

RECOMMENDATIONS FOR THE DESIGN AND ASSESSMENT OF MARINE OIL, GAS AND PETROCHEMICAL TERMINALS



MarCom Working Group Report N° 153B – 2022

PIANC REPORT N° 153B

MARITIME NAVIGATION COMMISSION

RECOMMENDATIONS FOR THE DESIGN AND ASSESSMENT OF MARINE OIL, GAS AND PETROCHEMICAL TERMINALS

26 October 2022

PIANC has Technical Commissions concerned with inland waterways and ports (InCom), coastal and ocean waterways (including ports and harbours) (MarCom), environmental aspects (EnviCom) and sport and pleasure navigation (RecCom).

This report has been produced by an international Working Group convened by the Maritime Navigation Commission (MarCom). Members of the Working Group represent several countries and are acknowledged experts in their profession.

The objective of this report is to provide information and recommendations on good practice. Conformity is not obligatory and engineering judgement should be used in its application, especially in special circumstances. This report should be seen as an expert guidance and state-of-the-art on this particular subject. PIANC disclaims all responsibility in the event that this report should be presented as an official standard.

PIANC HQ Boulevard du Roi Albert II 20 B. 3 1000 Brussels | Belgium

http://www.pianc.org

VAT BE 408-287-945

ISBN 978-2-87223-019-8

© All rights reserved

TABLE OF CONTENTS

1	Intro	duction	1-1
	1.1	Terminology and Symbols	1-1
	1.2	Background	1-1
	1.3	Purpose and Objectives	1-1
	1.4	Applicability	
	1.5	Scope of Document	1-2
	1.6	Target Audience	
	1.7	Authorities Having Jurisdiction	1-4
	1.8	Significant Changes and Owner's Responsibilities	1-4
	1.9	Definition of 'Fitness-for-Purpose'	1-5
	1.10	Use of References	
	1.11	Overview	1-5
2		s of Reference	2-8
_	2.1	Historical Background	
	2.2	Objectives of the Report	
	2.3	Earlier Reports to be Reviewed	2-0 2-8
	2.4	Relevance to Countries in Transition	2-0 2-8
	2.5	Climate Change Considerations	2-0 2-8
	2.0	Climate change considerations	20
PART 1	– Plan	ning and Design of New and Upgrade of Existing Terminals	2-9
3	Func	tional Requirements, Basis of Design and Design Phases	3-10
_	3.1	Terminology and Symbols	
	3.2	Scope	
	3.3	Project Description	3-10 3-11
	3.4	Consenting Agencies and Authorities Having Jurisdiction	3-17
	3.5	Functional Requirements	
	0.0	3.5.1 Functional Requirements for Navigation and Terminal Layout	3 13 3-13
		3.5.2 Functional Requirements for Mooring, Berthing and Structures	
		3.5.3 Functional Requirements for Cargo Transfer and Pipelines	
	3.6	Configuration Alternatives	
	5.0	3.6.1 General	3-13 3-15
		3.6.1 General	3-13
	3.7	3.6.4 Definitions of Mooring System Alternatives	3-1/ 2 17
	3.7		3-17
		3.7.1 Primary Site Characteristics for MOGPT Design	
	2.0	3.7.2 Considerations for Metocean Criteria	
	3.8	Basis of Design	
	3.9	Equipment Requirements	
	3.10	Interface Considerations	2.00
	3.11	Design Vessels	3-22
		3.11.1 Specific Waterway Capacity	3-25
	0.10	3.11.2 Third Party Verification Requirements	
	3.12	Design Phases	3-2/
	3.13	Considerations for Upgrade of Existing Terminals	
	3.14	References	
4		Safety and Security Management	4-31
	4.1	Terminology and Symbols	
	4.2	Introduction	
	4.3	Safety Philosophy and Risk Criteria	
	4.4	Risk Control Strategy	
	4.5	Risk Assessment in Relation to Project Development	
	4.6	Hazard Management Process	
	4.7	Data Gathering	
	4.8	Hazard Identification (HAZID)	4-36
	4.9	Hazard and Operability Study (HAZOP)	
	4.10	Safety Studies and Risk Assessment	
		4.10.1 Formal Safety Studies	4-39

