Table 16.1—Recommended Minimum Extent of NDE Inspection

Case	Extent %	Method
Structural tubulars		
Longitudinal weld seam (L)	10 [a]	UT or RT
Circumferential weld seam (C)	100	UT or RT
Intersection of L and C	100	UT or RT
Tubular joints		
Major brace-to-chord welds	100	UT
Major brace-to-brace welds	100	UT
Misc. bracing		
Conductor guides	10 [a]	UT (or MT) [b]
Secondary bracing and subassemblies, that is, splash zone, and/or mudline secondary bracing, boat landings, etc.	10 [a]	UT (or MT) [b]
Attachment weld connecting secondary bracing/subassemblies to main members	100	UT or MT
Deck members		
All primary full penetration welds	100	UT or RT
All partial penetration welds	100	Visual [c]
All fillet welds	100	Visual [c]

[a] Partial inspection should be conducted as 10 %of each piece, not 100 % of 10 % of the number of pieces. Partial inspection should include a minimum of three segments randomly selected unless specific problems are known or suspected to exist. All suspect areas (e.g. areas of tack welds) shall be included in the areas to be inspected. If rejectable flaws are found from such 10 % inspection, additional inspection should be performed until the extent of rejects has been determined and the cause corrected.

[b] Depending upon design requirements and if specified in the plans and specifications MT may be an acceptable inspection method.

[c] May include MT and/or PT.

16.4.3.4.2 UT Quality

Three levels of weld quality are widely accepted:

a) Level A—workmanship quality,

b) Level C—experienced based fitness-for-purpose quality, and

c) Level F—specific fitness-for-purpose quality.

Detailed interpretation of these levels and UT reject criteria for each level should be in accordance with API 2X [10].

16.4.3.4.3 Weld Quality for NDE

For welds subjected to nondestructive testing by radiography or any method other than UT the weld quality requirements of AWS D1.1/D1.1M:2010, Clause 6.12.1 (nontubular static or tubular static/cyclic), as applicable, should apply, except as modified herein.

16.4.3.4.4 Weld Profiles

Weld profiles in simple tubular joints should be free of excessive convexity and should merge smoothly with the base metal both brace and chord in accordance with AWS D1.1/D1.1M:2010.

16.4.3.4.5 Relaxation of Rejection Criteria

For simple tubular joints, defects in the root area of the weld are less detrimental than elsewhere, as well as being more difficult to repair. Subject to specific guidelines provided by the designer, some relaxation of the above-mentioned reject criteria may be appropriate. Defects in backup welds, or root lands, that are not part of theoretical strength weld (minimum “T” in Figure 14.1) should not be cause for rejection.

16.4.4 Corrosion Protection Systems

16.4.4.1 General

Details regarding the inspection of corrosion protection systems should be in accordance with NACE SP0176-2007 [34] and NACE SP0108-2008 [35].

16.4.4.2 Coatings

Inspections should verify that surface preparation, climatic conditions (i.e. wind, temperature, and humidity), coating process, and materials are in compliance with specified requirements prior to application of coating. Where applicable, manufacturer’s instructions should be closely followed. During the coating process, inspection should be performed to verify the surface preparation, the thickness of each layer, and adherence of the coating to the base metal.

Repaired coating should be subjected to the same inspection requirements as the original coating.

16.4.4.3 Splash Zone Protection

Inspection should verify that splash zone protection (i.e. Monel wrap, fiberglass coatings, rubber sheathing, fusion bonded epoxy, etc.) is installed according to the specified requirements, including the manufacturer’s recommendations.

16.4.4.4 Cathodic Protection Systems

Inspection of the cathodic protection equipment, whether sacrificial anode or impressed current type, should be performed to confirm that it meets the specified requirements.

If included in the system, cabling, junction boxes, etc. should be inspected to ensure all components are properly attached and that electrical continuity is confirmed. Attachment of anodes (e.g. welding of anode standoff posts, doubler plates, impressed current anode sockets; installation of impressed current anodes into sockets) should be inspected to ensure compliance with the specified requirements.

