

Compensating Ecological Damage

Comparative and Economic Observations

Compensating Ecological Damage
Comparative and Economic Observations

DISSERTATION

to obtain the degree of Doctor
at Maastricht University,
on the authority of the Rector Magnificus,
Prof. dr. L.L.G. Soete
in accordance with the decision of the Board of Deans,
to be defended in public
on Thursday 27 June 2013, at 10.00 hours

by

Jing Liu

Supervisor:

Prof. dr. M.G. Faure

Assessment Committee:

Prof. mr. M.G.W.M. Peeters

Prof. dr. Ch.W. Backes

Prof. dr. H.F.M.W. van Rijswick

Cover photo © Phototreat - iStockphoto

Layout by Marina Jodogne.

A commercial edition of this PhD-thesis will be published by Intersentia in the Ius Commune Europaeum Series, No. 118 under ISBN: 978-1-78068-174-0.

ACKNOWLEDGEMENTS

In 2009, when I moved from the other end of this continent to Maastricht and started my doctoral research, four years seemed an endless luxury to dive deep into one research topic and also too long period away from my family and friends. At the moment of finalizing the dissertation, however, I start to realize that doctoral research provides only a modest start in grasping a subject and every extra hour with my colleagues and friends here is appreciated. One of the joys of completion is to reflect on the journey and remember all the people who have helped and supported me along this long but fulfilling road.

This thesis is the result of PhD research at Maastricht University and is supported by the China Scholarship Council (CSC). I am sincerely grateful to the Faculty of Law of Maastricht University and the CSC for giving me the wonderful opportunity to carry out this research. I am particularly aware of the debt I owe to my supervisor Professor Michael Faure, who is both a great guide in knowledge and a caring guide in life for me. His inspiration, unrivalled understanding of law and economics and environmental law, as well as his sincere commitment to scholarship greatly enlightened me. He is also a close friend who made me feel at home since the beginning of my stay in Maastricht. As the first Chinese PhD student in Faculty of Law, coming to Europe for the first time, I found that the beginning was not that easy. Michael and his family – considerate Wang Hui (we call ‘teacher mother’ in Chinese) and lovely son Tony – help me enormously with their enthusiasm and hospitality. The wonderful time we had together to celebrate many Chinese and European holidays: Spring Festival, Mid-autumn day and Christmas will always be a precious and beautiful memory in my mind.

My deep gratitude and appreciation go to the members of my assessment committee for the enormous time and patience they spend to read the manuscript and for making valuable comments: Professor Marjan Peeters, Professor Chris Backes and Professor Marleen van Rijswick. Their insightful suggestions helped me greatly to improve my thesis. Additional thanks to Marjan for several inspiring discussions, guidance on my understanding of European environmental law and feedbacks in Ius Commune Workshops. I also would like to thank wholeheartedly other members who agree to sit in my committee and to participate in my defense:

Acknowledgements

Professor Nicolas de Sadeleer, Dr. Niels Philipsen, Professor Lucas Bergkamp, Professor Qin Tianbao and Professor Francisco Djedjro Melèdje. It is indeed a great honour for me. Additional thanks to Professor Qin Tianbao, who has been my teacher since I was a bachelor student, guided my journey to Maastricht and keeps supporting me all the way. Special thanks also to Dr. Niels Philipsen, who helps me to understand the fantastic area of law and economics.

There are also many other people in and around the faculty who support me warmly and to whom I owe my sincere gratitude. I am really grateful for the helpful METRO team of Yleen Simonis, Chantal Kuypers, Elke Hundhausen, Marina Jodogne and Marjo Mullers. Additional thanks to Marina, who was extremely helpful making the layout of the book and helping me catch up with the schedule. Many thanks also go to Kevine Kindji, Emma Dermawati, Laura Tilindyte, Mehdi Piri Damagh, Sachin Badkas, Tobias Heldt, Sarah Schoenmaekers, Thomas Biermeyer, Wenqing, Taotao, Huizhen, Yuan, Li Xuesong, Xiaowei, Guang and Jingjing, Viorelia Gasca and Katharina Eisele for the great pleasure they brought me and reminding me that I am not alone even so far away from home.

