6 Slippery surfaces												
4601	All	Greasy surface in engine room/ on deck	Personal injuries	☐	☐	☐	☐				0	
4.7 Poor Lighting												
4701	All	Poor lightning of work space: engine room, deck	Personal injuries, operational error	☐	☐	☐	☐				0	

4.8 Equipment and Maintenance													
4801	Maintenance	No or insufficient maintenance of equipment	Bad state of equipment, malfunctioning, out of order, commercial loss	☐	☐	☐	☐				0		
4802		Low standard of equipment used for dedicated jobs		☐	☐	☐	☐				0		
4803		Maintenance performed with the wrong materials or parts		☐	☐	☐	☐				0		
4.9 Hazards related to navigation													
4901	Navigation	Strong current	Difficult navigation	☐	☐	☐	☐				0		
4902	Navigation	Shallow water (no echo sounder)	Grounding	☐	☐	☐	☐				0		
4903	Navigation	Rapids	Steering difficulties, difficult to predict vessels behavior	☐	☐	☐	☐				0		
4904	Navigation	Tide (no tide tables)	Unable to predict correct Under keel clearance (UKC)	☐	☐	☐	☐				0		
4905	Navigation	Limited Local knowledge	Difficult and dangerous navigation	☐	☐	☐	☐				0		
4906	Navigation	Density of traffic	Increased risk for accidents (collision)	☐	☐	☐	☐				0		
4907	Navigation	Lack of navigation aids: buoys, leading lights	Navigable part of waterway unclear	☐	☐	☐	☐				0		
4908	Navigation	Lack of reporting system, Vessel Traffic Services (VTS)	No reports on the position, identity and intentions of other traffic; waterway conditions; weather; hazards; or any other factors that may influence the vessel's transit.	☐	☐	☐	☐				0		
4.10 Weather													
41001	Navigation	Storm	Difficult navigation, unable to maneuver, cargo shifting (packaged DG damaged)	☐	☐	☐	☐				0		
41002	Navigation	Heavy rain falls	Reduced visibility can lead to contact, collision, grounding	☐	☐	☐	☐				0		
41003	All	Lightning	Sudden electrical discharge striking vessel or other high structures. Navigation equipment affected and increased risk of fire / explosion	☐	☐	☐	☐				0		
41004	Navigation	High winds	Difficult navigation, unable to maneuver can lead to contact, collision	☐	☐	☐	☐				0		
41005	Navigation	Fog / Bad visibility	Restricted or difficult navigation	☐	☐	☐	☐				0		
41006	Navigation	Over flooding	Difficult navigation: course of navigation channel unclear	☐	☐	☐	☐				0		
41007	Navigation	Night navigation in dangerous river stretches (rocks, rapids, etc)	Dangerous navigation leading to contact, collision, striking rocks	☐	☐	☐	☐				0		

5. DANGEROUS GOODS

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level	Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		
5.1 Dangerous Goods												
5101	All	Hazard depending on kind of DG on board (see Material Safety Data Sheet (MSDS)): Flammable, Toxic, Corrosive, Infectious,...	If instructions on MSDS not followed: Possible fire, explosion, personal injury, diseases, pollution,...	☐	☐	☐	☐				0	
5102	All	No Dangerous Goods stowage plan	Unaware of the quantity and location, UN number, ...	☐	☐	☐	☐				0	
5103	All	No MSDS available	No knowledge of properties & hazards concerning the different dangerous goods carried on board.	☐	☐	☐	☐				0	
5104	All	Packaged Dangerous Goods not properly labeled	Unaware of hazards and properties of Dangerous goods	☐	☐	☐	☐				0	
5105	All	Dangerous goods in CTU (Cargo Transport Unit - container): stuffing of CTU not according legal requirements	Insufficiently packed, segregation requirements not met, injuries to persons and the environment, damage to ship and CTU, damage to cargo, ...	☐	☐	☐	☐				0	
5106	All	Transport documents not supplied, or incomplete, no necessary information on shipped DG	Unaware of hazards and properties of Dangerous goods	☐	☐	☐	☐				0	
5.2 Substances used for the overall maintenance												
5201	All	Paint, oil, grease, cleaning products	Depending on product properties: see hazardous properties of the specific substance (consult MSDS or product labels)	☐	☐	☐	☐				0	
5.3 Oil grades used for main engine, steering gear, generator, pumps,...												
5301	Ships operations	Fuel oil, diesel oil, hydraulic oil, lubricating oil,...	See MSDS: Fire, Explosion, Injuries, Pollution,...	☐	☐	☐	☐				0	

