CARRIAGE, HANDLING AND STORAGE OF
DANGEROUS GOODS
ALONG THE MEKONG RIVER

VOLUME I: RISK ANALYSIS

Mekong River Commission
Navigation Programme
CARRIAGE, HANDLING AND STORAGE OF
DANGEROUS GOODS
ALONG THE MEKONG RIVER

VOLUME I: RISK ANALYSIS

NAVIGATION PROGRAMME

April 2012
ACKNOWLEDGMENTS

Key MRC staff, members of the consulting team and National Working Groups in the MRC Member Countries who helped in the preparation of the Risk Analysis of the Carriage, Handling and Storage of Dangerous Goods along the Mekong River.

MRC Staff
Mr Pich Dun, Director, Operations Division, MRC Navigation Programme
Mr Hiek Phirun, Navigation Programme Coordinator, MRC Navigation Programme
Mr Lieven Geerinck, Chief Technical Advisor, MRC Navigation Programme
Mr Rory Hunter, Maritime Risk Management Specialist, MRC Navigation Programme
Mr Bounphet Phommachanh, Programme Officer, MRC Navigation Programme

Consulting Team
Professor Dr Eric Van Hooydonk, International Legal Expert
Mr Bart Fonteyne, International Expert for Ports and Terminals
Mr Peter Thys, International Expert for Vessels
Mr Jacques Dezeure, International Expert for Waterways

National Working Groups
Mr Vichet Chui, National Expert for Ports, Cambodia
Mr Suon Vansar, National Expert for Vessels, Cambodia
Mr Chrin Sokha, National Expert for Environment, Cambodia
Mr Xaysomphone Banchongphanith, National Expert for Ports, Lao PDR
Mr Somchith Pongsomphane, National Expert for Vessels, Lao PDR
Mr Phengkhamla Phonvisai, National Expert for Environment, Lao PDR
Mr Thanatip Jantaratapde, Chief of Vessel Traffic Control Section, Vessel Traffic Control and Maritime Security Center, Thailand
Mr Pitak Wattanapongpisal, Chief of Harbour Master Division, Marine Safety and Environment Bureau, Thailand
Mr Suranat Sirichote, Harbor Master, Marine Office 1, Chiang Rai Branch, Thailand
Mr Marut Suksomjit, Environmentalist, Professional Level, Pollution Control Department, Thailand
Mr Vu Manh Hung, VIWA, National Expert for Ports, Viet Nam
Mr Hoang Minh Toan, VIWA, National Expert for Vessels, Viet Nam
Ms Phan Ban Mai, National Expert for Environment, Viet Nam

National Navigation Coordinators
Mr Chheang Hong, Cambodia
Mr Keomany Luanglith, Lao PDR
Mr Nguyen Huy Phuong, Viet Nam
Ms Nuanlaor Wongpinitwarodom, Thailand

Photographer
Mr Joe Garrison

Design, Layout and Editing
Mr Chhut Chheana, Design and Layout
Mr Peter Starr, Editor
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 Guttmann
Chief Executive Officer
MRC Secretariat
CONTENTS

ACRONYMS AND ABBREVIATIONS ........................................................................................ XI
DEFINITIONS ........................................................................................................................ XVII
EXECUTIVE SUMMARY ......................................................................................................... XXI
I. INTRODUCTION AND PROJECT DESIGN .............................................................................. 1
   1.1 BACKGROUND ................................................................................................................... 1
   1.2 MRC NAVIGATION PROGRAMME ................................................................................... 2
   1.3 TRAFFIC SAFETY AND ENVIRONMENTAL SUSTAINABILITY ......................................... 2
   1.4 OVERVIEW OF TRANSPORTATION OF DANGEROUS GOODS ....................................... 3
   1.5 ENVIRONMENTAL IMPACTS ........................................................................................... 5
   1.6 INITIAL CONSULTATION ................................................................................................. 5
   1.7 JUSTIFICATION FOR THE RISK ANALYSIS .................................................................... 7
   1.8 OBJECTIVES OF THE RISK ANALYSIS .......................................................................... 8
   1.9 IMPLEMENTATION ARRANGEMENTS .............................................................................. 8
   1.10 THE GEOGRAPHICAL PROJECT AREA .......................................................................... 10
       1.10.1 Lao PDR and Thailand .......................................................................................... 13
       1.10.2 Cambodia ............................................................................................................. 13
       1.10.3 Viet Nam .............................................................................................................. 13
2. RISK ANALYSIS METHODOLOGY ....................................................................................... 15
   2.1 INTRODUCTION ............................................................................................................... 15
   2.2 RISK DEFINITIONS AND TERMINOLOGY ..................................................................... 15
   2.3 RISK ASSESSMENT PROCESS ....................................................................................... 16
   2.4 DANGEROUS GOODS ...................................................................................................... 17
       2.4.1 Definitions and Terminology .................................................................................. 17
       2.4.2 Incompatible Goods .............................................................................................. 20
       2.4.3 Risk Assessment .................................................................................................... 21
       2.4.4 Consequences of Dangerous Goods Incidents .................................................... 22
   2.5 RISK ANALYSIS METHODOLOGY ................................................................................. 23
       2.5.1 Risk Register ........................................................................................................... 23
       2.5.2 Activity and Operations .......................................................................................... 24
           2.5.2.1 Possible Hazards ......................................................................................... 24
           2.5.2.2 Possible Consequences ............................................................................... 24
           2.5.2.3 Risks ............................................................................................................... 26
2.5.2.4 Existing Prevention and Emergency Response Measures ................. 26
2.5.2.5 Risk Rating .......................................................................................... 26
2.5.2.6 Risk Level ........................................................................................... 28
2.5.2.7 Determine Prevention and Mitigation Measures ................................ 29