I would like to sincerely thank the officers and professors I interviewed for their wiliness to share their time and knowledge. I would particularly like to thank Professor Ludo Veuchelen, Professor Benjamin Van Rooij, Danny Van Welkenhuyzen, Harko Kremers, Professor Wang Canfa, Professor Wang Jin, Professor Li Zhiping, Li Zeyan, Kathinka Furst, Chen Ling, Lu Qingbin, Yang Yaxiao for making my interviews in Europe and China possible.

It is also a great pleasure for me to have many other friends in and around Maastricht, and also back in China, accompany me during the journey. Yang Liu, Wang Long, Han Xing, Lin Sheping, Mao Kai, Shi Xiaona, Chen Xiaohong, Zhao Jinjin, Hou Jun, Zhou Chen, Guo Lei all brought me beautiful memories in the past four years.

Special thanks to Professor Wang Shuyi, my supervisor during my master studies. I am indebted for his unconditional support both when I was in China and when I am here. My gratitude also goes to Dr. Du Zhihua and Liu Zhubin, who guided my way to research in the fantastic area of law and kept a close eye on me all through the years.

Finally, I must express my gratitude to my father Liu Chaoyin and my mother Li Zhongying. They give me a home where I can always go back to and they made me become who I am today. Without their love, everlasting support and endless care, this research would simply not have been accomplished.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS	V
LIST OF ABBREVIATIONS	XVII
LIST OF FIGURES AND TABLES.....	XXI
CHAPTER 1: INTRODUCTION.....	1
1. Background	1
2. Research Questions and Problem Definitions	4
3. Methodology	6
4. Structure	10
Part I Compensation Models for Ecological Damage: Theoretical Framework ...	13
CHAPTER 2: THE DEFINITIONS AND CHARACTERISTICS OF ECOLOGICAL DAMAGE	17
1. Introduction	17
2. The Choice of a Concept – Environmental Damage, Ecological Damage and Natural Resources Damage	18
2.1. Relevant Concepts in Legal Documents and Literature.....	18
2.1.1. Concepts in Legislation and Treaties.....	18
2.1.1.1. Environmental Damage.....	18
2.1.1.2. Pollution	20

Table of Contents

2.1.1.3.	Damage to the Environment, Impairment of the Environment and other Related Concepts	21
2.1.1.4.	Natural Resources Damage.....	23
2.1.2.	Concepts in Literature	23
2.1.2.1.	Environmental Damage and Pollution Damage	23
2.1.2.2.	Natural Resources Damage.....	24
2.1.2.3.	Ecological Damage	24
2.2.	The Choice of the Concept	25
2.2.1.	Environment, Natural Resources and Ecology	26
2.2.2.	The Choice and Definition of Concepts.....	28
3.	The Characteristics of Ecological Damage	29
3.1.	The Concept of Damage in Tort Law	29
3.1.1.	Damage and Relevant Concepts.....	29
3.1.2.	Definition of Damage.....	30
3.1.3.	Pecuniary and Non-Pecuniary Losses	31
3.2.	Ecological Damage: Does it Fit into the Traditional Tort Regimes?	34
3.2.1.	Damage to Owned Natural Resources	34
3.2.2.	Damage to Un-owned Natural Resources	36
3.2.2.1.	Cost of Restoration	36
3.2.2.2.	No Restoration	37
3.2.3.	Other Characteristics of Ecological Damage.....	38
4.	Definition of Compensation.....	40
5.	Conclusion.....	41
	CHAPTER 3: LEGAL RULES CONCERNING THE PREVENTION OF ECOLOGICAL DAMAGE: ECONOMIC OBSERVATIONS	45
1.	Introduction	45
1.1.	Regulation and Liability	47
2.	Liability Rules for Ecological Damage.....	50
2.1.	The Criteria in Designing Optimal Liability Rules	50
2.2.	Standing.....	51
2.2.1.	Legal Analysis.....	52
2.2.1.1.	Standing in the U.S.....	52
2.2.1.2.	Standing in the EU	53
2.2.2.	Tested in Economics.....	61
2.2.2.1.	Public Authority	62
2.2.2.2.	Environmental NGOs	63
2.2.2.3.	Individuals	64
2.3.	Liable Parties.....	65