5.4 Bilge content													
5401	All	Waste reception facilities for bilge content (mixture of oil-fuel-water) are not available	If no adequate facilities for removing bilge content are provided: bilge content disposed in the River (pollution)	☐	☐	☐	☐				0		
5402	All	Disposal of bilge content to reception facility is to expensive	Bilge content disposed in the River (pollution)	☐	☐	☐	☐				0		
5403	All	No adequate authority control on bilge content removal (oil record book)		☐	☐	☐	☐				0		
5.5 Slop tank content (save alls)													
5501	All	Waste reception facilities for cargo residue, or mixture of different cargo residues are not available	If no adequate facilities for removing slop tank content are provided: slop tank content disposed in the River (pollution)	☐	☐	☐	☐				0		
5502	All	Disposal of slop tank content to reception facility to expensive	Slop tank content disposed in the River (pollution)	☐	☐	☐	☐				0		
5503	All	No adequate authority control on slop tank content removal (cargo record book)		☐	☐	☐	☐				0		
5.6 Cargo residues in tanks													
5601	Tank cleaning	MSDS is not available for discharged cargo	If MSDS is not available: no information regarding the dangers of the DG on board such as fire, explosion, diseases, intoxication, suffocation, death, pollution, toxic vapours, …	☐	☐	☐	☐				0		
5602	Tank cleaning	No checklist available	Wrong or lack of precautionary measures	☐	☐	☐	☐				0		

6. FIRE HAZARDS

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level	Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		
6.1 Hot Works												
6101	Maintenance	No checklist completed prior to hot works	Increased risk of fire, explosion, personal injuries	☐	☐	☐	☐				0	
6102	Maintenance	Welding (sparks)		☐	☐	☐	☐				0	
6.2 Smoking/Open Light												
6201	All	No open light, no smoking requirements	Increased risk of fire, Explosion, personal injuries	☐	☐	☐	☐				0	
6.3 Sparks												
6301	All	No explosion proof equipment	Increased risk of fire, Explosion, personal injuries	☐	☐	☐	☐				0	

7. HUMAN FACTORS

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level		Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur			
7.1 Fatigue													
7101	All	Extended working hours, insufficient rest	Physical and mental exhaustion, resulting in diminished reaction, alertness and concentration	☐	☐	☐	☐				0		
7.2 Skills													
7201	All	Insufficient skill, training	Uncertainty, wrong handling	☐	☐	☐	☐				0		
7.3 Exposure to environmental conditions													
7301	All	High temperature, high humidity	Fatigue, exhaustion, dehydration	☐	☐	☐	☐				0		
7.4 Experience													
7401	All	New operating staff not properly trained	Uncertainty, mistakes, error	☐	☐	☐	☐				0		
7402	Loading/ Discharging	Crewmember does not perform a required action	Cargo operation interrupted: overflow, personal injury, property damage, Maximum Allowable Working pressure exceeded (MAWP), …	☐	☐	☐	☐				0		
7403	Loading/ Discharging	Crewmember performs a wrong action		☐	☐	☐	☐				0		
7404	Loading/ Discharging	Crewmember performs an action at the wrong place		☐	☐	☐	☐				0		
7405	Loading/ Discharging	Crewmember performs actions in the wrong sequence		☐	☐	☐	☐				0		
7406	Loading/ Discharging	Crewmember performs an action at the wrong time		☐	☐	☐	☐				0		
7407	All	Crew member not under supervision	Uncertainty, misjudgement, mistakes	☐	☐	☐	☐				0		
7.5 Education													
7501	All	Crewmember does not understand/ knows the hazards of the process, little knowledge of DG, little knowledge on critical procedures undertaken on board	Underestimation/ misjudgment/ errors/ mistakes	☐	☐	☐	☐				0		
7.6 Information													
7601	All	Insufficient information/ communication regarding the DG on board, and important activities on board	Misjudgment, wrong handling	☐	☐	☐	☐				0		
7.7 Communication													
7701	All	Lack of communication, no appropriate means of communication (no VHF, no Walkie-Talkie)	Misunderstanding (different languages), wrong handling, late response, …	☐	☐	☐	☐				0		
7702	All	wrong communication between crossing vessels because of different language use	Misunderstanding (different languages), wrong handling, late response, …	☐	☐	☐	☐				0		