2.6 RISK EVALUATION ..................................................................................... 31
2.6.1 Risk Management Approach .................................................................. 31
2.6.2 Priority Areas .......................................................................................... 31
2.6.2.1 Existing Standards in Member Countries .......................................... 31
2.6.2.2 Risk Criteria ....................................................................................... 31
2.6.2.3 Calculating Priority Areas .................................................................. 32

3. PORTS AND TERMINALS .............................................................................. 35
3.1 IDENTIFICATION OF OPERATIONS AND ACTIVITIES .............................. 35
3.1.1 Introduction ............................................................................................ 35
3.1.2 Ports and Terminals Hazard Groups ..................................................... 35
3.1.2.1 Infrastructure and Superstructure ..................................................... 37
3.1.2.2 Mechanical Equipment .................................................................... 37
3.1.2.3 Electricity .......................................................................................... 38
3.1.2.4 Operations ......................................................................................... 38
3.1.2.5 Maintenance ..................................................................................... 38
3.1.2.6 Human Elements ............................................................................. 38
3.1.2.7 Management and Regulations ......................................................... 39
3.1.2.8 Global Events .................................................................................. 39
3.1.2.9 Additional ......................................................................................... 39

3.2 IDENTIFICATION OF HAZARDS AND POSSIBLE CONSEQUENCES ............. 39
3.2.1 Introduction ............................................................................................ 39
3.2.2 Ports and Terminals Hazard Groups ..................................................... 39
3.2.2.1 Infrastructure and Superstructure ..................................................... 40
3.2.2.2 Mechanical Equipment .................................................................... 48
3.2.2.3 Electricity .......................................................................................... 52
3.2.2.4 Operations ......................................................................................... 53
3.2.2.5 Maintenance ..................................................................................... 54
3.2.2.6 Human Factors ................................................................................. 55
3.2.2.7 Management and Regulations ......................................................... 56
3.2.2.8 Global Events .................................................................................. 58
3.2.2.9 Additional Hazards ........................................................................... 58

