NEW PIANC GUIDELINES FOR MARINE OIL & PETROCHEMICAL TERMINAL DESIGN

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Presentation Outline

• Need and Purpose
• History and Background
• Scope
• The Team
• Content of the Guidelines
• Conclusion
Need and Purpose

• Over 5,000 marine oil & petrochemical terminals globally
• But no internationally recognized standards
• Properly designed facilities can serve 50+ yrs
• Improper design can have disastrous consequences
• Proactive maintenance pays off
Need and Purpose

“Recommendations for the Design and Assessment of Marine Oil & Petrochemical Terminals”

- Voluntary guidance, not regulatory
- Written by industry, for industry
History and Background

Building on Existing Documents:

• Waterfront Design Standards of Several Countries
  • Not specific to marine oil & petrochemical terminals

• Oil Company Standards
  • Not publicly available; not globally recognized

• Industry Standards (OCIMF, ISGOTT, etc.)
  • Touch on aspects but not comprehensive
  • Mostly operationally focused

• California Marine Oil Terminal Engineering & Maintenance Standards (MOTEMS)
  • Applicable to the State of California
MOTEMS

- Published in 2005
- Focused on existing as well as new design
- First comprehensive standards, including seismic upgrades
  - Inspection, above and underwater
  - Mooring & berthing
  - Structural/geotechnical/seismic
  - Mechanical/electrical/piping
  - Fire protection
Scope of New Guidelines

• Target Audience:
  • Designers of new terminals
  • Engineers charged with inspecting, rehabilitating and upgrading existing terminals
  • Owners and operators of terminals
  • Lessors and Lessees of third party terminals
  • Marine terminal equipment manufacturers
Scope of New Guidelines

- Applicability:
  - Existing and new marine oil & petrochemical terminals
  - At-shore and Nearshore terminals
  - Sea island terminals

- Limited to marine infrastructure and ship/shore interface
  - Excludes tank farms and shoreside pipelines

- Excludes LNG terminals, floating facilities and SPMs/MBMs
The Team

- 22 members representing 12 countries:
  - Australia
  - Belgium
  - France
  - Indonesia
  - Japan
  - Kazakhstan
  - Netherlands
  - Norway
  - Singapore
  - Spain
  - United Kingdom
  - United States
The Team

Representing:
• Energy companies
• Consulting engineers
• Former regulators
• Equipment manufacturers
• Academia

Disciplines:
• Civil/structural
• Coastal/ocean
• Shipping
• Geotechnical
• Electrical/instrumentation
• Mechanical/piping
• Fire protection
• Risk management
• Compliance
USA Team Members

Ron Heffron – M&N (Chairman)
Bill Asante – ExxonMobil (representing OCIMF)
Martin Eskijian – Independent Consultant/M&N
Gayle Johnson – SGH
Jerk Kocijan – SGH
Luis Palacios - SGH
Part I – Design of New and Upgrade of Existing Terminals

- Functional Requirements, Basis of Design and Design Phases
- Risk and Hazard Analysis
- Scope and Layout
- Structural Design Codes, Loads and Load Combinations
- Mooring and Berthing
- Structural Materials and Construction
- Geotechnical Design
- Seismic Design
- Piping and Pipelines
- Mechanical Equipment
- Electrical Systems, Instrumentation & Controls
- Fire Protection and Emergency Evacuation
Part II – Inspection and Assessment of Existing Terminals

- Records, Baseline Inspection and Assessment
- Reassessment of Existing Facilities
- Periodic Inspections
- Post-Event Inspection
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Functional Requirements, Basis of Design and Design Phases
  • Concept of Operations
    • Defines the Objectives of the Facility, Including Operational Requirements
  • Functional Requirements
    • Throughput parameters
    • Storage capacity
    • Crude or product mix
    • Number of berths
    • Anticipated occupancy
  • Site Characteristics
  • Basis of Design
    • Design life
    • Vessel characteristics
    • Applicable codes
    • Basic terminal dimensions
    • Proximity issues
    • Loading requirements
    • Equipment requirements
    • Construction phasing
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Risk and Hazard Analysis
  • Data Gathering and Hazard Identification
  • Structured Method of Identifying and Evaluating Project Risk Issues
  • Quantitative Risk Assessment Method and Risk Contour
  • Key Risk Parameters Include:
    • Geographic risks
    • Environmental hazards
    • Port traffic
    • Vessel-specific issues
    • Human factors
    • Product transfer
    • Security
  • Exclusion Zones
  • Security Risk Mitigation/Intl Ship and Port Facility Code Requirements
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Scope and Layout
  • Siting and Layout Considerations
  • Hazardous Area Classification Layout Considerations
  • Navigation and Vessel Maneuvering
    • Overall Configuration Issues
      • Terminal dimensions
      • Depths
      • Elevations
      • Emergency egress
  • Interface Management Issues
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Structural Design Codes, Loads and Load Combinations
  • Load and Load Combinations Tailored to Marine Oil & Petrochemical Terminals
  • Load and Resistance Methodology is Unique to Specific Design Codes and Jurisdictions
• Guidance Provided For:
  • Europe
  • American
  • General Guidance for Others
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Mooring and Berthing
  • Philosophy of Design
  • Description of Function Behind Mooring System Components
  • Analysis Methodology, Analysis Tools, Procedures, and Boundary Conditions
  • Guidance for Load Determination
    • Wind
    • Waves
    • Current
    • Seiche
    • Tsunamis
    • Snow
    • Ice
  • Design Guidance for Mooring Components
    • $F_ZA$ Equation
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Mooring and Berthing
  • Structural Design of Support Structure(s)
    • Fail-safe progressive failure philosophy
    • Use vessels with strongest mooring line MBLs to determine WRH SWL
    • Use SWL to determine loads on structure
    • Exception may be appropriate where MBLs are higher than required for design of the MOPT
    • Design must prevent sudden failure or breakout of equipment/hooks
    • European Union vs United States approach