Table of Contents

2.3.1.	Economic Analysis	65
2.3.2.	Applied to Ecological Damage	66
2.3.2.1.	Definition of Liable Party	66
2.3.2.2.	Limitation of Victims Claiming against other Parties and Recourses	68
2.4.	Liability Standards	69
2.4.1.	Economic Analysis	69
2.4.1.1.	Primary Costs.....	69
2.4.1.2.	Tertiary Costs.....	72
2.4.2.	Liability Standards for Ecological Damage.....	72
2.5.	Causation and Multiple Tortfeasors	75
2.5.1.	Economic Analysis	75
2.5.1.1.	Uncertain Causation.....	75
2.5.1.2.	Multiple Tortfeasors.....	77
2.5.2.	Applied to Ecological Damage	78
2.5.2.1.	Uncertain Causation.....	78
2.5.2.2.	Multiple Tortfeasors.....	79
2.6.	Damages	80
2.6.1.	Economic Analysis	80
2.6.2.	Applied to Ecological Damage	82
3.	The Evaluation of Liability Rules	84
3.1.	How Do Liability Rules Contribute to Prevention and Compensation? ..	85
3.1.1.	Compensation	85
3.1.2.	Prevention	86
3.2.	Remedies - Compensation Mechanisms	87
3.2.1.	Compensation	87
3.2.2.	Prevention	88
3.2.3.	Risk Spreading and Costs.....	89
4.	Conclusion.....	90
CHAPTER 4: ANALYSIS OF SPECIFIC COMPENSATION MECHANISMS.....		95
1.	Introduction	95
1.1.	A Brief Overview of Compensation Mechanisms for Ecological Damage	95
1.2.	Criteria for Compensation Mechanisms: Compensation, Prevention and Costs	98
2.	Liability Insurance.....	103
2.1.	The Basic Rationale of Liability Insurance	103
2.1.1.	Risk Aversion and the Law of Large Numbers	103
2.1.2.	Insurability	105
2.1.3.	Problems of Insurance	106
2.1.3.1.	Moral Hazard.....	106
2.1.3.2.	Adverse Selection	107

Table of Contents

2.2.	Liability Insurance for Ecological Damage	108
2.2.1.	Insurability of Liability for Ecological Damage.....	108
2.2.1.1.	Characteristics of Ecological Damage Influencing Insurability	108
2.2.1.2.	Liability Rules Influencing Insurability.....	109
2.2.2.	Moral Hazard and Adverse Selection.....	112
2.3.	The Evaluation of Liability Insurance.....	114
2.3.1.	Primary Costs (Prevention).....	114
2.3.2.	Secondary Costs (Compensation)	115
2.3.3.	Tertiary Costs	118
2.3.4.	Interaction between the Different Costs Reduction Goals.....	118
2.4.	Compulsory Insurance	120
3.	First-party and Direct Insurance	122
3.1.	Introduction: First-party Insurance and Direct Insurance	122
3.2.	The Feasibility of First-party Insurance and Direct Insurance in the Environmental Context.....	124
3.2.1.	First-party Insurance.....	124
3.2.2.	Direct Insurance.....	126
3.2.2.1.	Ecological Damage	126
3.2.2.2.	Traditional Damage	127
3.3.	The Evaluation of First-party Insurance and Direct Insurance	128
3.3.1.	First-party Insurance.....	128
3.3.1.1.	Primary Costs (Prevention).....	128
3.3.1.2.	Secondary Costs (Compensation)	128
3.3.2.	Direct Insurance.....	129
3.3.2.1.	For Ecological Damage	129
3.3.2.2.	For Traditional Damage	131
4.	Risk-sharing Agreements	131
4.1.	Introduction to Risk-sharing Agreements.....	131
4.2.	Specific Institutional Arrangements of a Risk-sharing Agreement	133
4.2.1.	Examples of Risk-sharing Agreements.....	133
4.2.2.	Institutional Arrangements.....	136
4.3.	Evaluation of Risk-sharing Agreements.....	137
4.3.1.	Primary Costs.....	137
4.3.2.	Secondary Costs.....	140
4.3.3.	Tertiary Costs	141
5.	Environmental Funds	142
5.1.	Introduction: the Various Types of Environmental Funds	142
5.1.1.	Funds with or without Risk-spreading Functions and Ways to Finance the Funds.....	144
5.1.2.	Funds Established for the Benefits of Victims and Injurers.....	145
5.1.3.	Relationship to Liability Rules and Insurance.....	146
5.2.	Evaluation of the Various Funds.....	149