3.3 RISK EVALUATION ....................................................................................... 59
3.3.1 Introduction .............................................................................................................. 59
3.3.2 International Agreements .......................................................................................... 59
3.3.3 Cambodia .................................................................................................................. 60
  3.3.3.1 Legislation and Authority Control ................................................................. 60
  3.3.3.2 Dangerous Goods Specifications ........................................................................ 62
  3.3.3.3 Petroleum Terminals ........................................................................................ 63
  3.3.3.4 Risk Evaluation for Ports, Terminals and Additional Operations .................. 67
3.3.4 Viet Nam .................................................................................................................... 77
  3.3.4.1 Legislation and Authority Control ................................................................. 78
  3.3.4.2 Dangerous Goods Specifications ........................................................................ 80
  3.3.4.3 Petroleum Terminals ........................................................................................ 80
  3.3.4.4 Risk Evaluation for Ports, Terminals and Additional Operations .................. 81
3.3.5 Thailand .................................................................................................................... 87
  3.3.5.1 Legislation and Authority ................................................................................. 87
  3.3.5.2 Dangerous Goods Specifications ........................................................................ 90
  3.3.5.3 Main Ports and Terminals ............................................................................... 90
  3.3.5.4 Risk Evaluation for Ports, Terminals and Additional Operations .................. 95
3.3.6 Lao PDR ..................................................................................................................... 97
  3.3.6.1 Legislation and Authority ............................................................................... 97
  3.3.6.2 Dangerous Goods Specifications ........................................................................ 98
  3.3.6.3 Main Ports and Terminals ............................................................................... 98
  3.3.6.4 Risk Evaluation for Ports, Terminals and Additional Operations .................. 99
3.4 INTERMEDIATE REGIONAL AND NATIONAL CONCLUSIONS .................................. 101
  3.4.1 Introduction .......................................................................................................... 101
  3.4.2 Petroleum Terminals .............................................................................................. 101
    3.4.2.1 Types of Accidents ......................................................................................... 102
    3.4.2.2 Cause of Accidents ....................................................................................... 102
    3.4.2.3 Ten Largest Tank Accidents between 1963 and 2002 .................................... 103
    3.4.2.4 Example of a Recent Accident and Related Costs ....................................... 104
  3.4.3 Ports ........................................................................................................................ 105
  3.4.4 Risk Analysis of Ports and Terminals .................................................................... 106
    3.4.4.1 General Observations ................................................................................... 106
  3.4.5 Cambodia ................................................................................................................. 107
    3.4.5.1 Conclusions for the Terminals ...................................................................... 109
    3.4.5.2 Conclusions for the Ports .............................................................................. 112
    3.4.5.3 Conclusions on Additional Activities and Operations ................................. 113
  3.4.6 Viet Nam ................................................................................................................. 115
3.4.6.1 Conclusions for the Terminals ................................................................. 116

3.4.6.2 Conclusions on Additional Activities and Operations ......................... 119

3.4.7 Regional Conclusions on Cambodia and Viet Nam ................................. 120

3.4.8 Thailand ...................................................................................................... 121

3.4.8.1 Conclusions ............................................................................................... 122

3.4.9 Lao PDR ........................................................................................................ 123

3.4.9.1 Conclusions ............................................................................................... 125

3.4.10 Regional Oil Spill Prevention and Response .............................................. 127

4. VESSELS .......................................................................................................... 129

4.1 IDENTIFICATION OF OPERATIONS AND ACTIVITIES ............................... 129

4.1.1 Introduction ................................................................................................. 129

4.1.2 Vessel Hazard Groups .................................................................................. 129

4.1.2.1 Mechanical .............................................................................................. 130

4.1.2.2 Structural ................................................................................................ 130

4.1.2.3 Electrical ................................................................................................. 132

4.1.2.4 Physical Environment .............................................................................. 132

4.1.2.5 Dangerous Goods ................................................................................... 133

4.1.2.6 Fire Hazards ............................................................................................. 133

4.1.2.7 Human Factors ........................................................................................ 134

4.1.2.8 Management ............................................................................................ 134

4.1.2.9 Lifesaving and Firefighting Equipment ...................................................... 135

4.2 IDENTIFICATION OF HAZARDS AND RISKS .............................................. 135

4.2.1 Introduction ................................................................................................. 135

4.2.2 Vessel Hazard Groups .................................................................................. 135

4.2.2.1 Mechanical .............................................................................................. 135

4.2.2.2 Structural ................................................................................................ 139

4.2.2.3 Electrical ................................................................................................. 141

4.2.2.4 Physical Environment .............................................................................. 142

4.2.2.5 Dangerous Goods ................................................................................... 143

4.2.2.6 Fire Hazards ............................................................................................. 144

4.2.2.7 Human Factors ........................................................................................ 144

4.2.2.8 Management ............................................................................................ 144

4.2.2.9 Lifesaving and Firefighting Equipment ...................................................... 146

4.3 RISK EVALUATION ......................................................................................... 147

4.3.1 Introduction ................................................................................................. 147

4.3.2 Cambodia ..................................................................................................... 147
4.3.2.1 Overview ........................................................................................................... 147
4.3.2.2 Legislation and Authority Control .............................................................. 147
4.3.2.3 Inland Navigation ....................................................................................... 149
4.3.2.4 Cross-Border Navigation ......................................................................... 150
4.3.2.5 Dangerous Goods Specifications ............................................................... 151
4.3.2.6 Barge Specifications .................................................................................... 151
4.3.2.7 Main Traffic Lines ..................................................................................... 152
4.3.2.8 Risk Evaluation .......................................................................................... 152