16.4.5 Installation Aids and Appurtenances

16.4.5.1 Inspections should verify that all installation aids and appurtenances are installed and tested in accordance with the specified requirements, including manufacturer’s recommendations. Installation aids include the following:

— launch systems,

— flooding systems,

— grouting systems,

— mudmats,

— jetting systems,

— lugs and guides,

— monitoring systems,

— preinstalled piles and conductors.

Appurtenances include the following:

— boat landings,

— riser guards,

— risers and clamps,

— J-tubes,

— sump and pump caissons.

The location, size, and orientation should be checked, and weld attachments (including temporary restraints) should be subjected to 100 % NDE.

16.4.5.2 Inspections should include functional tests of all mechanical and electrical equipment and systems, including instrumentation. Cabling and instrumentation should be checked to ensure continuity and all hydraulic and pneumatic lines should be pressure tested.

16.4.5.3 All nonsteel components (i.e. diaphragms, packers, valve seats, etc.) should be protected from damage by weld spatter, debris and/or any other construction activities, and hydraulic lines should be thoroughly flushed and drained before and after testing. The inside of jacket legs, skirt piles, etc. should be inspected to ensure complete removal of debris (e.g. welding rods, misc. pieces of wood, steel) that could damage nonsteel components during installation.

16.5 Loadout, Seafastening, and Transportation Inspection

16.5.1 Inspection should be performed for all areas related to loadout, seafastening and transportation to confirm compliance with the specified requirements. Prior to loadout, final inspection of the structure should be conducted to ensure:

a) all components are in place;

b) all welds have been properly completed and inspected;

c) all temporary transportation/installation aids are included and secure;

d) all hydraulic and pneumatic lines have been properly installed, tested, flushed, and secured;

e) all temporary fabrication aids and debris have been removed; and

f) all temporary welded attachments have been removed and attachment marks repaired according to the specified requirements.

16.5.2 The support foundations, including the loadout pathway, the dock, the transport vessel, and the seabottom at dockside should be inspected to ensure compliance with the specified requirements.

16.5.3 Other areas for inspection include the lifting/pulling/pushing components attached to the structure (which require NDE) and those between the structure and lifting equipment (i.e. lifting slings, shackles, spreader beams). For vendor-supplied items, documentation shall be provided in addition to the inspections. The capacity and condition of loadout equipment should be confirmed by inspection and documentation.

16.5.4 For skidded loadouts inspection should be performed to confirm that the skidway and/or launch surface is clean and properly lubricated (if required) prior to loadout. The winches, jacks, and pulling cables should be inspected for proper capacity and condition.

16.5.5 Where ballast and deballast operations are required to compensate for tidal variations, inspection of the ballast system shall be carried out to confirm adequacy and equipment condition. Monitoring of the operation is also recommended, to ensure compliance with the loadout procedure.

16.5.6 Inspection for seafastening of the structure and all deck cargo is required to confirm compliance with the specified requirements. This includes temporary tie-downs and bracing required for transport. Materials, fabrication and weld inspection requirements shall be as per 16.4. Inspection for jacket launch items should be conducted where possible prior to sea transport.

16.5.7 Sea worthiness of tugs, towing attachments and the transport vessel should also be confirmed. For preparation of self-floaters for transport to the site, inspection should be performed to confirm sea worthiness and that all towing/restraining lines are properly attached.

16.6 Installation Inspection

16.6.1 Jacket Launch and Upending

Prior to launch, inspection should confirm that all tie-downs and temporary bracing are cut loose, and tow lines and loose items are removed from the launch barge or safely secured. Inspection shall be performed to confirm that the jacket flooding system is undamaged, flooding valves are closed, and the launching arm system is in the proper mode of operation. For lifted jackets, inspection should confirm removal of all restraints and proper attachment of lifting equipment, as well as the undamaged and properly configured operation mode of the flooding system. For self-floating jackets, inspection should confirm removal of tow lines as well as the undamaged and properly configured operation mode of the flooding system.

Inspection should be carried out after the jacket is secured in place. If inspection is necessary before then (i.e. suspected damage to flooding system), inspection should be limited to those items required to upend and secure the jacket.