5.2.1.	Environmental Funds to Cover Liability.....	152
5.2.1.1.	Environmental Funds as One Type of Financial Guarantees	152
5.2.1.2.	Funds Offering an Upper Layer of Compensation.....	152
5.2.2.	Complementary Funds.....	153
5.2.3.	Environmental Funds Irrespective of Liability.....	153
5.3.	Conclusion.....	154
6.	Security Mechanisms Provided by the Liable Party or by a Third-party Guarantor	155
6.1.	The Various Security Mechanisms	155
6.1.1.	Self-insurance and Captives.....	155
6.1.2.	Mortgages and Liens.....	157
6.1.3.	Deposits, Trust Funds and Escrow Agreements	157
6.1.4.	Corporate Guarantees, Bank Guarantees and Surety Bonds.....	157
6.2.	Analysis: From the Perspective of Compensation and Prevention	158
6.2.1.	Self-insurance and Captives.....	159
6.2.2.	Mortgages and Liens.....	160
6.2.3.	Deposits, Trust Funds and Escrow Agreements	161
6.2.4.	Corporate Guarantees, Bank Guarantees and Surety Bonds.....	161
7.	The Use of the Capital Market to Provide Coverage	162
8.	Conclusion: Comparison between Individual Instruments and Policy Recommendations	165
8.1.	Liability Insurance.....	166
8.2.	First-party Insurance and Direct Insurance	167
8.3.	Risk-sharing Agreement.....	167
8.4.	Environmental Funds	168
8.5.	Guarantees by the Polluters	169
	CHAPTER 5: COMPENSATION MODELS FOR ECOLOGICAL DAMAGE	173
1.	Introduction	173
2.	Proposed Models to Prevent and Compensate for Ecological Damage..	174
2.1.	Compensation, Liability Rules, and Insolvency	174
2.1.1.	Recalling Characteristics of Ecological Damage.....	174
2.1.2.	Mandatory Financial Security.....	175
2.2.	Models of Compensation	177
2.2.1.	Model 1: Mandatory Financial Security	177
2.2.2.	Model II: Voluntary Financial Security	182
2.2.3.	Model III: Optimal Financial Cap.....	184
3.	Towards a Multilayered Approach to Compensate for Ecological Damage	185

Table of Contents

3.1.	Factors Influencing the Choice of Instruments.....	186
3.2.	When the Liable Party is Identifiable.....	187
3.3.	When the Liable Party is not Identifiable.....	189
Part II Empirical Part		191
CHAPTER 6: COMPENSATION SYSTEMS UNDER THE INTERNATIONAL REGIME		195
1.	International Compensation System for Oil Pollution	195
1.1.	Liability Rules under the International Regimes on Compensation for Oil Pollution.....	195
1.1.1.	Liability Rules under the CLC Regime.....	196
1.1.1.1.	The Adoption of the 1969 CLC and the 1971 Fund Convention	196
1.1.1.2.	The 1984 and 1992 Protocols	197
1.1.2.	Liability Rules under the Bunker Convention.....	199
1.2.	Compensation Instruments for Oil Pollution Damage.....	200
1.2.1.	Protection and Indemnity Policies	201
1.2.2.	Compensation Funds.....	202
1.2.2.1.	The 1971 Fund.....	202
1.2.2.2.	The 1992 Fund and the winding up of the 1971 Fund.....	203
1.2.2.3.	The 2003 Supplementary Fund.....	204
1.3.	Critical Analysis.....	205
2.	The International Compensation System for Nuclear Damage	207
2.1.	International Regimes for Compensation of Nuclear Damage	209
2.1.1.	Origins of International Regimes	209
2.1.2.	First Generation of Nuclear Liability Conventions.....	210
2.1.2.1.	Strict Liability.....	211
2.1.2.2.	Channeling of Liability	212
2.1.2.3.	Limited Liability	212
2.1.2.4.	Financial Security	213
2.1.2.5.	Exclusive Jurisdiction.....	213
2.1.2.6.	Public Funding.....	214
2.1.3.	The Second Generation of Nuclear Liability Conventions	214
2.1.3.1.	General Issues	214
2.1.3.2.	The Coverage of Environmental Damage	217
2.2.	Evaluation from a Law and Economics Perspective.....	221
2.2.1.	Liability	221
2.2.2.	Financial Security	223
2.2.2.1.	Public Funds.....	223
2.2.2.2.	Insurance	224
2.2.2.3.	Pooling	226
CHAPTER 7: COMPENSATION SYSTEMS IN THE U.S.....		231
1.	Compensation System for Nuclear Damage in the U.S.....	231