4.3.3 Viet Nam .................................................................................................................. 156
4.3.3.1 Background Information ........................................................................... 156
4.3.3.2 Legislation and Authority Control .............................................................. 156
4.3.3.3 Maritime Navigation .................................................................................. 156
4.3.3.4 Inland Navigation ...................................................................................... 159
4.3.3.5 Cross-Border Navigation ......................................................................... 159
4.3.3.6 Legal and Institutional Aspects Regarding Emergency Response ............. 160
4.3.3.7 Dangerous Goods Specifications ............................................................... 162
4.3.3.8 Main Traffic Lines ..................................................................................... 162
4.3.3.9 Barge Specifications ................................................................................... 164
4.3.3.10 Risk Evaluation ........................................................................................ 164

4.3.4 Thailand ................................................................................................................ 173
4.3.4.1 Legislation and Authority Control .............................................................. 173
4.3.4.2 Dangerous Goods Specifications ............................................................... 173
4.3.4.3 Main Traffic Lines ..................................................................................... 174
4.3.4.4 Barge Specifications ................................................................................... 174
4.3.4.5 Risk Analysis ............................................................................................. 174
4.3.4.6 Ferry Crossings .......................................................................................... 177

4.3.5 Lao PDR ................................................................................................................ 178
4.3.5.1 Legislation and Authority Control .............................................................. 178
4.3.5.2 Dangerous Goods Specifications ............................................................... 179
4.3.5.3 Main Traffic Lines ..................................................................................... 179

4.4 INTERMEDIATE NATIONAL AND REGIONAL CONCLUSIONS ................. 184
4.4.1 Introduction ....................................................................................................... 184
4.4.2 Cambodia ........................................................................................................... 186
4.4.2.1 Legislation and Authority Control .............................................................. 186
4.4.2.2 Types of Dangerous Goods ...................................................................... 187
4.4.2.3 Risk Assessment ......................................................................................... 187
4.4.3 Viet Nam ............................................................................................................. 189
4.4.3.1 Legislation and Authority Control ............................................................ 190
4.4.3.2 Legal and Institutional Framework for Emergency Response .............. 191
4.4.3.3 Types of Dangerous Goods ........................................................................ 191
4.4.3.4 Risk Assessment ........................................................................................ 192

4.4.4 Thailand ................................................................................................................. 195
   4.4.4.1 Legislation and Authority Control ............................................................. 195
   4.4.4.2 Types of Dangerous Goods ........................................................................ 196
   4.4.4.3 Risk Assessment ........................................................................................ 196

4.4.5 Lao PDR ................................................................................................................... 199
   4.4.5.1 Legislation and Authority Control ............................................................. 199
   4.4.5.2 Types of Dangerous Goods ........................................................................ 199

4.4.6 Regional Conclusions ............................................................................................ 202

5. WATERWAYS .............................................................................................................. 205

5.1 RISK ASSESSMENT OF WATERWAYS ................................................................. 205
   5.1.1 Introduction ........................................................................................................... 205
   5.1.2 Principles .............................................................................................................. 206

5.2 METHODOLOGY ....................................................................................................... 207