16.6.2 Piling and Conductor Installation

16.6.2.1 All pile and conductor welds performed during fabrication should be inspected (as per 16.4) prior to loadout, including lifting devices, lugs, and attachments. During installation, inspection should be conducted to ensure that the correct pile make-up is followed, and that the welding of add-on sections (if applicable) is performed in accordance with the specified requirements.

16.6.2.2 Prior to each use, pile hammers should be inspected for proper hook-up and alignment for operation.

16.6.2.3 If vibration levels in the structure (above water) appear to be excessive during pile driving, the driving operation should be interrupted to inspect for possible fatigue damage in the structure.

16.6.2.4 During pile installation, nondestructive testing should be performed on the welded connections at pile add-ons; between pile and deck support members; between the pile and jacket leg; and elsewhere, to confirm compliance with the specified requirements. NDE inspection should be performed as noted in 16.4 with 100 % UT of all critical welds except the pile-to-shim weld. The pile-to-shim weld is particularly difficult to evaluate with UT. Alternatively, careful visual inspection of each pass should be made, followed by MT inspection of the final weld.

16.6.3 Superstructure Installation

Prior to lifting, inspection should be performed to confirm that tie-downs and other items not considered in the lifting design are removed from the superstructure. Proper rigging and connection of all lifting components should also be confirmed.

Immediately after lifting, inspection should be performed on all scaffolding and other temporary support systems to confirm their adequacy for completion of weld out. Materials, fabrication, and welding requirements shall be in accordance with 16.4. Inspection should be performed on the jacket and deck mating points to confirm proper alignment and fit-up and to ensure that weld preparations are as per specified requirements. Following weld out, inspection should be performed on the welded connections as noted in 16.6.2 and/or other specified requirements.

These inspections should be performed for each component of a multiple-lift superstructure, with inspection for alignment during each lift.

16.6.4 Underwater Inspection

In the event the installation requires underwater operations, the inspection should verify either by direct communications with divers or through the use of a remote monitoring device that the operation has been conducted in accordance with the specified requirements.

16.7 Inspection Documentation

16.7.1 General

During the fabrication, erection, loadout, and installation phases, data related to the inspection of the platform will be generated that may not be part of the welding (see 13.4); fabrication (see 14.5); or installation (see 15.1.2) records. Such inspection data should be recorded as the job progresses and compiled in a form suitable to be retained as a permanent record.

All documentation described in this section, should be retained on file for the life of the structure.

16.7.2 Fabrication Inspection Documentation

16.7.2.1 Materials and Fabrication Inspection

During the fabrication phase, material inspection documentation covering the mill certificates and material identification records (as described in 14.3), as well as any additional materials, testing, or special inspections that were conducted, should be prepared and assembled. This should include documentation for any inspection related to the assembly of the structure.

16.7.2.2 Weld Inspection

A set of structural drawings should be marked with an appropriate identification system detailing the location of each weld to be examined and referenced as an integral part of the inspection record. All welds should be uniquely identified and be traceable to the individual welder or weld operator. A report should be prepared for each examination performed, the details of which should be documented sufficiently to permit repetition of the examination at a later date. Sketches and drawings incorporating the weld identification system should be used to augment descriptions of the part and locations of all discontinuities required to be reported. Forms should be provided to show the required details of documentation, and sketches of typical weld configurations should also be provided to clarify the written description. Discontinuities required to be reported should be identified on sketches by the appropriate weld number and position.

16.7.2.3 Other Inspection

Inspection of all nonstructural systems and testing should be documented to confirm details of the inspection and results. Any deviations from the specified requirements should be properly recorded, including sketches if necessary.

16.7.3 Loadout, Seafastening, and Transportation Inspection Documentation

Inspection documentation for any special materials, testing and for all welding inspection performed in connection with the loadout, seafastening, and transportation phases should be recorded and retained as part of the inspection record. Any special documentation for inspection of vendor-supplied items (i.e. lifting slings) and reports for other areas affecting loadout (i.e. transport vessel, dock) that is not included in the installation plan or records described in Section 15 should also be recorded.

