MARINE OIL TERMINAL
ENGINEERING AND MAINTENANCE STANDARDS

MOTEMS AUDIT MANUAL

CALIFORNIA STATE LANDS COMMISSION

MARINE ENVIRONMENTAL PROTECTION DIVISION

May 5, 2017

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TABLE OF CONTENTS

PREFACE

The Lempert-Keene-Seastrand Oil Spill Prevention and Response Act of 1990 charged the California State Lands Commission with the responsibility of adopting regulations to protect the public health, safety, and the environment for marine oil terminals (MOTs) in California. The Marine Environmental Protection Division (Division) provides regulatory oversight of the MOTs and has developed the Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS) to establish minimum engineering, inspection and maintenance criteria for preventing oil spills at MOTs.

MOTEMS is enforceable as Chapter 31F of the California Building Code and requires MOT operators to perform periodic audits and inspections (both above and below the waterline) to assess structural and non-structural systems' integrity and confirm continued "fitness-for-purpose". These audits and inspections involve structural, seismic, geotechnical, mooring, berthing, fire protection, piping/pipeline, mechanical, electrical and corrosion evaluations. For example, berthing and mooring systems must be adequate for vessels calling at each berth, hazards must be mitigated, and modern seismic standards must be satisfied. Audits comprise both field work and engineering analyses to ensure that MOTs operate within their inherent structural and system constraints. New MOTs and berthing systems are required to have MOTEMS compliance evaluations (analyses and designs) prior to construction, and an initial audit of the "as-built" MOT prior to commencement of operations.

This MOTEMS Audit Manual, including guidelines, checklists and supplemental tables, was developed to help MOT operators in conducting audits to verify compliance with the 2016 MOTEMS. The Audit Manual provides a structured template for methodically documenting characteristics and assessing compliance of MOTs. The MOTEMS audits may be conducted in accordance with the guidelines provided in this Manual and the overall audit requirements specified in MOTEMS Section 3102F.

The Audit Manual includes checklists and supplemental tables for the first 11 Sections (i.e. Sections 3101F through 3111F) of MOTEMS. While not required for MOTEMS compliance purposes, these checklists and supplemental tables have proven to be useful tools for compliance assessment and communications between terminal owners and operators, audit teams and the Division. This draft MOTEMS Audit Manual (May 5, 2017) is a work in progress and the Division welcomes suggestions for its improvement.

GENERAL MOTEMS AUDIT PROCESS

For conducting a MOTEMS Audit, the following steps are involved:

PRE-INSPECTION ACTIVITIES

1. Basic information about an MOT shall be collected including, but not limited to:
    - Physical Boundaries of the MOT
    - Facility Description
    - Facility and Berth Layout Drawings
    - Product Type, Throughput & Flow Rates
    - Previous Audit & Inspection Reports
    - Executive Summary (ES) Tables
    - Systems & Equipment Capacities and Specifications
    - Terminal Operating Limits (TOLs), Vessel Sizes and Environmental Limits
    - Mooring and Berthing Analyses
    - Pipeline & Instrumentation Diagrams (P&IDs)
    - Operating and Emergency Procedures
    - Mooring Hardware and Fender Capacities
    - Geotechnical Information
    - Fire Protection Assessment
    - Electrical Hazardous Area Classification Diagrams
    - Electrical One Line Drawings
    - As-Built MOT Drawings
2. A pre-audit meeting should be held between the audit team and MOT Project Manager, and may include representatives from the Division. The Audit Team Leader shall present the objective and purpose of the audit and the relevant background information from MOTEMS Section 3102F.

3. The Audit Team Leader shall define the team organization, and assign clear tasks and responsibilities to all team members, particularly for overlapping tasks. For example, a clear boundary shall be defined between above and below water inspections. The Audit Team Leader shall verify that each team member satisfies the minimum qualifications specified in MOTEMS Section 3102F.3.4.

4. A definite understanding of the audit procedures is required for the success of the audit program. Therefore, before the pre-audit meeting, the team members should review MOTEMS Section 3102F requirements and relevant MOTEMS and Audit Manual Sections.

5. The audit team should conduct a general on-site walk-through, and the MOT Project Manager should make available to the team any necessary documentation and personnel needed to answer their questions.

6. Prior to starting field inspections, "as-built" documentation shall be reviewed. Review shall include all changes since the previous audit. For example, modification and/or replacement of structural components, electrical/mechanical equipment and operations, new construction, and maintenance manuals.

INSPECTION ACTIVITIES

7. During field inspections, discrepancies between documentation and actual installations shall be noted and marked. If "as-built" documentation is not available, incomplete or inaccurate, baseline inspection may be required to gather data in sufficient detail for adequate evaluation.

8. Conduct comprehensive structural (above and below water), mechanical, electrical and corrosion inspections. Findings shall be reported, including supporting data, photographs and sketches.

POST-INSPECTION ACTIVITIES

9. Complete Audit Manual tables and inspection report documentation. Compare findings to previous audits and identify progression and patterns of deterioration.

10. A summary of structural, mooring and berthing, mechanical and electrical deficiencies found during the inspection shall be recorded. In preparation for populating Tables ES-1A and ES-1B, necessity for additional structural, geotechnical, mooring/berthing and pipeline analyses shall be identified.

11. At the conclusion of the on-site inspection, the Audit Team should advise the MOT's Project Manager and/or management of the team's preliminary findings. Recommendations for correction of the deficiencies and follow-up actions with appropriate timing should also be part of this discussion.

EXECUTIVE SUMMARY TABLES

12. The MOTEMS audit and inspection results shall be summarized in the following:

    - Table ES-1A Global Operational Structural Assessment Ratings (OSARs)
    - Table ES-1B Global Seismic Structural Assessment Ratings (SSARs)
    - Table ES-1C Global Inspection Condition Assessment Ratings (ICARs)
    - Table ES-2 Component Deficiency Remedial Action Priorities (RAPs)

13. Tables ES-1A, 1B and 1C (MOTEMS Tables 31F-2-7A through 7C) are intended to assert an MOT's overall fitness-for-purpose for operational (i.e. operating, mooring and berthing), seismic (including oil transfer pipelines) and inspected conditions (based on above and below water structural inspections). Assessment ratings are assigned to structures, systems and overall berths in the form of operational structural (OSARs), seismic structural (SSARs) and inspection condition (ICARs) assessment ratings in Tables ES-1A, 1B and 1C, respectively.

14. Table ES-2 (MOTEMS Table 31F-2-8) is intended to summarize the MOT's structural, mechanical and electrical deficiencies and assigned remedial action priorities (RAPs). Each deficiency shall be described in sufficient detail to properly convey magnitude and extent to justify the assigned rating.

15. The Assessment Ratings (OSARs, SSARs, ICARs) are required for structural systems, whereas Remedial Action Priorities (RAPs) are specified for structural components and the mechanical and electrical system deficiencies.

16. The Assessment Ratings (OSARs, SSARs, ICARs) and Remedial Action Priority (RAP) ratings shall be assigned per MOTEMS Tables 31F-2-4 & 31F-2-5, and justified in the inspection reports by supporting data, photographs and sketches. These ratings shall not be contingent on the proposed future mitigations or imposed restrictions at the MOT.

17. The MOTEMS ES Tables are structured to concisely communicate a MOT's fitness-for-purpose status, based on audit, inspection and evaluation results.

These Tables are required to be maintained up-to-date in accordance with the MOTEMS Section 3102F.3 requirements.

18. All ES Tables shall be prepared in Microsoft Excel according to the strict formatting requirements (including footnotes) in example MOTEMS Tables 31F-2-7A, 7B, 7C and 8. All tables shall be assigned Revision # in the title block for tracking purposes. Excel templates can be found on the Division website.

AUDIT REPORT

19. The Audit report shall be compiled per MOTEMS Section 3102F.3.8.

20. At the beginning of the audit report, the following information shall be provided in the order specified below:

    a. Audit report transmittal cover letter endorsed by the MOT Project Manager

    b. Table of Contents

    c. Signature pages for all MOTEMS Audit Sections

    d. Audit Team Organization Chart

    e. Audit Report Executive Summary

    f. All ES Tables

21. MOTEMS Audit Report shall follow these requirements:

    - The MOTEMS Initial Audit shall include “as-built” documentation for installations, attached within the audit report’s applicable sections.
    - MOTEMS Audits shall be referenced by the month and year of its completion and not as Revision 1, Revision 2, etc. This is important to eliminate confusion with the ES Tables Revision #s.
    - The Initial and Subsequent Audits comprise a compendium of sequential MOTEMS compliance records that shall be maintained and readily accessible at the MOT.
    - MOTEMS Audit report(s) shall be submitted in hard copy and electronic format. The Division does not accept “Draft” reports.

SECTION 3101F
AUDIT GUIDELINES

GENERAL

1. The Section 3101F Audit generally covers an overview of the MOTEMS applicability, spill prevention, oil spill exposure classification, management of change, and review requirements. This section also provides guidelines about grant of MOTEMS alternatives.

2. Review "General MOTEMS Audit Process" described in this Audit Manual.

3. Complete Tables 1-1 thru 1-9.

LIST OF TABLES

TABLE 1-1

SUMMARY OF IDENTIFIED DEFICIENCIES

CHECKLIST ITEM # FROM TABLE 1-3	DEFICIENCY ITEM LABEL IN TABLE ES-2	RAP RATING	DESCRIPTION OF DEFICIENCY	RECOMMENDED ACTION OR MITIGATION

TABLE 1-2

SUMMARY OF MISSING OR UNKNOWN INFORMATION

CHECKLIST ITEM # FROM TABLE 1-3	DESCRIPTION OF MISSING OR UNKNOWN INFORMATION*
* **If Missing or Unknown Information is a Deficiency, Identify in Table 1-1**	

TABLE 1-3
AUDIT CHECKLIST

ITEM #	QUESTION	RESPONSE	RAP RATING
3101F.3 GENERAL			
1.3.1	If MOT is “existing,” list all new structurally independent components or systems added since the previous audit.		
1.3.2	If MOT is “existing,” list all new (non-replacement) equipment, piping, pipeline, components or systems added since the previous audit.		
1.3.3	If MOT is “existing,” list major repairs, installations or modifications to in-place systems since the previous audit.		
1.3.4	List "in-kind" equipment, component or system replacement since the previous audit. Provide details.		
3101F.5 SPILL PREVENTION			
1.5.1	Specify the date of the MOT’s Oil Spill Contingency Plan (OSCP).		
1.5.2	Include a copy of OSCP Risk and Hazards Analysis (RHA). If there is no change since the last audit, provide reference to previous submittal.		
1.5.3	Is the RHA completed per CCPS guidelines? Identify the CCPS version utilized.		
1.5.4	Have there been any physical (structures, equipment, etc.) changes to the MOT since the OSCP date that may impact the RHA conclusions? Describe.		
1.5.5	Have there been any operational changes to the MOT since the OSCP date that may impact the RHA conclusions? Describe.		
1.5.6	Have any new hazard been identified since the OSCP date that may impact the RHA conclusions? Describe.		
1.5.7	Have all mitigations documented in the RHA been resolved?		
1.5.8	Record any outstanding mitigations as deficiencies in Table 1-1 and Table ES-2.		
3101F.6 OIL SPILL EXPOSURE CLASSIFICATION			
1.6.1	What is the MOT’s Oil Spill Exposure Classification per MOTEMS Table 31F-1-1?		

ITEM #	QUESTION	RESPONSE	RAP RATING
1.6.2	Has the MOT's Oil Spill Exposure Classification changed since the previous Audit Report? If yes, describe which category in MOTEMS Table 31F-1-1 has changed.		
1.6.3	Describe the scenario governing the MOT's Oil Spill Exposure Classification.		
1.6.4	Maximum cargo transfer rate (q_c) [BBL/HR]		
1.6.5	Time for closure of emergency shut-down (ESD) valve		
1.6.6	Stored volume of oil (V_S) during transfer [BBL]		
1.6.7	Flowing volume of oil (V_F) during transfer [BBL]		
1.6.8	Total volume of oil (V_T) during transfer [BBL]		
3101F.7 MANAGEMENT OF CHANGE			
1.7.1	Have physical changes been made to the MOT since the previous audit that significantly impact operations?		
1.7.2	Did the MOC process consider: (a) Materials or products handled? (b) Equipment used or installed? (c) Operations and procedures?		
3101F.8 REVIEW REQUIREMENTS			
1.8.1	Is there a process to ensure quality assurance of this audit report?		
3101F.9 ALTERNATIVES			
1.9.1	List all MOTEMS alternatives granted by the Division in Table 1-8.		

TABLE 1-4

GENERAL TERMINAL DESCRIPTION

NAME	
ADDRESS	
MOTEMS PROJECT MANAGER	
MOTEMS PROJECT MANAGER CONTACT INFO	
DATE OF COMMENCEMENT OR RECOMMENCEMENT OF OPERATIONS AT MOT	

TABLE 1-5

GENERAL BERTHING SYSTEMS DESCRIPTION

BERTH NAME	MAXIMUM # OF TRANSFERS PER YEAR	# TOLS PER BERTH	IS THIS A MULTIUSE TERMINAL? (I.E. OTHER THAN LIQUID BULK)

TABLE 1-6

PRODUCTS TRANSFERRED PER BERTH

BERTH NAME	PRODUCT (HYDROCARBON AND NON-HYDROCARBON)	PRODUCT FLASH POINT

TABLE 1-7

VESSEL INFORMATION

BERTH NAME	MAXIMUM VESSEL SIZE DWT	MAXIMUM VESSEL SIZE LOA	MAXIMUM VESSEL SIZE BEAM	MAXIMUM VESSEL ARRIVAL DISPLACEMENT

TABLE 1-8
MOTEMS ALTERNATIVES*

DATE	DESCRIPTION

*** This table is intended to chronologically log all MOTEMS alternatives granted to the MOT. Attach copies of the Division letters documenting alternatives. Alternatives in previous audit reports shall remain listed, but need not be attached. If previous alternatives are no longer valid, their status shall be indicated utilizing strikethrough text.**

TABLE 1-9

ATTACHMENTS*

ATTACH. NUMBER	AUDIT YEAR	REFERENCE TITLE	DESCRIPTION

*** For Section 3101F, this table is intended to chronologically log all MOTEMS Audit attachments starting from the Initial Audit. Attachments in previous audit reports shall remain listed, but need not be attached. If previous attachments are no longer valid, their status shall be indicated utilizing strikethrough text.**

SECTION 3102F
AUDIT GUIDELINES

GENERAL

1. The Section 3102F Audit requires condition review of structural, mechanical and electrical components and systems at Marine Oil Terminals (MOTs). For this purpose, MOTs are divided into “berthing systems”. A berthing system consists of the wharf and supporting structure, mechanical and electrical components that serve the berth. For more information, refer to MOTEMS Section 3102F.1.3.

2. Prior to starting field inspections, “as-built” conditions for all berthing systems shall be reviewed. Review shall include, but not be limited to, any modification and/or replacement of structural components or electrical/mechanical equipment after previous audit, operational changes, new construction including design drawings, calculations, engineering analyses, equipment manuals, specifications, shop drawings, technical and maintenance manuals.

3. Discrepancies between documentation and actual installations shall be marked and noted.

4. If “as-built” or subsequent modification drawings are not available, incomplete or inaccurate, a baseline inspection is required to gather data in sufficient detail for adequate evaluation.

5. New inspection findings shall be compared to previous MOTEMS Audit results to identify and report progression and patterns of damage/deterioration.

6. Photographs, sketches and supporting data shall be utilized to record and report the observed conditions and deficiencies, and to justify the assessment ratings (ICAR, OSAR, SSAR and RAPs) assigned.

7. Complete Tables 2-1 thru 2-19, as appropriate.

8. Remedial Action Priority (RAP) ratings shall be assigned according to MOTEMS Table 31F-2-5.

STRUCTURAL SYSTEM INSPECTION

A structural system inspection is to be performed on all structural elements to:

- Locate and record structural components or systems with deficiencies that may result in any local or global reduction in the capacity of the structure(s).
- Locate and record gross damage to the overall structure(s).
- Record any structural modifications or changes in operational use of the marine oil terminal.

Checklists are included at the end of this section for use in completing the inspection of structural components and systems. In addition to the checklists provided, field notes, sketches and photographs should be used as needed to record any additional information. As-built drawings of structures are often available, and are valuable for verifying structure layout and dimensions, and for locating structural modifications, anomalies, or areas of gross damage.

INSPECTION EQUIPMENT

Generally, the inspection of the above water portion of the marine terminal structure does not require sophisticated testing equipment. The equipment may include, but is not limited to, measuring apparatus (calipers, tape, wheel), pit gauge, UT, hammer and pick, scraper/knife/wire brush (for removal of corrosion and marine growth), drag chain tool, camera and/or video (above and underwater) and a small work boat (to view below-deck structural members).

The inspection of underwater items requires essentially the same equipment as that for the above water inspection, plus any specialized diving apparatus, and non-destructive or partially destructive testing equipment, as required for a Level III inspection.

STRUCTURAL DESCRIPTION OF DAMAGE

Structural elements in marine environments are subject to deterioration due to biological or chemical means, as well as mechanical damage or overloading. Definitions of defect types and deterioration mechanisms for steel, concrete, and timber structural members under marine conditions are described in MOTEMS reference [2.2] and provided herein.

COMPONENT EVALUATIONS

During the structural inspection, documentation of the types of defects and their general severity is required; however, documentation of the exact size and location of each defect or deficiency is typically not necessary. Instead, a severity rating should be assigned to each structural element inspected, based on the level of defect or deterioration observed. Tables C2-1 through C2-4, present severity rating terms for steel, reinforced concrete, prestressed concrete, and timber members, with a brief description of the levels of defects that would warrant each rating.

Representative depictions of the different categories of condition assessment ratings for steel, reinforced concrete, prestressed concrete, and timber members are presented in Figures C2-1 through C2-4 (below).

During an inspection, in cases where deterioration or damage to a member appears to have occurred as a result of overstress due to operational loads, a determination should be made by the inspectors as to whether or not the loads causing the overstress are still present and active.

TABLE C2-1

SEVERITY RATING FOR STEEL ELEMENTS

SEVERITY RATING	EXISTING DAMAGE	DEFECTS INDICATING HIGHER DAMAGE GRADE(S)
NOT INSPECTED	Not inspected, inaccessible or passed by[1]	
NO DAMAGE	• Protective coating intact • Light surface rust	
MINOR	• Less than 50 percent of perimeter or circumference affected by corrosion at any elevation or cross section • Loss of thickness up to 15 percent of nominal at any location	Minor damage not appropriate if: • Changes in straight line configuration or local buckling • Corrosion loss exceeding fabrication tolerances (at any location)
MODERATE	• Over 50 percent of perimeter or circumference affected by corrosion at any elevation or cross section • Loss of thickness 15 to 30 percent of nominal at any location	Moderate damage not appropriate if: • Changes in straight line configuration or local buckling • Loss of thickness exceeding 30 percent of nominal at any location
MAJOR	• Partial loss of flange edges or visible reduction of wall thickness on pipe piles • Loss of nominal thickness 30 to 50 percent at any location	Major damage not appropriate if: • Changes in straight line configuration or local buckling • Perforations or loss of wall thickness exceeding 50 percent of nominal
SEVERE	• Structural bends or buckling, breakage and displacement at supports, loose or lost connections • Loss of wall thickness exceeding 50 percent of nominal at any location	

(1) If not inspected because of inaccessibility, note as such.

FIGURE C2-1

SEVERITY RATING FOR STEEL MEMBERS

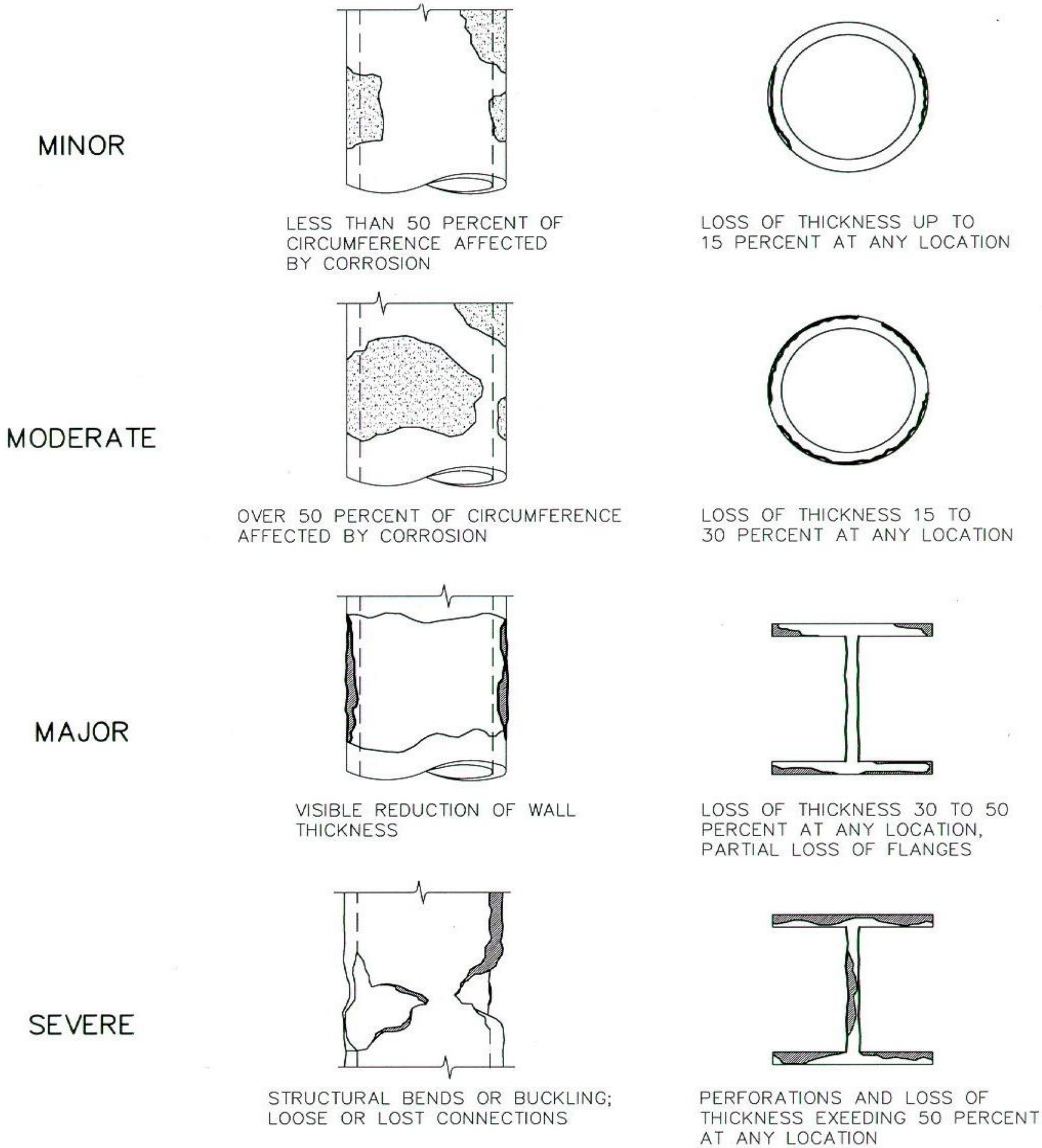


TABLE C2-2

SEVERITY RATINGS FOR REINFORCED CONCRETE ELEMENTS

SEVERITY RATING	EXISTING DAMAGE	DEFECTS INDICATING HIGHER DAMAGE GRADE(S)
NOT INSPECTED	Not inspected, inaccessible or passed by(1)	
NO DAMAGE	Good original surface, hard material, sound	
MINOR	• Mechanical abrasion or impact dents up to 1 in. in depth • General cracks up to 1/16 in. in width • Occasional corrosion stains or small pop-out corrosion spalls	Minor damage not appropriate if: • Structural damage • Corrosion cracks • Chemical deterioration(2)
MODERATE	• Structural cracks up to 1/16 in. in width • Corrosion cracks up to 1/4 in. in width • Chemical deterioration(2): Random cracks up to 1/16 in. in width; “Soft” concrete and rounding of corners up to 1 in. deep	Moderate damage not appropriate if: • Structural breakage and/or spalls • Exposed reinforcement • Loss of cross section due to chemical deterioration beyond “rounding of corner edges”
MAJOR	• Structural cracks 1/16 in. to 1/4 in. in width and partial breakages (structural spalls) • Corrosion cracks wider than 1/4 in. and open spalls (excluding pop-outs) • Multiple cracking and disintegration of surface layer due to chemical deterioration	Major damage not appropriate if: • Loss of cross section exceeding 30 percent due to any cause

SEVERITY RATING	EXISTING DAMAGE	DEFECTS INDICATING HIGHER DAMAGE GRADE(S)
SEVERE	• Structural cracks wider than 1/4 in. or complete breakage. Loss of bearing and displacement at connections • Complete loss of concrete cover due to corrosion of reinforcing steel with over 30 percent of diameter loss for any main reinforcing bar • Loss of concrete cover (exposed steel) due to chemical deterioration • Loss of over 30 percent of cross section due to any causes described above	

(1) Same as footnote 1 on previous table.

(2) Chemical Deterioration: Sulfate attack, alkali-silica reaction or ettringite distress.

FIGURE C2-2

SEVERITY RATINGS FOR REINFORCED CONCRETE MEMBERS

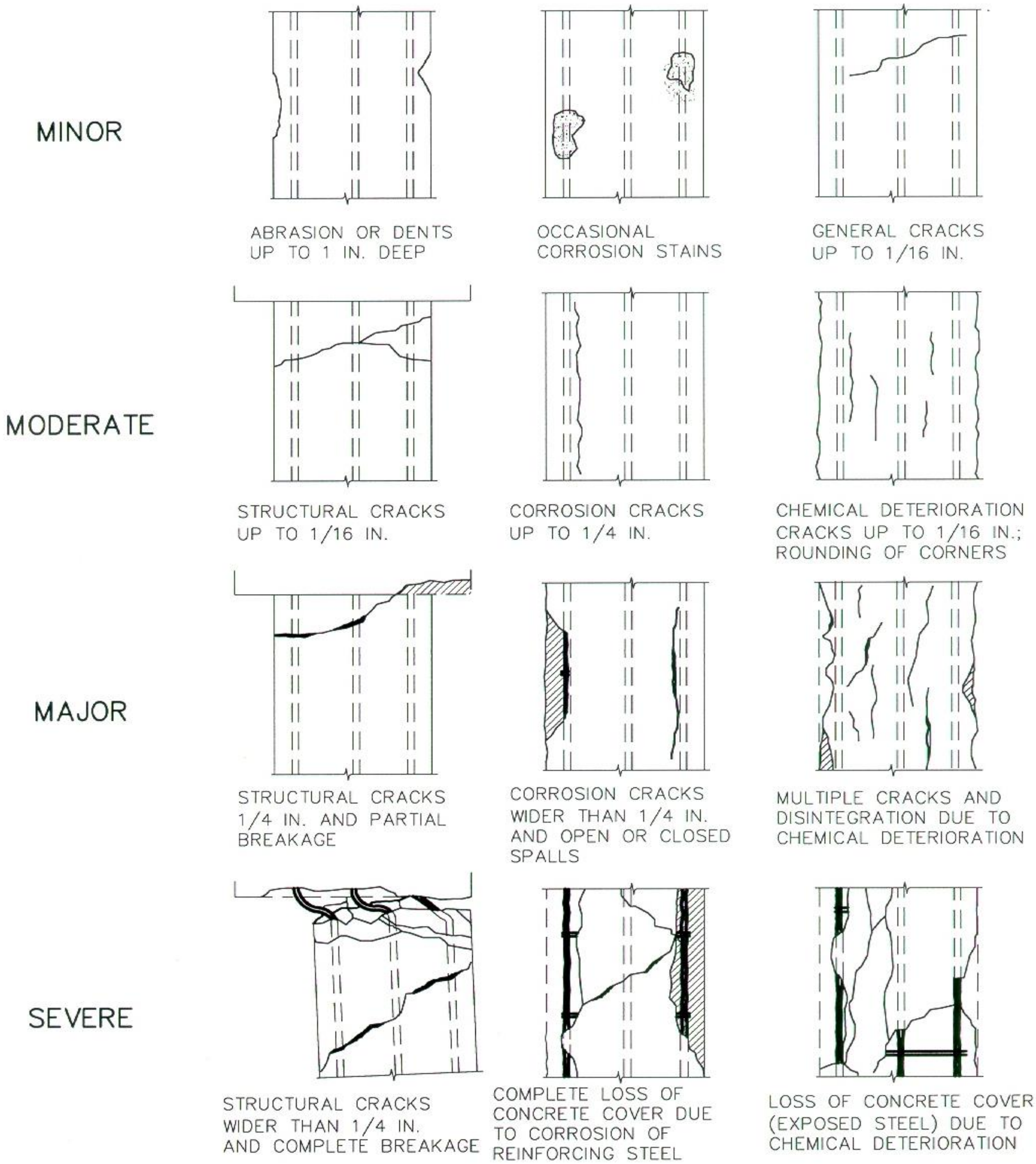


TABLE C2-3

SEVERITY RATINGS FOR PRESTRESSED CONCRETE ELEMENTS

SEVERITY RATING	EXISTING DAMAGE	DEFECTS INDICATING HIGHER DAMAGE GRADE(S)
NOT INSPECTED	Not inspected, inaccessible or passed by[(1)]	
NO DAMAGE	Good original surface, hard material, sound	
MINOR	Minor mechanical or impact spalls up to 0.5 in. deep	Minor damage not appropriate if: • Structural damage • Corrosion damage • Chemical deterioration(2) • Cracks of any type or size
MODERATE	• Structural cracks up to 1/32 in. in width • Chemical deterioration: random cracks up to 1/32 in. in width	Moderate damage not appropriate if: • Structural breakage and/ or spalls • Corrosion cracks • Loss of cross section in any form • “Softening” of concrete
MAJOR	• Structural cracks 1/32 in. to 1/8 in. in width • Any corrosion cracks generated by strands or cables • Chemical deterioration: cracks wider than 1/16 in. “Softening” or concrete up to 1 in. deep	Major deterioration not appropriate if: • Exposed prestressing steel
SEVERE	• Structural cracks wider than 1/8 in. and at least partial breakage or loss of bearing • Corrosion spalls over any prestressing steel • Partial spalling and loss of cross section due to chemical deterioration	

(1) Same footnote as in previous table

(2) Chemical Deterioration: Sulfate attack, alkali-silica reaction or ettringite distress.