		4.10.2	Risk Assessment	4-41
		4.10.3	Major Accident Hazards (MAHs) Identification	4-45
	4.11		l and Recovery Measures	
	4.12	ALARP	Demonstration	4-48
	4.13		al Risk and Risk Reduction	
	4.14	Monito	ring and Review	4-49
	4.15	Safety	in Design	4-49
		4 15 1	Inherently Safe Design (ISD)	4-49
		4 15 2	Controlled Zones Concept	4-50
		4 15 3	Human Factors Engineering (HFE)	4-57
	4.16		y Risk Mitigation/International Ship and Port Facility Code Requirements_	
	4.10		Port Facility Security Assessment	
		4.16.1	Security Strategy/Implementation	1-59
		4.10.2	Port Facility Security Plan (PFSP)	1-50
			Implementation of PFSP and Audit by Recognised Security Organisation	
			Port Facility Security Design	
	4.17	Consid	erations for Upgrade of Existing Terminals	4-00
	4.17		nces	
5		Concont		5-62
,	5.1		plogy and Symbols	
	5.2			
	5.3	Tormin	al Siting Considerations	5 42
	5.5	5.3.1		
		5.3.1	Port Master planning	
		5.3.3	Site Conditions	_ 3-66
		5.3.4	Navigation and Nautical Layout	
		5.3.5	Riverine Terminals	5-68
		5.3.6	Sensitive Environmental and Social Conditions	
		5.3.7	Exclusion and Safety Zones	
	E 4	5.3.8	Safety Management and Risk Assessment	
	5.4		onditions	
		5.4.1	General	
		5.4.2	Water Levels	
		5.4.3	WindWaves and Long Period Swell (Infragravity Waves)	5-/0
		5.4.4		
		5.4.5	Currents	
		5.4.6	Seiche	
		5.4.7	Tsunamis	
		5.4.8	Visibility	5-/1
		5.4.9	Ice, Snow and Cold Weather Considerations	
			Water Quality, Temperature and Salinity	
		5.4.11	Marine Growth	_5-/2
		5.4.12	Climate Change Considerations	5-/3
		5.4.13	Bathymetry and Geophysical Surveys	5-/3
			Geology, Geotechnical and Seismic Considerations	
		5.4.15	Channel Bottom Considerations	5-74
			Dredging Considerations	
			Siltation and Maintenance Dredging	
			Slope Stability and Structural Considerations	
	5.5		pt/Configuration Selection	
		5.5.1	General	_ 5-75
		5.5.2	Key Variables in Concept/Configuration Selection	_ 5-75
		5.5.3	Decision Factors for Terminal Configuration Selection	
		5.5.4	Onshore Oil, Petrochemical and LNG Terminal Configuration Alternative 80	s_5-
		5.5.5	Floating Terminal Configuration Alternatives	5-82
		5.5.6	Transient Mooring System Alternatives	5-86
		5.5.7	Permanent Mooring System Alternatives	5-86
	5.6		al Layout and Operational Considerations	
		5.6.1	Berth Operations	5-87
		5.6.2	Marine Terminal Operational Considerations	5-88
		5.6.3	Jetty Control, Control Building and Local Control Shelter	5-89
		5.6.4	Safety Considerations for Layout	5-90