16.7.4 Installation Inspection Documentation

Inspection documentation for materials, testing, and welding inspection performed during the installation phase should be recorded and retained. Pile blow count versus depth and final pile penetration should be documented, and a continuous log of events, including climatic conditions (i.e. temperature, wind, barometric pressure, and humidity), sea states, operational activities, etc., should be retained.

17 Accidental Loading

17.1 General

17.1.1 Accidental loading events could lead to partial or total collapse of an offshore platform resulting in loss of life and/or environmental pollution. Considerations should be given in the design of the structure and in the layout and arrangement of the facilities and equipment to minimize the effects of these events.

17.1.2 Implementing preventive measures has historically been, and will continue to be, the most effective approach in minimizing the probability of occurrence of an event and the resultant consequences of the event. For procedures identifying significant events and for assessment of the effects of these events from a facility engineering standpoint, guidance for facility and equipment layouts can be found in API 75 [18], API 14G [16], API 14J [17], and other API 14-series documents.

17.1.3 The operator is responsible for overall safety of the platform and as such defines the issues to be considered (i.e. in mild environments the focus may be on preventive measures, fire containment, or evacuation rather than focusing on control systems). The structural engineer needs to work closely with a facility engineer experienced in performing hazard analyses as described in API 14J [17] and with the operator's safety management system as described in API 75 [18].

17.1.4 The probability of an event leading to a partial or total platform collapse occurring and the consequence resulting from such an event varies with platform type. In the U.S. Gulf of Mexico, considerations of preventive measures coupled with established infrastructure, open facilities and relatively benign environment have resulted in a good safety history. Detailed structural assessment should therefore not be necessary for typical U.S. Gulf of Mexico–type structures and environment.

17.1.5 An assessment process is presented in this section to:

— initially screen those platforms considered to be at low risk, thereby not requiring detailed structural assessment; and

— evaluate the structural performance of those platforms considered to be at high risk from a life safety and/or consequences of failure point of view, when subjected to fire, blast, and accidental loading events.

17.2 Assessment Process

17.2.1 General

The assessment process is intended to be a series of evaluations of specific events that could occur for the selected platform over its intended service life and service function(s).

The assessment process is detailed in Figure 17.1 and comprises a series of tasks to be performed by the engineer to identify platforms at significant risk from fire, blast, or accidental loading and to perform the structural assessment for those platforms.

The following assessment tasks should be read in conjunction with Figure 17.1 and Table 17.1.

Task 1—Assign a platform exposure category as defined in 4.7 (i.e. L-1, L-2, or L-3) for the selected platform.

Task 2—Assign risk levels L, M, or H to the probability (likelihood or frequency) of the event occurring, as defined in 17.4. for a given event.

Task 3—Determine the appropriate risk level for the selected platform and event from Table 17.1.

Task 4—Conduct further study or analyses to better define risk, consequence, and cost of mitigation. In some instances the higher risk may be deemed acceptable on the ALARP principle (i.e. as low as reasonably practicable), when the effort and/or expense of mitigation becomes disproportionate to the benefit.