FIGURE C2-3

SEVERITY RATINGS FOR PRESTRESSED MEMBERS

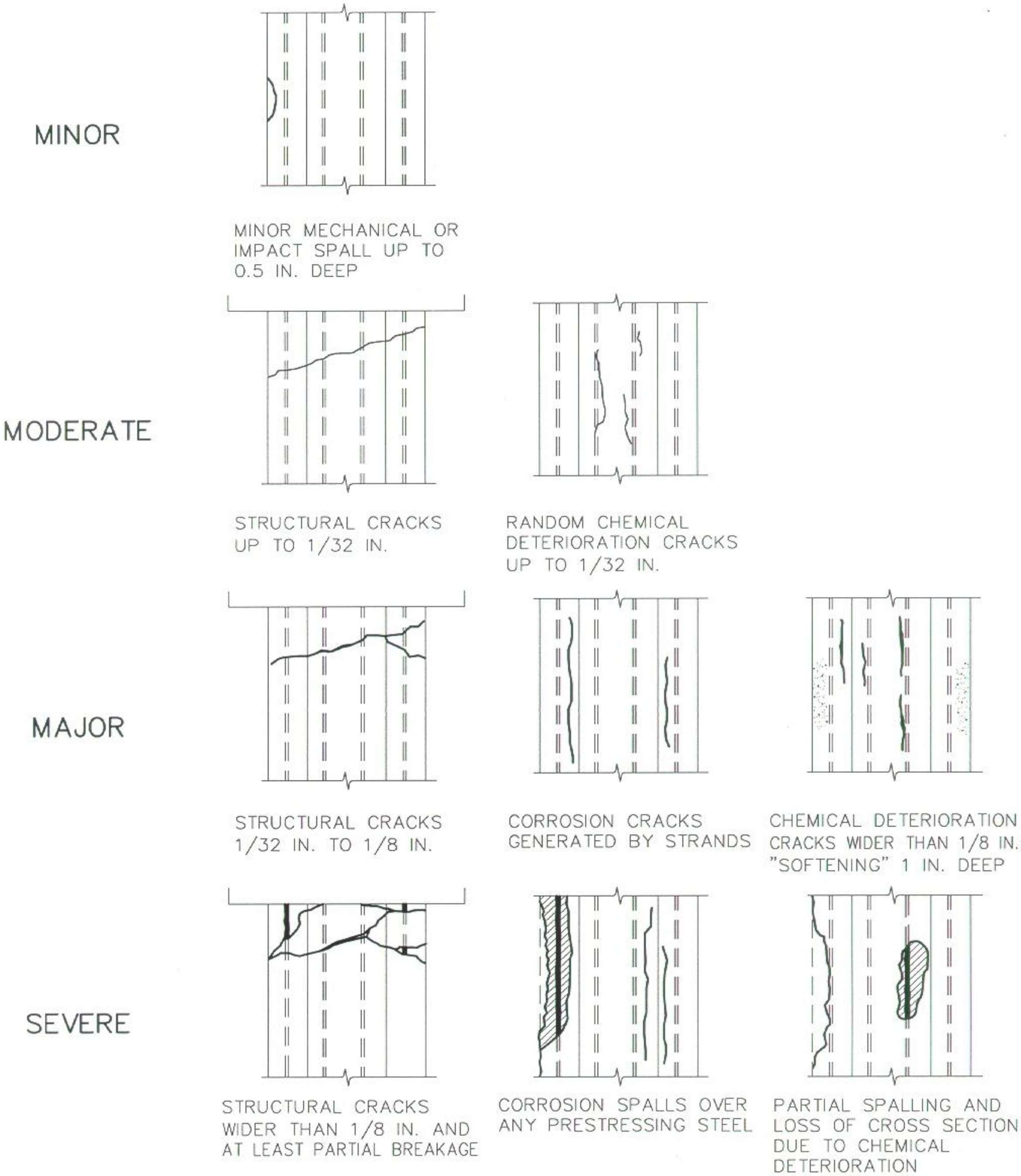


TABLE C2-4

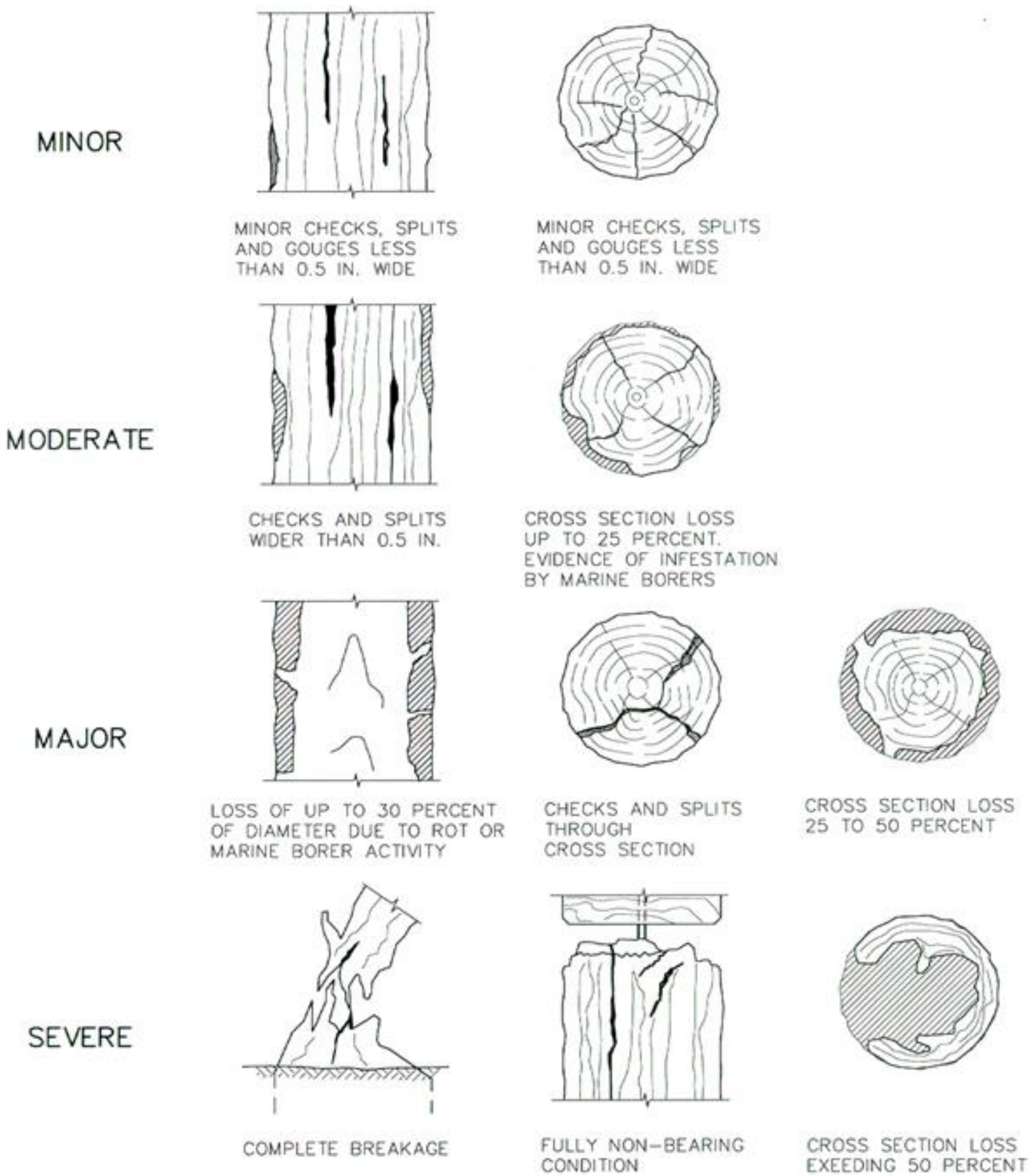
SEVERITY RATING OF TIMBER ELEMENTS

SEVERITY RATING	EXISTING DAMAGE	DEFECTS INDICATING HIGHER DAMAGE GRADE(S)
NOT INSPECTED	Not inspected, inaccessible or passed by(1)	
NO DEFECTS	Sound surface material	
MINOR	Checks, splits and gouges less than 0.5 in. wide	Minor damage not appropriate if: • Loss of cross section • Marine borers infestation • Displacements, loss of bearing or connections
MODERATE	• Checks and splits wider than 0.5 in. • Remaining diameter loss up to 15 percent • Cross-section area loss up to 25 percent. Corroded hardware • Evidence of infestation by marine borers	Moderate damage not appropriate if: • Displacements, loss of bearing or connections
MAJOR	• Checks and splits through full depth of cross section • Remaining diameter loss 15 to 30 percent • Cross-section area loss 25 to 50 percent. Heavily corroded hardware. • Displacement and misalignments at connections	Major damage not appropriate if: • Partial or complete breakage
SEVERE	• Remaining diameter reduced by more than 30 percent • Cross section area loss more than 50 percent • Loss of connections and/ or fully non-bearing condition • Partial or complete breakage	

(1) Same footnote as in previous table.

FIGURE C2-4

SEVERITY RATINGS FOR TIMBER MEMBERS



STRUCTURAL PILE INSPECTIONS

The purpose of this section is to provide guidance for inspection of the existing condition of the piles, in order to make a determination of the potential impacts to overall pile capacity and/or the local capacity of individual piles or groups of piles.

Generally, the piles along the breasting face and corner perimeter piles are the most vulnerable to direct contact damage from tankers/barges and small craft. Batter piles are most vulnerable to overload from excessive berthing forces. As an example, damage-prone locations for a typical platform/breasting dolphin (Figure C2-5). Typically, a smaller sampling of interior vertical piles is required in order to assess average overall conditions during an underwater inspection at marine platforms.

All piles are subject to varying levels of deterioration or damage effects that can occur along the exposed pile length. Table C2-5 summarizes common pile deterioration causes and symptoms within each of the pile zones (Figure C2-6).

During the above water visual inspection of the pile system, note any evidence of overload or impact damage to the piles that is apparent above the waterline, as well as any signs of movement/separation of the pile relative to the pile cap/beam above. All plumb piles should be checked for out of plumbness or misalignment beyond design tolerances.

During the underwater inspection, special attention should be paid to those piles that showed evidence of mechanical damage above the waterline, and these observations should be taken into consideration when determining which piles to include in the sample selected for the underwater Level II and/or Level III inspections.

To aid in the audit, piles should be labeled, based upon their location within the structure. Typically, the pile bents should be numbered from the front of the structure to the rear of the structure, and pile rows should be labeled alphabetically left to right, looking at the front of the structure. Using this system, the piles would be identified using notation such as *Pile 1A* (left exterior pile in Bent 1). This system may be modified depending upon the structure layout, and the engineers should use judgment to come up with a simple labeling system and legend.

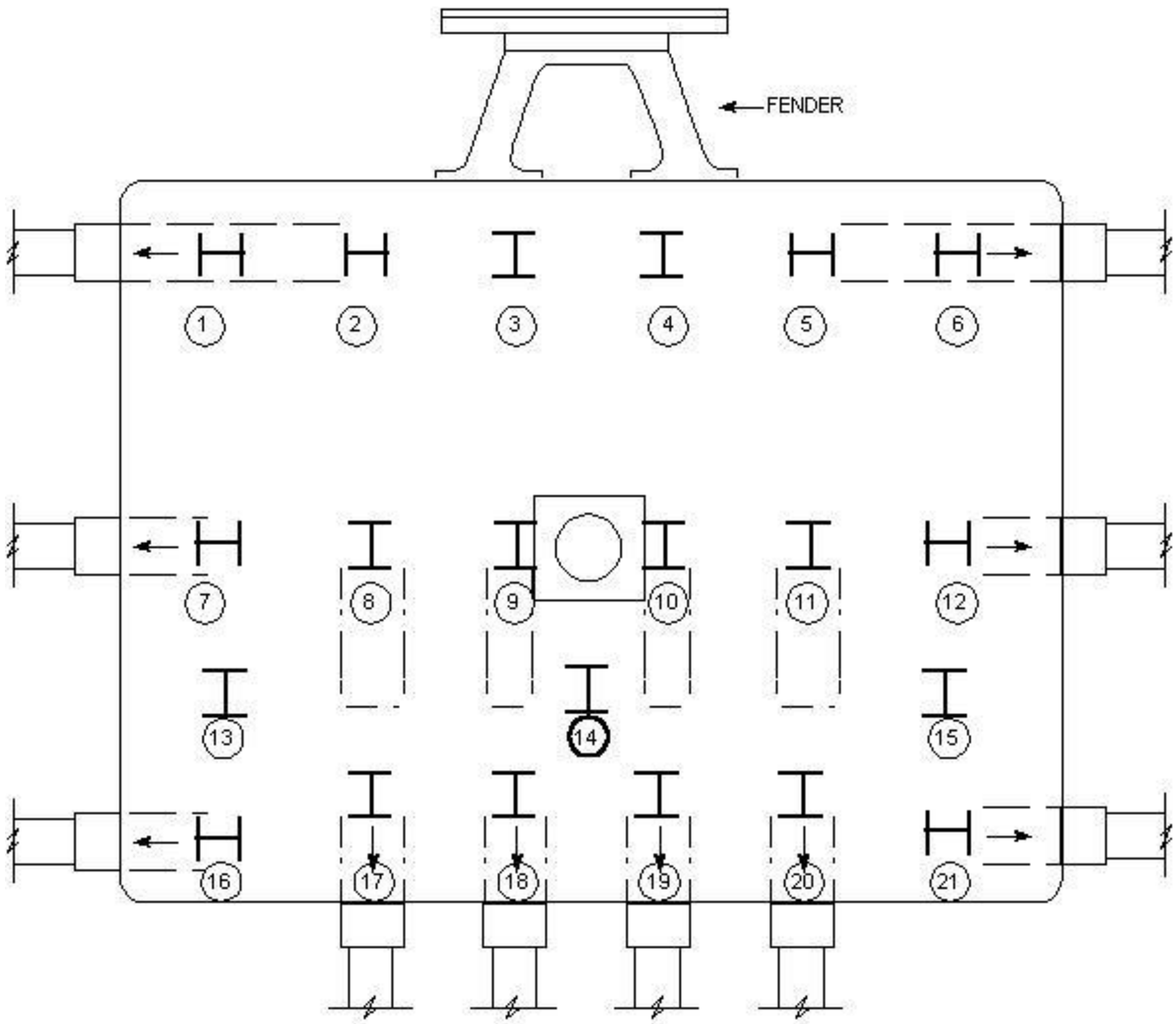
Once pile nomenclature is established, it shall be consistent for all subsequent inspections.

Each pile inspected shall be given a severity rating, and should be recorded on Table 2-15, along with any appropriate comments describing the condition of the piles. Field sketches and/or photos should be prepared to record any special cases or gross damage, as appropriate.

The following discussion presents general guidelines for the underwater inspection of steel, concrete, and timber piles, as well as typical areas of more severe or frequently encountered deterioration for each pile material. For guidelines regarding the underwater inspection sample size and methodology, see MOTEMS 3102F.3.5.1.2. These procedures may be modified as needed on a site-by-site basis. To obtain the most reliable data, observations should be relayed immediately from the diving inspector(s) to the engineer leading the dive.

FIGURE C2-5

DAMAGE-PRONE LOCATIONS (PLAN VIEW)



Pile ID	Pile Susceptibility
1, 6, 7, 12, 16, 21	Impact from Small Craft
3, 4	Separation @ Cap (Due to Uplift)
1, 2, 5, 6	Overload from Excessive Along-Berth Breasting Forces
8, 9, 10, 11, 17, 18, 19, 20	Overload from Excessive Fender Compression Forces
1, 6	Impact from Accidental Angular Berthing (Direct Hull/Pile Contact)

FIGURE C2-6

PILE EXPOSURE ZONES

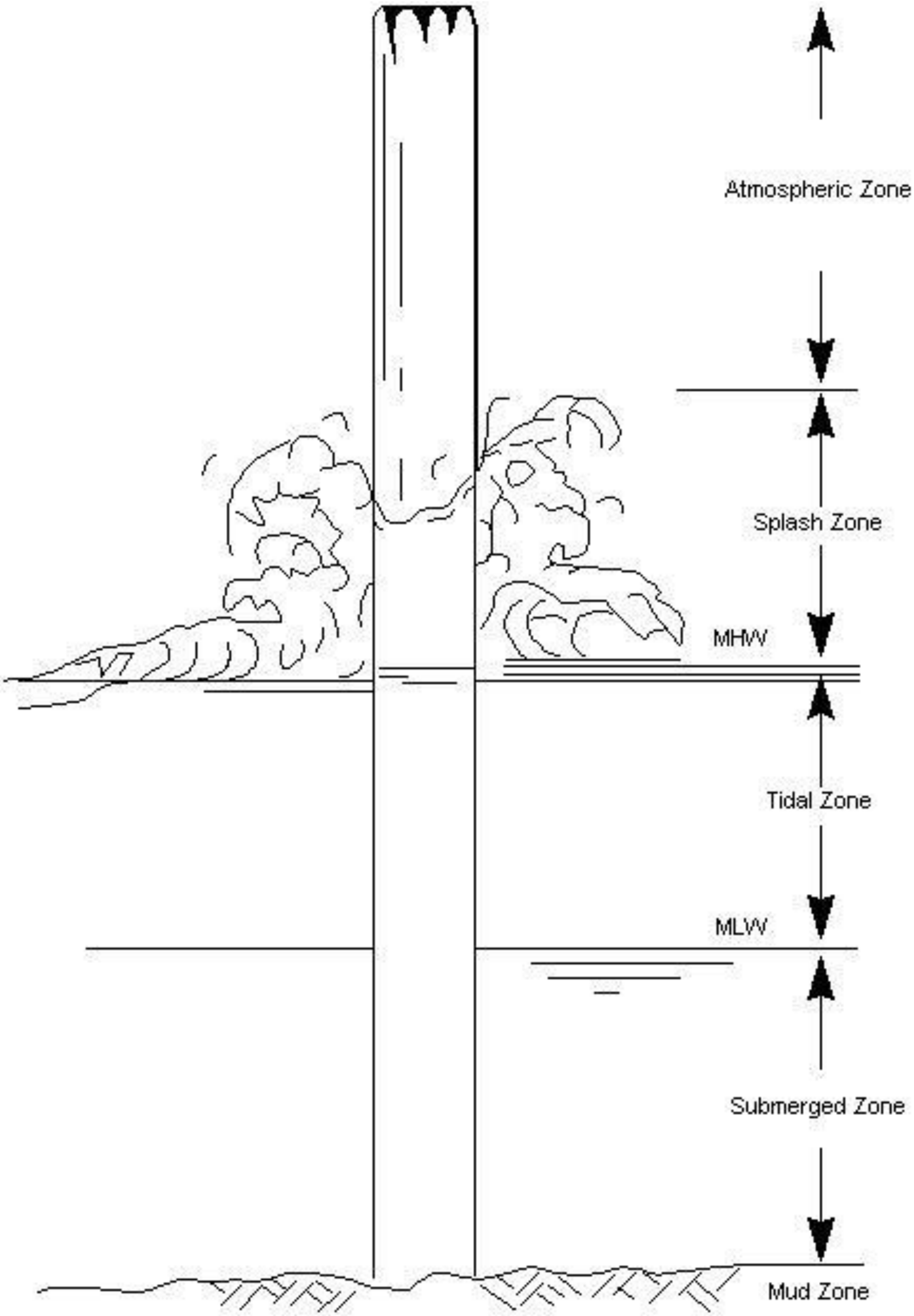


TABLE C2-5

TYPICAL CAUSES/SYMPTOMS OF PILE DETERIORATION

ZONE	STEEL	CONCRETE	TIMBER	SHEET PILES (STEEL)
ALL	**Out of Plumb** • Not vertically aligned	**Out of Plumb** • Not vertically aligned	**Out of Plumb** • Not vertically aligned	**Out of Plumb** • Not vertically aligned
ATMOSPHERIC Highest stresses	**Corrosion** • Coating breakdown, metal thinning & pitting **Overload** • Pile cap separation, cracks, deformation, or connection failure	**Chloride Ingress** • Corrosion of reinforcing steel, cracks, or spalls **Drainage Problems/ Leaks** • Corrosion of reinforcing steel, cracks or spalls **Overload** • Movement, crushing or cracks **Carbonation** **Freeze/thaw**	**Rotting** • Crumbling **Weathering** • Splitting **Overload** • Cracks & splinters **Impact/ Abrasion** • Splinters/ crushing **Insect damage** • Wood consumed	**Corrosion** • Coating breakdown, metal loss & pitting **Loss of Soil** • Sinkholes behind wall **Loss of Anchorage** • Bulging/tearing **Overload** • Bulging/tilting
SPLASH & TIDAL Worst deterioration zone	**Corrosion** • Coating failure, metal loss, pitting/holes **Vessel/Line Contact** • Twisted/bent flanges **Ice Effects** • Member distortions	**Chloride Ingress** **Sulfate Attack** • Softening of concrete **Carbonation** **Weathering/ Abrasion** • Wearing & scaling **Boring Mollusks** • Disintegration	**Rotting/Decay** • Loss of strength **Marine Borers** • Reduced diameter **Ice Damage** • Members dislodged, failed connections	**Corrosion** • Coating failure, metal loss & pitting/holes **Vessel Contact** • Flattening, ovalizing, open seams **Abrasion** • Sand in waves

ZONE	STEEL	CONCRETE	TIMBER	SHEET PILES (STEEL)
SUBMERGED	**Corrosion/ Abrasion** **Overload/ Impact** • Buckling/ cracking **Biological Corrosion** • Under marine growth	**Sulfate ingress** **Chloride ingress** • Abrasion (loss of cover)	**Marine borers** • Reduced diameter and/or interior cavities **Rotting/decay** • Loss of strength	**Abrasion** • Sand in propeller wash **Corrosion**
MUDLINE	**Corrosion** **Scour of mudline** **Dredging damage** **Soil failure**	**Corrosion** **Scour of mudline** **Dredging damage** **Soil failure**	**Marine borer** **Scour of mudline** **Dredging damage** **Soil failure**	**Corrosion** **Scour of mudline** **Dredging damage** **Soil failure**

Note: Most significant & likely deterioration causes are **underlined.**

STEEL AND SHEET PILES

Use Table C2-1 as a guide for modes of deterioration/defects frequently observed in each pile zone and MOTEMS Section 3102F.3.5.1.2 for Level I, II and III sample sizes and inspection methodology. Severity ratings should be assigned to piles based upon the observations made during inspections (see Tables C2-1 and Figure C2-1). Note evidence of mechanical damage or overstressing, and probable causes. A hammer or probe may be used to sound the pile during the Level II inspection. The Level III inspection effort includes gathering remaining thickness measurements shall be used for later structural analysis and evaluation of structural capacity. Calipers and scales shall be used to determine the remaining thickness of flanges and plates. Ultrasonic testing shall be used to determine the remaining thickness of webs, pipe piles or sheet piling, or to record more accurate thickness of H-piles. If the structure has a cathodic protection system, its effectiveness should be tested with an underwater voltmeter at areas where marine growth has been removed. Guidelines for acceptable cathodic protection voltages are shown in Table C2-6. See MOTEMS Sections 3102F.3.5.4, 3102F.3.6.5 and 3111F.10 for details of corrosion inspection and assessment.

MOTEMS Section 3102F.3.5.2 provides direction for the inspection of encased and wrapped steel piles. For steel piles and sheet pile cells without a protective wrap or splash zone coating, key inspection elevations are at mean low water and mean high water levels. These areas typically experience the highest rate of corrosion metal loss, especially in salt water. Inspect any holes in sheet piling for loss of backfill material. At the mudline, record the water depth and any scour at the base of the pile or sheet piling.

TABLE C2-6
VOLTAGES FOR CATHODICALLY PROTECTED STEEL STRUCTURES

MEASURED VOLTAGE	DESCRIPTION
0.0 to -0.7	The cathodic protection systems have failed, and the steel is cathodically unprotected. The rate of corrosion is dependent upon the effectiveness of paint or other coatings, marine growth, and local water chemistry and water currents. On some structures, a hard layer of marine growth may provide some protection. The closer to 0 volts, the more active is the corrosion potential. Note: -0.6 volts is the potential of bare, unprotected steel in a saltwater environment.
-0.7 to -0.82	The cathodic protection systems are working below full capacity, and the steel is being partially protected.
-0.83 to -1.1	The cathodic protection systems are working effectively and the steel is adequately protected.
-1.1 or lower	The cathodic protection systems are supplying more protection than is needed, and the steel is "overprotected". Note that under some circumstances the steel can be made more brittle when overprotected. Surface coatings may be damaged or lifted off by the excess formation of hydrogen bubbles.

CONCRETE PILES

Use Tables C2-2 and C2-3 as a guide for modes of deterioration/defects observed in each pile zone, MOTEMS Section 3102F.3.5.2 guidelines for sample sizes and Level I and II inspection methodology. Severity ratings should be assigned to piles based upon the observations made during these inspections. Note any evidence of mechanical damage or overstressing, and probable causes. During the Level II inspection, visually inspect the cleared areas for cracking, rust staining, spalling or mechanical damage, erosion, softening, and exposed reinforcing steel. If reinforcing steel is visible, note the extent of corrosion. Sound the cleared areas with a hammer or probe. A noticeable change in the rebound of the hammer will occur between a solid section of concrete and a hollow or softened section (Note: if sounding concrete during an above water inspection, a sharp ringing noise indicates sound concrete, while a hollow or softened section will produce a dull thud when struck, as well as a change in the hammer rebound).

MOTEMS Section 3102F.3.5.2 provides direction for the inspection of wrapped and encased concrete piles. For exposed concrete piles, the key inspection elevation is in the splash/tidal zone. Mechanical and biological damage is commonly found in this area. At the mudline, record the water depth and any scour at the base of the pile.

TIMBER PILES

Use Table C2-4 as a guide for modes of deterioration and/or defects observed in each pile zone, while following MOTEMS Section 3102F.3.5.1.2 as a guideline for Levels I, II and III sample size and inspection methodology. Severity ratings should be assigned to piles based upon the observations made during these inspections. Note evidence of mechanical damage or overstressing, and probable causes. A hammer and/or probe may be used to determine the depth of timber loss due to rot or exterior marine borer damage, if applicable, during the Level II inspection. If evidence of marine borers is observed, the type(s) of borers causing the damage should be determined, as well as whether or not the infestation is active. Additionally, calipers should be used to determine the remaining diameter of the pile. The Level III inspection effort for timber piles consists of determining the extent of internal marine borer infestation.

MOTEMS Section 3102F.3.5.2 provides directions for the inspection of encased and wrapped timber piles. For piles consisting of marine borer-resistant timber, or not exposed to borer attack, the key inspection areas are at the top of the piles and at any connections to bracing members. For timber piles vulnerable to marine borer attack, the zone of highest deterioration is typically within 5 feet above and below MLLW, as well as near the mudline. Pay close attention to locations where bracing is attached to the pile, and note the general condition of the connection hardware. At the mudline, record the water depth and any scour at the base of the pile.

PILE CAPS, BEAMS AND BRACING MEMBERS

This section provides guidance for collection of data on the existing condition of pile caps, beams, and bracing members, in order to make a determination of the structural capacity of the platform support system and/or the local capacity of individual members, and to verify that the structure meets the current MOTEMS requirements.

Pile caps, beams, and bracing members may be constructed of steel, concrete, or timber, depending on the structural configuration of the terminal. See Table C2-5 for common deterioration causes and symptoms, as well as Tables C2-1, C2-2, C2-3 and C2-4 for severity ratings, for elements of these materials, which apply to the rating of pile caps, beams, and bracing. Members located above the waterline can be inspected from a workboat at low tide, while, portions of submerged bracing members should be inspected as part of the underwater inspection.

A general observation of the pile caps, beams, and/or bracing should be performed, looking for severe damage or deterioration, misalignment or rotation of the members, and evidence of overloading. At the caps and beams, evidence of overloading may appear at points of maximum bending stress (cracking, sagging at mid-span between piles or bents) or at points of maximum compression stress (buckling or crushing directly over piles). Figure C2-7 shows common locations and causes of cracking in concrete beams/pile caps. Check for evidence of distress at the connections to the supporting piles. If evidence of overloading is present, an attempt should be made to determine the cause of the overloading (i.e. excessive equipment loads on the deck above), and whether or not the distress-causing load is still present and active. Based upon the observed deterioration, damage, and/or evidence of overstressing, the inspected members should each be assigned a severity rating.

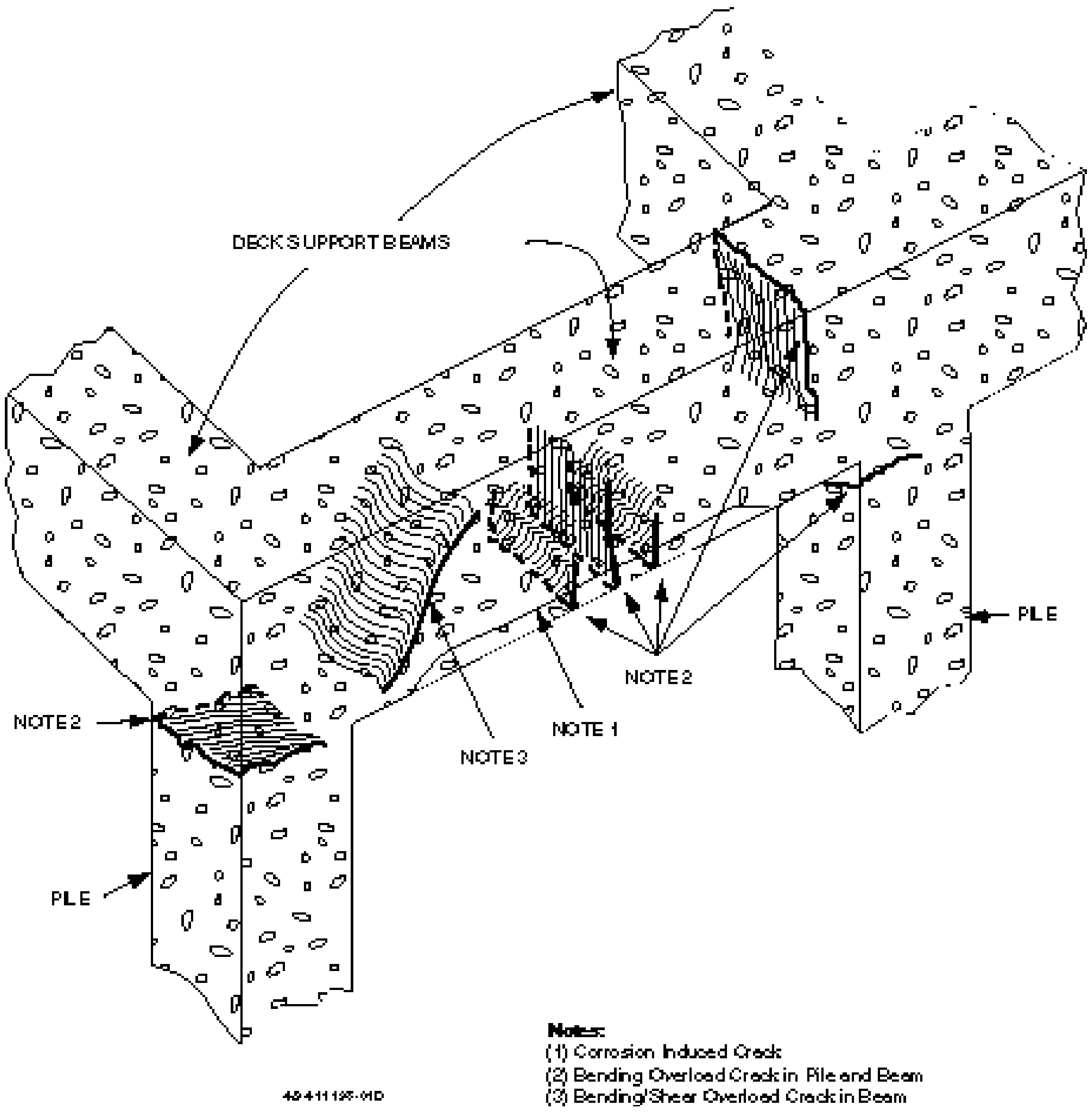
Where bracing members are present, note the overall level of intactness of the bracing system. Check connections between the bracing members and piles/pile caps for looseness or missing hardware.