1.1.	Liability for Nuclear Damage	232
1.2.	The Requirement of Financial Protection.....	236
1.2.1.	Financial Requirement for Third-party Liability.....	236
1.2.2.	Financial Requirement for Property Damage.....	238
1.2.3.	Compensation under the Convention on Supplementary Compensation.....	238
1.2.4.	Financial Requirement for Decommissioning Nuclear Facilities and Financing for Nuclear Waste Disposal	239
1.3.	The Instruments to Compensate for Nuclear Damage.....	240
1.3.1.	Nuclear Liability Insurance.....	240
1.3.1.1.	Basic Content.....	240
1.3.1.2.	Risk Differentiation	243
1.3.2.	The Retrospective Premiums Scheme.....	244
1.3.3.	The Mutual Pool for Property Damage	246
1.4.	Critical Analysis.....	247
1.4.1.	Combined Use of Regulation, Liability and Compensation Instruments	248
1.4.2.	Is there a Subsidy for the Nuclear Sector?.....	249
1.4.3.	Compulsory Financial Requirements	252
1.4.4.	Multiple Layers of Compensation Instruments	253
1.4.5.	Use of Insurance and Risk-sharing Pools	254
1.4.6.	Private Interest Approach	255
2.	The Compensation System for Natural Resources Damage in the U.S..	257
2.1.	Introduction	257
2.2.	Compensation System for Oil Pollution.....	258
2.2.1.	Liability for Oil Pollution	259
2.2.1.1.	Liability under the OPA	259
2.2.1.2.	State Statutes	263
2.2.2.	Financial Responsibility and Trust Fund	263
2.2.2.1.	Financial Responsibility: General	264
2.2.2.2.	P&I Clubs and Insurance.....	264
2.2.2.3.	Trust Fund	266
2.3.	Compensation System for Damage Caused by Hazardous Substances..	266
2.3.1.	Liability under the CERCLA.....	267
2.3.1.1.	Response Action and Natural Resources Damage.....	267
2.3.1.2.	Responsible Parties and the Scope of Liability	269
2.3.1.3.	Stringent Liability and the Relief of Liability	270
2.3.2.	Financial Responsibility and the Trust Funds under the CERCLA	272
2.3.2.1.	Financial Responsibility: General.....	272
2.3.2.2.	Insurance	273
2.3.2.3.	Trust Funds	274
2.4.	Empirical Data about Natural Resources Damage in the U.S.	275
2.5.	Economic Analysis	276
2.5.1.	Liability Rules	277

Table of Contents

2.5.1.1.	Liability Rules under the OPA.....	277
2.5.1.2.	Liability Rules under the CERCLA	279
2.5.2.	Financial Responsibility.....	282
2.5.2.1.	Financial Responsibility under the OPA.....	282
2.5.2.2.	Financial Responsibility under the CERCLA	284
2.5.3.	Trust Funds	285
2.5.3.1.	Trust Fund under the OPA	285
2.5.3.2.	Trust Fund under the CERCLA.....	285
CHAPTER 8: COMPENSATION SYSTEMS IN THE EU AND SOME EU MEMBER STATES		287
1.	The Compensation System under the ELD	287
2.	Compensation Mechanisms Used in Member States.....	293
2.1.	Liability Insurance in Germany	294
2.2.	Direct Insurance in the Netherlands	296
2.3.	Risk-sharing Agreements in Germany	299
2.3.1.	Nuclear Liability	299
2.3.2.	Pooling System	301
2.4.	Environmental Funds in the Netherlands.....	303
3.	Critical Analysis.....	304
CHAPTER 9: CONCLUSION OF PART II		309
1.	A Comparison of the Systems.....	309
2.	The Compensation Models	316
3.	The Choice between Different Compensation Instruments.....	317
4.	The Divergence of Practice from Theoretical Models and Indicators	318
4.1.	Inefficiency of Liability Rules	318
4.2.	Broad Use of Environmental Funds.....	318
4.3.	Implementation of Financial Requirement	318
Part III Towards an Efficient Compensation SYstem in China		321
CHAPTER 10: COMPENSATION SYSTEM FOR ECOLOGICAL DAMAGE IN CHINA AND POLICY RECOMMENDATIONS		323
1.	Introduction	323
1.1.	Theory: Environmental Liability in Past and Present.....	324