5.3 CURRENT SITUATION IN MEMBER COUNTRIES .................................................... 212
   5.3.1 Lao PDR and Thailand ....................................................................................... 212
      5.3.1.1 Section Golden Triangle (Km 2,373) – Chiang Saen (Km 2,364) .......... 212
      5.3.1.2 Section Chiang Saen (Km 2,364) – Chiang Khong/Huay Xay (Km 2,314) ... 212
      5.3.1.3 Section Chiang Khong/Huay Xay (Km 2,314) to Pak Beng (Km 2,172) ...... 215
      5.3.1.4 Section Pak Beng (Km 2,172) to Luang Prabang (Km 2,010) .............. 218
      5.3.1.5 Section Luang Prabang (Km 2,010) – Pak Lay (Km 1,800) – Vientiane (Km 1,585) 222
      5.3.1.6 Section Vientiane (Km 1,585) - Savannakhet (Km 1,126) ................. 228
      5.3.1.7 Section Savannakhet (Km 1,126) – Pakse (Km 869) ......................... 231
      5.3.1.8 Section Pakse (Km 869) – Khone Falls (Km 721) ......................... 234
   5.3.2 Cambodia .............................................................................................................. 238
      5.3.2.1 Section Khone Falls (Km 721) – Steung Treng (Km 684) ............... 238
      5.3.2.2 Section Steung Treng (Km 684) – Kratie (Km 561) ......................... 240
      5.3.2.3 Section Kratie (Km 561) – Kampong Cham (Km 448) .................... 243
      5.3.2.4 Section Kampong Cham (Km 448) – Phnom Penh (Km 348) ............ 245
      5.3.2.5 Section Phnom Penh (Km 348) – Cambodia-Viet Nam border (Km 251) ... 248
      5.3.2.6 Section Phnom Penh (Km 0) – Kampong Chhnang (Km 99) .............. 249
      5.3.2.7 Kampong Chhnang (Km 99) – Chhong Kneas (Km 149 + approx 55 km)...... 252
   5.3.3 Viet Nam .............................................................................................................. 254
5.3.3.1 Section Deep Sea Buoy (Km 0) – My Tho (Km 74): 74 km ...................................... 255
5.3.3.2 My Tho (Km 74) – Tan Chau (Km 236) ................................................................. 256
5.3.3.3 Tan Chau (Km 236) - Cambodia-Viet Nam (Km 251) ............................................ 261
5.3.3.4 Bassac River Mouth (Km 0) - Can Tho (Km 109) ................................................. 262
5.3.3.5 Section Can Tho (Km 129) - Long Xuyen (Km 162) ............................................. 263
5.3.3.6 Long Xuyen (Km 162) - Mekong Mainstream (Km 216) ................................. 265

5.4 SUMMARY OF THE RISK ASSESSMENT OF THE ENTIRE LOWER MEKONG RIVER .... 267

6. REGIONAL AND INTERNATIONAL LEGAL FRAMEWORK ........................................ 271
6.1 INTRODUCTION ........................................................................................................ 271
6.2 GENERAL INTERNATIONAL BACKGROUND ......................................................... 272
  6.2.1 International Convention for the Prevention of Pollution from Ships, 1973 ........ 272
  6.2.2 International Convention for the Safety of Life at Sea, 1974 (SOLAS)
      and the International Maritime Dangerous Goods (IMDG) Code .......................... 273
  6.2.3 ILO Code of Practice on Safety and Health in Ports, 2003 ................................. 274
  6.2.4 IMO Revised Recommendations on the Safe Transport of Dangerous
      Cargoes and Related Activities in Port Areas, 2006 ............................................. 274
  6.2.5 Other Relevant International Instruments .......................................................... 274
6.3 INTERNATIONAL INSTRUMENTS PERTAINING TO THE MEKONG .................... 275
  6.3.1 Agreement on the Cooperation for the Sustainable Development of the Mekong
      River Basin (MRC Agreement) ............................................................................ 275
  6.3.2 Agreement on Commercial Navigation on Lancang-Mekong River ................. 277
  6.3.3 Convention between Siam and France relating to the Regulation of
      the Relations between Siam and Indochina ......................................................... 280
  6.3.4 Agreement on Waterway Transportation between Cambodia and Viet Nam........ 281
6.4 NATIONAL LAWS AND REGULATIONS ............................................................... 284
  6.4.1 Inventory of National Instruments in Cambodia .................................................. 284
  6.4.2 Inventory of National Instruments in Lao PDR .................................................... 286
  6.4.3 Inventory of National Instruments in Thailand ...................................................... 288
  6.4.4 Inventory of National Instruments in Viet Nam ................................................... 291
6.5 INTERNATIONAL BENCHMARKS .......................................................................... 297
  6.5.1 European Inland Waterways .............................................................................. 297
      6.5.1.1 Rules of Safety for the Transportation of Dangerous Goods on the Rhine 297
      6.5.1.2 European Agreement concerning the International Carriage of
      Dangerous Goods by Inland Waterways .............................................................. 297
      24 September 2008 on the inland transport of dangerous goods .................... 300
6.5.1.4 The Sava River Basin .................................................................................................................. 302
6.5.2 Inland Waterways of the United States ............................................................................................. 305
  6.5.2.1 United States Code ....................................................................................................................... 305
  6.5.2.2 Code of Federal Regulations ........................................................................................................ 306
6.6 INTERNATIONAL BENCHMARKING ANALYSIS .................................................................................. 308
6.7 LEGAL BASES FOR THE ESTABLISHMENT OF HARMONISED RULES .............................................. 310
6.8 INTERIM CONCLUSIONS .................................................................................................................. 311