Piles should be labeled, based upon their location within the structure. Typically, pile caps can be labeled by the corresponding bent number, and reference can be made to the supporting piles to locate a specific defect (for example, breakage of Pile Cap 5, between Piles 5B/5C). Likewise, beams running longitudinally between the pile caps can be identified using the corresponding pile label (i.e. Stringer B, between Bents 1 and 2). This system may be modified depending upon the structure layout; engineers should use good judgment to come up with a simple labeling system and legend. Once nomenclature is established, it shall be consistent for all subsequent inspections.

General cap, beam, and bracing data should be input into Tables 2-4, 2-6, 2-8 and 2-10 and questions pertaining to the inspection of the members are to be answered in Table 2-15. Each member inspected shall be given a severity rating along with any appropriate comments describing the condition of the members. Field sketches and/or photos should be prepared to record any special cases or gross damage, as appropriate.

FIGURE C2-7

TYP. CRACK TYPES/LOCATIONS IN CONCRETE PILECAPS/BEAMS



DECKS

This section provides guidance for the collection of data on the existing condition of platform decks to make a determination of the structural capacity of the platform, and to verify that the structure meets the current MOTEMS requirements.

Decks of marine terminal structures, and associated platforms and walkways, may be constructed of reinforced concrete, steel, aluminum or fiberglass grating and framing, or timber planks. For a discussion of the common deterioration causes and symptoms, as well as severity ratings, for elements of these materials, which apply to the rating of deck structures (see Tables C2-1 thru C2-5).

Inspection of the topside of the deck should be performed, noting overall dimensions and locating expansion joints, and anchorage of railings, mooring equipment, drainage, and other features of, or attachments to the deck. Check for missing, broken, or loose connections, obstructions, and other hazardous conditions of curbings, handrails, and catwalks. Check deck drains and scuppers for blockage and for loose, missing, or broken screws. Check manhole covers for rust, corrosion, bent or worn hinge pins, or other damage. Note any locations of ponding. Use a field sketch, or as-built drawings if available, to record dimensions and observations.

The inspectors should document major equipment areas, vehicular loads, vapor control/processing units, and other major vertical dead and live loads. Major deck equipment should be marked on the plan view sketch of the facility, with approximate operating and maximum loads. Each major component should be inspected for lateral restraint for seismic loads, and for dead plus live vertical loads being transferred to the structure. Document all major loads, and the adequacy of the vertical and horizontal transfer into the deck, and then into the supporting structural components. If the transfer of loads appears to be inadequate, questions about the local/overall structural capacity should be raised documented in the audit report.

For concrete decks, note sizes of cracks, spalls (open and closed), areas with leakage, rust staining, exposed reinforcing bars, delamination, or other signs of corrosion of the reinforcement. For steel grating, note any areas of severe corrosion or loss of paint or other protective coatings. For timber planks, note loose planks, areas of rot or damage due to insect attack, as well as cracking, splitting, and missing connection hardware. If the timber is covered with a layer of asphalt, inspect the asphalt for cracks, holes, or other obvious damage. Moreover, inspection of the underside of the deck should also be performed if necessary. For all decks, note any areas that are sloping or sagging, which could indicate failure of the supporting piles or beams, resulting in a reduction in load carrying capacity.

For reinforced concrete decks, an inspection of the underside of the deck should also be performed. Sound the underside of the deck at any locations that are suspected to be hollow, or to remove the cover concrete from closed spalls to observe the level of corrosion of the underlying reinforcing bars.

Based upon the observed deterioration, damage, and/or evidence of overstressing, the deck should be assigned a severity rating.

The deck may be divided into quadrants (back left, back right, front left, and front right), with each quadrant being rated separately. The engineers should use their judgment, as the deck may not need to be divided up if the observations show that the condition of the deck is uniform throughout. General deck data should be input into Table 2-16. The deck, or deck subsections, shall be given a severity rating, as previously described along with any appropriate comments describing the condition of specific areas of the deck. Field sketches and photos should be prepared to record any special cases or gross damage, as appropriate.

RETAINING WALLS, BULKHEADS AND REVETMENTS

The purpose of this section is to assist in the collection of data on the existing condition of retaining walls, bulkheads, and revetments, in order to make a determination of the structural capacity of the retainment system, and to verify that the structure meets the current MOTEMS requirements.

Retaining walls and bulkheads at wharf-type marine terminals are typically constructed of steel sheet piling, cast-in-place concrete, or stacked blocks of stone or pre-cast concrete. The causes and symptoms of deterioration for steel and concrete components have been discussed, as well as severity ratings for elements of these materials, which also apply to the rating of retaining structures (see Tables C2-1 through C2-5). The inspection of retaining walls and bulkheads should be performed in accordance with MOTEMS Table 31F-2-3 using a method similar to that for the inspection of piles. As much of the wall as possible shall be inspected above water at low tide, and an underwater inspection of the remainder of the wall shall be performed. In addition to the standard detectable defects of wall materials, the following paragraphs discuss items that require special attention during inspection of bulkheads and retaining walls.

A general observation of the wall should be made, looking for misalignment of the overall structure and plumbness of individual units making up the wall. Differential settlement between units should be noted, as well as displacement or severe damage to units, by vessel impact or other means. For walls constructed of stone or concrete blocks, note the general condition of the joints between blocks, and any areas where differential settlement has widened the joint openings to allow for possible loss of fill from behind the wall. The general observation of the wall should include an observation of the fill behind the wall, noting any signs of loss of fill such as depressions or sinkholes.

One of the purposes of conducting an underwater inspection of a bulkhead or retaining wall is to investigate the condition at the base of the wall. Loss of foundation support at the toe of the structure from over dredging or excessive scour can initiate instability and excessive stresses in the wall, resulting in bulging and overstressing in sheet piling, and in settlement and displacements of concrete walls. Based upon the observed deterioration, damage, and/or evidence of overstressing, the bulkhead or retaining wall should be assigned a severity rating.

The inspectors should also document major equipment, vehicular loads, and other major vertical dead and live loads located just behind the retaining wall or bulkhead, which could create a large surcharge in the retained soil. If the loads appear to be creating an instability in the structure, questions about the local/overall structural capacity should be further evaluated in this audit process.

To aid in the inspection, the bulkhead or retaining walls may be divided into quadrants (back left, back right, front left, and front right), with each quadrant being rated separately. Engineers should use good judgment, as the wall may not need to be divided up if the observations show that the condition is uniform throughout. The wall or wall subsections shall be given a severity rating. Any appropriate comments describing the condition of specific areas shall be recorded. Field sketches and/or photos should be included to record any special cases or gross damage.

Revetments are protected slopes typically consisting of riprap, armor stone, concrete blanket, or gabions (rock-filled wire baskets). A general inspection of the revetment slope should be performed, noting the slope alignment, any signs of settlement or instability (slip failures), any areas missing the protection layer, and signs of erosion at the toe of the slope. Where gabions are used, note the general condition of the wire baskets. The baskets may be susceptible to corrosion and abrasion, potentially causing unraveling of the revetment. Concrete blankets may be susceptible to cracking and undermining. These conditions shall be observed and recorded.

MOORING HARDWARE

The purpose of this section is to assist in the collection of data on the existing condition of mooring hardware, in order to make a determination of the capacity of the mooring system, and to verify that the structure meets the current MOTEMS requirements.

Mooring hardware typically includes bollards, bitts, cleats, hooks, timber and steel-sleeved timber piles and concrete deadmen onshore. Mooring piles and deadmen are covered under the pile inspection requirements. Most mooring hardware components are steel. See Figure C2-1 and Tables C2-1 and C2-5 for a discussion of the common steel deterioration causes and symptoms, as well as severity ratings for steel elements, which would apply to the rating of mooring hardware components as well. A general overall inspection of the mooring system should be performed, noting location and type of mooring components, typical use of the system, and any obvious deterioration, damage or missing components.

Hardware anchorage should be inspected and the condition documented. Anchorage is extremely important and needs to be carefully inspected. Examples of anchorage failure may include: diagonal shear cracks in concrete pads; steel bolts partially pulled away from timber decking; missing bolts; or cracked concrete adjacent to mooring anchorage. When such observations are noted, the cause of damage shall be documented.

Possible associated damage from line pull should be investigated. Mooring hardware may require mooring lines to be draped over the edge of the structure, then pulled tight. Damage to the platform from line chafing should be checked.

Each mooring assembly should be located on the terminal plan view drawing and identified with a labeling system. General mooring hardware information should be documented in Table 2-12. Each mooring hardware assembly shall be given a severity rating along with comments describing the condition of the mooring system. Field sketches and photographs shall be included to record gross damage or any special observed conditions.

PLATFORMS, LADDERS, STAIRS, PERM. GANGWAYS & HANDRAILS

Locate all platforms, ladders, stairs, and handrails on a general plan view of the terminal (or verify as-built drawings, if available). For ladders and stairs, typically constructed of steel members, check for corrosion of treads, rungs, railings, and supporting members. Check all connections for looseness and/or missing hardware. Label the components on the general plan view and record severity ratings for each, along with any appropriate comments describing the condition of specific elements.

WATER DEPTH/OBSTRUCTIONS

The minimum water depth at the marine terminal should be established. This water depth will establish the maximum draft of a vessel allowed to moor at the marine terminal under normal operating conditions. Soundings may be required if recent information is not available.

Local pilot organizations may have minimum underkeel clearance requirements. For example, in the Los Angeles Harbor area, there is a minimum 12 inch keel clearance at the berth and an 18 inch minimum clearance in the approach channels. When the water depth is the critical component in the size of vessel allowed to moor in the marine terminal, the actual water depth at the berth should be verified on a regular basis. A review of the latest bathymetric survey should be made during each audit.

STRUCTURE SEVERITY RATING – SUMMARY

Upon completion of structural inspection, a comprehensive statistical summary should be prepared. This summary should state the percentage of occurrences of each severity rating out of the total number of observations, for each type of structural component (piles, pile caps, beams, etc.). For decks and retaining/bulkhead walls with varying severity ratings, the percentages may be calculated in terms of area inspected. For example, out of total piles inspected, 75% of the piles were observed to be in minor condition, 15% are in moderate condition, 7% are in major condition, and 3% are in severe condition. Likewise, for a platform deck, 50% of the deck is in minor condition and 50% is in moderate condition.

Statistical summary comparing the current inspection results with the previous inspection data shall be documented to show structural condition trending.

The summarized data should then be used to apply Inspection Condition Assessment Ratings (ICARs) based on MOTEMS Table 31F-2-4 to each structure and each overall structural system. Engineers should use their judgment in determining these overall ratings. However, certain modes of deterioration may automatically trigger a "*Poor*" or "*Serious*" ICAR ratings for the structural systems. Refer to MOTEMS Table 31F-2-4 (Table C2-9 herein) for definition of ICAR ratings. Ratings shall be documented in Executive Summary Table ES-1C (see MOTEMS 31F-2-7C for example).

INSPECTION OF FENDER SYSTEMS

The primary function of a marine fender system is to protect the marine terminal platform structure while absorbing the kinetic energy of the berthing or moored vessel without damaging its hull. The timely identification and reporting of fender damage is essential, as a ship berthing onto a damaged or inoperable fender system can result in severe damage to the vessel. A fender system review is to be performed on all fender elements to:

- Ensure that the fender components and systems meet the intended operational performance requirements;
- Locate any signs of gross damage to the fender units; and
- Locate fender components or systems with deficiencies that may result in any local or global reduction in capacity.

This inspection shall include all above water and underwater fender elements and supports, comprising a variety of fender types and components, rubber fender buffers and cells, steel coil fender springs, steel fender frames, synthetic and timber contact or rubbing pads, camels and separators, support chains, and associated miscellaneous hardware such as bolts, nuts, and washers. Guidelines for inspection of pile-supported fixed or flexible dolphin fender structures and contact frames are previously covered.

Forms are included at the end of this section for use in completing the inspection of fender systems. Table 2-18, *Fender Component Inspection Documentation Form*, should be used to record fender component types and materials, as well as any deterioration/damage symptoms observed, and the severity of the deterioration. Table C2-7 of this Audit Manual presents sample input that may be entered into Table 2-17, *Fender Pile Inspection Record*, should be used to record data collected during the above water and underwater inspection of fender piles. In addition to the forms, field notes, sketches and photos should be used as needed to record any additional information. As-built drawings of structures are often available, and are valuable for verifying fender system layout and dimensions, and for locating structural modifications, anomalies, or areas of gross damage.

TABLE C2-7

SAMPLE INPUT FOR DOCUMENTATION

FENDER UNIT	FENDER COMPONENT	COMPONENT MATERIAL	SYMPTOM OBSERVED	SEVERITY RATING	COMMENT
Fender 1A Dock 2 Berth 5 Etc.	Brace Beam Chain Fender Cell Buffer Spring Frame Bolt/Nut Hardware Housing Pad Grillage Eye Bolt Anchor Etc.	Concrete Steel Wood Synthetic Rubber Etc.	Borers Buckle Cavities Corrosion Cracking Disbond Distortion Fracture Holes Scaling Soft Spall Tilting Splintered Missing Etc.	Condition Rating (Minor, Moderate, Major, Severe) Etc.	Area Dimension Length % Loss # Affected Thickness Width Depth (in.) Deflection (in.) Etc.

Fender Piles

The inspection of fender piles is covered by the previous pile discussion. Record observations and severity ratings in Table 2-17.

Fender Systems

Examples of typical fender system arrangements are shown in Audit Manual Figures C2-8 through C2-10.

FIGURE C2-8

TYPICAL FENDER SYSTEMS

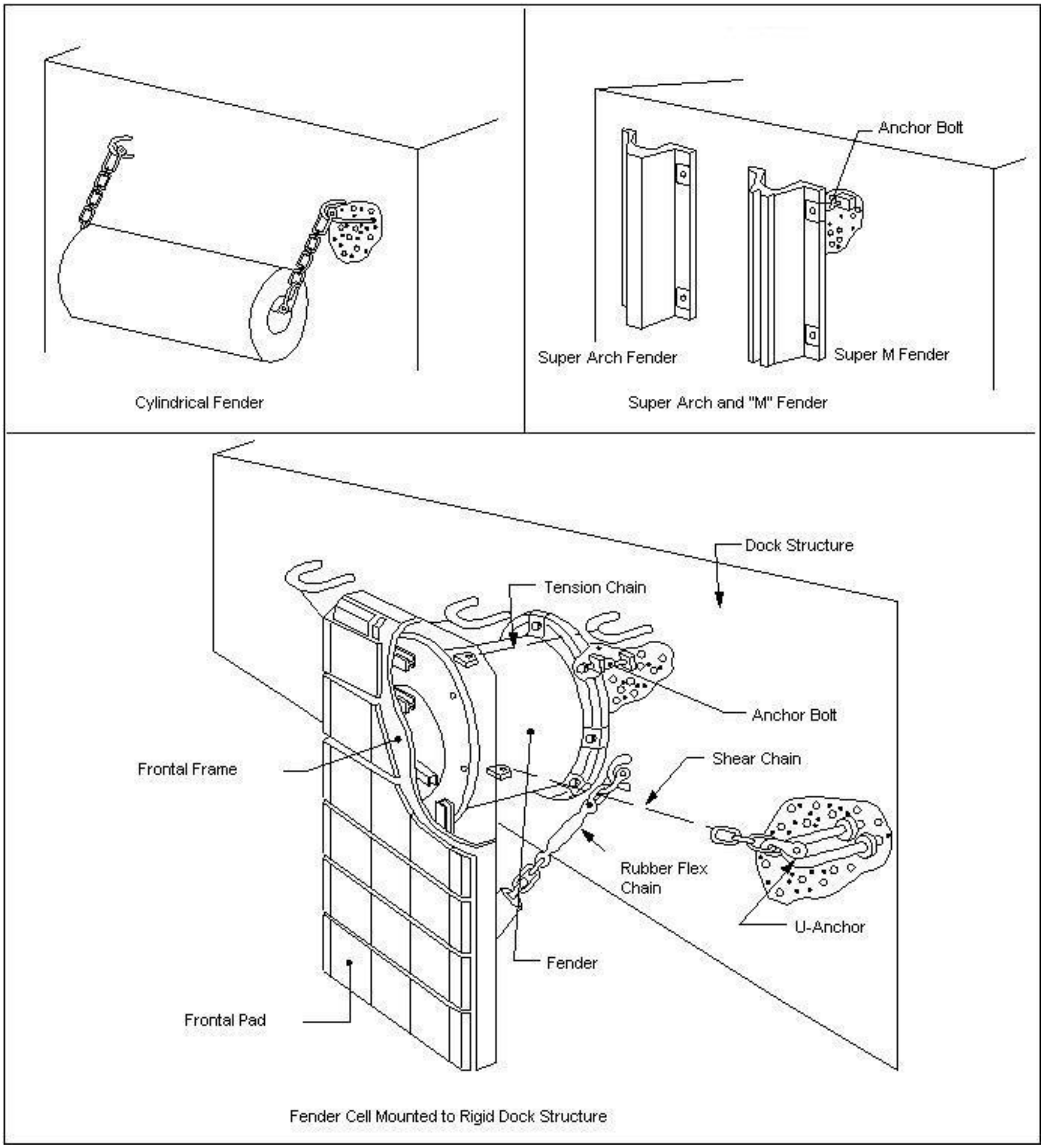


FIGURE C2-9
TYPICAL FENDER SYSTEMS

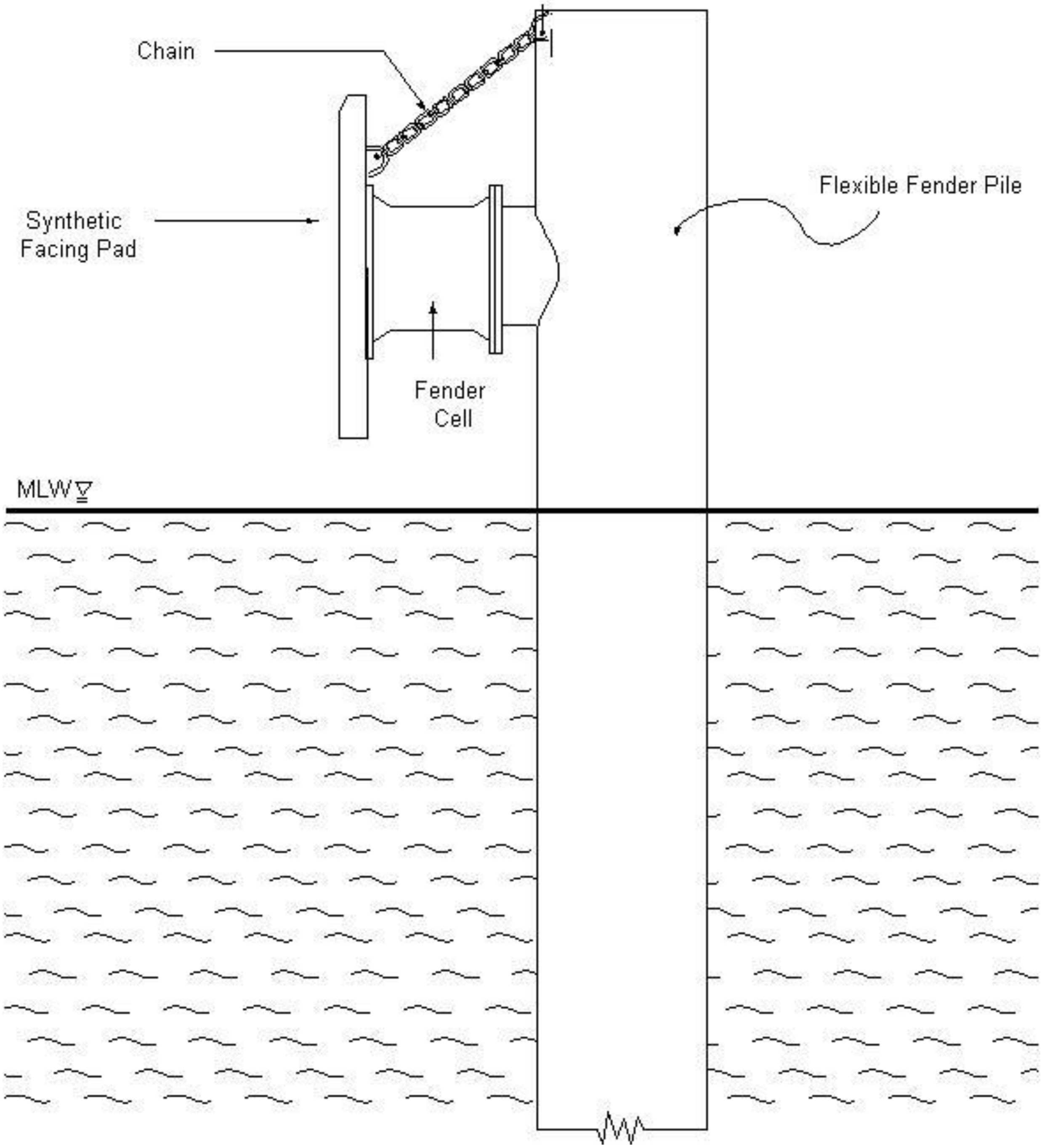
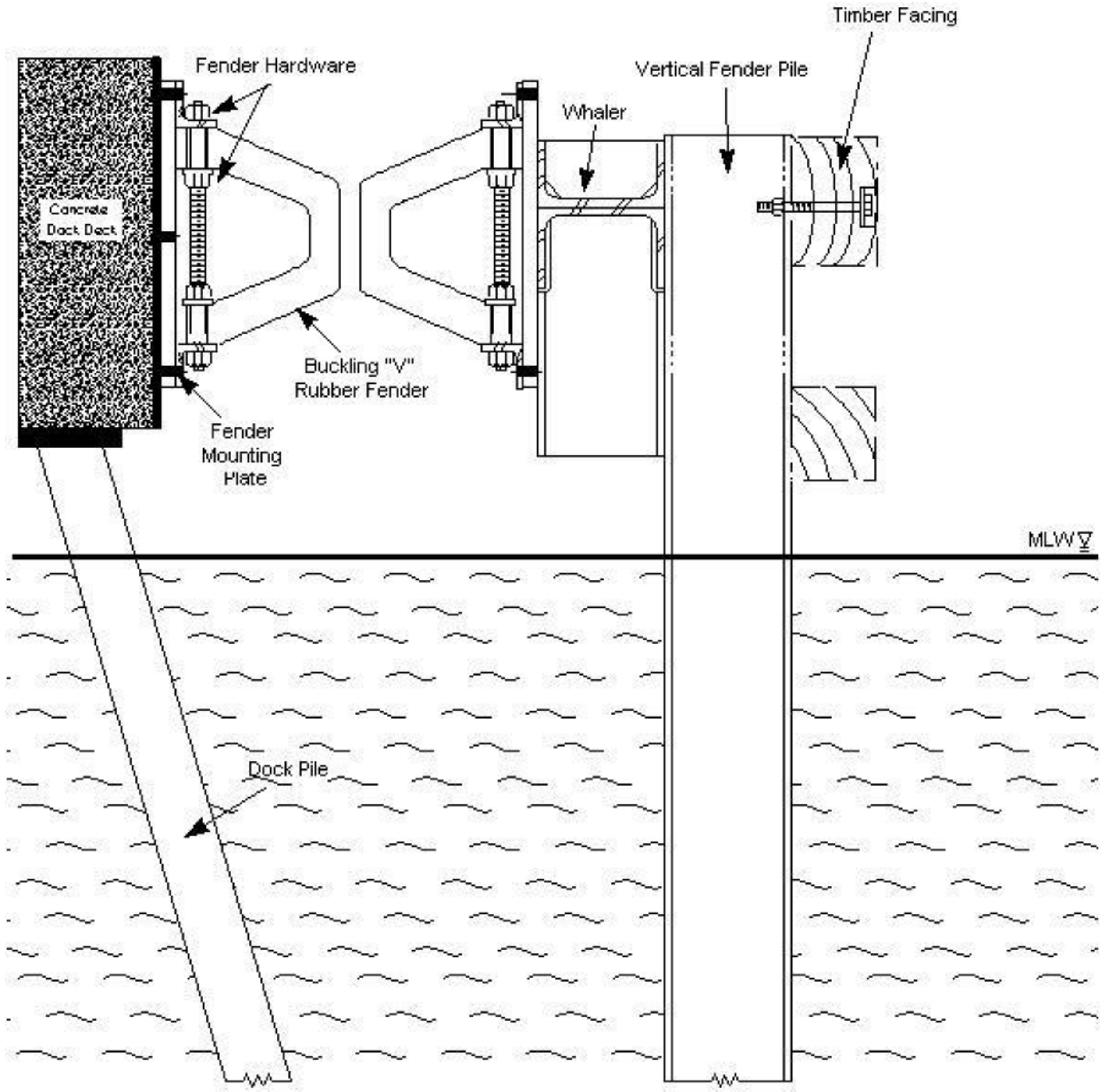


FIGURE C2-10

TYPICAL FENDER SYSTEMS



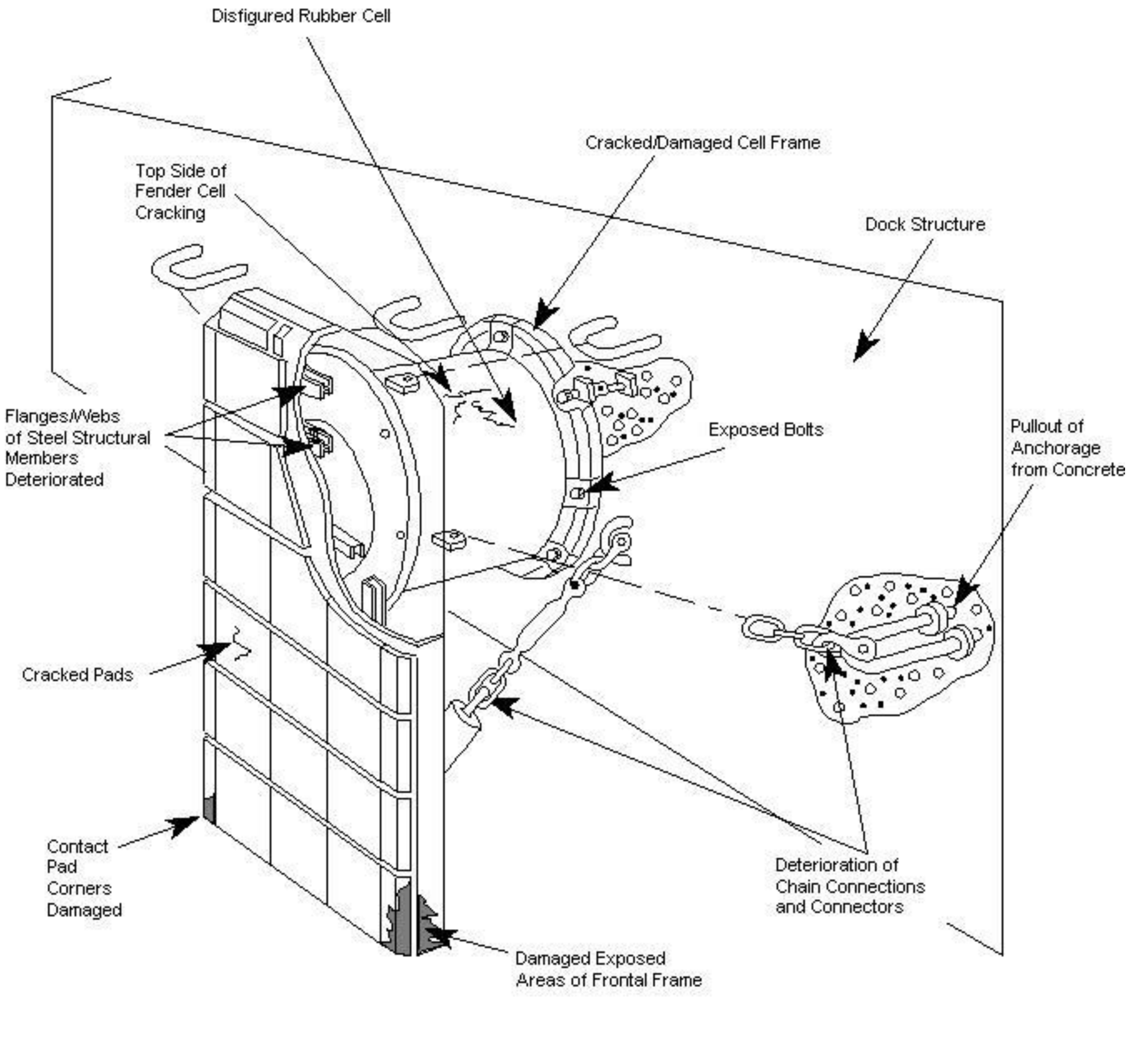
Location (Where to Inspect and Measure)

As a general guideline, fender component areas prone to deterioration are depicted in Figures C2-11 and C2-12 and include, but are not limited to:

