



HEALTH, SAFETY, AND ENVIRONMENTAL MANAGEMENT IN OFFSHORE AND PETROLEUM ENGINEERING

Srinivasan Chandrasekaran



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Health, Safety, and Environmental Management in Offshore and Petroleum Engineering

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Preface

The regulations of risks to health, safety, and environmental management that arise from the exploration and production works in the oil and gas industries are gaining more attention in the recent past. There is a growing necessity to maintain good and healthy work-space for people on board and also to protect the fragile ecosystem. The unregulated use of chemicals or other hazardous substances in oil and gas industries can challenge the technical workforce by putting their health at risk, causing various levels of discomfort in addition to causing catastrophic damage to the offshore assets. Accidents reported in the recent past in oil and gas sector also demonstrate the seriousness of Health, Safety, and Environmental Management in this domain of workspace. The objective of the book is to share the technical know-how in the field of health, safety, and environmental management, applicable to oil and gas industries. Contents of the book are spread across four chapters, addressing the vital areas of interest in HSE, as applicable to offshore and petroleum engineering. The first chapter highlights safety assurance and assessment, emphasizing the need for safety. The second chapter focuses on the environmental issues and management that arise from oil and gas exploration. The third chapter deals with the accident modeling, risk assessment, and management, while the fourth chapter is focused on safety measures in design and operations. The book explains the concepts in HSE through a simple and straightforward approach, which makes it comfortable for practicing engineers as well. The focus however is capacity building in safety and risk assessment, which is achieved through a variety of example problems and case studies. The author's experiences in both the academia and leading oil and gas industries are shared through the illustrated case studies. The book is an important milestone in the capacity building of young engineers and preparing them for a safe exploration process. Sincere thanks are due to Centre for Continuing Education, IIT Madras for assisting in writing this book.

Srinivasan Chandrasekaran

About the Author

Professor Srinivasan Chandrasekaran is a Professor in the Department of Ocean Engineering, Indian Institute of Technology, Madras, India. He has teaching, research, and industrial experience of about 24 years during which he has supervised many sponsored research projects and offshore consultancy assignments both in India and abroad. His active areas of research include dynamic analysis and design of offshore platforms, development of geometric forms of compliant offshore structures for ultra-deep water oil exploration and production, structural health monitoring of ocean structures, seismic analysis, and design of structures and risk analyses and reliability studies of offshore and petroleum engineering plants. He was a visiting fellow under the invitation of Ministry of Italian University Research to University of Naples Federico II, Italy, for a period of 2 years during which he conducted research on advanced nonlinear modeling and analysis of structures under different environmental loads with experimental verifications. He has published about 140 research papers in international journals and refereed conferences organized by professional societies around the world. He has authored five textbooks, which are quite popular among the graduate students of civil and ocean engineering: *Seismic Design Aids for Nonlinear Analysis of Reinforced Concrete Structures* (ISBN: 978-1-4398-0914-3); *Analysis and Design of Offshore Structures with Illustrated Examples* (ISBN: 978-89-963915-5-5); *Advanced Theory on Offshore Plant FEED Engineering* (ISBN: 978-89-969792-8-9); *Dynamic Analysis and Design of Offshore Structures* (ISBN: 978-81-322-2276-7); *Advanced Marine Structures* (ISBN: 978-14-987-3968-9). His books are also recommended as reference material in many universities in India and abroad.

He also conducted two online courses under Mass Open Online Courses (MOOC) under NPTEL, GoI titled Dynamic analysis of offshore structures and HSE in oil offshore and petroleum industries. He is a member of many national and international professional bodies and has delivered many invited lectures and keynote addresses in the international conferences, workshops, and seminars organized in India and abroad. He has also delivered four web-based courses:

- Dynamic Analysis of Ocean Structures (<http://nptel.ac.in/courses/114106036/>)
- Ocean Structures and Materials (<http://nptel.ac.in/courses/114106035/>)
- Advanced Marine Structures (<http://nptel.ac.in/courses/114106037/>)
- Health, Safety and Management in Offshore and Petroleum Engineering (<http://nptel.ac.in/courses/114106017/>)