• Zagreb Accord

\[ F_{ZA} = SWL \times (1.0 + 0.6 \times (n-1)) \]  
[Equation 7-1]
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

- Structural Materials and Construction
  - Structural Materials
  - Pile-supported Structures
  - Concrete Caissons
  - Cellular Sheet Pile Structures
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Geotechnical Loads, Hazards and Criteria
  • Geotechnical Risk Registry and Risk Management Plan
  • Guidance for Geotechnical and Geophysical Site Investigations
  • Guidance for Establishing Site-Specific Design Criteria
    • Static loading
    • Dynamic loading
    • Dredge material management
    • Settlement
    • Seismic loading
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Seismic Design
  • Design Philosophy
  • Difference between MOPT Practice and Conventional Building Codes
  • Performance Levels
  • Earthquake Motion Level
  • Classification of Structures
  • Acceptable Levels of Damage
  • Definition of Damage Levels
  • Seismic Analysis Methods
  • Topsides Systems
  • Seismic Detailing
  • Evolving Issues
    • Multiple Earthquakes
    • Combination of Mooring and Earthquake Loads
    • Combination of Inertial and Kinematic Loading
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Piping and Pipelines
  • Guidance for Determining Loads and Displacements
    • Operational
    • Thermal
    • Transient
    • Seismic
  • Piping Systems Included
    • On top of jetty/quay
    • Piping immediately upland of marine terminal
    • Subsea pipelines
  • Components Addressed
    • Pigging
    • Stripping and sampling
    • Corrosion protection
    • Vapor control
    • Fire suppression
    • Sump/drainage
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Mechanical Equipment
  • Guidance for Determining Loads
    • Marine transfer arms
    • Hose handling equipment
    • Unloading equipment
    • Vessel access equipment
    • Fire protection equipment
    • Miscellaneous equipment and systems
  • Guidance for Selecting Equipment
    • Features and options
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Electrical Systems, Instrumentation & Controls
  • Electrical Design Philosophy
  • Design and Equipment Selection
  • Guidance on Hazardous Area Classification
  • Guidance on System Design
    • Power supply and distribution
    • Emergency back-up power
    • Emergency shutdown
    • Lighting protection
    • Grounding
    • Lighting and navigation aids
    • Cathodic protection
    • Instrumentation and control
Content of the Guidelines – Part I
Design of New and Upgrade of Existing Terminals

• Fire Protection and Emergency Evacuation
  • Guidance on Standards, Types of Fires, and Typical Extinguishing Materials
  • Fire Prevention and Isolation
    • Materials, spacing, ignition sources
    • Focus on isolation
  • Alarm and Signaling Systems
  • Fire Detection
    • Smoke, gas & flame detection
    • Alarm and signal systems
  • Fire Suppression
  • Emergency Egress
Content of the Guidelines – Part II
Inspection and Assessment of Existing Systems

• Records, Baseline Inspection and Assessment
  • Guidance for Record Keeping
    • Terminal layout drawings
    • Structural record drawings
    • Berth operational parameters and limits
    • Water depth
    • Fender system details
    • Mooring points
    • Mechanical and electrical systems
    • Fire protection systems
  • Guidance for Baseline Inspections
Content of the Guidelines – Part II

Inspection and Assessment of Existing Systems

- Reassessment of Existing Facilities
  - Guidance on “Triggers” for Assessment
  - Functional Changes at Terminal
    - Change in vessel size (sail area, deeper draft)
    - Change in water depth (and resulting allowable vessel draft)
    - Equipment upgrades for code compliance
    - Increase of loads due to dual-purpose use or new equipment
    - External factors such as new large vessels passing terminal
  - Issues Arising through Vetting or from the Purchase or Lease of a Terminal
  - Significant Deterioration
  - Extraordinary Events
  - Water Level and Channel Bottom Changes
  - Regulatory Compliance
Content of the Guidelines – Part II

Inspection and Assessment of Existing Systems

• Periodic Inspections
  • Choosing an Inspection Philosophy
    • Time-based inspection philosophy
    • Risk-based inspection philosophy
  • Limits of Inspection
  • Structural Boundaries, Components and Systems
  • Guidance on:
    • Inspection frequency
    • Inspection team qualifications
    • Scope of the inspection effort
    • Evaluation and ratings
    • Follow-up activities
    • Documentation
    • Reporting
Content of the Guidelines – Part II
Inspection and Assessment of Existing Systems

• Post-Event Inspections
  • Guidance on Providing “Fitness for Purpose” Inspections After Event
  • Accidental or Environmental Events:
    • Vessel impact
    • Earthquakes
    • Cyclones
    • Fire or explosion
    • Flooding
    • Tsunamis or other high wave events
  • Additional Guidance:
    • Qualifications of the inspection team
    • Scope and focus of the inspection effort
    • Rating system
    • Follow-up activities
What’s Next?

• PIANC Working Group 153
  • Group Lives On!
  • Update to Incorporate LNG Terminals
  • Updates to Address Issues and Feedback
How to Order

PIANC Website:
http://www.pianc.org/edits/technicalreportsbrowseall.htm#MarCom
Questions?

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

The World Association for Waterborne Transport Infrastructure