- Contact pad corners
- Exposed areas of frontal frame
- Top side of fender cells
- Anchorage into concrete
- Whaler intersections with vertical piles
- Chain connections and connectors
- Exposed bolts
- Fender timber intersections with vertical piles
- Exposed timber members near tidal and splash zone
- Webs/Flanges of structural steel members
- Centers of whaler span (center of unreinforced span)
- Interior bottom of steel spring housings

FIGURE C2-11

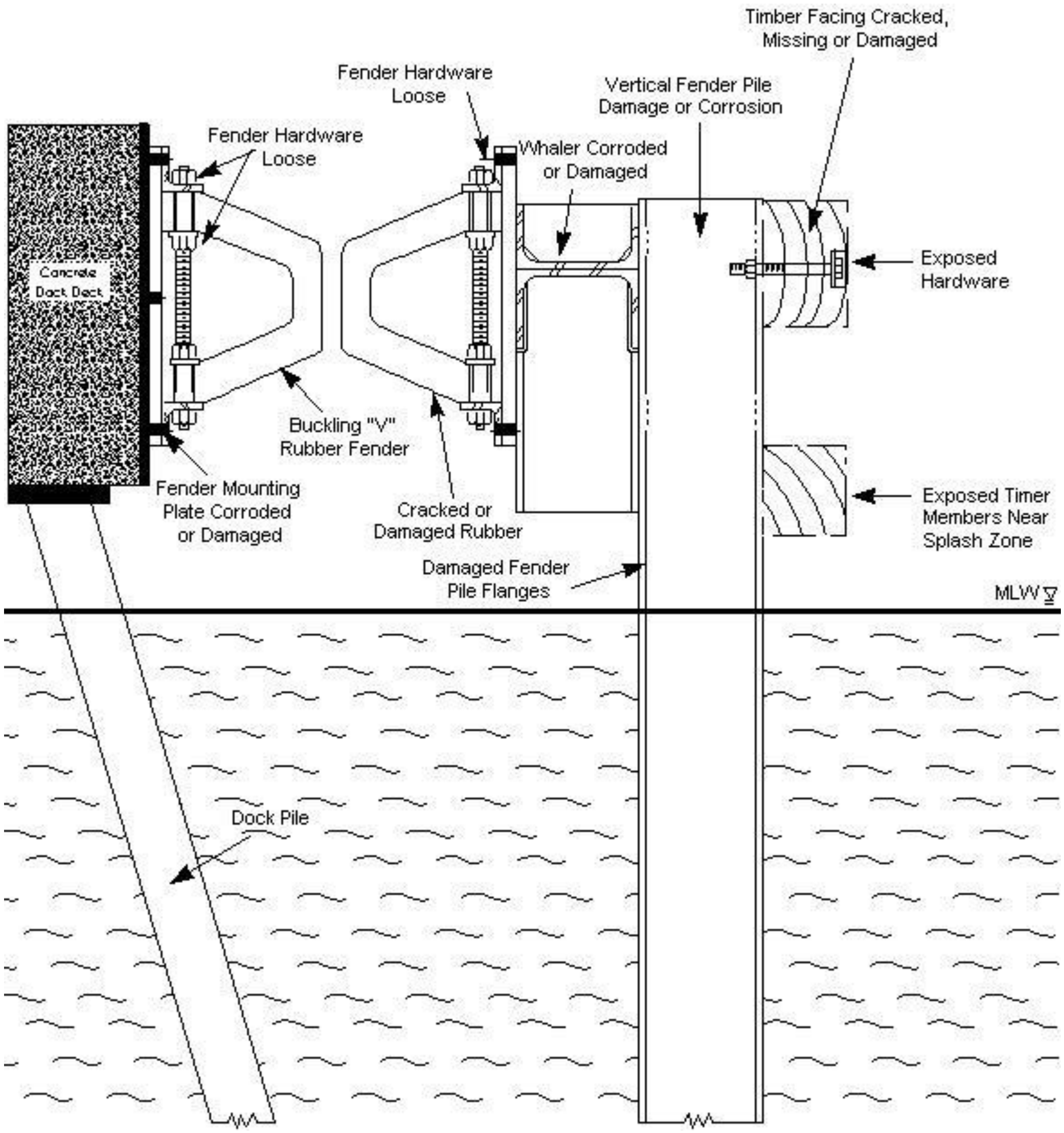
DETERIORATION-PRONE AREAS OF FENDER COMPONENTS



Fender Cells and Dock Mounted
Fender Components

FIGURE C2-12

DETERIORATION-PRONE AREAS OF FENDER COMPONENTS



General Fender Deterioration

The following subsections list additional common symptoms of deterioration for rubber fender units, steel frames/coil springs/structural members, timber fender components, synthetic facing materials, hardware (chains, pad eyes, bolts, nuts, and washers) and foam-filled fender units. General directives for the inspection of these components are also discussed.

The fender systems should have a means of identification, based on their location on the structure. A general plan view of the structure should be used to locate and label the fender units. Record the results of the fender component inspection in Table 2-18. Record the fender unit identification label, component type, material type, and a severity rating. For fender components consisting of rubber or other synthetic material, record the deterioration symptom(s) observed, and record an estimate of the level of severity of the deterioration using the standard severity ratings. Use the comments column to record additional observations or to record dimensions, and prepare field notes, photos and sketches to record additional information as required.

Monopiles

Subsea inspection of monopile should be carried out to check for the current state of scour protection, marine growth on the pile, corrosion, cathodic protection and any observed damage.

Rubber Fender Units

Rubber compounds are subject to deterioration or damage from physical and chemical reactions. Physical reactions include aging due to heat and ultraviolet rays (from direct sunlight), abrasion, fatigue, and impact damage from an excessive berthing force (typically accidental). Chemical reactions include oxygen and ozone oxidation, or weathering. Natural rubber also has poor resistance to chemical reactions with petroleum product or crude oil contact and vapors.

- Heat and U/V Aging - Black rubber, under direct sunlight in summer or tropical climates, can develop internal temperatures of up to 70 degrees C (160 degrees F). This creates changes in tensile strength, elasticity (elongation reactions) and hardness. Heat and U/V aging is evidenced by surface cracking of the rubber unit and eventually results in hardening, with a loss of energy absorption capacity.

Extreme fluctuation of temperatures may also contribute to rubber fender deterioration.

- Oxygen and Ozone Oxidation - Oxygen and ozone may react destructively with rubber compounds, resulting in hardening and cracking of the rubber surface if ozone additives are not used. Ozone is an unstable form of oxygen and is widely used in the rubber industry as an oxidizing agent in the manufacture of rubber products. On-site, ozone is produced by the evaporation of water, particularly of seawater spray in a marine environment, and also in the air during electrical storms or in the immediate vicinity of electric motors. Natural rubbers have poor resistance to ozone attack and consequently certain manufacturers coat their natural rubber fender units with 3 mils of neoprene for protection against ozone attack. However, these units may still suffer ozone attack if the coating is removed by direct hull contact abrasion or impact and the fender is within a marine environment with severe sea spray conditions.

- Abrasion - Rubber fenders, unfaced and exposed to ship contact, are subject to severe abrasion wear and abuse. To a lesser extent, certain types of rubber fenders are subject to abrasion even when placed behind fender frames. Fender components that are bolted to both structural facings and fender frames are generally not subject to this type of abrasion. Since the coefficient of friction between various types of rubber compounds and steel hull surfaces varies widely, the amount of damage from abrasion is a direct function of the fender component material type. The condition of the ship hull (corroded or non-corroded and smooth) also affects the level of resulting abrasion.

- Fatigue - Fatigue is a concern for high volume terminals that have systems operating close to their design limits. All rubber fenders suffer from some level of compression set. Compression set is the failure of the unit to return to its undeflected state after repeated loadings. This may result in considerable loss of energy absorption capability. Table C2-8 presents the amount of energy absorption capability loss in rubber fenders subjected to 1,000 compression cycles at 30, 40, and 50 percent deflection, according to industry tests.

TABLE C2-8

RUBBER FENDER ENERGY ABSORPTION CAPABILITY LOSS

DEFLECTION	ENERGY LOSS
30%	12%
40%	20%
50%	22%

This loss of energy absorbing capability may lead to very high loading on the ship's hull and pier structure during high-impact berthings and result in damage to both the ship and the structure. Compression set can often be identified by measuring the depth of the undeflected fender along the axis of deflection, and comparing that measurement with the dimensions listed in the manufacturer's specification sheets. If compression set has occurred, the measured dimension will be appreciably smaller (less than 80%).

Visually examine rubber surfaces for cracking, abrasion, and signs of aging. Check for dirt, sand, and debris accumulation. Make an overall check for obvious deterioration and damage such as rubber disfigurement, sagging, and distortion. Check urethane covers of foam filled floating fenders for distress or cracking and splitting at each end at the eye bolt/shackle connections.

When applicable, use appropriate measuring tools to determine the depth of cracking and to determine the amount of damage as the result of abrasion, impact or fatigue abuse. Measure the depth of the fender along the axis of deflection and record. If the current rubber depth is less than 80% of the original depth (from design drawings or manufacturer specifications), then replacement of the fender may be recommended. Other typical dimensions to be measured are fender length, width, depth, and circumference. It is not necessary to be overly exact while taking these measurements. It is more important to be consistent in how the measurements are taken from inspection to inspection and from fender to fender and documenting those measurements.

Steel Frames, Coil Springs, and Structural Members

The most common causes of steel deterioration for waterfront structures are corrosion, abrasion, fatigue, and vessel impact or allision. Note that for fender units, structural connections of steel members are critical. Structural connections joined together by means of bolts have a tendency to work loose over an extended period of time, especially when subjected to impact loadings of the type experienced by a pier or wharf fender system. Wave action and corrosion may also cause connection loosening (bolts or nuts, washers). Loosening of connections will tend to produce slipping between mated surfaces, which in turn could cause distortion in connections and framing members resulting in overstressing at other locations. The possibility of fatigue failure may also be increased.

Fatigue failure results in the fracture of structural members as a consequence of repeated variable loading. Evidence of fatigue distress is typically a series of small hairline fractures oriented perpendicular to the line of stress in the member. Full strength butt-welded joint connections are susceptible to fatigue failure in the base metal heat-affected zone immediately adjacent to the deposited weld metal. These hairline cracks are difficult to locate, and since they represent a dangerous condition in steel marine structures, care must be undertaken when inspecting structural members subjected to repetitive loading, particularly impact loading. If cracks are found, immediate repair procedures should be recommended. At the very least, steps should be taken to immediately limit the exposure of the structure to further fatigue causing loads.

Make an overall check for obvious deterioration or damage such as bent or twisted steel, gaps and metal discontinuities, and loose or missing connection components. Note the overall condition of paint or other coatings. At designated connections, visually check for deterioration or damage. Check horizontal surfaces of members for accumulations of dirt, sand, or debris, and evidence of water ponding due to rain or wave splash or debris accumulation. Ponding may indicate distortion and the possible need for repairs or replacement of the member. Ponding will also lead to localized increases of corrosion rates. For coil springs, check structural housing elements and appurtenances for evidence of water ponding due to rain or wave splash and spray. Check for greasing and lubrication needs.

Use appropriate instruments or devices to determine approximate loss of metal thickness due to corrosion or abrasion, or cracking due to impact or fatigue (dye-penetrant testing may be required to quantify fatigue cracking). Measure and record dimensions of members (depth, flange and web thickness) and compare with original member dimensions from as-built drawings, if available. Measure and record the depth of steel springs.

Timber Fenders and Structural Members

The most common causes of timber waterfront structure deterioration include decay or rot, insect and marine borer attack, splitting and checking, loosening of bolted connections, and abrasion or impact. Note that for fender units, structural connections of timber members are critical. Joints in timber are designed for allowable bearing pressure between the timber and the bolt and allowable loads on these connecting bolts are proportioned for such bearing stresses. However, in practice, the forces in the joint are resisted by friction between timber faces brought about by washer pressure from the bolted connection set up at the initial tightening of the connection. Subsequently, under heavy external loading, such as vessel impact, this washer pressure tends to increase, sometimes crushing the timber directly under the washer and loosening the connection. When this happens, friction between timbers is reduced after the load is removed and then when the connection is subject to a smaller external load, the joint will be thrown into bearing and there may be slippage and distortion in the joint.

The exposed faces of timber fender units are subject to constant abrasion from the vessel hull while the ship is in berth. The constant movement of the vessel under wave action will in time wear away the outer timber fibers, tending to expose the inset connecting hardware to contact with the vessel. Timber within the splash zone and submerged zones is subject to abrasion from suspended sand or silt in breaking wave zones. Timber fender faces are also subject to impact and fatigue from berthing vessel collision at moment of impact. Other possible sources of impact damage are heavy floating debris, breaking waves or strong currents.

Perform an overall observation for obvious deterioration or damage, such as missing or disfigured timber members, splitting, holes and discontinuities, loose or missing connection components, and elongated or enlarged bolt holes. Visually check for decay or rot, insect or marine borer attack, splitting and damage due to abrasion, impact or fatigue. Note any debris accumulation or ponding of water on horizontal surfaces.

Ponding indicates disfigured members and can lead to localized increases in wood deterioration. Check for exposed hardware protruding beyond the face of the fender unit.

Use appropriate instruments and devices such as a hammer, pick, and measuring devices to determine the presence and magnitude of decay or rot, or insect/marine borer attack. Measure the extent of damage resulting from abrasion, impact or fatigue abuse, by determining the depth of cracking or deterioration.

Synthetic Facing Materials

Synthetic facing materials are subject to lamination failures and structural failures. Lamination failures are the result of improper manufacturing and molding of the high-density polyethylene or nylon. They can be detected by the peeling away of surface layers of the synthetic facing. Structural failure may occur when synthetic facings are used to replace timber facings, since synthetic materials usually have lower flexure, compression, and tension strength properties than the more traditional timber (greenheart/oak/pine) facings. Inadequately designed synthetic facings may not possess the appropriate strength properties to perform adequately across a span that was previously adequately protected by timber. Cracking, splitting, and excessive deformations may result. Synthetic facings are also subject to abrasion and wear from ship hulls but usually perform much better than their timber-faced counterparts.

Visually check for deterioration or damage such as cracked, broken or missing pads. Check for exposed steel reinforcement and bolts/hardware. Check for splitting and damage due to abrasion and/or impact. Check for proper alignment of the facing units.

Use appropriate measuring instruments or devices to determine loss of facing thickness due to abrasion or cracking due to impact or fatigue. Determine how much material is remaining over the connecting bolt heads. Record findings.

Hardware (Chains, Pad Eyes, Bolts, Nuts, and Washers)

Fender mounting hardware generally consists of chains, shackles, connecting links, eyebolts, U-bolts, expansion bolts, pipes, plates, nuts, bolts, and washers. These components are subject to corrosion. This hardware, in certain installations, is also subject to abrasion and wear. Therefore, particular care should be taken when inspecting fender mounting components that are subject to rubbing or twisting action under load that would tend to wear away the parent metal. A shackle pin is a typical example.

Of importance to the structural integrity of timber connections is the proper sizing of marine bolts and washers. Since timber retains moisture, bolts are subject to corrosion that is very difficult to prevent. Therefore, all bolts should have been galvanized and oversized when installed to provide a corrosion allowance. The minimum diameter of any bolt used in this type of situation should be 2.5 centimeters (1 inch). Oversized washers should have been installed to maximize bearing area and reduce the potential for slippage of the connection. Make note of any substandard hardware connections.

Marine bolts on fender or synthetic faces are almost always countersunk (inset). It is important to provide sufficient clearance for facing abrasion and wear between the top of the bolt and the compressed facing. These recesses should always be plugged with timber discs or filled with pitch or mastic to protect the steel components from corrosion.

Perform an overall check for obvious deterioration or damage such as broken, bent, or missing hardware. Check for evidence of corrosion, abrasion, and fatigue. Check the condition of galvanizing and painted surfaces. Check all mounting bolts and nuts for tightness and, if possible, check the condition of anchor bolt entries into concrete, and welded connections. Check for looseness of anchor bolts and cracks in the concrete around the bolts. Check for evidence of slippage in connections and for resulting excessive deflection where slippage has occurred.

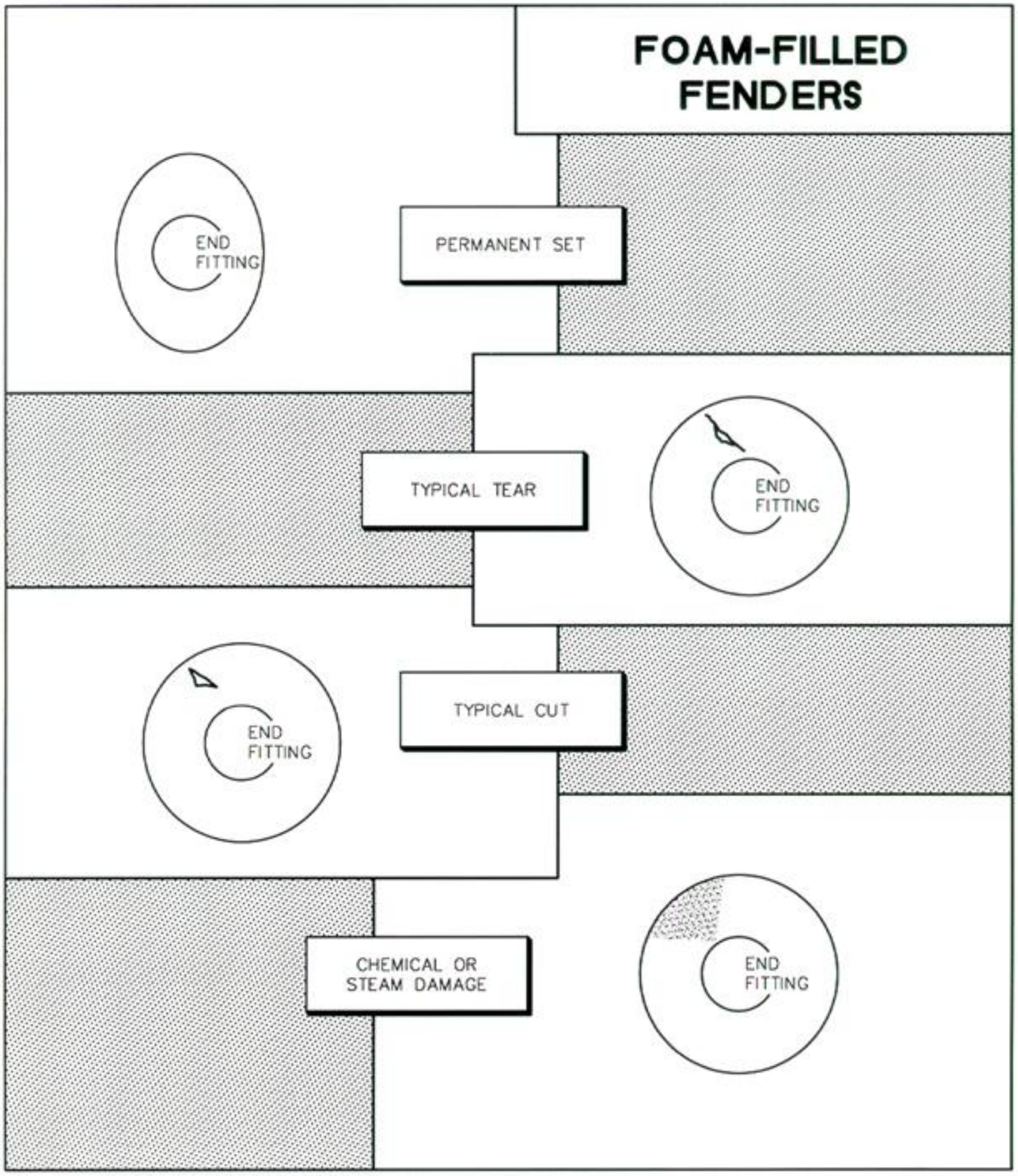
Use appropriate instruments or devices to determine loss of metal thickness due to corrosion or abrasion, or cracking due to impact or fatigue (dye-penetrant testing may be required to quantify fatigue cracking). Determine the extent of steel or concrete hardware connection deterioration or damage and extent of loose mounting bolts. Record findings.

Foam-Filled & Pneumatic Fender Units

Some rubber fender units are filled with foam or air, to increase the energy absorption capacity of the unit. These fender units are subject to deterioration or damage in the forms of permanent set, abrasion or impact damage, aging and chemical or steam damage. When permanent set (foam filled fenders) occurs, the energy absorption capability of the fender unit has been diminished. Abrasion and impact damage may be evidenced by tears and cuts, which expose the foam to the environment. Aging, chemical, or steam deterioration will result in the foam becoming brittle and crumbling, and losing the ability to return to its original volume. See Figure C2-13, below, for examples of these deterioration symptoms.

FIGURE C2-13

TYPICAL DAMAGE TO FOAM-FILLED FENDERS (PROFILE VIEW)



Camels and Separators

Camels are floating separators that may simply consist of a log or pile tethered to the pier or wharf terminal face, or may be more substantial built-up timber or steel pontoon structures. Camels may be installed as the sole source of fendering, or they may be used in conjunction with timber fender pile systems.

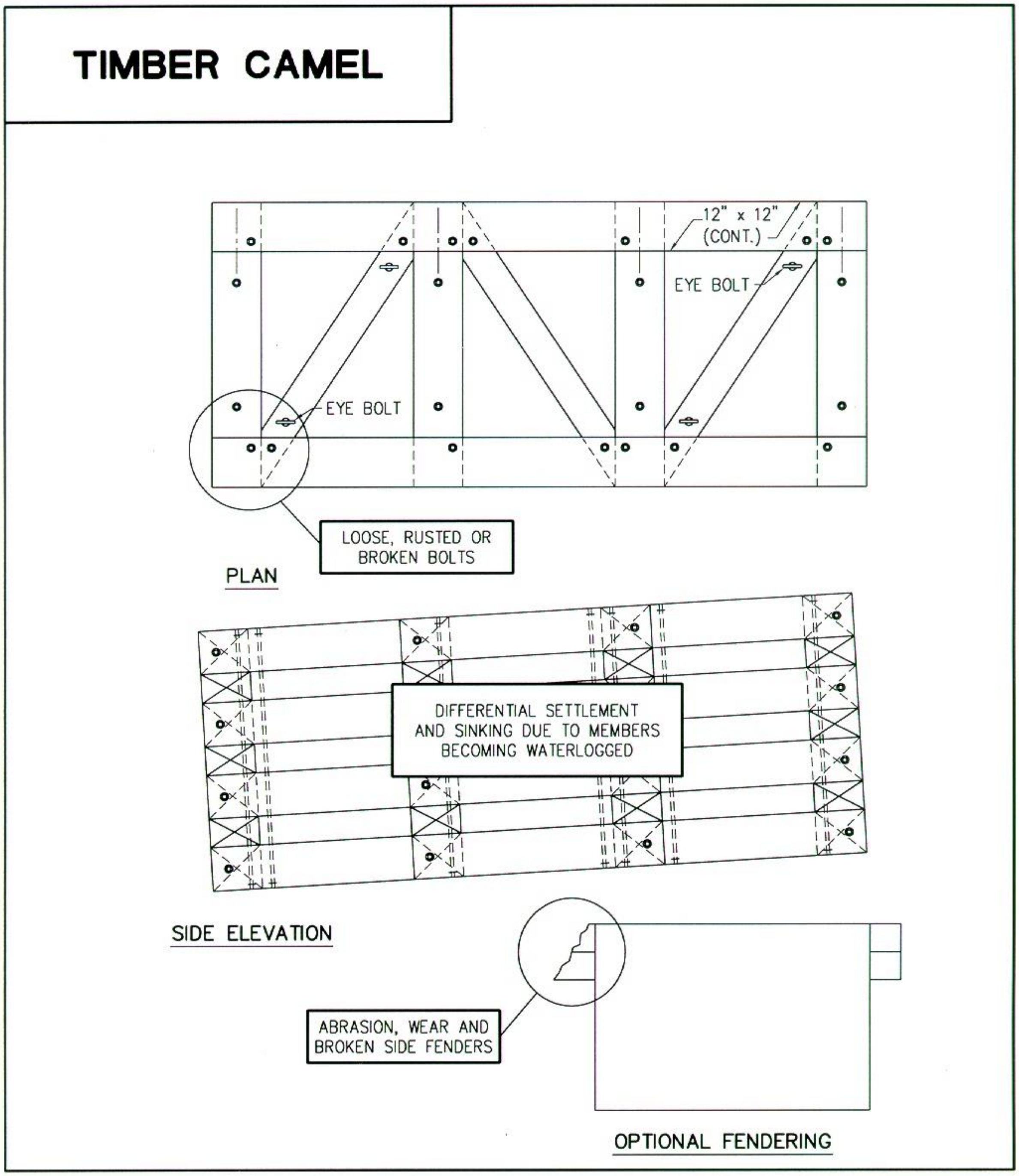
The most common causes of damage/deterioration of the overall camel structure include loosening of bolted connections, sinking or differential settlement due to timber members missing or becoming waterlogged, and abrasion or impact. Figure C2-14, below, presents examples of typical damage of a camel constructed of timber elements with bolted connections.

Perform an overall check of the camel, visually inspecting for damaged, broken, or missing members. Note the orientation, freeboard and levelness of the camel. Inspect all visible hardware connectors (bolts, angles, chains, etc.) for signs of looseness, damage, corrosion, or missing components. For timber camels, visually inspect the camel decking and upper framing for signs of corrosion, rot or fungal damage. For steel camels, check for corrosion, scaling, and holes. Also inspect for loss of the protective coating and cathodic protection system, if used. If rubber fendering is attached to the camel, inspect according to the requirements in the previous subsection.

If possible, the camel should be removed from the water for the Level II inspection. Clean the camel of marine growth as required, and visually inspect for surface deterioration (rot, marine borer infestation, loss of protective coating, corrosion, scaling, and holing). Sound the surface of the camel with a hammer and probe with a pick to determine the locations and magnitudes of deterioration, if any. Inspect and record the condition of all fasteners, including bolts, chains, and turnbuckles. If fiberglass flotation tanks are used at a steel camel, inspect them for abrasions, punctures, or exposed fiberglass. Use appropriate instruments or devices to measure any deterioration, and record the findings.

FIGURE C2-14

TYPICAL DAMAGE TO TIMBER CAMELS



Other Fender System Types

Other types of fender systems should be in inspected in a similar manner to that described above with particular attention to type specific failure mechanisms. Examples of other fender systems may include:

- Raykin Fenders
- Donut Fenders
- Cylindrical Fender

FENDER SEVERITY RATING – SUMMARY

Upon completion of the data collection for the fender system inspection of a MOT, a comprehensive summary of the data should be prepared. Each fender unit should be given a severity rating based upon the combined ratings of its components. Following the determination of fender unit ratings, a statistical summary of the unit ratings should be prepared. This summary should state the percentage of occurrences of each condition assessment rating out of the total number of observations. For example, out of a total of 10 inspected rubber fender units, 70% of the pads were observed to have minor deterioration, 10% are in moderate condition, 10% are in major condition, and 10% are in severe condition or missing.

The summarized data should then be used to apply berthing OSARs (see Table C2-9 below for OSAR descriptions) to the structures and overall berth systems.

TABLE C2-9

ASSESSMENT RATINGS

RATING		DESCRIPTION OF STRUCTURE(S) AND/OR SYSTEMS[4]	
		OSAR[1] and SSAR[2]	ICAR[3]
6	*Good*	*The capacity of the structure or system meets the requirements of this standard.* *The structure or system should be considered fit-for-purpose. No repairs or upgrades are required.*	*No problems or only minor problems noted. Structural elements may show very minor deterioration, but no overstressing observed.* *No repairs or upgrades are required.*
5	*Satisfactory*	*The capacity of the structure or system meets the requirements of this standard.* *The structure or system should be considered fit-for-purpose. No repairs or upgrades are required.*	*Limited minor to moderate defects or deterioration observed, but no overstressing observed.* *No repairs or upgrades are required.*
4	*Fair*	*The capacity of the structure or system is no more than 15 percent below the requirements of this standard, as determined from an engineering evaluation.* *The structure or system should be considered as marginal. Repair and/or upgrade measures may be required to remain operational. Facility may remain operational, provided a plan and schedule for remedial action is presented to and accepted by the Division.*	*All primary structural elements are sound, but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present, but do not significantly reduce the load bearing capacity of the structure.* *Repair and/or upgrade measures may be required to remain operational. Facility may remain operational, provided a plan and schedule for remedial action is presented to and accepted by the Division.*
3	*Poor*	*The capacity of the structure or system is no more than 25 percent below the requirements of this standard, as determined from an engineering evaluation.* *The structure or system is not fit-for-purpose. Repair and/or upgrade measures may be required to remain operational. The facility may be allowed to remain operational on a restricted or contingency basis until the deficiencies are corrected, provided a plan and schedule for such work is presented to and accepted by the Division.*	*Advanced deterioration or overstressing observed on widespread portions of the structure, but does not significantly reduce the load bearing capacity of the structure.* *Repair and/or upgrade measures may be required to remain operational. The facility may be allowed to remain operational on a restricted or contingency basis until the deficiencies are corrected, provided a plan and schedule for such work is presented to and accepted by the Division.*
2	*Serious*	*The capacity of the structure or system is more than 25 percent below the requirements of this standard, as determined from an engineering evaluation.* *The structure or system is not fit-for-purpose. Repairs and/or upgrade measures may be required to remain operational. The facility may be allowed to remain operational on a restricted basis until the deficiencies are corrected, provided a plan and schedule for such work is presented to and accepted by the Division.*	*Advanced deterioration, overstressing or breakage may have significantly affected the load bearing capacity of primary structural components. Local failures are possible and loading restrictions may be necessary.* *Repairs and/or upgrade measures may be required to remain operational. The facility may be allowed to remain operational on a restricted basis until the deficiencies are corrected, provided a plan and schedule for such work is presented to and accepted by the Division.*
1	*Critical*	*The capacity of the structure or system is critically deficient relative to the requirements of this standard.* *The structure or system is not fit-for-purpose. The facility shall cease operations until deficiencies are corrected and accepted by the Division.*	*Very advanced deterioration, overstressing or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur and load restrictions should be implemented as necessary.* *The facility shall cease operations until deficiencies are corrected and accepted by the Division.*

1. *OSAR = Operational Structural Assessment Ratings*
2. *SSAR = Seismic Structural Assessment Ratings*
3. *ICAR = Inspection Condition Assessment Ratings [2.2]; Ratings shall be assigned comparing the observed condition to the original condition.*
4. *Structural, mooring or berthing systems*

MECHANICAL & ELECTRICAL INSPECTION

Marine oil terminals consist of a variety mechanical and electrical equipment and systems to support operations. Each piece of equipment and system requires routine inspection to ensure proper function. The inspection should be tailored to the specific piece of equipment, system or component being observed (i.e. damage modes/failure mechanisms, operational requirements, hazardous area classifications, identification and tagging, grounding and bonding, panels, switches and conduit, communications and control systems). To the extent feasible, components shall be operated and tested during inspection. Maintenance, testing and calibration per the manufacturer recommendations shall be verified as appropriate. For examples of items that shall be considered in the inspection, see MOTEMS §3102F.3.5.3. Records such as P&IDs, hazardous area diagrams and illumination surveys shall be field verified.