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Contents

Preface	xiii
About the Author	xiv
1 Safety Assurance and Assessment	1
Introduction to Safety, Health, and Environment Management	1
1.1 Importance of Safety	2
1.2 Basic Terminologies in HSE	2
1.2.1 What Is Safety?	5
1.2.2 Why Is Safety Important?	5
1.3 Importance of Safety in Offshore and Petroleum Industries	5
1.4 Objectives of HSE	7
1.5 Scope of HSE Guidelines	8
1.6 Need for Safety	9
1.7 Organizing Safety	10
1.7.1 Ekofisk B Blowout	10
1.7.2 Enchova Blowout	11
1.7.3 West Vanguard Gas Blowout	12
1.7.4 Ekofisk A Riser Rupture	13
1.7.5 Piper A Explosion and Fire	14
1.8 Risk	14
1.9 Safety Assurance and Assessment	15
1.10 Frank and Morgan Logical Risk Analysis	16
1.11 Defeating Accident Process	23
1.12 Acceptable Risk	24
1.13 Risk Assessment	24
1.13.1 Hazard Identification	25
1.13.2 Dose–Response Assessment	25

1.13.3	Exposure Assessment	25
1.13.4	Risk Characterization	25
1.14	Application Issues of Risk Assessment	26
1.15	Hazard Classification and Assessment	26
1.15.1	Hazard Identification	27
1.15.2	Hazard Identification Methods	28
1.16	Hazard Identification During Operation (HAZOP)	29
1.16.1	HAZOP Objectives	29
1.16.2	Common Application Areas of HAZOP	30
1.16.3	Advantages of HAZOP	31
1.17	Steps in HAZOP	31
1.18	Backbone of HAZOP	32
1.19	HAZOP Flowchart	35
1.20	Full Recording Versus Recording by Exception	35
1.21	Pseudo Secondary Words	36
1.22	When to Do HAZOP?	37
1.22.1	Types of HAZOP	38
1.23	Case Study of HAZOP: Example Problem of a Group Gathering Station	38
1.24	Accidents in Offshore Platforms	47
1.24.1	Sleipner A Platform	47
1.24.2	Thunder Horse Platform	49
1.24.3	Timor Sea Oil Rig	50
1.24.4	Bombay High North in Offshore Mumbai	50
1.25	Hazard Evaluation and Control	51
1.25.1	Hazard Evaluation	52
1.25.2	Hazard Classification	52
1.25.3	Hazard Control	53
1.25.4	Monitoring	54
	Exercises 1	54
	Model Paper	66
2	Environmental Issues and Management	68
2.1	Primary Environmental Issues	68
2.1.1	Visible Consequences	68
2.1.2	Trends in Oil and Gas Resources	68
2.1.3	World's Energy Resources	69
2.1.4	Anthropogenic Impact of Hydrosphere	69
2.1.5	Marine Pollution	70
2.1.6	Marine Pollutants	70
2.1.7	Consequence of Marine Pollutants	73

2.2	Impact of Oil and Gas Industries on Marine Environment	74
2.2.1	Drilling Operations and Consequences	74
2.2.2	Main Constituents of Oil-Based Drilling Fluid	75
2.2.3	Pollution Due to Produced Waters During Drilling	77
2.3	Drilling Accidents	78
2.3.1	Underwater Storage Reservoirs	78
2.4	Pipelines	78
2.5	Impact on Marine Pollution	79
2.6	Oil Hydrocarbons: Composition and Consequences	79
2.6.1	Crude Oil	79
2.7	Detection of Oil Content in Marine Pollution	80
2.8	Oil Spill: Physical Review	80
2.8.1	Environmental Impact of Oil Spill	80
2.9	Oil: A Multicomponent Toxicant	81
2.9.1	Oil Spill	81
2.10	Chemicals and Wastes from Offshore Oil Industry	81
2.10.1	Drilling Discharges	81
2.11	Control of Oil Spill	82
2.12	Environmental Management Issues	83
2.12.1	Environmental Protection: Principles Applied to Oil and Gas Activities	83
2.12.2	Environmental Management: Standards and Requirements	84
2.13	Ecological Monitoring	84
2.13.1	Ecological Monitoring Stages	84
2.14	Atmospheric Pollution	85
2.14.1	Release and Dispersion Models	85
2.14.2	Continuous Release and Instantaneous Release (Plume and Puff Models)	85
2.14.3	Factors Affecting Dispersion	86
2.15	Dispersion Models for Neutrally and Positively Buoyant Gas	89
2.15.1	Plume Dispersion Models	89
2.15.2	Maximum Plume Concentration	90
2.16	Puff Dispersion Model	91
2.16.1	Maximum Puff Concentration	92
2.17	Isopleths	92
2.18	Estimate of Dispersion Coefficients	93
2.18.1	Estimates from Equations	93
2.19	Dense Gas Dispersion	96
2.19.1	Britter-McQuaid Dense Gas Dispersion Model	96