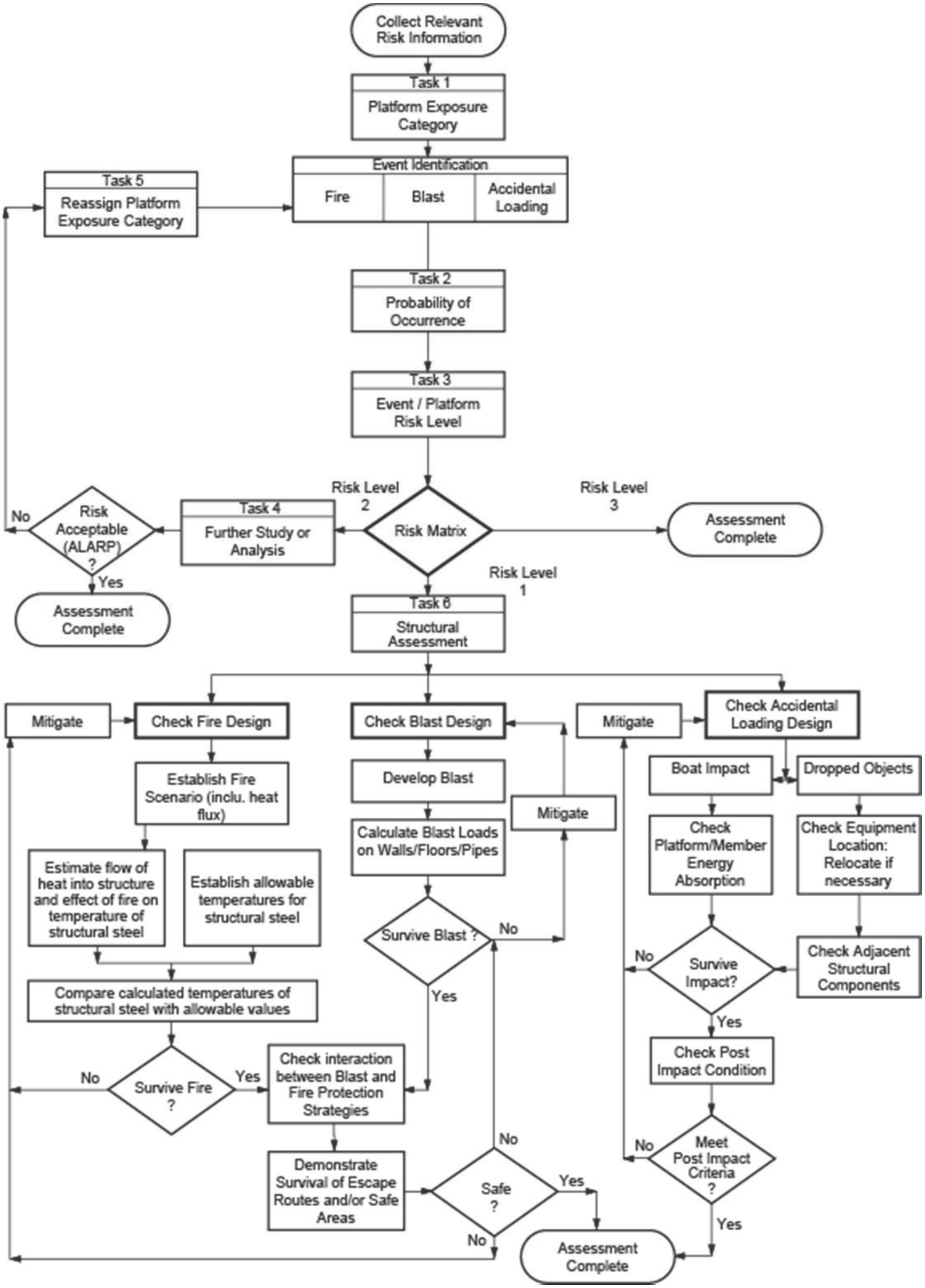

Figure 17.1—Assessment Process

Table 17.1—Platform Risk Matrix

Probability of Occurrence	Platform Exposure Category		
	L-1	L-2	L-3
H	Risk Level 1	Risk Level 1	Risk Level 2
M	Risk Level 1	Risk Level 2	Risk Level 3
L	Risk Level 2	Risk Level 3	Risk Level 3
NOTE See 4.7 and 17.5 for definitions of abbreviations.			

Task 5—If necessary, reassign a platform exposure category and/or mitigate the risk or the consequence of the event.

Task 6—Complete a detailed structural integrity assessment for fire (see 17.6), blast (see 17.7), or accidental loading (see 17.9) events for those platforms considered at high risk for a defined event.

17.2.2 Definitions

17.2.2.1
mitigation
The action taken to reduce the probability or consequences of an event to avoid the need for reassignment (i.e. provision of fire or blast walls to accommodation areas and/or escape routes).

17.2.2.2
reassignment
Requires some change in the platforms function to allow the reassignment of life safety (i.e. manned vs unmanned, and/or reassignment of consequence of failure level).

17.2.2.3
survival
For the purposes of Section 17, survival means demonstration that the escape routes and safe areas are maintained for a sufficient period of time to allow platform evacuation and emergency response procedure.