CORROSION INSPECTION AND ASSESSMENT

The corrosion assessment is a visual assessment of all metallic wharf components and structures for the purpose of determining the significance of existing corrosion and protective coating deterioration. Components may include, but not be limited to: a) steel and steel re-enforced concrete piles, b) sheet piles, c) steel and steel re-enforced concrete structural members and deck, d) mooring and berthing dolphins, fenders and hardware, e) piping and equipment supports and anchorage, f) wharf fire protection equipment, g) mechanical and electrical equipment, h) electrical conduit, i) spill containment, etc. Corrosion assessment results shall be included in the audit report.

Marine oil terminals are located in an aggressively corrosive environment. Corrosion is a natural and inevitable process, even for the best protected metallic components. Some consequences of corrosion are: loss of material loss and component strength, reduced safety, and loss of oil containment.

Some components at a MOT may be protected by a cathodic protection system; however all metallic components must be included in the corrosion assessment. The corrosion assessment is a visual assessment of metallic wharf components and structures for the purpose of determining the significance of existing corrosion and protective coating deterioration. Components may include, but not be limited to:

- Steel and steel re-enforced concrete piles
- Sheet piles
- Steel and steel-reinforced concrete structural members and deck
- Mooring and berthing dolphins, fenders and hardware
- Piping and equipment supports and anchorage
- Wharf fire protection equipment
- Mechanical and electrical equipment
- Electrical conduit

- Spill containment, etc. Corrosion assessment results shall be included in the audit report.

Observed extent of corrosion (visual and wall thickness gaugings), and performance of the corrosion protection system during the inspection should be summarized and any potential impacts such as structural capacity, equipment operability due to corrosion observed should be evaluated. If cathodic protection is installed, evaluations should include review of impressed potential and rectifier readings, equipment condition and maintenance records.

LIST OF TABLES

TABLE 2-1

SUMMARY OF IDENTIFIED DEFICIENCIES

CHECKLIST ITEM # FROM TABLE 2-14	DEFICIENCY ITEM LABEL IN TABLE ES-2	RAP RATING	DESCRIPTION OF DEFICIENCY	RECOMMENDED ACTION OR MITIGATION

TABLE 2-2

SUMMARY OF MISSING OR UNKNOWN INFORMATION

CHECKLIST ITEM # FROM TABLE 2-14	DESCRIPTION OF MISSING OR UNKNOWN INFORMATION*
* **If Missing or Unknown Information is a Deficiency, Identify in Table 2-1**	

TABLE 2-3
AUDIT CHECKLIST

ITEM #	QUESTION	RESPONSE	RAP RATING
3102F.1 GENERAL			
3102F.1.3 BERTHING SYSTEMS			
2.1.1	How many berthing systems does the marine terminal have?		
3102F.1.4 RECORDS			
2.1.2	Does MOT have records reflecting current, "as-built" conditions for all berthing systems?		
2.1.3	Verify that all as-build records since the previous audit are included. Records include, modifications and/or replacement of structural components, electrical or mechanical equipment or relevant operational changes, new construction including design drawings, calculations, engineering analyses, soil borings, equipment manuals, specifications, shop drawings, technical and maintenance manuals and documents.		
2.1.4	Are records indexed and be readily accessible?		
3102F.1.5 BASELINE ASSESSMENT			
2.1.5	If "as-built" or subsequent modification drawings or records are not available, has a baseline inspection been completed to gather data in sufficient detail for adequate evaluation?		
2.1.6	Have all structural member sizes, connection and reinforcing details been documented?		
2.1.7	Has an overall above water inspection of the terminal been performed, looking for gross damage or deterioration of structural items, or potentially dangerous situations?		
2.1.8	Have all fire, piping, mechanical and electrical systems been documented as to location, capacity, operating limits and physical conditions?		
3102F.3 AUDITS OVERVIEW			
2.3.1	Provide Initial Audit date		
2.3.2	If this is a new Initial Audit subsequent to a major MOT upgrade, attach all applicable previous documents to this report.		
3102F.3.3 SCHEDULE			
2.3.3	Has the Audit Team Leader recommend audit schedule based on: (1) a default subsequent audit interval of 4 years, or (2) an alternate interval,		

ITEM #	QUESTION	RESPONSE	RAP RATING
	based on assessments of the structural, mechanical and electrical systems, and consideration of: 1. The extent of the latest deterioration and/or disrepair 2. The rate of future anticipated deterioration and/or disrepair, 3. The underwater inspection guidance provided in Table 31F-2-1, and 4. Other specified factors.		
2.3.4	If the Audit Team Leader chose: *“(2) an alternate [audit] interval”*, provide a detailed description of the factors and rationale considered for the interval recommended.		
2.3.5	Have there been any changes in the defined purpose of the berthing system(s), including changes in operations or conditions, which warrant new analyses?		
3102F.3.4 AUDIT TEAM			
2.3.6	Does the project manager have specific knowledge of the MOT? Identify any other roles on the audit team held by the project manager.		
2.3.7	Did the Audit Team Leader lead the on-site audit team and direct all field activities, including the inspection of all structural, mechanical and electrical systems?		
2.3.8	Is the Audit Team Leader a California registered civil or structural engineer? Identify any other roles on the audit team held by the Audit Team Leader.		
2.3.9	Was the structural inspection conducted under the direction of a registered civil or structural engineer?		
2.3.10	Are all members of the structural inspection team graduates of a 4-year civil/structural engineering, or closely related (ocean/coastal) engineering curriculum, and have been certified as an Engineer-in-Training; or technicians who have completed a course of study in structural inspections per MOTEMS requirements?		
2.3.11	Identify registered civil engineer and members of the structural inspection team.		
2.3.12	For underwater inspections, is the engineer directing the structural inspection a registered civil engineer and a commercially trained diver or equivalent?		
2.3.13	Has the engineer directing the underwater structural inspection personally conducting a		

ITEM #	QUESTION	RESPONSE	RAP RATING
	minimum of 25 percent of the underwater examination?		
2.3.14	Are all underwater inspection team members commercially trained diver, or equivalent?		
2.3.15	Are all structural evaluations performed by a California registered civil engineer?		
2.3.16	Are electrical inspections and evaluations directed by a California registered electrical engineer? Identify registered electrical engineer and members of the electrical inspection team.		
2.3.17	Are mechanical inspections and evaluations directed by a California registered engineer? Identify registered engineer and members of the inspection team.		
2.3.18	Is the corrosion specialist a chemical engineer, corrosion engineer, chemist or other professional with expertise in the types and causes of corrosion, and available means to prevent, monitor and mitigate associated damage? Identify the corrosion specialist and qualification credentials.		
2.3.19	Is the engineer performing the geotechnical evaluation required for the audit and all other geotechnical evaluations a California registered civil engineer with a California authorization?		
3102F.3.5 SCOPE OF INSPECTIONS			
2.3.20	Has an inspection been made of all above water steel components?		
2.3.21	If there is a concrete deck, has the underside of the deck been inspected?		
2.3.22	Is there evidence of damage to the concrete structure from erosion or overstressing?		
2.3.23	Is there evidence of chemical damage to the concrete?		
2.3.24	Is there evidence of corrosion of the reinforcing steel?		
2.3.25	Is the concrete protected using surface coatings or linings, if so, what is the condition?		
2.3.26	Has an inspection been made of all above water timber components?		
2.3.27	Is there any cracking or other surface damage in the above water timber structural members?		
2.3.28	Has an underwater inspection been made of the piles?		
2.3.29	If not, what is the date of the last underwater inspection?		
2.3.30	Is there evidence of damage to the concrete structure from erosion or overstressing?		

ITEM #	QUESTION	RESPONSE	RAP RATING
2.3.31	Is there evidence of corrosion of the reinforcing steel?		
2.3.32	Is the concrete protected using surface coatings or linings, if so, what is the condition?		
2.3.33	If so, does the protective layer appear to be effective?		
2.3.34	Is there any evidence of marine borer damage?		
2.3.35	Are the piles protected with plastic or other type of coating?		
2.3.36	If so, does the protective layer appear to be effective?		
2.3.37	If there are bracing members, have the bracing connections been inspected?		
2.3.38	Is the fenders/mooring equipment in good condition? Provide a brief description of observed condition noting specific fenders with damage.		
2.3.39	Are the fender supports in good condition?		
2.3.40	Are the vessel approach speed and angle limitations complied with?		
2.3.41	Is an anemometer installed? Provide location and elevation.		
2.3.42	Does the anemometer have set points to alarm for design wind conditions?		
2.3.43	Is anemometer data recording in operation?		
2.3.44	What anemometer parameters are recorded/logged?		
2.3.45	Is a current meter installed and operational? Provide location and depth.		
2.3.46	Are the record current meter measurements available?		
2.3.47	What current parameters are recorded/logged?		
2.3.48	Does the current have set points to alarm for operational limitations?		
2.3.49	Is current data recording in operation?		
2.3.50	Does the terminal have access to current flow forecasts?		
2.3.51	Does the terminal have functional instrumentation to measure and record mooring loads?		
2.3.52	Have all alarms, limit switches, load cells, current meters, anemometers, leak detection equipment, etc., been operated and/or tested to the extent		

ITEM #	QUESTION	RESPONSE	RAP RATING
	feasible, to ensure proper function?		
2.3.53	Has a comprehensive corrosion inspection shall be performed by a qualified engineer or technician? This inspection shall include all steel and metallic components, and any installed cathodic protection system (CPS). Provide the inspectors name and affiliation.		
2.3.54	Have utility, auxiliary and fire protection piping external visual inspections been performed? [Similar to Section 10.1, API RP 574]		
2.3.55	Have submerged wharf structures and associated cathodic protection equipment (if installed) been inspected? [ASCE “Underwater Investigations - Standard Practice Manual”]		
2.3.56	Have all above water structures, ancillary equipment, supports, and hardware shall be visually inspected?		
2.3.57	Have the latest API 570 inspection results, calculations, and conclusions been reviewed? Are there any significant results? If so, are the results considered in the corrosion assessment?		
3102F.3.6 EVALUATION AND ASSESSMENT			
2.3.58	Provide date(s) for current Terminal Operating Limits (TOLs) and reference(s).		
2.3.59	Verify the TOLs accurately reflect the following: 1. How many mooring points are available / in service? 2. Provide ID/Names of each Provide the SWL of each bollard, hook, or assembly, including calculations/ basis for each.		
2.3.60	Is each TOL diagram stamped and signed by the Professional Engineer (PE) of record?		
2.3.61	Does the TOLs comply with latest revision of MOTEMS?		
2.3.62	Do the mooring analyses comply with latest revision of MOTEMS? Update the “M” OSARs in ES-1A accordingly with a detailed description (e.g. mooring hardware limitations, etc)		
2.3.63	Do the berthing analyses comply with latest revision of MOTEMS? Update the “B” OSARs in ES-1A accordingly with a detailed description (e.g. velocity monitoring, etc)		
2.3.64	Do the operational loading structural analyses comply with latest revision of MOTEMS? Update the “O” OSARs in ES-1A accordingly with a detailed description (e.g. gravity load limitations,		

ITEM #	QUESTION	RESPONSE	RAP RATING
	etc)		
2.3.65	Do the seismic structural analyses comply with latest revision of MOTEMS? Update the SSARs in ES-1B accordingly with a detailed description (e.g. level 1 & 2 evaluations, software and analyses performed, etc)		
2.3.66	Do the seismic structural analyses comply with latest revision of MOTEMS? Update the SSARs in ES-1B accordingly.		
2.3.67	Do the above water structural assessments/inspections comply with latest revision of MOTEMS? Update the ICARs in ES-1C accordingly.		
2.3.68	Do the underwater structural assessments/inspections comply with latest revision of MOTEMS? Update the ICARs in ES-1C accordingly.		
2.3.69	3102F.3.6.4 Mechanical and Electrical Systems		
2.3.70	Do the pipeline stress analyses comply with latest revision of MOTEMS? Update the SSARs in ES-1B accordingly.		
2.3.71	Have follow-up actions per 31F-2-6 been prescribed by the audit team?		
2.3.72	How many assessment ratings of “1”, “2”, “3” (Table 31F-2-4) been assigned?		
2.3.73	How many RAP assessment ratings of “P1” and “P2” (Table 31F-2-5) been assigned?		
2.3.74	How many “Emergency Action” items (Table 31F-2-6) been assigned?		
2.3.75	Do all deficiencies in Table ES-2 have follow-up and remedial actions and implementation schedule? (i.e. Populated “Description of Planned Remedial Action” and “Repair/replacement Due Date” columns)		
3102F.3.8 DOCUMENTATION AND REPORTING			
2.3.76	Has the audit report been signed and stamped by the Audit Team Leader?		
2.3.77	Has all inspections and other reports been signed and stamped by the engineers in in responsible charge?		
2.3.78	Do each audit inspection report meet the minimum documentation and reporting requirements per MOTEMS?		
2.3.79	3102F.3.9 Action Plan Implementation Between Audits		

ITEM #	QUESTION	RESPONSE	RAP RATING
2.3.80	Have recommended repairs from latest underwater inspection for mooring system been completed?		

TABLE 2-4
MAIN LOADING PLATFORM INFORMATION

LENGTH (FT)	
WIDTH (FT)	
MINIMUM PILE LENGTH, MUDLINE TO PILE (FT)	
MAXIMUM PILE LENGTH, MUDLINE TO PILE (FT)	
MAXIMUM ALLOWABLE UNIFORM VERTICAL LOAD (PSF)	
MAXIMUM DESIGN IMPACT LOAD (KIPS)	
PROVIDE AS-BUILT DESIGN DRAWING REFERENCE(S)	
PROVIDE STRUCT. DESIGN CALCULATION REFERENCE(S)	

TABLE 2-5
MAIN LOADING PLATFORM CONSTRUCTION INFORMATION

ELEMENT	MATERIAL	QUANTITY (PER MATERIAL)	CORROSION PROTECTION (DESCRIBE)
PLUMB PILES			
BATTER PILES			
PILECAPS			
DECK BEAMS			
BRACING			
DECK			

TABLE 2-6

TRESTLE INFORMATION

LENGTH (FT)	
WIDTH (FT)	
ROADWAY WIDTH (FT)	
PIPEWAY WIDTH (FT)	
MINIMUM PILE LENGTH, MUDLINE TO PILE CAP (FT)	
MAXIMUM PILE LENGTH, MUDLINE TO PILE CAP (FT)	
MAXIMUM ALLOWABLE UNIFORM VERTICAL LOAD (PSF)	
PROVIDE AS-BUILT DESIGN DRAWING REFERENCE(S)	
PROVIDE STRUCT. DESIGN CALCULATION REFERENCE(S)	

TABLE 2-7

TRESTLE CONSTRUCTION INFORMATION

ELEMENT	MATERIAL	QUANTITY (PER MATERIAL)	CORROSION PROTECTION (DESCRIBE)
PLUMB PILES			
BATTER PILES			
PILECAPS			
DECK BEAMS			
BRACING			
DECK			

TABLE 2-8

BULKHEAD/RETAINING WALL INFORMATION

LENGTH (FT)	
WIDTH (FT)	
MINIMUM PILE LENGTH, MUDLINE TO CAP (FT)	
MAXIMUM PILE LENGTH, MUDLINE TO CAP (FT)	
MAXIMUM ALLOWABLE SURCHARGE LOAD (PSF)	
PROVIDE AS-BUILT DESIGN DRAWING REFERENCE(S)	
PROVIDE STRUCT. DESIGN CALCULATION REFERENCE(S)	

TABLE 2-9

BULKHEAD/RETAINING WALL CONSTRUCTION INFORMATION

ELEMENT	MATERIAL	ELEMENT DESCRIPTION (E.G. TYPE, QUANTITY, ETC)	CORROSION PROTECTION (DESCRIBE)
SHEET PILES/PILES			
CAP			
WALL ANCHORS			

TABLE 2-10
CATWALK INFORMATION

LENGTH (FT)	
WIDTH (FT)	
MINIMUM PILE LENGTH, MUDLINE TO PILE CAP (FT)	
MAXIMUM PILE LENGTH, MUDLINE TO PILE CAP (FT)	
MAXIMUM ALLOWABLE UNIFORM VERTICAL LOAD (PSF)	
PROVIDE AS-BUILT DESIGN DRAWING REFERENCE(S)	
PROVIDE STRUCT. DESIGN CALCULATION REFERENCE(S)	

TABLE 2-11
CATWALK CONSTRUCTION INFORMATION

ELEMENT	MATERIAL	QUANTITY (PER MATERIAL)	CORROSION PROTECTION (DESCRIBE)
PLUMB PILES			
BATTER PILES			
PILECAPS			
DECK BEAMS			
BRACING			
DECK			

TABLE 2-12
DOLPHIN INFORMATION

DOLPHIN ID	DOLPHIN TYPE	CONSTRUCTION DESCRIPTION

TABLE 2-13
MOORING HARDWARE INFORMATION

MOORING HARDWARE ID	TYPE	DESIGN CAPACITY	EXISTING CAPACITY	INSTALLATION DATE	DESIGN REFERENCE

TABLE 2-14
FENDER INFORMATION

FENDER ID	TYPE	DESIGN CAPACITY	EXISTING CAPACITY	INSTALLATION DATE	DESIGN REFERENCE

TABLE 2-15
(DUPLICATE AS NECESSARY)
STANDARD PILE AUDIT INSPECTION RECORD

TERMINAL: **BERTH NO.:**	**LOCATION:** **AUDITOR:**	**COMPANY:** **AUDIT DATE:**	**DIVERS:**
TIME OF DAY:	**TIDE:**	**PILE TYPE (BEARING, BATTER, SHEET):**	**PILE MATERIAL:**

LOCATION		**LEVEL II INSP.**	**LEVEL III INSP.**	**WATER DEPTH**	**PILE CONDITION RATING**						**COMMENTS**
BENT	**PILE**				**NI**	**ND**	**MN**	**MD**	**MJ**	**SV**	
ADDITIONAL COMMENTS:											

CONDITION RATING LEGEND:

NI = Not inspected, inaccessible
ND = No Deterioration/Damage
MN = Minor Deterioration/Damage
MD = Moderate Deterioration/Damage
MJ = Major Deterioration/Damage
SV = Severe Deterioration/Damage

Refer to Section 3102F.3 for definitions and examples of Condition Rating Levels

TABLE 2-16

(DUPLICATE AS NECESSARY)

STRUCTURAL COMPONENT AUDIT INSPECTION RECORD

TERMINAL:	**LOCATION:**	**COMPANY:**	**DIVERS:**
BERTH NO.:	**AUDITOR:**	**AUDIT DATE:**	
TIME OF DAY:	**TIDE:**	**COMPONENT TYPE:**	**COMPONENT MATERIAL:**

COMPONENT ID	**LOCATION**	**COMPONENT CONDITION RATING**						**COMMENTS**
		NI	**ND**	**MN**	**MD**	**MJ**	**SV**	

ADDITIONAL COMMENTS:

CONDITION RATING LEGEND:

NI = Not inspected, inaccessible
ND = No Deterioration/Damage
MN = Minor Deterioration/Damage
MD = Moderate Deterioration/Damage
MJ = Major Deterioration/Damage
SV = Severe Deterioration/Damage

Refer to Section 3102F.3 for definitions and examples of Condition Rating Levels

TABLE 2-17
(DUPLICATE AS NECESSARY)
FENDER PILE INSPECTION RECORD

TERMINAL: T1	**LOCATION: PORT OF LONG BEACH**	**COMPANY: BP SHIPPING (USA)**	**DIVERS:**
BERTH NO.: 121	**AUDITOR:**	**AUDIT DATE:**	
TIME OF DAY:	**TIDE:**	**PILE TYPE (BEARING, BATTER, SHEET): N/A**	**PILE MATERIAL: N/A**

LOCATION		LEVEL II INSP	LEVEL III INSP	WATER DEPTH	PILE CONDITION RATING						COMMENTS
BENT	PILE				NI	ND	MN	MD	MJ	SV	

ADDITIONAL COMMENTS:

CONDITION RATING LEGEND:

NI = Not inspected, inaccessible
ND = No Deterioration/Damage
MN = Minor Deterioration/Damage
MD = Moderate Deterioration/Damage
MJ = Major Deterioration/Damage
SV = Severe Deterioration/Damage

Refer to Section 3102F.3 for definitions and examples of Condition Rating Levels

TABLE 2-18

(DUPLICATE AS NECESSARY)

FENDER COMPONENT INSPECTION DOCUMENTATION FORM

(Complete for each fender structure at the berth, label each inspected structure by number on plan view for reference)

TERMINAL:	**LOCATION:**	**COMPANY:**
BERTHING SYSTEM:	**AUDITOR:**	**AUDIT DATE:**

FENDER UNIT	FENDER COMPONENT	COMPONENT MATERIAL	SYMPTOM(S) OBSERVED	SEVERITY RATING	COMMENTS

TABLE 2-19

ATTACHMENTS*

ATTACH. NUMBER	AUDIT YEAR	REFERENCE TITLE	DESCRIPTION

*** For Section 3102F, this table is intended to chronologically log all MOTEMS Audit attachments starting from the Initial Audit. Attachments in previous audit reports shall remain listed, but need not be attached. If previous attachments are no longer valid, their status shall be indicated utilizing strikethrough text.**

SECTION 3103F
AUDIT GUIDELINES

GENERAL

1. The Section 3103F Audit checks for compliance with environmental and operating loads acting on the marine oil terminal (MOT) structures and on moored vessel(s).

2. Complete Tables 3-1 thru 3-4.

3. Remedial Action Priority (RAP) ratings shall be assigned according to MOTEMS Table 31F-2-5.

4. Information should be field verified using drawings, as appropriate. Discrepancies between documentation and actual installations shall be marked and noted.

5. New inspection findings shall be compared to previous MOTEMS Audit results to identify and report any changes.

6. Photographs, sketches and supporting data shall be utilized to record and report the observed conditions and deficiencies.

LIST OF TABLES

TABLE 3-1

SUMMARY OF IDENTIFIED DEFICIENCIES

CHECKLIST ITEM # FROM TABLE 3-3	DEFICIENCY ITEM LABEL IN TABLE ES-2	RAP RATING	DESCRIPTION OF DEFICIENCY	RECOMMENDED ACTION OR MITIGATION

TABLE 3-2

SUMMARY OF MISSING OR UNKNOWN INFORMATION

CHECKLIST ITEM # FROM TABLE 3-3	DESCRIPTION OF MISSING OR UNKNOWN INFORMATION*
* If Missing or Unknown Information is a Deficiency, Identify in Table 3-1	

TABLE 3-3

AUDIT CHECKLIST

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
3103F.2 Dead Loads			
3.2.1	Were any equipment and non-structural components included in the structural analysis?		
3.2.2	How were these dead loads incorporated into the structural analysis model?		
3103F.3 LIVE LOADS AND BUOYANCY			
3.3.1	Does this MOT include multi-use berths?		
3.3.2	Were any additional live loads included in the structural analysis model? If so, specify.		
3103F.4 EARTHQUAKE LOADS			
3.4.1	What is the oil spill exposure classification of the MOT? [MOTEMS Table 31F-1-1]		
3.4.2	What is the site latitude and longitude?		
3.4.3	What is the closest earthquake fault and its distance from the site?		
3.4.4	What is the return period for the Level 1 Design Earthquakes? [MOTEMS Table 31F-4-1]		
3.4.5	What is the return period for the Level 2 Design Earthquakes? [MOTEMS Table 31F-4-1]		
3.4.6	Have the effects of directivity been incorporated for faults closer than 15 km from the site?		
3.4.7	What level of damping was used in the analysis? Provide justification, if >5%.		
3.4.8	Is soil amplification considered? Provide a copy of the final design spectra.		
3.4.9	If time histories are used. If so, how many? Are the design values envelope or average?		
3.4.10	What is the design earthquake magnitude?		
3103F.5 MOORING LOADS ON VESSELS			
3.5.1 (F)	Does the MOT have an on-site anemometer?		
3.5.2 (F)	Specify anemometer location		
3.5.3 (F)	Does wind blockage due to structures, equipment, or vessels impact wind velocity readings?		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
3.5.4 (F)	Are anemometer measurements taken at 33ft (10m) above the water (MLLW)? If not, is a correction factor applied in the anemometer output?		
3.5.5 (F)	Does the anemometer output 30 second wind gust values? If not, is a correction factor applied in the anemometer output?		
3.5.6	Specify design current velocity (magnitude and direction, ebb and flood).		
3.5.7	Is design current velocity based on one or more year of site specific data?		
3.5.8	What is the predicted sea-level rise over the remaining life of the terminal?		
3.5.9	Do wave loads impact the mooring system?		
3.5.10	Do passing vessel loads impact the mooring system?		
3.5.11	Is there a potential for a seiche to impact the mooring terminal?		
3.5.12	What are the estimated run-up values from a tsunami event that may impact the terminal?		
3.5.13	Does the terminal have a tsunami plan?		
3103F.6 BERTHING LOADS			
3.6.1	Are there berthing restrictions at the terminal? Specify.		
3.6.2	Is velocity monitoring utilized?		
3.6.3	If velocity monitoring is utilized due to berthing restriction, has it been used for >1 year?		
3103F.8 LOAD COMBINATIONS			
3.8.1	What is the site PGA?		
3.8.2	Do all load combinations used in analyses conform to MOTEMS requirements?		
3103F.9 SAFETY FACTORS FOR MOORING LINES			
3.9.1	DO MOORING LINES (TYPE/MIN. MBL) SPECIFIED ON TOLS (OR MOORING ANALYSIS) MATCH MOORING LINES USED FOR VESSELS WHILE AT THE BERTH(S)? IF NOT, PROVIDE DETAILS.		
3103F.10 MOORING HARDWARE			

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
3.10.1	Is the wharf structural capacity greater than the Safe Working Load (SWL) of the mooring hardware? Provide calculations or reference the submitted documents.		
3103F.11 MISCELLANEOUS LOADS			
3.11.1	Is there significant deterioration of the hand and guard rails and their connections?		
3.11.2	Do calculations account for deterioration?		
3.11.3	Do all hand and guard rails comply with MOTEMS capacity requirements?		

TABLE 3-4

ATTACHMENTS*

ATTACH. NUMBER	AUDIT YEAR	REFERENCE TITLE	DESCRIPTION

*** For Section 3103F, this table is intended to chronologically log all MOTEMS Audit attachments starting from the Initial Audit. Attachments in previous audit reports shall remain listed, but need not be attached. If previous attachments are no longer valid, their status shall be indicated utilizing strikethrough text.**

SECTION 3104F AUDIT GUIDELINES

GENERAL

1. The Section 3104F Audit requires review of compliance with minimum standards specified in MOTEMS Division 4 for seismic analysis and structural performance. Seismic performance is evaluated for two criteria. Level 1 requirements define a performance criterion to ensure MOT functionality. Level 2 requirements safeguard against major structural damage or collapse.
2. Complete Tables 4-1 thru 4-7.
3. Prior to completion of Table 4-3 checklist, collect the most recent seismic analysis, structural drawings and pertinent geotechnical information.
4. Table 4-4 thru 4-7 pertain to structural analysis using “push-over” methodology. For analysis using other structural assessment methods (e.g. linear modal), provide appropriate tables.
5. Remedial Action Priority (RAP) ratings shall be assigned per MOTEMS Table 31F-2-5.
6. Information should be field verified using drawings, as appropriate. Discrepancies between documentation and actual installations shall be marked and noted.
7. New inspection findings shall be compared to previous MOTEMS Audit results to identify and report any changes.
8. Photographs, sketches and supporting data shall be utilized to record and report the observed conditions and deficiencies.

LIST OF TABLES

TABLE 4-1

SUMMARY OF IDENTIFIED DEFICIENCIES

CHECKLIST ITEM # FROM TABLE 4-3	DEFICIENCY ITEM LABEL IN TABLE ES-2	RAP RATING	DESCRIPTION OF DEFICIENCY	RECOMMENDED ACTION OR MITIGATION

TABLE 4-2

SUMMARY OF MISSING OR UNKNOWN INFORMATION

CHECKLIST ITEM # FROM TABLE 4-3	DESCRIPTION OF MISSING OR UNKNOWN INFORMATION*
* **If Missing or Unknown Information is a Deficiency, Identify in Table 4-1**	

TABLE 4-3

AUDIT CHECKLIST

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
3104F.1 GENERAL			
4.1.1	What is the MOT oil spill exposure classification? [MOTEMS Table 31F-1-1]		
4.1.2	What is the configuration classification (regular or irregular)? If irregular, reference calculations.		
4.1.3	What performance criteria has been used for seismic design and/or evaluation?		
3104F.2 EXISTING MOTS			
4.2.1	Describe performance criteria used for seismic design and/or evaluation.		
4.2.2	Are there structural drawings available? If not, has a baseline assessment been performed?		
4.2.3	Is adequate geotechnical information available?		
4.2.4	What analytical procedures are used for demand and capacity calculations? [MOTEMS Table 31F-4-2]		
4.2.5	What is the fundamental period, T in both horizontal directions?		
4.2.6	Was 5% damping constant used? If not, is MOTEMS Equation 4-10 used?		
4.2.7	What software package and version is used? Has the package been validated?		
4.2.8	Explain modeling assumptions and describe modelling details.		
4.2.9	What assumptions and procedure are used for SSI (Soil-Structure Interaction)?		
3104F.4 GENERAL ANALYSIS AND DESIGN REQUIREMENTS			
4.4.1	Describe how orthogonal effects are combined?		
4.4.2	Is P-Δ considered? [MOTEMS Equation 4-19]		
4.4.3	Are there expansion joints? If so, how are they modeled?		
4.4.4	Are there batter piles? If so, provide direction and how they are modeled.		
3104F.5 NONSTRUCTURAL COMPONENTS			
4.5.1	How are nonstructural components on the pipeline trestle and wharf/pier deck accounted for in the structural model?		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
4.5.2	Provide a laydown pattern for equipment loads on the wharf/pier deck and trestle.		
3104F.6 NONSTRUCTURAL CRITICAL SYSTEMS ASSESSMENT			
4.6.1	List the critical systems evaluated during this audit. Include critical systems seismic assessment results in the audit report.		
4.6.2	Has the anchorage, flexibility and seismically-induced interaction of these components been considered?		