8. MANAGEMENT

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level	Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur		
8.1 Safe Working Procedures (Sequence and explanation of activities to be carried out when performing a certain work)												
8101	Berthing the vessel	No procedures on mooring/ unmooring	Wrong PPE, wrong sequence, wrong or no action, underestimation, wrong emergency procedures/ response, increased risk on personal injuries, property damage, …	☐	☐	☐	☐				0	
8102	Loading/ discharging	No procedures on loading/ discharging		☐	☐	☐	☐				0	
8103	Cargo transferring	No procedures on transfer operations		☐	☐	☐	☐				0	
8104	Loading/ discharging	No procedures on spill containment		☐	☐	☐	☐				0	
8105	Bunkering	No procedures on bunkering operations		☐	☐	☐	☐				0	
8106	Tank Cleaning	No procedures on tank cleaning		☐	☐	☐	☐				0	
8107	Cargo handling	No procedures on cargo handling		☐	☐	☐	☐				0	
8108	Deck: loading/ discharging	No procedures on deck watch keeping		☐	☐	☐	☐				0	
8109	Bridge: sailing	No procedures on watch keeping		☐	☐	☐	☐				0	
8110	Entering enclosed spaces	No procedures on entering enclosed spaces		☐	☐	☐	☐				0	
8111	Executing hot work	No procedures on hot works		☐	☐	☐	☐				0	
8112	Dealing with an emergency situation	No procedures on emergency situations		☐	☐	☐	☐				0	
8113	Dealing with a fire, an explosion	No procedures on fire / explosion		☐	☐	☐	☐				0	
8114	Dealing with an abandon ship situation	No procedures on abandon ship emergency situation		☐	☐	☐	☐				0	
8115	Vessel running aground	No procedures on grounding		☐	☐	☐	☐				0	
8116	Vessel colliding, or making contact	No procedures on collision, contact		☐	☐	☐	☐				0	
8.2 Safety Measures												
8201	All	No management on safety measures	No procedures, no training, no drills	☐	☐	☐	☐				0	
8202	All	No management concerning protective equipment	Safety of crewmembers at risk	☐	☐	☐	☐				0	
8203	All	No management concerning life saving equipment	Safety of crewmembers at risk	☐	☐	☐	☐				0	
8204	All	No management concerning fire fighting equipment	Risk to crew, public, property, environment	☐	☐	☐	☐				0	
8205	All	No safety committee	Increased risk on personal injuries	☐	☐	☐	☐				0	