		5.6.5 Disconnectable Mooring Considerations	_ 5-91
		5.6.6 Cargo Transfer Considerations	5-92
		5.6.7 Water Intake and Outfall Considerations	5-92
		5.6.8 Physical Distance Between Moored Vessels and Space for Safe Berthing	g 5-92
		5.6.9 Datums, Coordinate Systems and Terminal References	_ 5-93
		5.6.10 Water Depth at Berth	5-94
		5.6.11 Landside Elevations and Topography Considerations	5-95
		5.6.12 Multi-Use Berths/Terminals	_ 5-95
	5.7	Jetty-Type Terminal Design Considerations	_ 5-96
		5.7.1 Basic Configuration	_ 5-96
		5.7.2 Deck Elevations	
		5.7.3 Mooring and Berthing System Configuration	_ 5-98
		5.7.4 Loading Platform Topsides Layout	5-102
		5.7.5 Access Trestle Topside Layout	5-109
		5.7.6 Other Considerations and Interface Management	5-111
	5.8	Multi-Point and Single-Point Mooring Terminal Layout Considerations	
		5.8.1 General	
		5.8.2 Multi-Point Moorings and Spread Moorings	5-112
		5.8.3 Single-Point Moorings	5-116
		5.8.3 Single-Point Moorings	5-122
		5.8.5 Interface Management Considerations	5-122
	5.9	Alternative Mooring Systems	5-123
	5.10		5-124
	5.11	References	
6	Structural		6-127
	6.1	Terminology and Symbols	
	6.2	Introduction	
	6.3	Terminal Mooring Types	
		6.3.1 Principles and Expanded Definitions	
		6.3.2 Transient Mooring	
		6.3.3 Semi-Permanent (Disconnectable) Mooring	6-129
		6.3.4 Permanent Mooring	6-131
		6.3.6 Summary of Considerations for Code Selection and Structural Design Accord	ina to
		Usage and Disconnection Premises	
	6.4	Design Codes	
		6.4.1 General	
		6.4.2 Europe 6-135	
		6.4.3 United States	6-136
		6.4.4 Additional Design Codes and Guidelines	6-137
	6.5	Loads (or Actions) on Marine Oil, Gas and Petrochemical Terminals (MOGPTs)	
	0.0	6.5.1 Dead Loads	
		6.5.2 Buoyancy	
		6.5.3 Live Loads	
		6.5.4 Wind on the Structure	
		6.5.5 Current Load on the Structure	
		6.5.6 Wave Loads on the Structure	
		6.5.7 Earth Loads on Structures	
		6.5.8 Mooring and Berthing Loads	
		6.5.9 Earthquake Loads	
		6.5.10 Ice Loads	
		6.5.11 Temperature Loads (Structural)	
		6.5.12 Tsunami Loads	
		6.5.12 Isofidifi Loads	2 1 4 4
	6.6	Load Combinations	
	0.0		0-143
		6.6.1 Europe 6-145	Z 1 4 F
		6.6.2 United States	0-145
		6.7 Upgrade of Existing Terminals	
_	A4 :: -	6.8 References	
7			7-150
	7.1	Terminology and Symbols	
	7.2	Introduction Vessel Movement and Mooring and Breasting Loads	7-150
	7.3	vessei movement and mooring and Breasting Loads	/-151

		7.3.1	Wind Loads	7-152
		7.3.2	Current Loads	7-152
		7.3.3	Wave Loads	7-152
		7.3.4	Tide, Water Level Variations and Cargo Transfers	7-153
		7.3.5	Passing Vessels	7-154
		7.3.6	lce	7-154
		7.3.7	Seiche	
		7.3.8	Tsunamis	7-155
		7.3.9	Marine growth	
	7.4	Moorin	g System Design	7-155
		7.4.1	Function of Mooring System	
		7.4.2	Safety Philosophy	
		7.4.3	Definition of Operating Limits	
		7.4.4	Operational Limits	
		7.4.5	Response	
		7.4.6	Design Methodology	
		7.4.7	Mooring Analysis	
		7.4.8	Mooring Configuration	7-164
		7.4.9	Breasting Dolphins and Fenders	7-164
			Mooring Dolphins and Quick Release Hooks	7-165
			Pre-Tensioning Characteristics and Recommendations	
			Elasticity	
			ing Technologies for Jetty Moorings	
	7.5	Moorin	g Equipment Support System Structural Design	7-171
	7.5	7.5.1	General Philosophy	
		7.5.2	Mooring Line Capacities	
		7.5.2		
		7.5.4	FendersQuick Release Hooks and Bollard Structural Design	7-173 7-174
		7.5.4	Structural Design of Support Structures	
	7.6		g and Fender Design	7 179
	7.0	7.6.1	Berthing Loads	7 170
		7.6.1 7.6.2	Factors for Abnormal Vessel Impact	
		7.6.2	Fender Calculation	
		7.6.3 7.6.4		
		7.6. 4 7.6.5	Fender Panels Fender Support Structure Design	7 102
	7.7			
	7.7		nent Hardware	7 104
		7.7.1 7.7.2	CapstansBollards	
		7.7.2 7.7.3		
			Quick Release Hooks (QRHs)	
		7.7.4	Remote Release Systems	
		7.7.5		7-186
			Docking Aid Systems	7-187
	7.0	7.7.7		
	7.8		erations for Upgrade of Existing Terminals	
_	7.9	Referei	nces	
8		ıral Materia	als and Constructability Considerations	8-193
	8.1		ology and Symbols	
	8.2	Introdu	uction	8-193
	8.3		ral Materials	
		8.3.1	Steel	
		8.3.2	Concrete	
		8.3.3	Low Temperature Splash Protection of Concrete and Steel	
		8.3.4	Steel for Low Temperature Service	
		8.3.5	Timber	
		8.3.6	Aluminium	
		8.3.7	Rock	8-198
		8.3.8	Synthetic, Composite, or Plastic Materials	8-199
		8.3.9	Backfill Material	
	8.4		uctability Considerations	8-200
		8.4.1	Selection of Resources for Construction of Terminals	8-200
		8.4.2	Protected Environments for Construction	
		8.4.3	Material Offloading Facilities	
		8.4.4	Modular Construction	