TABLE 4-4

GLOBAL PERFORMANCE SUMMARY - LONGITUDINAL PUSHOVER ANALYSIS [1]

MOTEMS LIMIT STATE	PROB. OF OCCURRENCE IN 50 YEARS	ELASTIC PERIOD (SEC.)	TARGET DISPL. (IN.)	EFFECTIVE PERIOD (SEC.)	EFFECTIVE DAMPING (% OF CRIT.)	SEISMIC ACCEL. (G)	BASE SHEAR[2] (KIP)	ADEQUATE AT TARGET DISPL.?
Maximum Longitudinal Displacement =								

[1] **Values presented are based on governing load combination of 1.0*E+0.68*D**

[2] **Base shear listed is for portion of wharf modeled. Global base shear approximate 6 times this value.**

TABLE 4-5

GLOBAL PERFORMANCE SUMMARY - TRANSVERSE PUSHOVER ANALYSIS [1]

MOTEMS LIMIT STATE	PROB. OF OCCURRENCE IN 50 YEARS	ELASTIC PERIOD (SEC.)	TARGET DISPL. (IN.)	EFFECTIVE PERIOD (SEC.)	EFFECTIVE DAMPING (% OF CRIT.)	SEISMIC ACCEL. (G)	BASE SHEAR[2] (KIP)	ADEQUATE AT TARGET DISPL.?
Maximum Transverse Displacement =								

[1] **Values presented are based on governing load combination of 1.0*E+0.68*D**

[2] **Base shear listed is for portion of wharf modeled. Global base shear approximate 6 times this value.**

TABLE 4-6

MEMBER ELEMENT DCR - LONGITUDINAL PUSHOVER ANALYSIS

STRUCTURAL ELEMENT	LEVEL 1 (XX-YEAR EARTHQUAKE)			LEVEL 2 (XX-YEAR EARTHQUAKE)		
	AXIAL DCR	BENDING DCR	SHEAR DCR	AXIAL DCR	BENDING DCR	SHEAR DCR

DCR = DEMAND/CAPACITY RATIO

TABLE 4-7

MEMBER ELEMENT DCR - TRANSVERSE PUSHOVER ANALYSIS

STRUCTURAL ELEMENT	LEVEL 1 (XX-YEAR EARTHQUAKE)			LEVEL 2 (XX-YEAR EARTHQUAKE)		
	AXIAL DCR	BENDING DCR	SHEAR DCR	AXIAL DCR	BENDING DCR	SHEAR DCR

DCR = DEMAND/CAPACITY RATIO

TABLE 4-8
ATTACHMENTS*

ATTACH. NUMBER	AUDIT YEAR	REFERENCE TITLE	DESCRIPTION

*** For Section 3104F, this table is intended to chronologically log all MOTEMS Audit attachments starting from the Initial Audit. Attachments in previous audit reports shall remain listed, but need not be attached. If previous attachments are no longer valid, their status shall be indicated utilizing strikethrough text.**

SECTION 3105F
AUDIT GUIDELINES

GENERAL

1. The Section 3105F Audit requires review of compliance with minimum standards specified in MOTEMS Division 5 for safe mooring and berthing of vessels at Marine Oil Terminals (MOTs).

2. Complete Tables 5-1 thru 5-4.

3. Prior to completion of Table 5-3 checklist, collect the most recent mooring and berthing analyses, TOLs and other pertinent information.

4. Remedial Action Priority (RAP) ratings shall be assigned according to MOTEMS Table 31F-2-5.

5. Information should be field verified using drawings, as appropriate. Discrepancies between documentation and actual installations shall be marked and noted.

6. New inspection findings shall be compared to previous MOTEMS Audit results to identify and report any changes.

7. Photographs, sketches and supporting data shall be utilized to record and report the observed conditions and deficiencies.

LIST OF TABLES

TABLE 5-1

SUMMARY OF IDENTIFIED DEFICIENCIES

CHECKLIST ITEM # FROM TABLE 5-3	DEFICIENCY ITEM LABEL IN TABLE ES-2	RAP RATING	DESCRIPTION OF DEFICIENCY	RECOMMENDED ACTION OR MITIGATION

TABLE 5-2

SUMMARY OF MISSING OR UNKNOWN INFORMATION

CHECKLIST ITEM # FROM TABLE 5-3	DESCRIPTION OF MISSING OR UNKNOWN INFORMATION*
* If Missing or Unknown Information is a Deficiency, Identify in Table 5-1	

TABLE 5-3

AUDIT CHECKLIST

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
3105F.1 GENERAL			
5.1.1	Provide as-built drawing(s) of pier/wharf configurations, specifically showing mooring and berthing equipment layout (plan and elevations views with dimensions utilized)		
5.1.2	In case of multiple berths, is there any reason for different environmental loads?		
5.1.3 (F)	If the MOT has high currents (>1.5 knots), does it have an on-site current meter?		
5.1.4 (F)	Does the MOT have remote reading/recording tension devices on the mooring hooks?		
5.1.5 (F)	Does the MOT have Quick-Release Hooks (QRHs)?		
5.1.6 (F)	Is the QRH freeing mechanism activated by a two-step process?		
5.1.7 (F)	Are the QRHs insulated electrically from the mooring structure?		
5.1.8 (F)	Are QRHs in contact with the deck?		
5.1.9	Were the loading combinations and safety factors cited in MOTEMS 3103F.8 thru 3103F.10 complied with in the analysis and design of mooring components?		
3105F.2 MOORING ANALYSES			
5.2.1	What is the water depth (relative to MLLW) at the location?		
5.2.2	Has mooring analysis been performed for each berth? Provide reference(s) to the mooring analyses in Table 5-4.		
5.2.3	Is there an Management of Change (MOC) process for re-evaluating mooring analysis when conditions change, such as any modification in mooring configuration, vessel size or new information indicating greater wind, current or other environmental load? [MOTEMS 3101F.7]		
5.2.4	What is the maximum surge and sway permitted for each size of vessel (from the analysis)?		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
5.2.5	What are the safe limits of the berth's transfer equipment motion (surge, sway and vertical)? If MOT uses transfer hose(s), does the hose length safely accommodate the vessel's size and maximum movements during transfer operations? [MOTEMS 3105F.2]		
5.2.6	For the mooring analysis, have two current directions (maximum ebb and flood) been considered? If so, Provide maximum ebb and flood current magnitudes and directions. Provide reference to current study.		
5.2.7	For the mooring analysis, have two tide levels, highest high and lowest low been considered? Provide levels used in analyses. Provide tidal data reference.		
5.2.8	For the mooring analysis, have two vessel loading conditions (ballast and maximum draft at facility)? Provide reference.		
5.2.9	For the mooring analysis, have eight wind directions in minimum 45 degree increments been considered?		
5.2.10	For the mooring analysis, have both vessel positions, Port and Starboard, been evaluated?		
5.2.11	Is a manual, simplified procedure been used for the mooring analysis?		
5.2.12	Is mooring analysis performed using a numerical procedure? Reference the submitted document(s).		
5.2.13	What software package has been used, and has the program been validated?		
5.2.14	Provide or reference input data files, including berth and vessel information, environmental load data (wave, current and wind), mooring line properties, force-deflection curve of breasting fenders.		
5.2.15	Provide or reference output files, showing loads on all mooring lines and wind roses.		
5.2.16	Define criteria for Survival Condition (trigger for vessel disconnect).		
3105F.3 WAVE, PASSING VESSEL, SEICHE, AND TSUNAMI			
5.3.1	Is the significant wave period, T_s, < 4 seconds? What is the source of this data?		
5.3.2	If $T_s \geq 4$ seconds, specify type of analysis performed.		
5.3.3	Do passing vessels impact the mooring analysis per MOTEMS criteria?		
5.3.4	If mooring is impacted by passing vessels, what procedure has been used for the analysis? Reference the submitted document(s).		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
5.3.5	If the MOT is within a harbor basin prone to penetration of ocean waves, has a seiche analysis been performed?		
5.3.6	Was tsunami assessment performed? How are risks from tsunami run ups and associated currents mitigated?		
5.3.7	Does the MOT have a tsunami action plan?		
3105F.4 BERTHING ANALYSIS AND DESIGN			
5.4.1	Specify site condition per Table 31F-3-8		
5.4.2	Is the berthing system designed for appropriate impact velocity per MOTEMS Table 31F-3-7? Reference the submitted document(s).		
5.4.3	Describe the fender system for each berth.		
5.4.4	Reference the document providing the force-deflection curve for each fender type.		
5.4.5	Reference the procedure to establish the combined force-deflection curve for fender system and structure if the structure is flexible.		
5.4.6	Provide reference to the berthing calculations?		
5.4.7	If fenders are continuous, provide vessel contact length used in the analysis.		
3105F.6 OFFSHORE MOORINGS			
5.6.1	Provide latest bathymetric survey.		
5.6.2	Describe the offshore mooring type		
5.6.3	How many offshore mooring points and name/ID each and reference drawing(s).		
5.6.4	Provide the standard used for analyzing offshore moorings (OCIMF or UFC).		
5.6.5	State the dynamic analysis software package used for analysis.		
5.6.6	Does the analysis consider bathymetric survey and results of u/w inspections?		
5.6.7	How was correlation of winds, waves and currents determined?		
5.6.8	Was the mooring component designed per MOTEMS specified loading combinations and safety factors?		

TABLE 5-4

ATTACHMENTS*

ATTACH. NUMBER	AUDIT YEAR	REFERENCE TITLE	DESCRIPTION

*** For Section 3105F, this table is intended to chronologically log all MOTEMS Audit attachments starting from the Initial Audit. Attachments in previous audit reports shall remain listed, but need not be attached. If previous attachments are no longer valid, their status shall be indicated utilizing strikethrough text.**

SECTION 3106F
AUDIT GUIDELINES

GENERAL

1. The Section 3106F Audit requires assessment of geotechnical hazards and analyses and evaluation of foundations under static and seismic conditions.

2. Complete Tables 6-1 and 6-2.

3. Prior to completion of Table 6-1 checklist, collect the most recent and any historical geotechnical documentation and any other pertinent information.

4. New inspection findings shall be compared to previous MOTEMS Audit results to identify and report any changes.

5. Photographs, sketches and supporting data shall be utilized to record and report the observed conditions and deficiencies.

LIST OF TABLES

TABLE 6-1

SUMMARY OF IDENTIFIED DEFICIENCIES

CHECKLIST ITEM # FROM TABLE 6-3	DEFICIENCY ITEM LABEL IN TABLE ES-2	RAP RATING	DESCRIPTION OF DEFICIENCY	RECOMMENDED ACTION OR MITIGATION

TABLE 6-2

SUMMARY OF MISSING OR UNKNOWN INFORMATION

CHECKLIST ITEM # FROM TABLE 6-3	DESCRIPTION OF MISSING OR UNKNOWN INFORMATION*
* If Missing or Unknown Information is a Deficiency, Identify in Table 6-1	

TABLE 6-3
AUDIT CHECKLIST

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
3106F.2 SITE CHARACTERIZATION			
6.2.1	What is the terminal site class?		
6.2.2	Provide reference(s) to site-specific geotechnical information in Table 6-2.		
6.2.3	Provide the following information: a) Borings (number and locations - attach drawings) b) Standard penetration tests (SPT) or Cone Penetration Tests (CPT) results (number and locations of tests – attach results or provide reference) c) Foundation loading?		
6.2.4	Does exploration provide adequate coverage of subsurface data both horizontally and vertically?		
6.2.5	Do the borings penetrate to a depth of 100 feet below the mudline?		
6.2.6	Is the information from current or historical records? Give details.		
6.2.8	If historical information was used to determine site class, provide justification.		
6.2.9	Is CPT or SPT conversion used? If yes, what relationship was used?		
6.2.10	If geotechnical data other than CPT or SPT was used, provide details.		
3106F.3 SEISMIC LOADS FOR GEOTECHNICAL EVALUATIONS			
6.3.1	Are both Level 1 and Level 2 earthquake evaluated?		
3106F.4 LIQUEFACTION POTENTIAL			
6.4.1	Are investigations and testing in compliance with NCEER report (1996, 1998), the SCEC (1999) and CGS Special Publication 117A (2008) references?		
6.4.2	What is the CSR value?		
6.4.3	If liquefaction strata exist, how are resulting hazards associated with liquefaction addressed?		
6.4.4	If the geotechnical hazards are beyond acceptable ranges, describe mitigation measures have been implemented, such as: a) Modified the structure?		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
	b) Performed sophisticated analysis? c) Modify the foundation soil?		
3106F.5 SLOPE OR EMBANKMENT STABILITY AND SEISMICALLY INDUCED LATERAL SPREADING			
6.5.1	How was the Cyclic Resistance Ratio (CRR) evaluated (simplified procedure or site-specific)?		
6.5.2	Was site-specific response analysis one or two-dimensional?		
6.5.3	What ground motion parameters values were used?		
6.5.4	What methodology was used to calculate residual shear strength?		
6.5.5	What is the safety factor against liquefaction (SF = CRR/CSR)?		
6.5.6	If using a simplified procedure, does it conform to the SCEC (1999) reference?		
6.5.7	If the Safety Factor is less than 1.4, what residual shear strength has been used?		
6.5.8	If the Safety Factor is between 1 and 1.4, what reduction factor has been applied to the initial shear strength of the soil?		
6.5.9	If the Safety Factor is between 1.0 and 1.2, how have the seismically induced ground movements been evaluated?		
6.5.10	If the Safety Factor is 1.0 or less, what is the residual shear strength? Are mitigation measures required?		
6.5.11	Is any slope failure likely to affect the MOT? If yes, what is the factor of safety for slope failure?		
6.5.12	Is lateral spreading evaluated?		
3106F.6 SEISMICALLY INDUCED SETTLEMENT			
6.6.1	What methods were used for evaluation of seismically induced settlement?		
6.6.2	Is displacement greater than 0.1 ft?		
6.6.3	Is it necessary to consider this movement in structural analysis?		
6.6.4	What mitigation measures are considered if factor of safety is less than 1.0?		
3106F.7 EARTH-PRESSURE			
6.7.1	What method is used to calculate static earth-pressure and pressure under seismic loading? Provide reference to calculation(s).		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
3106F.8 PILE AXIAL BEHAVIOR			
6.8.1	What is the safety factor of static loading to ultimate axial geotechnical capacity of the pile?		
6.8.2	Is seismically induced settlement anticipated during the design earthquake?		
3106F.9 SOIL SPRINGS FOR LATERAL PILE LOADING			
6.9.1	What method is used to calculate p-y curves?		
3106F.10 SOIL PILE INTERACTION			
6.10.1	What assumptions and procedures are used to combine inertial and kinematic loading?		
3106F.11 SOIL STRUCTURES INTERACTION – SHALLOW FOUNDATION AND UNDERGROUND STRUCTURES			
6.11.1	What assumptions and procedures are used to model Soil Structures Interaction (SSI)? Describe.		
3106F.12 UNDERWATER SEAFLOOR PIPELINES			
6.12.1	Reference calculation used for seismic evaluation of underwater pipelines.		

TABLE 6-4
ATTACHMENTS*

ATTACH. NUMBER	AUDIT YEAR	REFERENCE TITLE	DESCRIPTION

*** For Section 3106F, this table is intended to chronologically log all MOTEMS Audit attachments starting from the Initial Audit. Attachments in previous audit reports shall remain listed, but need not be attached. If previous attachments are no longer valid, their status shall be indicated utilizing strikethrough text.**

SECTION 3107F
AUDIT GUIDELINES

GENERAL

1. The Section 3107F Audit requires compliance review of minimum performance standards specified in MOTEMS Division 7 for structural components at Marine Oil Terminals (MOTs).

2. Complete Tables 7-1 thru 7-4.

3. Prior to completion of Table 7-3 checklist, collect the most recent structural analyses, design drawings and other pertinent information.

4. Remedial Action Priority (RAP) ratings shall be assigned according to MOTEMS Table 31F-2-5.

5. Information should be field verified using drawings, as appropriate. Discrepancies between documentation and actual installations shall be marked and noted.

6. New inspection findings shall be compared to previous MOTEMS Audit results to identify and report any changes.

7. Photographs, sketches and supporting data shall be utilized to record and report the observed conditions and deficiencies.

LIST OF TABLES

TABLE 7-1

SUMMARY OF IDENTIFIED DEFICIENCIES

CHECKLIST ITEM # FROM TABLE 7-3	DEFICIENCY ITEM LABEL IN TABLE ES-2	RAP RATING	DESCRIPTION OF DEFICIENCY	RECOMMENDED ACTION OR MITIGATION

TABLE 7-2

SUMMARY OF MISSING OR UNKNOWN INFORMATION

CHECKLIST ITEM # FROM TABLE 7-3	DESCRIPTION OF MISSING OR UNKNOWN INFORMATION*
* If Missing or Unknown Information is a Deficiency, Identify in Table 7-1	

TABLE 7-3

AUDIT CHECKLIST

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
3107F.1 GENERAL			
7.1.1	Describe the MOT's structural configuration, materials and age.		
7.1.2	Describe the vertical and lateral support systems for the wharf/pier, trestle and dolphins. If the lateral support system includes batter piles, include a description of material and the type of connection to the wharf/pier trestle and dolphins deck.		
7.1.3	If there is structural damage or deterioration that alters the capacity, is it accounted for in the analysis?		
3107F.2 CONCRETE DECK WITH CONCRETE OR STEEL PILES			
7.2.1	Specify what material properties are being used for the non-seismic analyses?		
7.2.2	Specify what material properties are being used for the seismic analyses?		
7.2.3	Is recent inspected condition accounted for in calculations for components?		
7.2.4	If sufficient information is not available, what knowledge factor value is used? Provide justification.		
7.2.5	Provide reference to the stress-strain models used to estimate non-linear behavior in the analysis.		
7.2.6	What component acceptance/damage criteria is used in the analysis?		
7.2.1	What assumptions have been made regarding batter piles in the structural analyses? Reference the model(s) and summarize assumptions.		
3107F.3 TIMBER PILES AND DECK COMPONENTS			
7.3.1	What are the material properties used in the analysis? Provide reference.		
7.3.2	What depth to pile fixity has been used in the analysis? Provide justification.		
3107F.4 RETAINING STRUCTURES			
7.4.1	What methodology was used to obtain the static and seismic loads on the retaining system? Provide reference.		
7.4.2	Provide reference(s) of the demand and capacity calculations.		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
7.4.3	Provide reference(s) to assumption(s) used in the calculations.		
3107F.5 MOORING AND BERTHING COMPONENTS			
7.5.1	Is the mooring structure (including soil) performance adequate?		
7.5.2	Is there sufficient deck capacity to withstand maximum component loads?		

TABLE 7-4

ATTACHMENTS*

ATTACH. NUMBER	AUDIT YEAR	REFERENCE TITLE	DESCRIPTION

*** For Section 3107F, this table is intended to chronologically log all MOTEMS Audit attachments starting from the Initial Audit. Attachments in previous audit reports shall remain listed, but need not be attached. If previous attachments are no longer valid, their status shall be indicated utilizing strikethrough text.**

SECTION 3108F
AUDIT GUIDELINES

GENERAL

1. The Section 3108F Audit involves field inspection and compliance review of fire protection systems and equipment for condition assessment and operational readiness, in accordance with MOTEMS Division 8.

2. Complete Tables 8-1 thru 8-5.

3. Prior to any fire system inspection or completion of Table 8-3 checklist, collect the most recent *Fire Hazard Assessment and Risk Analysis (FHARA)*, *Fire Protection Assessment (FPA)*, equipment layout drawings, process flow diagrams, and P&IDs and audit results.

4. Complete field verification of all items in #3 above to check accuracy.

5. Remedial Action Priority (RAP) ratings shall be assigned according to MOTEMS Table 31F-2-5.

6. New inspection findings shall be compared to previous MOTEMS Audit results to identify and report any changes.

7. Photographs, sketches and supporting data shall be utilized to record and report the observed conditions and deficiencies.

FIRE PROTECTION ASSESSMENT (FPA)

The firefighting system for a MOT is detailed in the FPA and determines the adequacy of available fire protection resources. The Fire Hazard Assessment and Risk Analysis (FHARA) identifies any hazards that need mitigation and these findings should be documented in the FPA as recommendations.

Using the FPA as a guide, the Auditor shall address each item, and record findings in the corresponding checklists. Additionally, if there have been changes to the fire protection system since the last audit, the Auditor shall determine if the existing FHARA and FPA are current. If not found current, the FHARA and FPA shall be revised.

EMERGENCY SHUTDOWN AND FIRE ALARM SYSTEM

The location of all Emergency Shut-Down (ESD) stations should be verified by highlighting the stations on the equipment layout drawings. The actuator/pull-box locations and the final controlled elements (i.e., responding valves) should be listed and verified against the operator's requirements and regulations/codes.

FIRE DETECTION

Detection systems consist of mechanical, electrical or electronic devices that are installed to detect environmental changes due to fire or presence of toxic or combustible gases. The location of all fire detectors and fusible plugs should be highlighted on the terminal equipment layout drawings. Actual installation of these devices should be verified.

The operation of all detection devices should be traced through the instrumentation and logic drawings to verify that the desired alarm and shut-down sequences are carried out. For each detection loop, a simplified block diagram of the instrument logic should be prepared from the instrumentation drawings

FIRE ALARMS

The location of all fire alarms should be highlighted on the terminal equipment layout drawings. Fire alarms should be field verified.

FIRE SUPPRESSION

The fire suppression system should be marked on the equipment layout drawings. All phases of the system, such as water supply, firewater pumps, hydrant locations, foam locations, wheeled extinguishers, portable extinguishers, standpipes, fire alarm boxes, hose stations, etc. should be shown. Where the local fire department may respond, the location and the time to respond should be shown. Pump capacity and pressure ratings should be reviewed to assure that the pumps meet the minimum provisions of MOTEMS and are documented in the FPA.

When sprinklers and hose reels are used, the locations should be highlighted in the equipment layout drawings. A check should be made that the equipment conforms to applicable NFPA guidelines, U. S. Coast Guard requirements, and those required by the local fire department.

Operating procedures should be prepared to minimize the possibility of fires and/or explosions during operation of facilities. These procedures should cover internal combustion engine powered equipment, use of spark arresters, welding and heating equipment, open fires, maintenance of electrical equipment, etc. The procedures should conform to Cal OSHA Title 8 General Industry Safety Orders, Coast Guard regulations and the operator's requirements

CRITICAL SYSTEMS SEISMIC ASSESSMENT

A Critical Systems Seismic Assessment (CSSA) shall be performed that includes fire detection and protection systems, and emergency shutdown systems. The fire protection professional or engineer performing the Section 3108F audit shall coordinate with the civil, mechanical, or structural engineer performing the CSSA to ensure that the latest configuration for all critical equipment, and current conditions are included in the CSSA.

LIST OF TABLES

TABLE 8-1

SUMMARY OF IDENTIFIED DEFICIENCIES

CHECKLIST ITEM # FROM TABLE 8-3	DEFICIENCY ITEM LABEL IN TABLE ES-2	RAP RATING	DESCRIPTION OF DEFICIENCY	RECOMMENDED ACTION OR MITIGATION

TABLE 8-2

SUMMARY OF MISSING OR UNKNOWN INFORMATION

CHECKLIST ITEM # FROM TABLE 8-3	DESCRIPTION OF MISSING OR UNKNOWN INFORMATION*
* If Missing or Unknown Information is a Deficiency, Identify in Table 8-1	

TABLE 8-3
AUDIT CHECKLIST

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
3108F.1 GENERAL			
8.1.1	If MOT is “existing,” has there been the addition of new non-replacement equipment, components or systems since the last audit? [MOTEMS 3101F.3] If yes, then “new” requirements apply. List additions with dates in the response column		
8.1.2	If MOT is “existing,” has there been the installation of new "in-kind" replacement equipment, components or systems since the last audit? If yes, then “existing” requirements apply. [MOTEMS 3101F.3] List installations with dates in the response column.		
8.1.3	Is there a common or separate fire system for each berthing system?		
8.1.4	Are all existing fire protection equipment shown on an equipment layout drawing? Identify drawing number(s) in Table 8-5.		
8.1.5	Are fire water pipelines shown on P&IDs or “as-built” drawings? Identify diagram or drawing number(s) in Table 8-5.		
3108F.2 HAZARD ASSESSMENT AND RISK ANALYSIS			
8.2.1	Has a fire hazard assessment and risk analysis been performed? Date(s)? Preparer?		
8.2.2	Have all materials present at the MOT that could contribute to increased fire hazards or incidental hazards (e.g. ethanol, propane, biodiesel, lithium and other flammable, corrosive or toxic chemicals), been considered in FHARA?		
8.2.3	Does the most recent Fire Hazard Analysis and Risk Assessment (FHARA) reflect current conditions and hazards at the MOT?		
8.2.4	Has a Fire Protection Assessment (FPA) been prepared? Date? Preparer?		
8.2.5	Does the FPA consider the risks identified in the (FHARA? Does the most recent FPA reflect current conditions and hazards at the MOT?		
8.2.6	Does the FPA satisfactorily address all fourteen points provided in 24 CCR§3108F2.2? Briefly describe any deficiencies.		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
8.2.7 (F)	Have the following items been field verified (location and condition) to ensure operability: a) Water supply? b) Fire pumps? c) Fire water jockey pumps? d) Hydrant locations? e) Foam supply? f) Wheeled extinguishers? g) Portable extinguishers? h) Hose connections? i) Hose storage stations? j) Fire alarm pull stations? k) Fire Detector(s) l) Fire monitors? m) Fire boat connections? n) International Shore Connection? Note leakage, physical damage, or corrosion. Summarize any deficiencies or recommendations.	a) b) c) d) e) f) g) h) i) j) k) l) m) n)	
8.2.8	Are all fire water pumps inspected, maintained, and tested per NFPA-25?		
3108F.3 FIRE PREVENTION			
3108F.3.1 IGNITION SOURCE CONTROL			
8.3.1	How is the terminal protected from static electricity, lightning and stray currents? [API 2003, ISGOTT Section 6.10, 20.6 and Appendix D]. Provide brief details and reference.		
8.3.2	Verify that cargo manifolds and loading arms conform to electrical isolation requirements per 2CCR2341? Provide brief details and reference audit section(s).		
8.3.3	If the wharf structure is steel, is there an insulating flange that electrically isolates the pipeline on wharf from the first pipeline support on-shore? Are pipeline(s) electrically bonded to the wharf? [API 2003, Section 6.3]		
8.3.4	If the wharf is concrete or timber, is the pipeline grounded either to the water or on shore? [API 2003, Section 6.3]		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
8.3.5	If a multi-berth terminal, is there a minimum of 100 feet between adjacent manifolds (N)?		
3108F.3.2 EMERGENCY SHUTDOWN (ESD) SYSTEMS			
8.3.6	Fill out Table 8-4 for ESD valves.		
8.3.7	What is the ESD effective time to stop the flow of oil after initiating closure action?		
8.3.8	For ESD systems, are actuation stations located such that ESD can be initiated within 30 seconds of a shutdown order received on the wharf? [2 CCR 2380 (h)(5)]		
8.3.9 (F)	For multiple actuation station installations, is at least one station located >100' from an electrical hazard classified area (N)?		
8.3.10	Are ESD actuation stations wired in parallel (N)?		
8.3.11	Are communications or control circuits synchronized for the simultaneous closure of the SIVs and the shutdown of the loading pumps (N)?		
8.3.12	Does the installed ESD system require a manual reset to operational state after each initiation (N)?		
8.3.13 (F)	Is there an alarm to indicate failure of the primary power source (N)? Describe location.		
8.3.14 (F)	Is there a secondary power source should the primary power source fail (N)?		
8.3.15	Is the automated ESD system tested periodically? Date of last test?		
8.3.16	Are electrical, instrument, control systems (i.e. ESD system), located within hazardous classified areas, protected from fire damage, if such equipment is used to activate equipment needed to control a fire or mitigate its consequences. Have API Pub 2218 guidelines been followed (N)? [API 2218, California Electrical Code]		
3108F.3.2.1 Emergency Shutdown (ESD) Valves			
8.3.17 (F)	Are all ESD valves located near the dock manifold connection or loading arm? Describe location(s)?		
8.3.18	Do the automated ESD valve(s), have local and remote actuation capabilities (N)?		
3108F.3.2.2 Shore Isolation Valves (SIVs)			
8.3.19	Fill out Table 8-4 for SIVs.		
8.3.20 (F)	Are all SIVs for each cargo line located on shore and clustered together?		
8.3.21 (F)	Are SIVs clearly marked with identification of each associated pipeline (N)?		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
8.3.22 (F)	Is there adequate lighting to identify and manually operate the SIVs?		
8.3.23 (F)	Is there a manual reset to restore the SIV system after shutdown (N)?		
8.3.24 (F)	Are thermal expansion relief valves installed to relief pressure from a blocked-in offshore segment of pipeline when the SIV is in the closed position?		
3108F.4 AUTOMATED FIRE DETECTION SYSTEM			
8.4.1 (F)	Does the MOT have a permanently installed automated fire detection or sensing system (N)?		
8.4.2 (F)	Are fire (flame, heat, or smoke) sensors installed in all enclosed spaces within classified areas?		
8.4.3	Is each fire detection system of the manual reset type?		
8.4.4	Is each fire-detection system capable of continuous monitoring?		
8.4.5	Do detection devices automatically initiate ESD?		
8.4.6	Is there a periodic testing of the detection system? When last tested?		
8.4.7	Are fire detection system specifications available and have these been verified by the audit team?		
3108F.5 FIRE ALARMS			
8.5.1 (F)	Are there automatic and manual fire alarm initiating devices at strategic locations?		
8.5.2 (F)	Are triggered alarms visible and audible by all MOT and vessel personnel involved in transfer operations?		
8.5.2 (F)	During a triggered MOT fire alarm, is alarm also visually and audibly displayed at the facility's control center?		
8.5.3	Is the fire alarm system integrated with the ESD system?		
8.5.4	Is alarm system tested per NFPA-72? When last tested?		
8.5.5	Are fire alarm system manufacturer maintenance and testing requirements available and have these been complied with and verified by the audit team?		
3108F.6 FIRE SUPPRESSION			
8.6.1	What is the fire hazard classification from MOTEMS Table 31F-8-2?		
8.6.2	Is the firewater flow rate consistent with the requirements of MOTEMS Table 31F-8-3?		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
8.6.3 (F)	Are the portable dry chemical extinguishers consistent with the requirements of MOTEMS Table 31F-8-3?		
8.6.4	If there is simultaneous cargo transfer, or in situations in a multi-berth facility, have the minimum MOTEMS provisions (ref. MOTEMS Table 31F-8-3) been augmented? If not, does the audit team have any recommendations?		
8.6.5 (F)	Field verify fire pump capacity and pressure ratings, and compare to latest pump flow test results. Do pump ratings and test results match? Any recommendations? Provide latest flow test results in audit report and reference here		
8.6.6	Verify that water-based fire protection systems have been maintained by the MOT operator per NFPA-25.		
8.6.7 (F)	For diesel powered pumps, field verify the following: a) Fuel tank at least 2/3 full. b) Battery electrolyte level is within acceptable range c) Crankcase oil is within acceptable range. d) Coolant level is within acceptable range. Note observation results. [NFPA-25]	a) b) c) d)	
8.6.8 (F)	For seawater drafting pumps, field verify that pump suction is free from marine growth and other obstructions. Note observation results.		
8.6.9 (F)	Is a standby fire pump available? If so, describe.		
3108F.6.1 COVERAGE			
8.6.10 (F)	Does the fire suppression include coverage for: a) Marine structures (pier, wharf, or approach trestle)? b) Terminal cargo manifold? c) Vessel manifold? d) Cargo transfer systems? e) Sumps? f) Pipelines? g) Control stations? Summarize any deficiencies or recommendations.	a) b) c) d) e) f) g)	
3108F.6.2 FIRE HYDRANTS			
8.6.11 (F)	What is the maximum separation distance between hydrants?		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
8.6.12 (F)	Are there hose connections: At the base of fixed monitors? Upstream of the water/foam isolation valves?		
8.6.13 (F)	Is the wharf currently accessible to fire trucks and mutual aid equipment? Are firewater connections accessible to fire trucks or mutual aid equipment? Describe access locations.		
8.6.14 (F)	Do hoses and monitors have the capability of applying two independent water streams to cover the cargo manifold, transfer system, vessel manifold and sumps?		
3108F.6.3 FIRE WATER			
8.6.15	Are wet systems pressurized?		
8.6.16	Are wet headers equipped with a low-pressure alarm wired to the control room?(N)		
8.6.17 (F)	Are the fire pumps installed at a distance of at least 100 feet from the nearest cargo manifold area (N)?		
8.6.18	Does the terminal have a pump-in point for firefighting vessels and trucks to augment the fire water supply to the shore fire main grid?		
8.6.19 (F)	Are pump-in-points located at a safe distance form high-risk areas, such as sumps, manifolds, loading arms, etc.?		
3108F.6.4 FOAM SUPPLY			
8.6.20	Have calculations as to aqueous film forming foam (AFFF) type, flow rates, and application duration been verified by the audit team?		
8.6.21 (F)	Record AFFF type, quantity, and location.		
8.6.22 (F)	Is AFFF proportioning equipment located at least 100 feet from sumps, manifolds and loading arms?		
8.6.23	Is a facility program/procedure in place to ensure that AFFF is replaced consistent with the manufacturer's recommendations? Date of last AFFF replacement?		
3108F.6.5 FIRE MONITOR SYSTEMS			
8.6.24 (F)	Can all monitors be oscillated and moved throughout their full range? [NFPA-25]		
8.6.25 (F)	Is AFFF educator tubing and its connection to monitors, free from obstructions and in good serviceable condition?		
8.6.26 (F)	Are monitors located to provide an unobstructed path between the monitor and target area?		
8.6.27	What is the maximum vessel manifold height		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
	(ballast draft, high tide) above the MOT deck?		
8.6.28	If the maximum vessel manifold height is greater than 30 feet above the wharf deck, are the monitors raised?		
8.6.29 (F)	Are there sprinklers and/or remotely controlled water/foam monitors to protect personnel, escape routes, shelter locations and the fire water system?		
8.6.30 (F)	Are there isolation valves in the firewater and foam lines, and are the isolation valves at least 150 feet from the manifold and loading arm/hose area?		
3108F.6.6 SUPPLEMENTAL FIRE SUPPRESSION SYSTEMS			
8.6.31	Is supplemental fire suppression necessary to meet minimum suppression requirements?		
8.6.32	If yes, does it provide less than 25% of the fire water/foam requirements of the Fire Protection Assessment?		
8.6.33	Is the supplementary resource available within 20 minutes of the fire alarm?		
8.6.34	Is there a contingency wherein the supplemental fire/foam resource is not available? Is this considered in the Fire Protection Assessment?		
3108F.7 CRITICAL SYSTEMS SEISMIC ASSESSMENT			
8.7.1	Does the critical systems seismic assessment reflect the current fire protection system installation and equipment condition? [MOTEMS 3104F.6]		