8.3 No training on: see column possible hazards													
8301	All	First aid		☐	☐	☐	☐				0		
8302	All	Fire fighting equipment		☐	☐	☐	☐				0		
8303	All	Life saving equipment		☐	☐	☐	☐				0		
8304	All	DG Training		☐	☐	☐	☐				0		
8305	All	Emergency procedures	No skill, no knowledge, no experience	☐	☐	☐	☐				0		
8306	All	Accident prevention		☐	☐	☐	☐				0		
8307	All	Marine pollution prevention		☐	☐	☐	☐				0		
8308	All	Environmental protection		☐	☐	☐	☐				0		
8309	All	Ship waste Management		☐	☐	☐	☐				0		
8.4 No checklist regarding: see column possible hazards (items to be checked prior to start the work activity)													
8401	Loading/ discharging	Loading/ discharging	Wrong PPE, wrong sequence, wrong or no action, underestimation, actions and situations overlooked	☐	☐	☐	☐				0		
8402	Transfer of cargo	Cargo Transfer		☐	☐	☐	☐				0		
8403	Bunkering	Bunkering		☐	☐	☐	☐				0		
8404	Watch keeping deck/ bridge	Watch keeping		☐	☐	☐	☐				0		
8405	All	Maintenance		☐	☐	☐	☐				0		
8406	All	Safety items		☐	☐	☐	☐				**0**		
8407	All	Survival equipment		☐	☐	☐	☐				**0**		
8408	All	Navigation tools		☐	☐	☐	☐				**0**		
8.5 Waste Management													
8501	All	No solid waste management (garbage, maintenance residues)	Solid waste is disposed of directly into the River: pollution	☐	☐	☐	☐				**0**		
8502		No Liquid waste management (Bilge water, wash water, sewage & liquid residues containing oil or chemicals)	Liquid waste is disposed directly into the River: pollution	☐	☐	☐	☐				**0**		
8.6 Emergency Response Plan													
8601	All	No emergency response plans available	Chaos, underestimation, wrong sequence, wrong action, time lost	☐	☐	☐	☐				**0**		
8.7 Drugs and Alcohol													
8701	All	No drug and alcohol policy	Drug use or alcohol abuse, decreasing alertness, misjudgment, bad response, decreased reaction ability	☐	☐	☐	☐				**0**		
8.8 Dangerous Goods													
8801	All	No management concerning dangerous goods	Endangering crewmembers, vessel, environment, due to negligence, unawareness	☐	☐	☐	☐				**0**		