		8.4.5 Dredging and Reclamation	
		8.4.6 Piling	8-202
		8.4.7 Subsea Pipelines	8-202
		8.4.8 Safety in Design (SID)	8-203
		8.4.9 Early Contractor Involvement	8-203
		8.4.10 Decommissioning	8-203
	8.5	Environmental and Sustainability Considerations	8-203
	8.6	Considerations for Upgrades of Existing Terminals	8-204
	8.7	References	
9	Geotec	chnical Design	9-205
	9.1	Terminology and Symbols	9-205
	9.2	Introduction	
		9.2.1 Recommendations Purpose	9-206
		9.2.2 Codes	
		9.2.3 Geotechnical Engineering Design Process Elements	9-208
		9.2.4 Geotechnical Reports and Documentation	
	9.3	Geotechnical Risk Register and Risk Management Plan	9-210
	9.4	Site Selection, Data Review, Desktop Study, and Conceptual Planning	
	9.5	Development of Basis of Design	
	9.6	Geotechnical and Geophysical Field Exploration Program	9-217
	7.0	9.6.1 Exploration Program Planning and Execution	
		9.6.2 Overview of Subsurface Exploration Techniques	9 215
		9.0.2 Overview of Substitute Exploration Techniques	7-213
	0.7	9.6.3 Geotechnical Data/Factual Report	9-219
	9.7	Geological and Geotechnical Interpretation of Subsurface Conditions	
	9.8	Geotechnical Assessment and Design	9-221
		9.8.1 Geotechnical Design Report	9-221
		9.8.2 General Design Approach	9-221
		9.8.3 Geotechnical Parameters for Design	
		9.8.4 Factors of Safety	9-224
		9.8.5 Seismic Considerations	9-226
		9.8.6 Tsunamis/Seiche	9-230
		9.8.7 Non-Seismic Geohazards	9-230
		9.8.8 Construction Considerations	9-230
	9.9	Ground Improvement	9-231
	9.10	Geotechnical Support During Construction	9-232
	9.11	Maintenance Support	
	9.12	References	9-233
10	Seismic	: Design	10-235
	10.1	Terminology and Symbols	
	10.2	Introduction	
	10.3	Background	10-235
	10.4	Design Philosophy	10-237
	10.5	Difference between MOGPT Practice and Conventional Building Codes_	
	10.5		
	10.7	Performance Levels	10-237
	10.7	Classification of Structures	
	10.8		
		Acceptable Levels of Damage	
	10.10	Definition of Damage Levels	10-239
	10.11	Seismic Analysis Methods	
	10.12	Topsides Systems	
	10.13	Seismic Detailing	
	10.14	Evolving Issues	10-240
		10.14.1 Multiple Earthquakes	10-240
		10.14.2 Combination of Mooring and Earthquake Loads	
		10.14.3 Combination of Inertial and Kinematic Loading	10-241
	10.15	Considerations for Upgrades of Existing Terminals	10-241
	10.16	Considerations for LNG Terminals	10-242
	10.17	References	10-243
11	Piping o	and Pipelines	11-245
	11.1	Terminology and Symbols	11-245
	11.2	Introduction	
	11.3	Overall Design Philosophy	
	11.4	General Design Considerations	11-246
		-	