TABLE 8-4

EMERGENCY SHUTDOWN VALVES AND SHORE ISOLATION VALVES

SIV OR ESDV	VALVE ID#	PIPELINE	MANUAL OR MOTOR CONTROLLED	IF MOTOR CONTROLLED FAILSAFE OR FAIL LAST	P&ID NO.	REMARKS

TABLE 8-5
ATTACHMENTS*

ATTACH. NUMBER	AUDIT YEAR	REFERENCE TITLE	DESCRIPTION

*** For Section 3108F, this table is intended to chronologically log all MOTEMS Audit attachments starting from the Initial Audit. Attachments in previous audit reports shall remain listed, but need not be attached. If previous attachments are no longer valid, their status shall be indicated utilizing strikethrough text.**

SECTION 3109F
AUDIT GUIDELINES

GENERAL

1. The Section 3109F Audit requires a compliance review of “oil” piping and pipelines from the loading arms/hoses to the shore isolation valves, or first valve outside the EPA containment, in accordance with MOTEMS Division 9. A definition of “oil” is found in MOTEMS 3101F.1. Because the MOTEMS defines “oil” as “any fraction or residue thereof”, oil piping/pipelines would include slop, and waste oil products, liquid distillates from unprocessed natural gas and also could include ballast water.

2. Steel “oil” pipelines, utility and auxiliary pipelines, instrumentation piping, supports, manifolds, appurtenances and crossovers are covered under the scope of this section. Smaller diameter stripping and sampling piping are considered auxiliary pipelines.

3. Any attachments to the structure used to support, guide, hang or anchor piping, such as pipe racks, concrete curbs or pedestals, etc. should also be inspected.

4. Complete Tables 9-1 thru 9-7.

5. Prior to any pipeline/equipment inspection or completion of Table 9-3 checklist:
    a. Collect and review the most recent audit results (including pipeline stress analysis).
    b. Collect the most recent equipment layout drawings, process flow diagrams, P&IDs, equipment specifications, repair/maintenance records, or other pertinent information.

6. Pipelines, piping, and appurtenances should be field verified using drawings, P&ID’s, or process flow diagrams. Discrepancies between documentation and actual installations shall be marked and noted.

7. For “oil” pipelines, the following should be noted during inspections:

a. Pipeline differential settlement, or areas of the line moving off the supports. Large horizontal displacements should also be reported.

b. If the pipeline is supported by hangers, these should be carefully inspected, and checked for missing bolts, broken hangers, excessive displacement, corrosion/rust, etc.

c. Temporary or inadequate supports, pipeline sag, excessive free spanning, or any other pipeline discrepancy, as well as damage to pipe saddles.

d. Corroded, or obstructed base plates where pipe is guided and or free to slide; cracked or missing grout from base plate supports.

e. Faulty or corroded welds of support components, including weld of support to pipe, where applicable.

f. Bent support components such as rods, steel members, stanchions, etc.

g. Missing or damaged insulation shields, where applicable.

8. Remedial Action Priority (RAP) ratings shall be assigned according to MOTEMS Table 31F-2-5.

9. New inspection findings shall be compared to previous MOTEMS Audit results to identify and report any changes.

10. Photographs, sketches and supporting data shall be utilized to record and report the observed conditions and deficiencies.

PIPELINE STRESS ANALYSIS

Review any existing Pipeline Stress Analyses (PSAs) for MOT oil transfer and firewater pipeline systems. Determine if existing PSA is up-to-date considering any subsequent changes to pipeline routing or conditions. Complete a new PSA for oil transfer and firewater pipelines if either a PSA has not been completed previously or the existing PSA does not reflect current pipeline conditions. Note, for firewater pipelines, a PSA is required only for new installations.

ANCHORS AND SUPPORTS

Review existing seismic assessment for anchors and supports. From field inspection, determine if assessment is up-to-date considering any subsequent changes or new installations to pipeline system anchors and supports. If assessment has not been performed previously or is not current, complete an assessment per CalARP or ASCE-7, as appropriate.

APPURTANCES

Appurtenances include pipeline fittings, valves, valve actuators, manifolds, instrumentation, etc. Pressure relief evaluation for pipeline systems shall be done for both static blocked-in conditions (thermal induced pressure) and flowing pipelines' normal and abnormal operating conditions (surge pressure). After evaluation, if a pipeline or pipeline system has the possibility of overpressure, then a deficiency shall be assigned. MOTEMS 3108F has additional requirements for ESD valves and SIVs.

UTILITY AND AUXILIARY PIPING SYSTEMS

Utility and auxiliary pipelines include pipeline services that support oil transfer operations at the MOT and include: oil stripping and sampling, vapor control, natural gas, compressed air, nitrogen and venting. Gravity drain and discharge pipelines serving sumps, spill containment, and vapor control systems should also be inspected. An external visual inspection of utility and auxiliary piping, using criteria similar to in API RP 574-2009, Section 10.1, shall be performed. Special inspection focus shall be on external corrosion, leaks, and supports condition.

FIRE PROTECTION PIPING SYSTEMS

Fire protection piping systems include firewater and Aqueous Film Forming Foam (AFFF). A pipeline stress analysis for newly installed or significantly modified firewater pipelines should be verified. An external visual inspection of fire protection piping, similar to criteria specified in API RP 574-2009, Section 10.1, shall be performed. Special inspection focus shall be on external corrosion, leaks, and supports condition.

LIST OF TABLES

TABLE 9-1

SUMMARY OF IDENTIFIED DEFICIENCIES

CHECKLIST ITEM # FROM TABLE 9-3	DEFICIENCY ITEM LABEL IN TABLE ES-2	RAP RATING	DESCRIPTION OF DEFICIENCY	RECOMMENDED ACTION OR MITIGATION

TABLE 9-2

SUMMARY OF MISSING OR UNKNOWN INFORMATION

CHECKLIST ITEM # FROM TABLE 9-3	DESCRIPTION OF MISSING OR UNKNOWN INFORMATION*
*** If Missing or Unknown Information is a Deficiency, Identify in Table 9-1**	

TABLE 9-3

AUDIT CHECKLIST

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
3109F.1 GENERAL			
9.1.1	Which pipelines were reviewed for this audit? In addition to oil service pipelines, review should include: ethanol, waste oil, fire water, utility and auxiliary pipelines. (Fill out Table 9-4)		
9.1.2	Are pipeline materials, seals, gaskets and other elastomers compatible with products and product additives? [API 2610]		
9.1.3	Is non-metallic piping used for any pipeline service? Describe.		
9.1.4	Has an incident or accident involving pipelines occurred since the last audit? If so, has a MOTEMS post-event analysis or study been performed? Provide a brief description. [MOTEMS 3102F.4]		
9.1.5	List all in-kind replacements and component modifications, since last audit.		
9.1.6	List all new replacements and component modifications not considered in-kind, since last audit.		
9.1.7	Have any new pipelines or components been placed in service? Provide brief details.		
9.1.8	Have any existing *Out of Service* (O-O-S) pipelines been placed back in-service since the last audit? Provide brief details.		
3109F.2 OIL PIPING AND PIPELINE SYSTEMS			
9.2.1	Are all piping/pipelines, including components, documented on a current P & ID? Provide as report attachment.		
9.2.2 (F)	Verify that P&ID depicts out-of-service pipelines. Also, are removed pipelines either designated as such or no longer shown on P&ID?		
9.2.3 (F)	Identify vulnerable areas where pipelines are not protected from vehicle or vessel impact? [API 2610]		
9.2.4 (F)	Is any pipeline or valve susceptible to vandalism)? [API 2610]		
9.2.5	Have the removed portions of replaced pipelines been studied for internal corrosion or other pipe wall anomalies? What are the results of this study?		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
9.2.6	Does the facility have piping flow diagrams indicating all major valves and flow directions for normal conditions as well as upset conditions? Provide as report attachment. [API 2610]		
9.2.7 (F)	Does either configuration or routing of piping or pipelines obstruct access to or removal of other components?		
9.2.8 (F)	Is plastic piping used for hydrocarbon services at the MOT? If so, have manufacturer specifications been verified that it is rated for oil service at the MOT?		
9.2.9 (F)	Does a flange connection exist within 20 pipe diameters from the end of any replaced section? If so, identify and document the location.		
9.2.10 (F)	Are there dead legs in the pipelines? If so, identify location(s). [API 2610]		
9.2.11	Identify all pipelines which do not have a valid SLPT certificate per 2CCR 2567?		
9.2.12 (F)	Have any piping or pipelines not been used for transferring oil in the last three years? If so, are these designated and/or marked “Out of Service”, gas-freed, and physically isolated from oil sources?		
9.2.13	For each identified O-O-S pipeline specify whether above ground, over water, submerged, or buried.		
9.2.14	Have buried or submerged O-O-S pipelines been filled with inert gas or corrosion inhibitor? If so, briefly describe.		
9.2.15	Is there any plan(s) to physically remove any O-O-S pipeline? Identify such pipelines and associated schedule for removal.		
3109F.3 PIPELINE STRESS ANALYSIS			
9.3.1	Do above ground pipelines have enough flexibility for movement (seismic and thermal) in all directions? [API 2610]		
9.3.2	Has a pipeline stress analysis (PSA) for oil and fire water service pipelines been performed for: a) New piping and pipelines. b) Significant routing/relocation of piping. c) Any replacement of “not-in-kind” piping. d) Any significant rearrangement or replacement of “not-in-kind” anchors and/or supports. e) Significant seismic displacements calculated	a) b) c) d) e)	

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
	from the structural assessment.		
9.3.3	Is the completed PSA representative and reflective of current conditions and configuration?		
9.3.4	What are the maximum transverse and longitudinal seismic displacements used in the PSA?		
9.3.5	Have all PSAs been performed in accordance with ANSI/ASME B31E or B31.4, as appropriate?		
9.3.6	Has a pipeline flexibility analysis been performed in accordance with ASME B31.4?		
9.3.7	Has the largest temperature differential considering all thermal load cases (startup, shutdown, normal and abnormal) been used in the flexibility analysis?		
9.3.8	Are there large unsupported masses (e.g. valves) included in the analysis?		
9.3.9	Are buried pipelines evaluated to withstand the dynamic forces exerted by anticipated traffic loads? [49CFR195]		
9.3.10 (F)	Has the piping system been evaluated for seismic interaction with other elements (equipment, falling objects, other pipelines, etc.)? [CalARP 2013]		
9.3.11 (F)	During a seismic event, is there a possibility of the pipeline(s) impacting safety sensitive equipment? [CalARP 2013]		
9.3.12 (F)	Are flanged and threaded connections present in high stress locations? If yes, provide recommendations. [CalARP 2013]		
9.3.13 (F)	Are flanged or threaded connection locations susceptible to high moment loads? If so, are they checked for leakage? [CalARP 2013]		
9.3.14 (F)	Are there adequate expansion loops or joints in the pipeline? If not, provide recommendations.		
3109F.4 ANCHORS AND SUPPORTS			
9.4.1 (F)	Are the vertical supports and lateral restraints adequate for seismic conditions? [CalARP 2013]		
9.4.2 (F)	Is equipment (such as valves, metering devices, etc.) anchorage adequate for seismic behavior? [CalARP 2013]		
9.4.3 (F)	Are there short/rigid spans such that pipe cannot accommodate the relative seismic displacement of the supports? [CalARP 2013]		
9.4.4 (F)	Are there welded attachments to pipeline walls? Could seismic loading cause pipeline/support failure at these welded attachments? [CalARP 2013]		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
9.4.5 (F)	Are guides or lateral restraints provided just past the elbow where a pipe changes direction?		
9.4.6 (F)	Identify areas of temporary or inadequate supports, pipeline sag, or excessive free spanning.		
3109F.5 APPURTENANCES			
3109F.5.1 VALVES AND FITTINGS			
9.5.1	Are check valves relied on for positive shut off in the reverse direction? [API 2610]		
9.5.2	Are non-ductile materials, iron, cast iron or low melting temperature materials used in hydrocarbon service valves? If so, describe. [API 2610]		
9.5.3	Are any cast iron or brass fittings used in hydrocarbon service? [API 2610]		
9.5.4	Is there a documented testing program for all pressure relief valves and are these valves tested on a regular schedule? Provide date(s) of last test(s). [API 2610]		
9.5.5 (F)	Is all piping with blocked sections containing stagnant oil, provided with a relief valve to mitigate pressure build-up due to temperature increase? [API 2610]		
9.5.6 (F)	Identify any information labels on valves that are: Illegible, painted over, damaged, or missing? [API 2610]		
9.5.7 (F)	Are valves susceptible to damage and tampering, protected? [49CFR195]		
9.5.8 (F)	Is access to valves and important appurtenances inhibited during emergencies? [API 2610]		
9.5.9 (F)	Are valve stems oriented in a way not to pose a hazard in operation or maintenance?		
9.5.10 (F)	Are swing check valves installed in vertical down flow piping? If so, describe briefly.		
9.5.11	Are pressure safety valves (PSVs) set to equal or higher than the maximum allowable working pressure of the protected tank, pipeline or system? Fill-in Table 9-5.		
9.5.12 (F)	Is discharge from PSVs directed into lower pressure piping for recycling and proper disposal? If no, identify the discharge areas.		
9.5.13 (F)	Are double-block and bleed valves used for manifold valves?		
9.5.14	Are all the oil transfer system valves included in a periodic maintenance program? Describe briefly.		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
9.5.15	Are all fire water system valves maintained, inspected, and tested per NFPA-25?		
9.5.16	Do all SIV and ESD valves conform to MOTEMS requirements? Fill in Table 9-6. [MOTEMS 3108F.3.2.1 and 3108F.3.2.2]		
3109F.5.2 VALVE ACTUATORS			
9.5.17 (F)	Do valve actuators have a readily accessible manually operated overriding device to enable operation during a power loss?		
9.5.18	Are torque switches set to stop the motor opening operation at a specified limit switch setting?		
9.5.19	Is thermal insulation for critical valves inspected and maintained at periodic intervals? How frequent? Are the records kept for at least six years? Are they available?		
9.5.20	At what interval has the electrical insulation for critical valves been measured for resistance following installation? Are the past records for the 6 years available?		
3109F.6 UTILITY AND AUXILLIARY PIPING AND PIPELINE SYSTEMS			
9.6.1	Are utility and auxiliary pipelines included on P&IDs? Are P&IDs current? Provide as report attachment.		
9.6.2	What is the design standard(s) for stripping and sampling lines, compressed air, nitrogen or natural gas pipelines? State the design standard for each. Fill-in Table 9-4.		
9.6.3	Are there any buried utility/auxiliary pipelines? If so, briefly describe service, location, and corrosion protection.		
9.6.4 (F)	Does vapor collection piping provide proper slope towards condensation collection points?		
3109F.7 FIRE PIPING AND PIPELINE SYSTEMS			
9.7.1	Are firewater and AFFF pipelines included on P&IDs? Are P&IDs current? Provide as report attachment.		
9.7.2	Is carbon steel used for all fire main piping? If not, describe construction material and location.		
9.7.3 (F)	Are any portion(s) of fire water pipelines buried? Are they cathodically protected? Provide date of last inspection.		
9.7.4 (F)	Are all fire water and foam pipelines color-coded per local jurisdiction requirements or ASME A13.1?		

TABLE 9-4

LIST OF PIPELINES

PIPELINE SERVICE DESCRIPTION	ID#	DIAMETER	INSTALLATION YEAR OF OLDEST SECTION	DESIGN STANDARD	OPERATING PRESSURE

TABLE 9-5

PRESSURE RELIEF VALVES AT THE DOCK

SYSTEM	PSV IDENTIFICATION NUMBER	DESIGN PRESSURE (PSI)	SET PRESSURE (PSI)	EQUIPMENT PROTECTED	REMARKS

TABLE 9-6

EMERGENCY SHUTDOWN VALVES AND SHORE ISOLATION VALVES

SIV OR ESD	PIPELINE	MANUAL OR MOTOR CONTROLLED	IF MOTOR CONTROLLED FAILSAFE OR FAIL LAST	P&ID NO.	REMARKS

TABLE 9-7

ATTACHMENTS*

ATTACH. NUMBER	AUDIT YEAR	REFERENCE TITLE	DESCRIPTION
*** For Section 3109F, this table is intended to chronologically log all MOTEMS Audit attachments starting from the Initial Audit. Attachments in previous audit reports shall remain listed, but need not be attached. If previous attachments are no longer valid, their status shall be indicated utilizing strikethrough text.**			

SECTION 3110F
AUDIT GUIDELINES

GENERAL

1. The Section 3110F Audit requires a compliance review of loading arms, cranes, sumps, pumps, vessel access, etc., in accordance with MOTEMS Division 10. Spacing and location of equipment must consider the function of the particular system in the terminal, maintainability of the system and other surrounding systems, access to the system, egress and evacuation in time of emergency, and hazardous area classification.

2. An equipment/system review is to be performed to ensure all mechanical equipment and systems:

    a. Meet the intended operational performance requirements

    b. Meet operational safety requirements in accordance with the applicable codes and regulations

    c. Eliminate or reduce the potential for hydrocarbon leaks

    d. Eliminate or reduce the potential for explosion or fire, hydrocarbon spill pollution and personal injury

3. Complete Tables 10-1 thru 10-8

4. Prior to inspecting any equipment or completion of Table 10-3 checklist, collect and review the following:

    a. Most recent audit results

    b. Most recent equipment layout drawings, process flow diagrams, P&IDs, equipment specifications, maintenance and repair records, and other pertinent information.

5. Remedial Action Priority (RAP) ratings shall be assigned according to MOTEMS Table 31F-2-5.

6. New inspection findings shall be compared to previous MOTEMS Audit results to identify and report any changes.

7. Photographs, sketches and supporting data shall be utilized to record and report the observed conditions and deficiencies.

LOADING ARMS

Each loading arm has an operating envelope, within which it is designed to connect to the vessel's manifold and follow its motion. The limits of this envelope are critical because extension of the loading arm components outside the envelope can result in overstress or potential failure. Information about the envelope should be verified during the audit and recorded. Verify that the envelope take into account the elevation of the pier or wharf, tidal changes, design freeboard range, and design vessel manifold setback range. The envelope should also take into account the surge and drift motions of the vessel.

Each loading arm should have a means of identification and include basic operating data/information, design environmental data, basic envelope data, and loading arm design information. Typical problems common in marine loading arms are erosion and corrosion of piping elbows, leaks at flanged connections and at swivel joints, pitting and wear of seal face, dry ball/raceway, excessive loading or brinnelling of raceways, sticking/plugging of various small bore valves.

LIFTING EQUIPMENT (CRANES AND WINCHES)

Marine terminals may employ various types of lifting equipment to handle the cargo transfer or related systems. Hose based cargo transfer systems require lifting equipment to handle either the hose end (crane) or intermediate sections of hose over a saddle (winch). A key component in both cranes and winches is the wire rope. Winches also use blocks and sheaves to guide the wire rope from the drum to the saddle/hose.

Typical problems common in terminal lifting equipment are wire rope wear, sheave/block groove wear, and obstructions within the operating envelope of the crane. The full operating envelope of both cranes and winches shall be examined for clear passage and obstructions. The wire ropes shall be inspected for their integrity and lack of broken strands. Each lifting equipment item should have a means of identification.

EQUIPMENT ANCHORS AND SUPPORTS

All major or critical mechanical and electrical equipment shall be checked for anchorage, using the principles described in CalARP and ASCE-7.

CRITICAL SYSTEMS SEISMIC ASSESSMENT

A Critical Systems Seismic Assessment (CSSA) shall be performed that includes mechanical and electrical equipment related to personnel safety, oil spill prevention or response. The engineer performing the Section 3110F audit shall coordinate with the civil, mechanical, or structural engineer performing the CSSA to ensure that the latest configuration for all equipment, and current conditions are included in the CSSA.

LIST OF TABLES

TABLE 10-1

SUMMARY OF IDENTIFIED DEFICIENCIES

CHECKLIST ITEM # FROM TABLE 10-3	DEFICIENCY ITEM LABEL IN TABLE ES-2	RAP RATING	DESCRIPTION OF DEFICIENCY	RECOMMENDED ACTION OR MITIGATION

TABLE 10-2

SUMMARY OF MISSING OR UNKNOWN INFORMATION

CHECKLIST ITEM # FROM TABLE 10-3	DESCRIPTION OF MISSING OR UNKNOWN INFORMATION*
*If Missing or Unknown Information is a Deficiency, Identify in Table 10-1	