2.20	Evaluation of Toxic Effects of Dispersed Liquid and Gas	97
2.21	Hazard Assessment and Accident Scenarios	99
2.21.1	Damage Estimate Modeling: Probit Model	99
2.21.2	Probit Correlations for Various Damages	102
2.22	Fire and Explosion Models	102
	Exercises 2	105
3	Accident Modeling, Risk Assessment, and Management	109
3.1	Introduction	109
3.2	Dose Versus Response	109
3.2.1	Various Types of Doses	110
3.2.2	Threshold Limit Value (TLV) Concentration	111
3.3	Fire and Explosion Modeling	112
3.3.1	Fundamentals of Fire and Explosion	112
3.4	Fire and Explosion Characteristics of Materials	112
3.4.1	Flammability Characteristics of Liquids	114
3.4.2	Flammability Characteristics of Vapor and Gases	115
3.5	Flammability Limit Behavior	115
3.6	Estimation of Flammability Limits Using Stoichiometric Balance	115
3.6.1	Stoichiometric Balance	116
3.6.2	Estimation of Limiting Oxygen Concentration (LOC)	116
3.7	Flammability Diagram for Hydrocarbons	117
3.7.1	Constructing Flammability Diagram	117
3.8	Ignition Energy	119
3.9	Explosions	120
3.10	Explosion Characteristics	120
3.11	Explosion Modeling	120
3.12	Damage Consequences of Explosion Damage	121
3.13	Energy in Chemical Explosions	124
3.14	Explosion Energy in Physical Explosions	124
3.15	Dust and Gaseous Explosion	124
3.16	Explosion Damage Estimate	125
3.17	Fire and Explosion Preventive Measures	126
3.17.1	Inerting and Purging	126
3.18	Use of Flammability Diagram	131
3.18.1	Placing a Vessel Out of Service	131
3.18.2	Placing a Vessel into Service	132
3.19	NFPA 69 Recommendations	132

3.20	Explosion-Proof Equipments	133
3.20.1	Class Systems	133
3.20.2	Group Systems	134
3.20.3	Division Systems	134
3.21	Ventilation for Storage and Process Areas	134
3.21.1	Storage Areas	134
3.21.2	Process Areas	134
3.22	Sprinkler Systems	135
3.22.1	Anti-freeze Sprinkler System	135
3.22.2	Deluge Sprinkler System	135
3.22.3	Dry Pipe Sprinkler System	135
3.22.4	Wet Pipe Sprinkler System	135
3.23	Toxic Release and Dispersion Modeling	136
3.23.1	Threshold Limit Values (TLVs)	136
3.24	Industrial Hygiene	136
3.25	Exposure Evaluation: Chemical Hazard	137
3.25.1	Time Weighted Average Method	137
3.25.2	Overexposure at Workplace	138
3.25.3	TLV-TWA Mix	138
3.26	Exposure Evaluation: Physical Hazards	138
3.27	Industrial Hygiene Control	138
3.27.1	Environmental Control	139
3.27.2	Personal Protection	139
3.28	Ventilation Hoods to Reduce Hazards	139
3.29	Elements to Control Process Accidents	140
3.30	Methods for Chemical Risk Analysis	141
3.30.1	Qualitative Risk Analysis	141
3.30.2	Quantitative Risk Analysis	141
3.31	Safety Review	142
3.32	Process Hazards Checklists	142
3.33	Hazard Surveys	142
3.34	Emergency Response Planning Guidelines	142
3.35	Chemical Exposure Index	143
3.36	Guidelines for Estimating Amount of Material Becoming Airborne Following a Release	151
3.36.1	Example Problem on Ammonia Release	151
3.36.2	Example Problem on Chlorine Release	153
3.37	Quantified Risk Assessment	154
3.38	Hazard Identification (HAZID)	154
3.39	Cause Analysis	155