	11.5	Materials	11-247
	11.6	Pressure Relief	11-247
	11.7	Containment and Sumps	11-248
	11.8	Pipe Stress Analysis	
	11.9	Valves	
	11.10	Pipe Supports	11-249
	11.11	Subsea Pipelines	
	11.12	Low-Temperature Hoses, Piping and Equipment	11-251
	11.13	Considerations for Upgrades of Existing Terminals	
	11.14	References	
12	Mechai	nical Equipment	12-254
	12.1	Terminology and Symbols	12-254
	12.2	General Requirements	12-254
	12.3	Cargo Transfer Equipment	12-254
		12.3.1 Marine Loading Arms	12-255
		12.3.2 Marine Loading Arms for Cryogenic Service	12-256
		12.3.3 High Pressure Gas Loading Arms	
		12.3.4 Cargo Hoses	12-257
		12.3.5 High Pressure Hoses and Flexible Risers	12-258
	12.4	Ship-to-Shore Access	12-258
	12.5	Cranes and Winches	
	12.6	Vapour Control Systems	12-259
	12.7	Product Transfer Pumps	12-259
	12.8	Surge Tanks	12-260
	12.9	Flare and Vent Systems	
	12.10	Boil Off Gas (BOG) Compressors	12-260
	12.11	Considerations for Upgrades of Existing Terminals	12-261
	12.12	References	12-261
13	Electric	al Systems, Instrumentation and Controls	13-262
	13.1	Terminology and Symbols	
	13.2	Introduction	
		13.2.1 MOGPTs	13-263
		13.2.2 MOGPTs with FSRU or FSU	
	13.3	Scope	
	13.4	Design and Equipment Selection	
	13.5	Electrical Design Philosophy	13-264
		13.5.1 Local and International Codes and Standards	13-264
		13.5.2 Company Standards	13-265
		13.5.3 Other Relevant Documents or Policies	
		13.5.4 Order of Precedence	
		13.5.5 Hazardous Area Classification	
		13.5.6 Power Supply	
		13.5.7 Emergency Shutdown System	13-266
		13.5.8 Grounding, Ship Shore Isolation, and Lightning Protection	
		13.5.9 High Voltage Shore Connection or Cold Ironing (HS)	
		13.5.10 Electromagnetic Compatibility	13-266
		13.5.11 Substation Requirements	13-266
		13.5.12 Electrical Equipment and Materials	
		13.5.13 Cable Specification	
		13.5.14 Cable Installation	13-267
		13.5.15 Equipment Marking and Tagging	13-267
		13.5.16 Cybersecurity	13-267
	13.6	Hazardous Area Classification and Equipment Marking	
		13.6.1 Zone and Group System	13-268
		13.6.2 Class, Division and Group System	13-268
		13.6.3 Comparison of Zone and Class Systems	
		13.6.4 Temperature Classification	13-270
	10 =	13.6.5 Equipment Selection in Classified Areas	
	13.7	Design Guidelines for Systems and Instrumentation	
		13.7.1 Grounding	13-270
		13.7.2 High Voltage Shore Connection or Cold Ironing (HS)	
		13.7.3 Ship-to-Shore Isolation	13-271
		13.7.4 Lightning Protection	13-2/1

		13.7.5 Surge Protection	13-271
		13.7.6 Cathodic Protection Systems	
		13.7.7 Electromagnetic Compatibility	13-272
		13.7.8 Lighting Systems	
		13.7.9 Quick Release Hook Systems and Capstans	13-272
		13.7.10 Remote Release Systems	13-273
		13.7.10 Remote Release Systems	els are
		Moored Side-by-Side	13-27/
		13.7.12 Alternative Mooring Systems	13_274
		13.7.13 Docking Aid Systems	
		13.7.14 Metocean and Environmental Monitoring Systems	12 277
		13.7.15 CCTV, Perimeter Intruder Detection, and Access Control Systems	
		13.7.17 Seriate Jacks upon to all Systems	
		13.7.17 Safety Instrumented Systems	13-2/8
		13.7.18 Equipment Failure and Detection Systems	
		13.7.19 Fire and Gas Protection Systems	13-2/9
		13.7.20 Analyser Sampling Systems	13-2/9
		13.7.21 Spill Detection Systems	13-279
		13.7.22 Custody Metering	
		13.7.23 Gangways	13-279
		13.7.24 Marine Loading Arms	13-279
		13.7.25 Aids to Navigation	13-279
		13.7.26 SPM Buoy Mooring Systems	13-280
		13.7.27 Solar Power Systems	13-280
		13.7.28 Process Control Systems	
		13.7.29 Control and Monitoring Philosophy and Design	13-280
		13.7.30 Cybersecurity	13-281
		13.7.31 Emergency Shutdown Systems	13-281
		13.7.32 Ship to Shore Safety Links and Communication Systems	
		13.7.33 5-Pin Electric Link	
		13.7.34 Basic Electric SSL Systems	13-284
		13.7.35 Fibre Optic SSL Systems	
		13.7.36 LNG Terminal Considerations for a Ship-Shore Link (SSL)	13-284
		13.7.37 Considerations for Ship-Shore Links with LNG Banked Moored Vessels	
	13.8		
	13.9	Typical Standards Considerations for Upgrades of Existing Terminals	13-205
	13.10	References	
14			14-288
14	14.1	Terminology and Symbols	
	14.1	Definitions	
	14.3		14-288
	14.4		14-289
		14.4.1 Emergency Shutdown Valves	
		14.4.2 Shore/Emergency Isolation Valves Vessel Side	
		14.4.3 Fire and Gas Detection and Alarm Systems	
	14.5		14-290
	14.6	· · · · · · · · · · · · · · · · · · ·	14-290
	14.7		14-292
			14-292
		14.7.2 System Types	14-292
		14.7.3 Portable and Wheeled Fire Extinguishers	14-294
			14-294
		14.7.5 Fire Water Piping	14-295
		14.7.6 Foam Systems	14-295
		14.7.7 Dry Chemical Powders	
		14.7.8 Fire Monitors	
	14.8		14-297
	14.9		14-299
	14.10		14-299