7. ENVIRONMENT ....................................................................................................................................... 313

7.1 OVERVIEW ........................................................................................................................................... 313
  7.1.1 Lower Mekong Basin ......................................................................................................................... 313
  7.1.2 Important Wetlands ............................................................................................................................ 315
    7.1.2.1 Cambodia ....................................................................................................................................... 317
    7.1.2.2 Lao PDR ......................................................................................................................................... 318
    7.1.2.3 Thailand ....................................................................................................................................... 319
    7.1.2.4 Viet Nam ...................................................................................................................................... 321
    7.1.2.5 Wetland Classifications ................................................................................................................. 322
  7.1.3 Water Quality Monitoring ................................................................................................................. 324
    7.1.3.1 Cambodia ....................................................................................................................................... 324
    7.1.3.2 Lao PDR ......................................................................................................................................... 324
    7.1.3.3 Thailand ....................................................................................................................................... 325
    7.1.3.4 Viet Nam ...................................................................................................................................... 325
    7.1.3.5 MRC Water Quality Monitoring Network ....................................................................................... 325
  7.1.4 Water Quality Threats in the Lower Mekong Basin ............................................................................ 329
    7.1.4.1 Urban Development ....................................................................................................................... 329
    7.1.4.2 Industry ......................................................................................................................................... 329
    7.1.4.3 Tourism ....................................................................................................................................... 330
    7.1.4.4 Navigation ................................................................................................................................... 330
  7.1.5 Trans-Boundary Pollution .................................................................................................................. 333
    7.1.5.1 Trans-Boundary Areas in the Lower Mekong Basin ....................................................................... 333
    7.1.5.2 Procedures for Water Quality ......................................................................................................... 333
  7.1.6 Potential Environmental Impacts of Inland Waterborne Transport ..................................................... 334
    7.1.6.1 Ports and Terminals ....................................................................................................................... 334
    7.1.6.2 Vessels .......................................................................................................................................... 335
    7.1.6.3 Solid Wastes ................................................................................................................................. 335
  7.1.7 Potential Environmental Impacts of Oil Spill Pollution ....................................................................... 336
    7.1.7.1 Oil Spills in Inland Waterways ....................................................................................................... 336
7.3.4.3 Legal Framework and Compliance .......................................................... 354
7.3.5 Regional ....................................................................................................... 355
7.3.5.1 Potential for Oil Spills and Pollution ...................................................... 355

8. CONCLUSIONS ................................................................................................. 357

8.1 OVERVIEW ..................................................................................................... 357
8.1.1 Cambodia ..................................................................................................... 357
8.1.1.1 Ports and Terminals ................................................................................ 358
8.1.1.2 Vessels .................................................................................................... 358
8.1.1.3 Waterways ............................................................................................. 358
8.1.1.4 Legal Framework .................................................................................... 359
8.1.1.5 Environment .......................................................................................... 359
8.1.2 Lao PDR ....................................................................................................... 360
8.1.2.1 Ports ........................................................................................................ 360
8.1.2.2 Vessels .................................................................................................... 360
8.1.2.3 Waterways ............................................................................................. 361
8.1.2.4 Legal Framework .................................................................................... 361
8.1.2.5 Environment .......................................................................................... 362
8.1.3 Thailand ....................................................................................................... 362
8.1.3.1 Ports and Terminals ................................................................................ 362
8.1.3.2 Vessels .................................................................................................... 363
8.1.3.3 Waterways ............................................................................................. 363
8.1.3.4 Legal Framework .................................................................................... 363
8.1.3.5 Environment .......................................................................................... 363
8.1.4 Viet Nam ...................................................................................................... 364
8.1.4.1 Terminals ................................................................................................ 364
8.1.4.2 Vessels .................................................................................................... 364
8.1.4.3 Waterways ............................................................................................. 365
8.1.4.4 Legal Framework .................................................................................... 365
8.1.4.5 Environment .......................................................................................... 365
8.1.5 Regional ....................................................................................................... 366

ANNEX 1: DANGEROUS GOODS DEFINITIONS
ANNEX 2: RISK REGISTER FOR PORTS AND TERMINALS
ANNEX 3: RISK REGISTER FOR VESSELS
ACRONYMS AND ABBREVIATIONS

ADN  Accord européen relatif au transport international des marchandises 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 Engineers