1.1.1.	Basis of Liability.....	324
1.1.2.	Scope of Liability: Is Natural Resources Damage Covered?.....	326
1.1.3.	Standing.....	329
1.1.4.	Causation, Multiple Tortfeasors and Burden of Proof	332
1.1.5.	Quantification	333
1.2.	Practice.....	335
1.2.1.	Who Acts after an Accident?.....	335
1.2.2.	Barriers to Access to Justice.....	336
1.2.3.	NGOs	339
1.2.4.	Remedies.....	341
1.3.	Summary	343
2.	Environmental Insurance	344
2.1.	Theory	344
2.1.1.	Statutory Background	345
2.1.2.	Theoretical Insurance Options.....	346
2.2.	Practice.....	347
2.2.1.	Insolvency Risk – Compulsory Insurance?	347
2.2.2.	Environmental Insurance in Practice	348
2.2.3.	Difficulties and Limits	352
2.3.	Summary	353
3.	Compensation for Vessel-induced Marine Oil Pollution	354
3.1.	Theory	354
3.1.1.	Scope of Compensable Damage and Quantification of Damage	354
3.1.2.	Standing.....	358
3.1.3.	Mandatory Financial Security.....	359
3.1.4.	Compensation Funds.....	360
3.2.	Practice.....	361
3.2.1.	Filing Claims	361
3.2.2.	Compensation via P&I Clubs.....	362
3.2.3.	Remedies.....	364
3.2.4.	Cases.....	365
3.2.5.	Challenges	367
4.	Economic Analysis of the Chinese Compensation System for Natural Resources Damage	367
4.1.	Liability Rules	367
4.2.	Insurance	369
4.3.	Marine Oil Pollution	370
5.	Recommendations to Improve the Compensation System.....	371
5.1.	Legal Framework.....	371
5.2.	Practical Issues	372

Table of Contents

CHAPTER 11: CONCLUSION AND POLICY RECOMMENDATIONS	375
1. Summary	377
2. Proposed Models to Prevent and Compensate for Ecological Damage..	378
3. Indicators to Choose Compensation Instruments and a Multilayered Compensation Approach	382
4. The Compensation System in China and Policy Recommendations.....	386
5. Limits and Future Research	388
SUMMARY: COMPENSATING ECOLOGICAL DAMAGE: COMPARATIVE AND ECONOMIC OBSERVATIONS	391
SAMENVATTING: COMPENSATIE VOOR ECOLOGISCHE SCHADE: RECHTSVERGELIJKENDE EN ECONOMISCHE BESCHOUWINGEN	395
POLICY DOCUMENTS, GUIDELINES, REPORTS	399
LEGISLATION.....	405
BIBLIOGRAPHY	413
CURRICULUM VITAE.....	449

LIST OF ABBREVIATIONS

AEC	Atomic Energy Commission
ANI	American Nuclear Insurers
APPA	Air Pollution Prevention Act (China)
ART	Alternative Risk Transfer
AtG	Atomgesetz
AVB	Aansprakelijkheidsverzekering Bedrijven (Liability Insurance Policy)
Bofas	Bodemsaneringsfonds voor tankstations
BP	British Petroleum
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (US)
CGAA	Coast Guard Authorization Act
CGMTA	Coast Guard and Maritime Transportation Act
CLAPV	Centre for Legal Assistance to Pollution Victims
CLC	International Convention on Civil Liability for Oil Pollution Damage
CMC	Chinese Commercial Maritime Code
COFR	Certificate of Financial Responsibility (US)
CPL	Civil Procedural Law (China)
CRISTAL	Contract Regarding an Interim Supplement to Tanker Liability for Oil Pollution
CRS	Congressional Research Service
CRTD	Civil Liability for Damage Caused during Carriage of Dangerous Goods by Road, Rail and Inland Navigation Vessels
CSC	Convention on Supplementary Compensation for Nuclear Damage
CSMAA	China Shipowners Mutual Assurance Association
CWA	Clean Water Act (US)
DOE	Department of Energy (US)
DOI	Department of Interior (US)
ECtHR	European Court of Human Rights