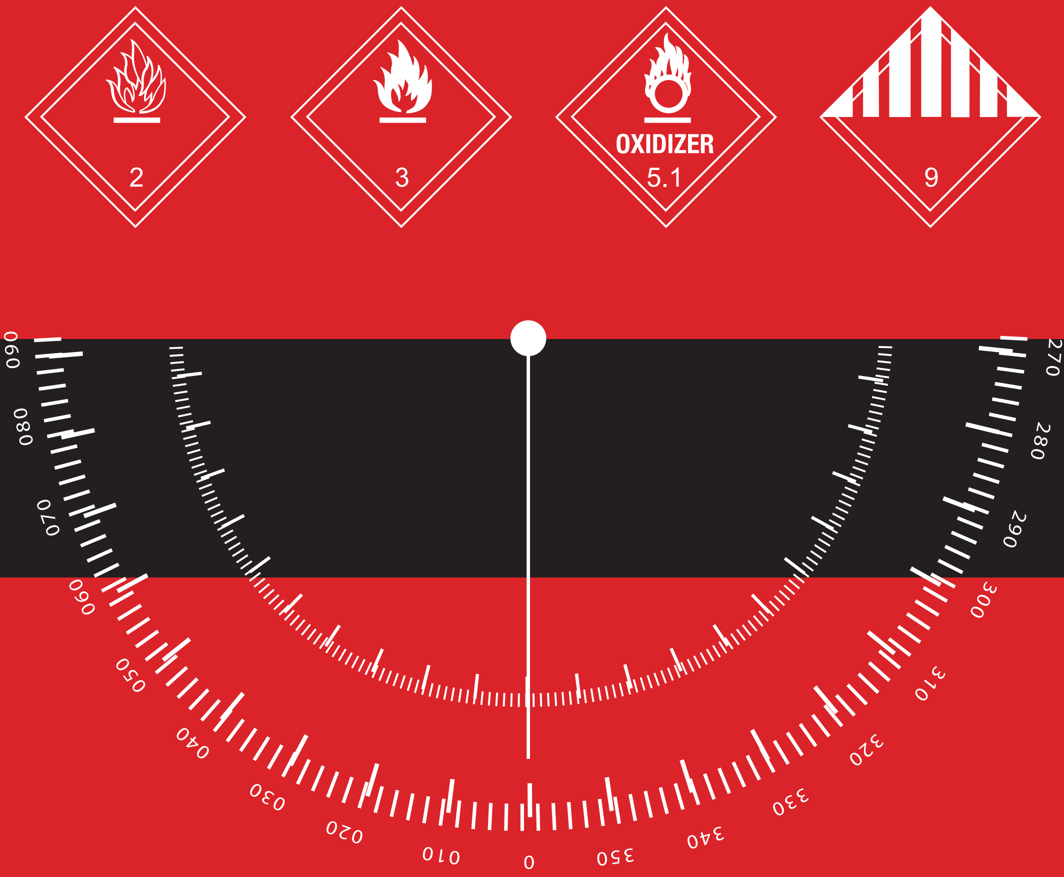
8.9 Safe Manning													
8901	All	Safe manning levels are not maintained	Insufficient crewmembers to carry out the work on board	☐	☐	☐	☐				**0**		
8902	All	Certification is not provided to prove courses followed and examination result acceptable	Inexperienced crewmembers on board to carry out the job	☐	☐	☐	☐				**0**		
8903	All	No medical check up performed and certified, to prove fitness of crewmember	Unfit, or unhealthy crewmember. Crewmembers with limited hearing or limited sight	☐	☐	☐	☐				**0**		
8.10 Courses													
81001	All	No courses for crewmembers in DG and shipboard operations	Little or limited knowledge	☐	☐	☐	☐				**0**		
81002	All	No refreshment courses for crewmembers in DG and shipboard operations	No update, no knowledge refresh	☐	☐	☐	☐						
8.11 Drills													
81101	All	Fire drills are not conducted on board	No experience, no efficiency, no activity sequence, chaos, panic in case of fire. Not used to handle fire fighting equipment. No check of working condition, place of equipment, muster place	☐	☐	☐	☐				**0**		
81102	All	No abandon ship drill	No experience, no efficiency, no activity sequence, chaos, panic in case of abandon ship. No check of working condition, place of equipment; muster place	☐	☐	☐	☐				**0**		
8.12 Muster List													
81201	All	No muster List	No place or task dedicated for specified emergencies such as: fire, abandon ship, … No report on missing persons	☐	☐	☐	☐				**0**		
8.13 Inspection of ship's condition													
81301	Quality control, surveying vessels condition	Class inspection: not existing , not carried out at regular interval	Deteriorating ship's state.	☐	☐	☐	☐				**0**		
8.14 Authority Control													
81401	Authority Regulation making	No regulation	Basic, elementary requirements regarding vessel, crew and cargo not fulfilled	☐	☐	☐	☐				**0**		

8.15 Law Enforcement													
81501	Authority regulation control	No control	Basic, elementary requirements regarding vessel and crew not fulfilled, illegal transport, use of substandard ships	☐	☐	☐	☐				**0**		
8.16 Company Policy													
81601	Company policy, management	No policy, bad management	Short term profit. Low quality standards. No respect for safety of crewmembers, other property or the environment	☐	☐	☐	☐				**0**		
8.17 Company Control													
81701	Company control, management	No control, bad management	Short term profit. Low quality standards. No respect for safety of crewmembers, other property or the environment	☐	☐	☐	☐				**0**		