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

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

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   Laem 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
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRC</td>
<td>Mekong River Commission</td>
</tr>
<tr>
<td>MRCS</td>
<td>Mekong River Commission Secretariat</td>
</tr>
<tr>
<td>MRCS-NPO</td>
<td>Mekong River Commission Secretariat Navigation Programme Office</td>
</tr>
<tr>
<td>MSDS</td>
<td>Material Safety Data Sheets</td>
</tr>
<tr>
<td>MTSA</td>
<td>Maritime Transportation Security Act</td>
</tr>
<tr>
<td>M/V</td>
<td>Motor Vessel</td>
</tr>
<tr>
<td>NACE</td>
<td>National Society of Corrosion Engineers (US)</td>
</tr>
<tr>
<td>NAP</td>
<td>Navigation Programme</td>
</tr>
<tr>
<td>NEG</td>
<td>Navigation Expert Groups</td>
</tr>
<tr>
<td>NFPA</td>
<td>National Fire Protection Association (US)</td>
</tr>
<tr>
<td>NNC</td>
<td>National Navigation Coordinator</td>
</tr>
<tr>
<td>NMC</td>
<td>National Mekong Committee</td>
</tr>
<tr>
<td>NOHSC</td>
<td>National Occupational Health and Safety Commission (Australia)</td>
</tr>
<tr>
<td>NWG</td>
<td>Navigation Working Group</td>
</tr>
<tr>
<td>OCIMF</td>
<td>Oil Companies International Marine Forum</td>
</tr>
<tr>
<td>ODA</td>
<td>Official Development Assistance</td>
</tr>
<tr>
<td>OISD</td>
<td>Oil Industry Safety Directorate (India)</td>
</tr>
<tr>
<td>ONEP</td>
<td>Office of Natural Resources and Environmental Policy and Planning</td>
</tr>
<tr>
<td>OSH</td>
<td>Occupational Safety and Health</td>
</tr>
<tr>
<td>OPRC</td>
<td>Oil Spill Preparedness and Response Cooperation</td>
</tr>
<tr>
<td>PACPLAN</td>
<td>Pacific Island Regional Marine Spill Contingency Plan</td>
</tr>
<tr>
<td>PACPOL</td>
<td>Pacific Ocean Pollution Prevention Program</td>
</tr>
<tr>
<td>PAH</td>
<td>Polycyclic Aromatic Hydrocarbons</td>
</tr>
<tr>
<td>PAT</td>
<td>Port Authority of Thailand</td>
</tr>
<tr>
<td>PCD</td>
<td>Pollution Control Department</td>
</tr>
<tr>
<td>PDR</td>
<td>Peoples’ Democratic Republic</td>
</tr>
<tr>
<td>PEMSEA</td>
<td>Partnership in Environmental Management for the Seas of East Asia</td>
</tr>
<tr>
<td>PERC</td>
<td>Powered Emergency Release Coupling</td>
</tr>
<tr>
<td>PHSEMS</td>
<td>Port Health, Safety and Environmental Management System</td>
</tr>
<tr>
<td>POP</td>
<td>Persistent Organic Pollutants</td>
</tr>
<tr>
<td>PPAP</td>
<td>Phnom Penh Autonomous Port (Cambodia)</td>
</tr>
<tr>
<td>PPC</td>
<td>Provincial Peoples Committees</td>
</tr>
<tr>
<td>PPE</td>
<td>Personal Protective Equipment</td>
</tr>
<tr>
<td>PRC</td>
<td>Peoples Republic of China</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>PRF</td>
<td>Port Reception Facilities</td>
</tr>
<tr>
<td>PRP</td>
<td>Police River Patrol</td>
</tr>
<tr>
<td>PRSP</td>
<td>Poverty Reduction Strategy Papers</td>
</tr>
<tr>
<td>PSA</td>
<td>Port Security Assessment</td>
</tr>
<tr>
<td>PSC</td>
<td>Port State Control</td>
</tr>
<tr>
<td>PSHEMS</td>
<td>Port Safety and Health and Environmental Management System</td>
</tr>
<tr>
<td>PSN</td>
<td>Proper Shipping Name</td>
</tr>
<tr>
<td>QCDPS</td>
<td>Vietnamese Local Technical Regulation</td>
</tr>
<tr>
<td>QCVN</td>
<td>Vietnamese national technical regulation</td>
</tr>
<tr>
<td>R</td>
<td>Risk Rating</td>