3.40	Fault Tree Analysis (FTA)	155
3.41	Event Tree Analysis (ETA)	157
3.42	Disadvantages of QRA	157
3.43	Risk Acceptance Criteria	157
3.44	Hazard Assessment	159
3.45	Identify Hazards	159
3.45.1	Prioritizing Hazards	159
3.46	Risk Assessment	160
3.46.1	Identify and Implement Hazard Controls	160
3.46.2	Communicate	160
3.47	Evaluate Effectiveness	161
3.48	Fatality Risk Assessment	161
3.48.1	Statistical Analysis	161
3.48.2	Phenomena-Based Analysis	161
3.48.3	Averaging of FAR Values	162
3.49	Marine Systems Risk Modeling	162
3.49.1	Ballast System Failure	162
3.50	Risk Picture: Definitions and Characteristics	162
3.51	Fatality Risk	163
3.51.1	Platform Fatality Risk	163
3.51.2	Individual Risk	163
3.52	Societal Risk	164
3.53	Impairment Risk	164
3.54	Environmental Risk	166
3.55	Asset Risk	166
3.56	Risk Assessment and Management	167
3.57	Probabilistic Risk Assessment	167
3.58	Risk Management	167
3.58.1	Risk Preference	168
	Exercises 3	168
4	Safety Measures in Design and Operation	177
4.1	Introduction	177
4.2	Inerting or Purging	178
4.3	Terminologies	178
4.4	Factors Affecting Purging	180
4.5	Causes of Dilution or Mixing	180
4.5.1	Area of Contact	181
4.5.2	Time of Contact	181
4.5.3	Input Velocities	181

4.5.4	Densities of Gases	182
4.5.5	Temperature Effects	182
4.6	Methods of Purging	183
4.6.1	Siphon Purging	183
4.6.2	Vacuum Purging	183
4.6.3	Pressure Purging	184
4.6.4	Sweep-Through Purging	184
4.6.5	Fixed-Rate Purging	184
4.6.6	Variable-Rate or Demand Purging	185
4.7	Limits of Flammability of Gas Mixtures	185
4.8	Protection System Design and Operation	185
4.9	Explosion Prevention Systems	186
4.10	Safe Work Practices	186
4.10.1	Load Lifting	186
4.10.2	Confined Space, Excavations, and Hazardous Environments	187
4.10.3	Lockout/Tagout	187
4.10.4	Well Pumping Units	188
4.11	Hot Work Permit	188
4.12	Welding Fumes and Ventilation	190
4.13	Critical Equipments	190
4.13.1	Changes to Critical Equipment	190
4.14	Fire Prevention	191
4.15	Fire Protection	191
4.16	Grounding and Bonding	192
4.17	Other General Requirements	192
4.17.1	Performance-Based Design	192
4.17.2	Inspection of Protection Systems	195
4.18	Process Safety Management (PSM) at Oil and Gas Operations	196
4.18.1	Exemptions of PSM Standards in Oil and Gas Industries	197
4.18.2	Process Safety Information	197
4.19	Process Hazard Analysis (PHA)	198
4.20	Safe Operating Procedures	199
4.21	Safe Work Practice Procedures	200
4.21.1	Training	200
4.21.2	Pre-startup Review	200
4.22	Mechanical Integrity	201
4.23	Management of Change	201

4.24	Incident Investigation	202
4.25	Compliance Audits	202
4.26	Software Used in HSE Management	203
4.26.1	CMO Compliance	203
4.26.2	Spiramid's HSE Software	203
4.26.3	Integrum	204
4.26.4	Rivo HSE Management Software	204
	Exercises 4	204
 Application Problem: Quantified Risk Assessment of LPG Filling Station		 210
 References		 220
 Index		 226

1

Safety Assurance and Assessment

Introduction to Safety, Health, and Environment Management

Health, Safety, and Environmental (HSE) management is an integral part of any business and is considered to be extremely essential when it comes to managing business in oil and gas sectors. HSE requirements are generally laid out considering the expectations of the divisional compliance with that of the standard policies. This is the most important part of HSE through legislation in the recent decades and thus forms the basis of HSE regulations in the present era. Apart from setting out the general duties and responsibilities of the employers and others, it also lays the foundation for subsequent legislation, regulations, and enforcement regimes. HSE standards are circumscribed around activities that are “reasonably practicable” to assure safety of the employees and assets as well. HSE regulations impose general duties on employers for facilitating the employees with minimum health and safety norms and members of the public; general duties on employees for their own health and safety and that of other employees, which are insisted as regulations.