17.3 Platform Exposure Category

Platforms are categorized according to life safety and consequence of failure as defined in 4.7 (i.e. L-1, L-2, or L-3).

17.4 Probability of Occurrence

17.4.1 General

The probability of occurrence of a fire, blast, or accidental loading event is associated with the origin and escalation potential of the event. The type and presence of a hydrocarbon source can also be a factor in event initiation or event escalation. The significant events requiring consideration and their probability of occurrence levels (i.e. L, M, or H) are normally defined from a fire and blast process hazard analysis.

The factors affecting the origin of the event can be found in 17.4.2 through 17.4.8.

17.4.2 Equipment Type

The complexity, amount, and type of equipment are important. Separation and measurement equipment, pump and compression equipment, fired equipment, generator equipment, safety equipment, and their piping and valves should be considered.

17.4.3 Product Type

Product type (i.e. gas, condensate, light or heavy crude) should be considered.

17.4.4 Operations Type

The types of operations being conducted on the platform should be considered in evaluation of the probability of occurrence of an event. Operations can include drilling, production, resupply, and personnel transfer.

17.4.5 Production Operations

Production operations are those activities that take place after the successful completion of the wells. They include separation, treating, measurement, transportation to shore, operational monitoring, modifications of facilities, and maintenance. Simultaneous operations include two or more activities.

17.4.6 Deck Type

The potential of a platform deck to confine a vapor cloud is important. Whether a platform deck configuration is open or closed should be considered when evaluating the probability of an event occurring. Most platforms in mild environments such as the U.S. Gulf of Mexico are open allowing natural ventilation. Platform decks in northern or more severe climates (e.g. Alaska, the North Sea), are frequently enclosed, resulting in increased probability of containing and confining explosive vapors and high explosion overpressures. Equipment-generated turbulence on an open deck can also contribute to high explosion overpressures.

17.4.7 Structure Location

The proximity of the fixed offshore platform to shipping lanes can increase the potential for collision with non-oil-field related vessels.

17.4.8 Other

Other factors such as the frequency of resupply and the type and frequency of personnel training, etc. should be considered.

17.5 Risk Assessment

17.5.1 General

As indicated in Table 17.1, by using the exposure category levels assigned in 17.3 and the probability of occurrence levels developed in 17.4, fire, blast, and accidental loading scenarios may be assigned over all platform risk levels for an event as follows:

— Risk Level 1, significant risk that will likely require mitigation;

— Risk Level 2, risks requiring further study or analyses to better define risk, consequence, and cost of mitigation;

— Risk Level 3, insignificant or minimal risk that can be eliminated from further fire, blast, and accidental loading considerations.

In some instances, the higher risk may be deemed acceptable on the ALARP principle (i.e. as low as reasonably practicable) when the effort and/or expense of mitigation becomes disproportionate to the benefit.

17.5.2 Risk Matrix

The risk matrix shown in Table 17.1 is a 3 × 3 matrix that compares the probability of occurrence with the platform exposure category for a defined event.

The matrix provides an overall risk level as described in 17.5.1 for each identified event for a given platform. More detailed risk assessment techniques or methodology, as described in API 14J [17], may be used to determine the platform risk level. The overall risk level determines whether further assessment should be performed for the selected platform.

17.6 Fire

See API 2FB [3]for information on assessment of fire risk.

17.7 Blast

See API 2FB [3] for information on assessment of blast risk.

17.8 Fire and Blast Interaction

See API 2FB [3] for information on assessment of fire and blast interaction.

17.9 Accidental Loading

17.9.1 General

Fixed offshore platforms are subject to possible damage from:

— vessel collision during normal operations; and

— dropped objects during periods of construction, drilling, or resupply operations.

If the assessment process discussed in 17.2 identifies a significant risk from this type of loading, the effect on structural integrity of the platform should be assessed.

17.9.2 Vessel Collision

The platform should survive the initial collision and meet the postimpact criteria.

See B.17.9.2 for guidance on energy absorption techniques for vessel impact loading and recommendations for postimpact criteria and analyses.