</tr>
<tr>
<td>RADAR</td>
<td>Radio Detection and Ranging</td>
</tr>
<tr>
<td>RGC</td>
<td>Royal Government of Cambodia</td>
</tr>
<tr>
<td>RA</td>
<td>Risk Analysis</td>
</tr>
<tr>
<td>RID</td>
<td>Règlement concernant le transport international ferroviaire des marchandises dangereuses (International rule for transport of dangerous substances by railway)</td>
</tr>
<tr>
<td>RWP</td>
<td>Rated Working Pressure</td>
</tr>
<tr>
<td>SEA</td>
<td>Strategic Environmental Assessment</td>
</tr>
<tr>
<td>SIA</td>
<td>Social Impact Assessment</td>
</tr>
<tr>
<td>SMS</td>
<td>Safety Management System</td>
</tr>
<tr>
<td>SOLAS</td>
<td>Safety of Life at Sea</td>
</tr>
<tr>
<td>SOPEP</td>
<td>Shipboard Oil Pollution Emergency Plan</td>
</tr>
<tr>
<td>SWL</td>
<td>Safe Working Load</td>
</tr>
<tr>
<td>SWP</td>
<td>Safe Working Procedures</td>
</tr>
<tr>
<td>TEU</td>
<td>Twenty-Foot Equivalent Units (intermodal shipping container)</td>
</tr>
<tr>
<td>TCCSS</td>
<td>Organization’s Standards</td>
</tr>
<tr>
<td>TCVN</td>
<td>Vietnamese National Standard</td>
</tr>
<tr>
<td>TG</td>
<td>Technical guidance</td>
</tr>
<tr>
<td>TMD</td>
<td>Thailand Marine Department</td>
</tr>
<tr>
<td>TNMC</td>
<td>Thailand National Mekong Committee</td>
</tr>
<tr>
<td>TWG</td>
<td>Technical Working Groups</td>
</tr>
<tr>
<td>UHA</td>
<td>Updating of the Hydrographic Atlas</td>
</tr>
<tr>
<td>UNCCD</td>
<td>United Nations Convention to Combat Desertification</td>
</tr>
<tr>
<td>UNECE</td>
<td>United Nations Economic Commission for Europe</td>
</tr>
<tr>
<td>UNFCCC</td>
<td>United Nations Framework Convention on Climate Change</td>
</tr>
<tr>
<td>USCG</td>
<td>United States Coast Guard</td>
</tr>
<tr>
<td>USD</td>
<td>US dollar</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>VEA</td>
<td>Vietnam Environment Administration</td>
</tr>
<tr>
<td>VHF</td>
<td>Very High Frequency</td>
</tr>
<tr>
<td>VINASARCOM</td>
<td>Vietnam’s National Search and Rescue Committee</td>
</tr>
<tr>
<td>VIWA</td>
<td>Viet Nam Inland Waterway Administration</td>
</tr>
<tr>
<td>VND</td>
<td>Vietnamese Dong</td>
</tr>
<tr>
<td>VNMC</td>
<td>Viet Nam National Mekong Committee</td>
</tr>
<tr>
<td>VR</td>
<td>Viet Nam Register</td>
</tr>
<tr>
<td>VSQI</td>
<td>Viet Nam Standards and Quality Institute</td>
</tr>
<tr>
<td>VTS</td>
<td>Vessel Traffic System</td>
</tr>
<tr>
<td>WG</td>
<td>National Working Group</td>
</tr>
<tr>
<td>WREA</td>
<td>Water Resources and Environment Authority</td>
</tr>
<tr>
<td>WQ</td>
<td>Water Quality</td>
</tr>
<tr>
<td>WQI</td>
<td>Water Quality Index</td>
</tr>
<tr>
<td>WQM</td>
<td>Water Quality Monitoring</td>
</tr>
<tr>
<td>WQMN</td>
<td>Water Quality Monitoring Network</td>
</tr>
</tbody>
</table>
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, covered 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 60°C 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
Mekong River Commission

Office of the Secretariat in Phnom Penh (OSP)
576 National Road, #2, Chak Angre Krom,
P.O. Box 623,
Phnom Penh, Cambodia
Tel. (855-23) 425 353
Fax. (855-23) 425 363

Office of the Secretariat in Vientiane (OSV)
Office of the Chief Executive Officer
184 Fa Ngoum Road, P.O. Box 6101,
Vientiane, Lao PDR
Tel. (856-21) 263 263
Fax. (856-21) 263 264

© Mekong River Commission
E-mail: mrcs@mrcmekong.org
Website: www.mrcmekong.org