9. LIFE SAVING/FIRE FIGHTING EQUIPMENT

No.	Activity/ Operations	Possible Hazards	Possible Consequences	Risk				Existing Prevention and Emergency Response Measures (list)	Risk		Risk Level		Determine Prevention and Emergency Response Measures to be implemented (list)
				Environment	Safety	Property Damage	Stakeholders		Severity of consequences	Likelihood of the accident to occur			
9.1 Fire Fighting Equipment													
9101	Fire fighting	Fire extinguishers: absent, no regular check (yearly), out of order	Not usable in case of fire: loss of vessel, injuries, death	☐	☐	☐	☐				0		
9102	Fire fighting	Fire hoses: missing or bad state		☐	☐	☐	☐				0		
9103	Fire fighting	Fire monitors: missing or bad state		☐	☐	☐	☐				0		
9104	Fire fighting	Fire hydrants: blocked		☐	☐	☐	☐				0		
9105	Fire fighting	Fire axe missing	Injuries	☐	☐	☐	☐				0		
9106	Fire fighting	Breathing apparatus not available	Injuries, death	☐	☐	☐	☐				0		
9107	Fire fighting	Explosion proof safety lamp missing	Injuries, explosion	☐	☐	☐	☐				0		
9108	Fire fighting	Helmet not available	Injuries	☐	☐	☐	☐				0		
9109	Fire fighting	Sand not available	Not usable in case of fire: possible loss of vessel, injuries, death	☐	☐	☐	☐				0		
9.2 Fire Fighting Pumps													
9201	Fire fighting	Poor maintenance	Not usable in case of fire: loss of vessel, injuries, death	☐	☐	☐	☐				0		
9203	Fire fighting	No regular testing		☐	☐	☐	☐				0		
9.3 Fire Detection													
9301	Fire fighting	Fire and Smoke detection alarm: absent or not working	Unable to detect fire in time: loss of vessel, injuries, death	☐	☐	☐	☐				0		
9.4 Fire Fighting Control													
9401	Fire fighting	Fire Control Plan: not available	Not usable in case of fire: loss of vessel, injuries, death	☐	☐	☐	☐				0		
9.5 Lifeboats													
9501	Abandon ship	Absence/ poor condition	Drowning	☐	☐	☐	☐				0		
9.6 Life rafts				☐	☐	☐	☐				0		
9601	Abandon ship	Absence/ poor condition	Drowning	☐	☐	☐	☐				0		
9.7 Rescue boat													
9701	Abandon ship	Absence/ poor condition	Drowning	☐	☐	☐	☐				0		
9.8 Life buoys				☐	☐	☐	☐				0		
9801	All	Absence/ poor condition	Drowning	☐	☐	☐	☐				0		
9.9 Life Jackets													
9901	Mooring, unmooring, working near ship's side	Absence/ poor condition	Falling overboard, Drowning	☐	☐	☐	☐				0		

9.10 Gas Detection													
91001	Checking tank atmosphere (tank cleaning), pump room atmosphere	Absent/ not working/ not calibrated	Depending on kind of DG (toxic/ explosive vapours): intoxication, suffocation, fire, explosion	☐	☐	☐	☐				0		
9.11 Oxygen level measurement													
91101	Checking tank atmosphere, pump room atmosphere, entering enclosed spaces	Absent/ not working/ not calibrated	Unconsciousness, suffocation	☐	☐	☐	☐				0		
9.12 Personnel Protective Equipment (PPE)													
91201	Eye protection: loading/discharging chemical substances, grinding	Safety glasses, goggles, face shield: not available	Eye injuries, face injury due to flying objects (dust, grit), toxic or irritant liquid	☐	☐	☐	☐				0		
91202	Respiratory protection: entering enclosed spaces, tank cleaning	Breathing apparatus: not available	unconsciousness, suffocation, intoxication due to gases, fumes, toxic atmosphere, oxygen-deficient atmosphere,...	☐	☐	☐	☐				0		
91203	Hearing protection: working in the engine room	Ear muffs, ear plugs: not available	Hearing loss due to excessive, long-lasting noise (engine room)	☐	☐	☐	☐				0		
91204	Hand protection: working on deck, contact with chemical substances when taking samples or tank cleaning	Appropriate gloves: not available	Injuries to hand and fingers, exposure to toxic and irritant substances	☐	☐	☐	☐				0		
91205	Foot protection: working on the vessel	Steel capped safety boots: not available	Crush injuries, exposure to toxic substances	☐	☐	☐	☐				0		
91206	Fall protection: working near ship's side, on heights, mooring/ unmooring	Harness, life lines, life jacket: not available	Drowning due to falling in the water when mooring/ unmooring, working close to ship's side	☐	☐	☐	☐				0		
91207	Head protection: working on the vessel	Helmet: not available	Injuries to the head, unconsciousness, death	☐	☐	☐	☐				0		
91208	Reflective clothing: working at night on the vessel	Reflective jacket: not available	Difficult to spot during night, or poorly lit working conditions	☐	☐	☐	☐				**0**		



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