1.1 Importance of Safety

There are risks associated with every kind of work and workplace in day-to-day life. Levels of risk involved in some industries may be higher or lower due to the consequences involved. These consequences affect the industry as well as the society, which may create a negative impact on the market depending upon the level of risk involved (Ale, 2002). It is therefore very important to prevent death or injury to workers, general public, prevent physical and financial loss to the plant, prevent damage to the third party, and to the environment. Hence, rules and regulations for assuring safety are framed and strictly enforced in offshore and petroleum industries, which is considered to be one of the most hazardous industries (Arshad Ayub, 2011). The prime goal is to protect the public, property, and environment in which they work and live. It is a commitment for all industries and other stakeholders toward the interests of customers, employees, and others. One of the major objectives of the oil and gas industries is to carry out the intended operations without injuries or damage to equipment or the environment. Industries need to form rules, which will include all applicable laws and relevant industry standards of practice. Industries need to continuously evaluate the HSE aspects of equipment and services. It is important for oil and gas industries to believe that effective HSE management will ensure a good business. Continuous improvement in HSE management practices will yield good return in the business apart from ensuring goodness of the employees (Bottelberghs, 2000). From the top management through the entry level, every employee should feel responsible and accountable for HSE. Industries need to be committed to the integration of HSE objectives into management systems at all levels. This will not only enhance the business, but also increase the success rate by reducing risk and adding value to the customer services.

1.2 Basic Terminologies in HSE

ALARP: To reduce a risk to a level 'as low as reasonably practical' (ALARP). It involves balancing reduction in risk against time, trouble, difficulty, and cost of achieving it. Cost of further reduction measures become unreasonably disproportionate to the additional risk reduction obtained.

Audit: A systematic, independent evaluation to determine whether or not the HSE-MS and its operations comply with planned arrangements. It also examines whether system is implemented effectively and is suitable to fulfill the company's HSE policies and objectives.

Client: A company that issues a contract to a contractor or subcontractor. In this document the client will generally be an oil and gas exploration company that will issue a contract to a contractor to carry out the work. The contractor may then take the role of a client by issuing contract(s) to subcontractor(s).

Contract(s): An agreement between two parties in which both are bound by law and which can therefore be enforced in a court or other equivalent forum.

Contractor(s): An individual or a company carrying out work under a written or verbally agreed contract for a client.

Hazard: An object, physical effect, or condition with the potential to harm people, the environment, or property.

HSE: Health, safety, and environment. This is a set of guidelines, in which security and social responsibilities are recognized as integral elements of HSE management system.

HSE capability assessment: A method of screening potential contractors to establish that they have the necessary experience and capability to undertake the assigned work in a responsible manner while knowing how to effectively deal with the associated risks.

HSE Plan: Is a definitive plan, including any interface topics, which sets out the complete system of HSE management for a particular contract.

Incident: An event or chain of events that has caused or could have caused injury or illness to people and/or damage (loss) to the environment, assets, or third parties. It includes near-miss events also.

Inspection: A system of checking that an operating system is in place and is working satisfactorily. Usually this is conducted by a manager and with the aid of a prepared checklists. It is important to note that this is not the same as an audit.

Interface: A documented identification of relevant gaps (including roles, responsibilities, and actions) in the different HSE-MS of the participating parties in a contract, which, when added to the HSE plan will combine to provide an operating system to manage all HSE aspects encountered in the contract with maximum efficiency and effectiveness.

Leading indicator: A measure that, if adopted, helps to improve performance.

Subcontractor(s): An individual or company performing some of the work within a contract, and under contract to either the original client or contractor.

Third party: Individuals, groups of people, or companies, other than the principal contracted parties, that may be affected by or involved with the contract.