15	Record	s, Baseline Inspection and Assessment	15-302
	15.1	Terminology and Symbols	15-302
	15.2	Records	15-302
		15.2.1 Records Components	15-303
	15.3	15.2.1 Records Components	15-304
		15.3.1 Desktop Appraisal	15-305
		15.3.2 Baseline Inspection	15-306
	15.4	Baseline Assessment	
		15.4.1 Structural Assessment	15-307
		15.4.2 Berth Operational Assessment	15-307
	15.5	Records Retention	
	15.6	References	15-308
16		ssment of Existing Facilities	16-309
10	16.1	Terminology and Symbols	
	16.1		
		Introduction	16-309
	16.3	Reasons for Reassessment	16-310
		16.3.1 Functional Changes at the Terminal	16-310
		16.3.2 Issues Arising from Changes of Ownership or User, or Vetting of a T311	
		16.3.3 Significant Deterioration	16-311
		16.3.4 Extraordinary Events	16-312
		16.3.5 Changes to Basis of Design or Design Criteria	
		16.3.6 Regulatory Compliance	16-313
		16.3.7 Classification Society Rule Compliance	
	16.4	Guidelines for Reassessment	
	16.5	References	
17	Periodio	Inspections	17-314
	1 <i>7</i> .1	Terminology and Symbols	17-314
	17.2	Introduction	
		17.2.1 Overview of Chapter Contents	17-315
	17.3	Choosing an Inspection Philosophy	17-315
	17.0	17.3.1 Time-Based Inspection Philosophy	
		17.3.2 Risk-Based Inspection Philosophy	
	17.4	Types of Inspections	
	17.4		
			17-316
		17.4.2 Condition Assessment Inspections	
		17.4.3 Regular Walkdown Inspections	
	17.5		17-317
	17.6	Structural Boundaries, Components and Systems Comprising a Facility	
	17.7	Time-Based Approach to Inspection Frequency	
		17.7.1 Frequency of Structural Inspections	
		17.7.2 Frequency of Topsides and Equipment Inspections	17-319
		17.7.3 Frequency of Navigation Route and Channel Bottom	17-320
	17.8	Risk-Based Approach to Inspection Frequency	17-320
		17.8.1 Frequency of Inspections Using Risk-Based Approach	17-321
	17.9	Inspection Team Qualifications	17-322
		17.9.1 Project Manager	17-324
		17.9.2 Team Leader	
		17.9.3 Team Members for Structural Inspections	17-324
		17.9.4 Team Members for Topsides Inspection	
	17.10	Scope of the Condition Assessment Inspection for Structural Components a	ind Systems
		17,10.1 Definition of Inspection Levels of Effort	
		17.10.2 Above Water Structure Inspection	
		17.10.2 Underwater Structure Inspection	17-026
		17.10.3 Underwater Structure Inspection	
	17.11	17.10.4 Navigation Berth and Channel Depth	
	17.11	Scope of Condition Assessment Inspection for Topside Equipment ar	
		Inspection	17-328
	17.12	Special Considerations for Piping and Subsea Pipeline Inspections	
	17.13	Special Considerations for Specific Terminal Types and Systems	
	17.14	Evaluation and Assessment	17-331

	17.15	Recommended Action Guidelines	17-333
	17.16	Documentation and Reporting	17-334
	17.17	References	
18	Post-Ev	ent Inspection	18-336
	18.1	Terminology and Symbols	18-336
	18.2	Introduction	18-336
	18.3	Purpose	
		18.3.1 Inspection Team Qualifications	
		18.3.2 Limits of Inspection	
	18.4	Scope and Methods of Inspection	
		18.4.1 Scope of Inspection	
		18.4.2 Methodology of Inspection	
	18.5	Evaluation, Assessment and Resumption of Operations	
		18.5.1 Post-Event Rating	18-338
		18.5.2 Recommended Action Guidelines	
	18.6	Documentation and Reporting	18-340
	18.7	References	18-340