TABLE 10-3

AUDIT CHECKLIST

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
	3110F.1 GENERAL		
10.1.1	Is there any new (non-replacement) equipment installed since the last audit? [MOTEMS 3101F.3]		
10.1.2	Has there been replacement-in-kind of existing equipment and/or mechanical or minor modifications? If yes, describe changes. [MOTEMS 3101F.3]		
10.1.3	Have any electrical and/or mechanical equipment been modified or replaced since installation? If yes, describe changes. [MOTEMS 3101F.3]		
10.1.4 (F)	Are all existing equipment identified and properly located on an equipment layout drawing? Reference drawing in Table 10-8.		
10.1.5	Fill out Table 10-4.		
	3110F.2 MARINE LOADING ARMS		
10.2.1 (F)	Provide a description of the loading arm systems, manufacturer's name and year of installation.		
10.2.2	Are loading arms seismically qualified for the given location?		
10.2.3 (F)	Do supports have adequate capacity to resist expected seismic forces based on ASCE-7? [MOTEMS 3110F.8] [CalARP 2013]		
10.2.4 (F)	Do anchors have adequate capacity to resist expected seismic forces? [MOTEMS 3110F.8] [CalARP 2013]		
10.2.5 (F)	Provide recommendations, if necessary, for the replacement or repair of any support or anchor system, based upon the current condition. [CalARP 2013]		
10.2.6	Does the maximum allowable movement envelope limits for each loading arm comply with 2 CCR 2380?		
10.2.7	Is the radio controller compliant with requirements for transmitters operating in an industrial environment? With FCC requirements? [2 CCR 2370, 47 CFR Part 15]		
10.2.8	Do all valves comply with ASTM specifications? [API 6D Table 3-1]		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
10.2.9	Are all valves made of steel? [OCIMF]		
10.2.10	Is the loading arm provided with alarms to indicate that the limits of the operating envelope are being reached? [OCIMF]		
10.2.11	Is the loading arm equipped with a quick-disconnect coupling used during transfer operations? [2 CCR 2380]		
10.2.12	If so, does it meet ASTM standard F-1122? [2 CCR 2380]		
10.2.13	Is the outboard arm provided with a support jack to relieve the load on the manifold? [OCIMF]		
3110F.3 OIL TRANSFER HOSES			
10.3.1 (F)	Does the MOT use transfer hose(s) in normal operations?		
10.3.2	Provide nominal diameter of hoses		
10.3.3	If nominal diameter of hoses are less than 6 inches, are they equipped with quick disconnect fittings? Do fittings meet ASTM F1122 requirements?		
10.3.4	If nominal diameter of hoses are greater than 6 inches, do they meet ASME B16.5 requirements?		
10.3.5	Does the minimum hose length safely accommodate the vessel's size and maximum movements during transfer operations and mooring? [MOTEMS 3105F.2]		
10.3.6	Are any metallic hoses in service? Provide replacement frequency.		
3110F.4 LIFTING EQUIPMENT: WINCHES AND CRANES			
10.4.1	Provide a description of the winch and crane systems. Include the date on which each unit began service.		
10.4.2	Are the cranes, winches and ancillary equipment suitable for a marine environment?		
10.4.3	Are there written procedures for testing and inspecting cranes and/or winches?		
10.4.4	Are there written procedures for handling abnormal operations and emergencies?		
10.4.5	How frequently is the unit inspected? Last inspected? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.6	Is the inspector qualified to inspect winches and cranes? Specify qualifications.		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
10.4.7	Are inspection and maintenance records retained?		
10.4.8	When did unit begin service (installed)? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.9	Was each newly installed or repaired hoist load tested with 125% of the rated load (or recommended test load)? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.10 (F)	Do supports have adequate capacity to resist expected seismic forces? [MOTEMS 3110F.8, CalARP 2013]		
10.4.11 (F)	Do anchors have adequate capacity to resist expected seismic forces? [MOTEMS 3110F.8, CalARP 2013]		
10.4.12 (F)	Provide recommendations, if necessary, for the replacement or repair of any support or anchor system, based upon the current condition. [CalARP 2013]		
10.4.13 (F)	Are there cracked or worn drums, or sheaves? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.14 (F)	Are there any worn, cracked, or distorted parts, e.g. pins beatings, shafts, gears, rollers, and locking and clamping devices? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.15 (F)	Is there excessive wear, distortion, or damage on brake and clutch system parts and linings, and on pawls and ratchets? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.16 (F)	Is there excessive wear of chain drive sprockets and excessive chain stretch? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.17 (F)	Do electrical apparatus have any contact pitting or any deterioration? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.18 (F)	Are there any deformed, cracked, or corroded structural support members of the crane or boom? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.19 (F)	Are there any loose bolts or rivets? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.20 (F)	What is the condition of the foundation and tie-downs? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.21 (F)	Does hook have a latch? [ASME B30.4, ASME 30.7, ASME HST-4]		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
10.4.22 (F)	Does rope have any distortions, e.g. kinking, crushing, unstranding, bird caging, corrosion, broken or cut strands? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.23 (F)	Does the power plant provide adequate performance? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.24 (F)	Is the drum/cable restraint functional? [ASME B30.4, ASME 30.7, ASME HST-4]		
10.4.25	Have limit switches been tested? Date of last test?		
10.4.26 (F)	Do winches have a fail-safe braking system, capable of holding the load under all conditions, including a power failure?		
10.4.27 (F)	Do winches have limit switches and automatic trip devices?		
10.4.28 (F)	On the load hoisting equipment with an ungrooved drum, are there at least three full turns of cable remaining under all operating conditions?		
10.4.29 (F)	On the load hoisting equipment with a grooved drum, are there at least two full turns of cable remaining under all operating conditions?		
10.4.30 (F)	For winches, are all moving parts sufficiently guarded to prevent caught-in hazards to personnel? MOTEMS Section 3110F.4.1.7		
10.4.31 (F)	Do all winches have clearly identifiable and readily accessible stop controls? MOTEMS Section 3110F.4.1.8		
3110F.5 SHORE-TO-VESSEL ACCESS FOR PERSONNEL			
10.5.1 (F)	Provide a description of all shore-to-vessel access systems.		
10.5.2	Fill out Table 10-5		
10.5.3	Is the means of access adequately illuminated? [MOTEMS 3111F.8]		
10.5.4 (F)	Is the gangway walking surface width at least 20 inches?		
10.5.5 (F)	Does each side of the gangway have railing that is at least 33 inches high measured perpendicularly from the walkway surface? Does each railing have a mid-rail?		
3110F.6 OIL SUMPS & ANCILLARY EQUIPMENT			
10.6.1 (F)	Provide a description of all sump systems used for oil service during normal operations.		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
10.6.2	Fill out Table 10-6		
10.6.3 (F)	Do the vents discharge outside of hazardous areas? Distance greater than 25 feet (N)?		
10.6.4	If the sump provides drainage for more than one berth, is it equipped with liquid seals?		
10.6.5 (F)	Do supports have adequate capacity to resist expected seismic forces? [MOTEMS 3110F.8] [CalARP 2013]		
10.6.6 (F)	Do anchors have adequate capacity to resist expected seismic forces? [MOTEMS 3110F.8] [CalARP 2013]		
10.6.7 (F)	Provide recommendations, if necessary, for the replacement or repair of any support or anchor system, based upon the current condition. [CalARP 2013]		
10.6.8 (F)	Are the following safety devices installed and operable on each sump: a) Level Safety Low (LSL)? b) Level Safety High (LSH)?	a) b)	
10.6.9 (F)	Is each enclosed sump equipped with the following? a) Vacuum relief valve? b) Pressure safety valve and vent? c) Flame arrestor?	a) b) c)	
10.6.10 (F)	Do the sumps have automatic draining pumps? Is installed sump pump operable?		
10.6.11	Are the sumps tightly covered?		
	3110F.7 VAPOR CONTROL SYSTEMS		
10.7.1	Does the MOT have a vapor control system?		
10.7.2 (F)	Provide a description of all VC systems.		
10.7.3	When was the vapor control system installed?		
10.7.4 (F)	Is the VCS located on a wharf, pier, skid-mounted, or onshore?		
10.7.5	When was the last structural inspection of the existing vapor control system?		
10.7.6	What remedial measures have occurred based upon the last inspection or audit?		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
10.7.7	Is periodic testing of vapor return lines performed to check for tightness of connections? [API 2610]		
10.7.8	When was the date of the last inspection or test? [API 2610, Sec. 10.6.2 and 10.6.4]		
10.7.9	Are flame arrestors and detonation arrestors periodically tested and cleaned to prevent clogging? When was the date of the last inspection? [API 2610, Sec 11.7.1.6]		
10.7.10	Are pressure/vacuum vents inspected and serviced periodically to ensure proper operation? When was the date of the last inspection? [API 2610, Sec. 11.7.1.6]		
10.7.11	Do all vapor hose flanges conform to ANSI B16.5? [API 1124, Section 4]		
10.7.12	Does a lugged key mechanism exist on vapor hose flanges and vapor control arms to prevent cross connection between vapor and cargo? [API 1124, Section 4]		
10.7.13	Do supports have adequate capacity to resist expected seismic forces per ASCE 7? [CalARP 2013]		
10.7.14	Do anchors have adequate capacity to resist expected seismic forces per ASCE-7? [CalARP 2013]		
10.7.15 (F)	Provide recommendations, if necessary, for the replacement or repair of any support or anchor system, based upon the current condition. [CalARP 2013]		
10.7.16 (F)	Is the last meter length of vapor hose and offshore terminal vapor hose connection piping painted with three band of 100 mm (4”) wide end bands being red in color and the center band being yellow in color? [API 1124, Section 4]		
10.7.17 (F)	Is the word “VAPOR” painted in black letters at least 50mm (2”) high at approximately 120° intervals on both ends of the vapor hose in approximately the 2 o’clock and 10 o’clock positions of the terminal vapor hose connection piping’s offshore end? [API 1124, Section 4]		
10.7.18 (F)	Is the last meter length of the vapor control arm painted with three band of 100 mm (4”) wide end bands being red in color and the center band being yellow in color? [API 1124, Section 4]		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
10.7.19 (F)	Is the word "VAPOR" painted in black letters at least 50mm (2") high at approximately 120° intervals on both ends of the vapor hose and in approximately the 2 o'clock and 10 o'clock positions of the terminal loading arm connection piping's offshore end? [API 1124, Section 4]		
3110F.8 EQUIPMENT ANCHORS AND SUPPORTS			
10.8.1	Have all new and existing equipment supports and anchors been assessed in accordance with FEMA 450 (N), CalARP 2013 (E) or ASCE Guidelines (E)?		
10.8.2 (F)	Provide recommendations, if necessary, for the replacement or repair of any support or anchor system, based upon the current condition. [CalARP 2013]		
3110F.9 SPILL PREVENTION EQUIPMENT AND SYSTEMS MAINTENANCE			
10.9.1	Is all critical spill prevention equipment, such as but not limited to mooring line quick release and loading arm quick disconnect systems, maintained per the manufacturer's recommendations? Have the latest test records been verified?		
3110F.10 PUMPS			
10.10.1 (F)	Provide a description of all pump systems (fill-in Table 10-7).		
10.10.2 (F)	Are pumps with gray cast iron cases used in hydrocarbon service with design pressure ratings above 175 psig?		
10.10.3 (F)	If so, would they create a hazard in the event of a fire?		
10.10.4 (F)	Has a check valve been installed on the discharge of each pump where backflow is possible?		
10.10.5	If not, is there another safety device to prevent backflow?		
10.10.6	Are pumps equipped with a pressure (pumped) oil system for bearing lubrication equipped with a low lube pressure shutdown device?		
10.10.7 (F)	Do supports have adequate capacity to resist expected seismic forces? [MOTEMS 3110F.8] [CalARP 2013]		
10.10.8 (F)	Do anchors have adequate capacity to resist expected seismic forces per ASCE 7? [MOTEMS 3110F.8] [CalARP 2013]		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
10.10.9 (F)	Provide recommendations, if necessary, for the replacement or repair of any support or anchor system, based upon the current condition. [CalARP 2013]		
10.10.10	Are all oil service pumps maintained per API 2610?		
10.10.11	Are all fire water pumps inspected, maintained, and tested per NFPA-25?		
3110F.11 CRITICAL SYSTEMS SEISMIC ASSESSMENT			
10.11.1 (F)	Does the critical systems seismic assessment reflect the current installation and equipment condition?		

TABLE 10-4

SUMMARY OF EQUIPMENT REVIEWED

ITEM	EQUIPMENT NO.	COMMENTS

TABLE 10-5

PERMANENT GANGWAY AUDIT

Berthing System:					

PART 1 - BASIC OPERATING INFORMATION		
Date of last overhaul:		
Length of walkway (feet):		
Maximum angle of walkway with the horizontal		
Minimum width of the walkway		
Height of guardrails?		
Condition of the walkway surface?		
Gangway maneuver control method? [Ramp/Manual/Powered (electrical/hydraulic)]		
PART 2 - BASIC ENVELOPE DATA		
Datum [LLWL/MLWL/HHWL/…] (feet):		
Wharf deck elevation above Datum (feet):		
Minimum Freeboard [loaded smallest vessel] (feet):		
Maximum Freeboard [light largest vessel] (feet):		
Pier face to berthing line distance [minimum/maximum] (feet):		
Vessel rail setback [minimum/maximum] (feet):		
Allowable drift/surge of moored vessel (feet):		

TABLE 10-6

SUMP/SUMP TANK DESIGN REVIEW

SUMP	CONSTRUCTION	ROOF TYPE	CAPACITY	SUMP PUMP

TABLE 10-7

PUMP REVIEW

PUMP EQUIP. NO.	SYSTEM	TYPE	DRIVER	CAPACITY (GPM)	DESIGN PRESSURE (PSI)	PREVENTATIVE MAINTENANCE PROGRAM (Y/N)

TABLE 10-8

ATTACHMENTS*

ATTACH. NUMBER	AUDIT YEAR	REFERENCE TITLE	DESCRIPTION

*** For Section 3110F, this table is intended to chronologically log all MOTEMS Audit attachments starting from the Initial Audit. Attachments in previous audit reports shall remain listed, but need not be attached. If previous attachments are no longer valid, their status shall be indicated utilizing strikethrough text.**

SECTION 3111F
AUDIT GUIDELINES

GENERAL

1. The Section 3111F Audit electrical system compliance review is intended to ensure all electrical equipment and systems have been designed and installed to meet the correct hazardous area electrical classification, with proper grounding, wiring and installation practices in accordance with MOTEMS Division 11.

2. The audit requires a review of all electrical equipment such as motors, lighting, wiring, etc. Spacing and location of electrical equipment must consider the requirements of the terminal's hazardous area electrical classification. If the recommended spacing requirements are not met, consideration must be given to increasing the fire preventive aspects of design, such as increased fire suppression equipment, equipment isolation, or locating electrical equipment in purged and pressurized enclosures.

3. Prior to any conduit/equipment inspection or completion of Table 11-3 checklist:

    a. Collect and review the most recent audit results

    b. Collect the most recent equipment layout drawings, electrical single line diagrams, hazardous classified area diagrams/drawings, lighting and grounding layout diagrams, corrosion inspections, maintenance and repair records, and other pertinent information.

    c. Where MOTs are found to have insufficient documentation, the operator must be directed to have the necessary plans, details and layouts prepared by a Professional Engineer prior to the scheduling of the on-site audit inspections.

4. Complete Tables Tables 11-1 thru 11-9.

5. Remedial Action Priority (RAP) ratings shall be assigned according to MOTEMS Table 31F-2-5.

6. New inspection findings shall be compared to previous MOTEMS Audit results to identify and report any changes.

7. Photographs, sketches and supporting data shall be utilized to record and report the observed conditions and deficiencies.

HAZARDOUS AREA DIAGRAMS

The hazardous area classification diagrams should be reviewed in detail before the on-site audit. This information should then be reviewed and confirmed as part of the on-site audit. The site auditor must be capable of recognizing the extent of the hazardous areas as defined by the applicable codes and regulations and as set forth by the on-site documentation. The definition of the areas is dependent on the topology of the MOT and the operations being carried out. In addition, events can occur that can create hazardous conditions that are random in time and location, planned or unplanned and of a varied severity. The auditor must understand all of these conditions and the inspection shall be conducted accordingly.

The audit will confirm the boundaries of each hazardous area, noting any operational or other site changes near the area that could redefine its boundaries, and establish that the equipment and wiring contained within complies with rules, codes and regulations for hazardous areas. All areas at the MOT should be covered, including elevations above and below of the pier deck (including all depressed areas), near vents, and within buildings and enclosed spaces.

Likely violations will occur, when the hazardous area has not been defined, when it has been defined but equipment or operations has changed such that the original area is no longer compliant, or when non-classified equipment have been installed.

IDENTIFICATION AND TAGGING

Table 11-5 provides the format for identifying the electrical components that are tagged. All existing electrical equipment shall be tagged. If identification is necessary for the proper and safe operation, the markings are to be clearly visible and illuminated.

ELECTRICAL SERVICE

Other electrical equipment not previously noted, including switches, photoelectric eyes, circuit breakers, panels, switchboards, and junction boxes in the electrical system should be audited to ensure the components and seal fittings meet the hazardous area classification. This equipment may be critical for safe, reliable and successful operation of the terminal. All of the components must conform to all applicable codes, rules and regulations and be in good, serviceable condition.

Inspect all switchboards for obvious indications of overloading such as heat buildup or discolored bus bars or connectors. Inspect panel boards similarly. Check for large accumulations of dust, dirt or debris both within and without the enclosures. For all equipment within hazardous areas, check for compliance with classified area rules. Of special importance is the presence of conduit seals in conformance with classified area rules and whether they are properly filled and sealed to perform effectively. Switchboards or panel boards may be located in electrical rooms where the space is often used for storage, thus impeding maintenance and violating the CEC.

GROUNDING AND BONDING

Grounding and bonding at MOTs is essential for personnel safety, fire prevention, lightning control and to adhere to applicable codes, rules and regulations. Nearly all electrical circuits now installed in modern terminals are grounded with both a neutral and a green grounding conductor carried throughout the system. Bonding is applied to interconnect all non-current carrying elements of the electrical distribution system such as enclosures and conduits as well as certain elements of the piping and structures where necessary for safety or lightning protection.

A grounded conductor refers to the power system neutral and must be grounded where derived, either at the service entrance to the MOT or at the step-down transformer or generator from which the service is derived. Grounding conductors, as opposed to grounded conductors, are normally non-current carrying and are connected to the grounded terminal of the service entrance device and then extended throughout the MOT's electrical system and ultimately connected to various electrical enclosures. Bonding jumpers and conductors are used to electrically bond together non-current carrying elements of the structure, piping, towers and sometimes ships, to assure a good ground is available. All grounding and bonding connections are expected to carry very heavy currents developed during short circuit and power surge conditions or lightning and so must be rugged and in good condition. Bonding of pipes and structure supports may be integrated into the MOT Cathodic Protection system if installed.

The electrical system should be checked to ensure that the incoming neutral conductor is properly grounded at the service point and that proper grounding is provided for all electrical equipment. The electrical resistance of the grounding point should be measured with specialized equipment to make certain that it falls within the range allowed by the California Electrical Code and local requirements. Bonding of any tower structure is essential to provide lightning protection and in view of its importance, should be redundant. Bonding of any element under cathodic protection, such as piles and pipes, should be inspected as part of the Cathodic Protection System. The audit should verify whether the grounding and bonding connections are in good condition and capable of carrying out their intended function.

The main ground point at the service entrance of the MOT would be located within the service equipment, the incoming over current device, circuit breaker or fused switch. Some facilities may have the main grounding point at the step-down transformer secondary and others within the meter enclosure if served by the local utility company. The grounding electrode may be a ground rod inserted into either the shore or into the seabed. Alternately, piles or other structures may be used for the grounding electrode when not cathodically protected.

Defects commonly encountered are high grounding resistance and poor connections at either the main grounding point or onto the items to be bonded or grounded. These connections may have been poorly made up during construction or they may have deteriorated and corroded with time and weather. Where conduits and equipment enclosures act as the sole grounding means, loose couplings, locknuts, poorly installed flexible conduits and other connections are common problems in both new and old installations.

COMMUNICATIONS AND CONTROL SYSTEMS

The items covered in this review include all communication equipment i.e. telephones, intercoms, Public Address (PA) Systems and associated speakers, radios, hand-held devices, and associated wiring. Spacing and location of fixed communication equipment must consider the requirements of the terminal's hazardous area classification. If the recommended spacing or location requirements are not met, consideration must be given to equipment isolation, or locating communication equipment in purged and pressurized enclosures (NFPA 496).

Older communication systems used fixed telephones, PA systems, intercoms, wiring and other equipment that may not be intrinsically safe and require either explosion-proof construction in a Hazardous Area or location in an approved area. More modern systems use radios and other hand-held devices that often can be manufactured as intrinsically safe and can be used throughout the MOT irrespective of the area classification. Both types of systems must also be identified and inspected to verify their suitability for use in hazardous areas including battery chargers for portable devices. In addition, the nature and condition of each piece of equipment, communication device and wiring must be inspected and function-tested to assess the reliability of the communication system to function as intended by applicable codes and regulations.

Fixed communications systems may be limited to one telephone in the smaller MOTs or comprised of many different and numerous elements at more complex installations. In the latter case where more than six elements are concerned, drawings should either exist or be prepared to identify the equipment and their locations. Systems made obsolete by new approved technology should be taken out of service and removed unless an analysis indicates that the older systems can perform a necessary backup function.

Typical system faults include worn-out batteries (or unable to retain a charge), frayed wiring, broken elements, unsuitable enclosures/sealing for the area or against weather, etc. The ability of all equipment to reliably communicate shall be tested and suitably recorded. The type and model shall be recorded for each fixed device and the type, model, serial number, location and purpose for each portable device.

CORROSION INSPECTION AND ASSESSMENT

The corrosion assessment is a visual assessment of metallic wharf components and structures for the purpose of determining the significance of existing corrosion and protective coating deterioration. Components may include, but not be limited to: a) steel and steel re-enforced concrete piles, b) sheet piles, c) steel and steel re-enforced concrete structural members and deck, d) mooring and berthing dolphins, fenders and hardware, e) piping and equipment supports and anchorage, f) wharf fire protection equipment, g) mechanical and electrical equipment, h) electrical conduit, i) spill containment, etc. Corrosion assessment results shall be included in the audit report.

Some components at a MOT may be protected by a cathodic protection system; however all metallic components must be included in the corrosion assessment. Cathodic protection systems are installed to mitigate corrosion of submerged or buried structures and/or components. Where cathodic protection exists, the systems directly associated with the MOT only will be reviewed.

A cathodic protection system should be designed, tested, adjusted, and commissioned by a competent corrosion professional. Each system should have an Operations and Maintenance Manual including permanent records, system design specifications, test results, and all system settings. The auditor must verify the satisfactory and continued performance of the cathodic protection system by reviewing the latest test results. All equipment should also be inspected for damage and condition including the interior of test stations, rectifiers, wiring and connections. The underwater inspection, if conducted, should also make an inspection of all anodes that may be visible and a record made of each one's type, condition and location.

LIST OF TABLES

TABLE 11-1

SUMMARY OF IDENTIFIED DEFICIENCIES

CHECKLIST ITEM # FROM TABLE 11-3	DEFICIENCY ITEM LABEL IN TABLE ES-2	RAP RATING	DESCRIPTION OF DEFICIENCY	RECOMMENDED ACTION OR MITIGATION

TABLE 11-2

SUMMARY OF MISSING OR UNKNOWN INFORMATION

CHECKLIST ITEM # FROM TABLE 11-3	DESCRIPTION OF MISSING OR UNKNOWN INFORMATION*
* If Missing or Unknown Information is a Deficiency, Identify in Table 11-1	

TABLE 11-3

AUDIT CHECKLIST

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
3111F.1 GENERAL			
11.1.1	Do all electrical systems conform to API 540 and the CEC (CEC)? (Answer based on responses to questions below)		
3111F.2 HAZARDOUS AREA DESIGNATIONS AND PLANS			
11.2.1	Does the MOT transfer any products with a flash point below 140°F?		
11.2.2	Does the MOT require any electrical hazard class areas (flash point below 140°F)? [API RP 500 Section 5] If none exist, skip to 3111F.3 IDENTIFICATION AND TAGGING		
11.2.3	Verify a current set of scaled plan and elevation drawings, with clearly designated areas showing the electrical hazard class, division and group.		
11.2.4	Are the current hazardous area classification drawings certified by a Professional Electrical Engineer? [2 CCR 2385(d)(4)] [API RP 500 Section 8.2.4 and Figure 19]		
11.2.5	Has there been any electrical modification(s) since the last audit? If so, what was modified?		
11.2.6	Are the modifications reflected in the current set of electrical hazard class area drawings? Fill-in Table 11-4		
11.2.7 (F)	Are receptacles and plugs in Class 1 areas approved for that service and do they have grounding for flexible cords? [CEC]		
11.2.8 (F)	Are flexible cords within Class 1 areas supported by clamps or other means to prevent tension on the terminal connections? [CEC]		
11.2.9 (F)	Within the Class I areas, is there any exposed electrical wiring from conduit, electrical boxes or electrical equipment?		
11.2.10 (F)	Is the wiring of intrinsically safe circuits physically separated from the wiring of all other circuits that are not intrinsically safe? [CEC]		
11.2.11 (F)	Are temperature markings present on equipment (e.g. motors, generators, heaters, and lighting fixtures) located within hazardous class areas? [CEC]		
11.2.12 (F)	Does any equipment (e.g. motors, generators, heaters, and lighting fixtures) operate at temperatures above 80% of ignition temperature of the lowest flash point product handled at the		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
	MOT? [CEC] [API RP 540 Section 7.5.5, Table 5]		
11.2.13 (F)	Are all motors in Class 1, Division 1 locations explosion proof or totally enclosed and pressurized? [CEC] [API RP 540 Section 6.13]		
11.2.14 (F)	Are all motors in Class 1, Division 2 locations explosion proof or non-arcing? [CEC] [API RP 540 Section 6.13]		
11.2.15 (F)	If flexible metal conduit or liquid tight metal conduit is installed, are internal or external bonding jumpers also installed in parallel with each conduit and complies with CEC Section 250.102. [API RP 540 Section 8.4.5]		
3111F.3 IDENTIFICATION AND TAGGING			
11.3.1	Using Table 11-5, list all items that are not tagged or identified. Provide justification (if any) for untagged items, in the table comment column. [CEC Articles 110, 200, 210, 230, 384, 480, & 504]		
11.3.2 (F)	Where identification is necessary for the proper and safe operation of electrical equipment, is equipment identification clearly visible and illuminated?		
3111F.4 PURGED OR PRESSURIZED ENCLOSURES FOR EQUIPMENT IN HAZARDOUS LOCATIONS			
11.4.1 (F)	Is the pressurizing equipment and its power supply electrically monitored?		
11.4.2 (F)	Are alarms provided to indicate failure of the purging/pressurizing system?		
11.4.3 (F)	Is a warning plate conspicuously located on purged and pressurized enclosure with an statement such as, "*Enclosure shall not be opened unless the area is known to be non-hazardous or unless all devices within have been de-energized. Power shall not be restored after enclosure has been open until closure has been purged for ___ minutes.*"		
11.4.4 (F)	Are all purged/pressurized instruments and enclosures fastened reasonably tightly and free from damage?		
11.4.5 (F)	Do all positive pressure air systems maintain at least 0.1 inch water (25 Pascal) internal pressure with all the openings closed?		
11.4.6 (F)	If electrical enclosures or control rooms are pressurized with air, is the air intake located outside a hazardous classified area? If not, provide recommendations. [API RP 500 Section 6.3.2.2]		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
11.4.7 (F)	Is there adequate ventilation for any building or enclosed space located within a Class 1 area to prevent significant quantities of vapor-air or gas-air mixtures in concentration above 25% of LEL? [API RP 500 Section 6.3]		
11.4.8 (F)	Is the control room pressurized? If so, does it conform to NFPA 496, Chapter 7?		
3111F.5 ELECTRICAL SERVICE			
11.5.1	How do the critical systems (spill prevention, fire control or life safety) operate during loss of electrical power?		
11.5.2	Do critical systems (spill prevention, fire control or life safety) have an alternate service derived from a separate source and conduit system?		
11.5.3	Is the capacity of the electrical service feeders and transformers adequate to serve the peak demand of all electrical loads?		
11.5.4	Are emergency cables and conductors supplying block valve motors, starters and associated conduits and conductors fire rated or otherwise capable to remain in service for 15 minutes in a 2000° F fire?		
11.5.5	Will the temperature around critical components (within spill prevention, fire control or life safety systems) exceed 200° F during the 15 minutes in a 2000° F fire?		
11.5.6	Are emergency cables and conductors located where they are protected from traffic, corrosion, or other sources of damage?		
11.5.7	Does the MOT have an emergency power system? If so, is the system maintained per NFPA-110?		
11.5.8	Does the MOT have a stored energy emergency power system (SEEPS)? If so, is the system maintained per NFPA-111?		
3111F.6 GROUNDING AND BONDING			
11.6.1 (F)	Is all equipment properly grounded? Fill out Table 11-6.		
11.6.2	When flanges of pipelines with cathodic protection are to be opened for repair or other work, are the flanges bonded prior to separation? Verify facility's applicable procedure and provide reference in response.		
11.6.3	Is the grounding resistance of the main service within that allowed by CEC Article 250?		
11.6.4 (F)	Is the neutral of the incoming service grounded? [CEC Art.250.56]		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
11.6.5 (F)	Are all of the neutrals of separately derived circuits properly grounded? [CEC Art. 250.26]		
11.6.6 (F)	Are all electrical equipment effectively grounded by means of an approved electrode or other means in accordance with CEC Article 250?		
11.6.7 (F)	Are loading arms, anemometers, gangway towers and other metallic high points connected solidly to earth through redundant means to provide adequate protection against lightning strikes?		
11.6.8 (F)	Are all non-current carrying metallic equipment, structures, piping and other elements effectively bonded to the grounded system?		
11.6.9 (F)	Are active corrosion protection systems grounded for on-shore piping, submerged support structures or other systems?		
11.6.10 (F)	Are bonding jumpers installed across flexible conduits where required? CEC Art. 250.96		
11.6.11 (F)	Are all rigid conduit and flexible connections to couplings, hubs, fittings and other devices made wrench tight to afford a good ground path?		
11.6.12 (F)	Are cathodic protection systems isolated from electrical/static sources with insulation barriers, including flanges or non-conducting hoses?		
3111F.7 EQUIPMENT SPECIFICATIONS			
11.7.1	Are all new electrical systems and components certified by a nationally recognized testing laboratory (e.g. NEMA)?		
3111F.8 ILLUMINATION			
11.8.1	Has there been a significant change in the MOT layout or lighting system, since the previous audit?		
11.8.2 (F)	Have lighting levels been determined quantitatively? [2 CCR 2365] [33 CFR 154.570]		
11.8.3	Are lighting intensities adequate for: a) Transfer operations work area on the terminal, including mooring points? b) Transfer operations work area on any barge moored at the terminal to or from which oil is being transferred?	a) b)	
11.8.4 (F)	Does lighting inside of Class 1, Division 1 locations conform to CEC requirements?		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
11.8.5 (F)	Does lighting inside of Class 1, Division 2 locations conform to CEC requirements?		
3111F.9 COMMUNICATIONS, CONTROL AND MONITORING SYSTEMS			
11.9.1	Provide a brief description of facility's overfill protection system(s).		
11.9.2	What is the frequency of testing for overfill protection systems equipment?		
11.9.3	Does the overfill protection system comply with 33 CFR 154.2102?		
11.9.4	Does the overfill protection system, if installed, meet the provisions of API Standard 2350 and 40 CFR 112.7(e)(2)]?		
11.9.5 (F)	Is the alarm/signal control panel (annunciator) located so that the assigned operator and/or transported personnel are readily alerted to take response action when a detector signals that the liquid level in a tank has reached a predetermined height? [API RP 2350]		
11.9.6 (F)	Does the alarm/signal control panel have a deactivation switch that turns off the system? [API RP 2350]		
11.9.7 (F)	Are there means at the MOT to receive signals from vessel overfill sensors and alarms?		
11.9.8 (F)	Are all communication devices (e.g. telephones, intercoms, speakers, etc.) in working order and capable of operating for the intended purpose? Fill out Table 11-7.		
11.9.9	Are all monitoring systems and instrumentation (e.g. velocity monitoring systems, tension monitoring systems, anemometers, and current meters) maintained and calibrated per the manufacturer's recommendations?		
11.9.10	Do the communication systems comply with 2 CCR 2370 and OCIMF "*Guide on Marine Terminal Fire Protection and Emergency Evacuation*" Section 6? [MOTEMS 3111F.9.1]		
3111F.10 CORROSION PROTECTION SYSTEMS (CPS)			
11.10.1	Is wharf structure and/or piping protected by a cathodic protection system? If so, briefly describe what is protected. If no CPS is installed at the MOT, mark all following responses to this group's questions as N/A.		

(F) ⇨ FIELD VERIFICATION

ITEM #	QUESTION	RESPONSE	RAP RATING
11.10.2	a) Is the CPS design criteria, location of anodes, electrical leads and rectifiers documented? b) Are CPS inspection records available? c) Was this information reviewed by the audit team?	a) b) c)	
11.10.3	If underwater structures are protected by a CPS, does operation, testing and maintenance conform to UFC 3-570-02N?		
11.10.4	If buried/submerged piping is protected by CPS, does operating, testing and maintenance conform to API 570?		
11.10.5	a) If the wharf structure's cathodic protection is a sacrificial anode type, were components inspected during the audit inspection? b) Were observations recorded in accordance with MOTEMS 3102F.3.5.4?	a) b)	
11.10.6	Are annual potential readings of the underwater structure taken and documented? Fill out Table 11-8 from most recent inspection. UFC 3-570-02N		
11.10.7	For impressed current systems, are monthly rectifier readings recorded?		
11.10.8 (F)	a) Are isolating means installed between buried/ submerge CPS protected piping and unprotected above ground/water piping? b) If so, are records or other means available to identify the appropriate insulating flanges and their exact location?	a) b)	
11.10.9	Have tests been performed on insulating and isolating devices in accordance with 2 CCR 2341 and 2380?		
11.10.10	Has onshore/MOT isolating means inspection been coordinated with a corrosion engineer?		

TABLE 11-4

MISSING/INCORRECT CLASSIFICATION – AREA OR EQUIPMENT

AREA/EQUIPMENT *	CLASSIFICATION DRAWING ID	FIELD VERIFIED?	CLASS I DIV 1	CLASS I DIV 2
***Equipment includes motors, Switchboards, Panelboards, Switches, Junction Boxes, transformers, overcurrent devices, controllers, lighting fixtures, heaters, appliances, etc.**				

TABLE 11-5

IDENTIFICATION AND TAGGING

IDENTIFICATION CATEGORY	ITEMS NOT TAGGED	LOCATION	COMMENTS

TABLE 11-6
EQUIPMENT GROUNDING

ITEM	CONNECTED TO SKID/DECK	GROUNDED	METHOD OF GROUNDING	GROUNDING ADEQUATE?	COMMENTS

TABLE 11-7
COMMUNICATION SYSTEMS

COMMUNICATION DEVICE LOCATION	CLASSIFICATION	TYPE OF COMMUNICATION DEVICE	ACTUAL INSTALLATION VERIFIED?	MEETS CEC?

TABLE 11-8

UNDER WATER STRUCTURES – CPS POTENTIAL READINGS

FACILITY ELEMENT ID NUMBER	DESCRIPTION AND LOCATION	POTENTIAL READING (VOLTS)	PASS (P)/ FAIL (F) STD. –0.85 VOLT CRITERIA ($CUSO_4$) ?	REMARKS OR TEST OBSERVATIONS

TABLE 11-9
ATTACHMENTS*

ATTACH. NUMBER	AUDIT YEAR	REFERENCE TITLE	DESCRIPTION

*** For Section 3111F, this table is intended to chronologically log all MOTEMS Audit attachments starting from the Initial Audit. Attachments in previous audit reports shall remain listed, but need not be attached. If previous attachments are no longer valid, their status shall be indicated utilizing strikethrough text.**