List of Abbreviations

EDA	Environmental Damage Prevention and Remediation Act (Germany)
EGA	Environmental Guarantee Account
EII	Environmental Impairment Insurance
EIL	Environmental Liability Insurance Policies
ELD	Environmental Liability Directive
ELINI	European Liability Insurance for the Nuclear Industry
EMANI	European Mutual Association for Nuclear Insurance
enGO	Environmental Non-Governmental Organization
ENO	Extraordinary Nuclear Occurrence
EPA	Environmental Protection Act (US)
ERF	Engineering Rating Factor
ERICAM	Environmental Risk Internalisation through Capital Markets
EU	European Union
GAO	General Accounting Office (US)
GDP	Gross Domestic Product
GDV	German Insurance Association
GONGO	Government-Organized Non-Governmental Organization
GPCL	General Principle Civil Law (China)
GPL	General Public Liability Policies
GTPL	General Third Party Liability Policies
HNS	International Convention on Liability and Compensation in Connection with Carriage of Hazardous and Noxious Substances by Sea
IAEA	International Atomic Energy Agency
Ibs	Interimwet Bodemsanering
IMO	International Maritime Organization
INPO	Institute of Nuclear Power Operations
INTERTANKO	International Association of Independent Tanker Owners
IOPCF	International Oil Pollution Compensation Fund
LRTAP	Long-Range Transboundary Air Pollution
Lugano Convention	1993 Lugano Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment
MAERP	Mutual Atomic Energy Reinsurance Pool
MAS	Milieu-aansprakelijkheidsverzekering Samenwerkingsverband (Environmental Liability Insurance)
MEP	Ministry of Environmental Protection
MEPA	Maritime Environmental Protection Act (China)
MOE	Minister of the Environment
MS	Member States (of the European Union)
MSA	Maritime Safety Agency
MSV	Milieuschadeverzekering (Dutch Environmental Damage Insurance)
NEA	OECD Nuclear Energy Agency
NEIL	Nuclear Electri Insurance Limited

NELIA	Nuclear Energy Liability Insurance Association
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priority List
NRC	Nuclear Regulatory Commission
NRD	Natural Resource Damage
OCIL	Oil Casualty Insurance Ltd.
OECD	Organization for Economic Co-operation and Development
OJ	Official Journal (of the European Union)
OPA	Oil Pollution Act (US)
OSLTF	Oil Spill Liability Trust Fund
PAA	Price-Anderson Act (US)
P&I Clubs	Protection and Indemnity Clubs
PLA	Public Liability Action
RCRA	Resource Conservation and Recovery Act (US)
RRG	Risk Retention Group
SFP	Secondary Financial Protection
SMCRA	Surface Coal Mining and Reclamation Act
SME	Small or Medium Enterprises
SOA	State Oceanic Agency
SUBAT	Stichting Uitvoering Bodemsanering Amovering Tankstations ((Foundation for the Remediation of Petrol Stations) (The Netherlands))
SWPPA	Solid Waste Pollution Prevention Act (China)
TEU	The Treat on European Union
TFEU	The Treaty on the Functioning of the European Union
TLL	Tort Liability Law (China)
TOVALOP	Tanker Owners Voluntary Agreement concerning Liability for Oil Pollution
UHV	Environmental Impairment Liability Insurance (Germany)
UK	United Kingdom
USV	Allgemeine Versicherungsbedingungen für die Umweltschadensversicherung (Environmental Damage Insurance) (Germany)
U.S.	United States
VAN	Verenigde Assurantiebedrijven Nederland
WANO	World Association of Nuclear Operators
Wbb	Wet Bodembescherming
WPPA	Water Pollution Prevention Act (China)
WTP	Willingness to Pay

LIST OF FIGURES AND TABLES

List of Figures

Figure 1: Model I: Mandatory Financial Security.....	178
Figure 2: Model II: Voluntary Financial Security.....	182
Figure 3: Model III: Optional Financial Cap.....	184

List of Tables

Table 1: Comparison among Various Compensation Instruments.....	170
Table 2: Liability Caps under the OPA.....	262
Table 3: Liability Caps under the CERCLA.....	271
Table 4: Comparison of different Compensation Systems.....	311
Table 5: The Types of Vessels and Required Financial Security in China.....	360

