HID Inspection Guide Offshore

Inspection of Temporary Refuge Integrity (TRI)

Contents

(Appendices 1 to 4 are performance assessment elements)

Summary

This guidance describes current key topic areas that inspectors should consider when they are inspecting offshore TR integrity management. It also sets out the success criteria against which duty holder performance will be rated for each of these elements. References are made to technical standards and other sources of guidance and information that inspectors should use to assess compliance with the law.

Introduction

The aim of this Inspection Guide (IG) is to provide information and guidance to offshore inspectors to support the delivery of consistent and effective offshore installations temporary refuge (TR) integrity management interventions. It does this by highlighting current key areas to be covered during inspections, providing a framework for inspectors to judge compliance, assign performance ratings, and decide what enforcement action to take should they find legislative breaches. In doing so, it complements HSE's Enforcement Policy Statement (EPS) and Enforcement Management Model (EMM).

This IG follows HSE's existing TRI inspection practice, which breaks the topic down into the four core-intervention issues described in the appendices. These are:

1. TR definition and description.
2. TR Integrity, survivability (duration) and impairment analysis, the identification of safety critical elements.
3. Identification, establishment and implementation TR SCE performance standards.
4. The TR integrity management process: maintenance, inspection and verification.

Action

Effective asset integrity management should be a priority for industry. A key objective for ED 3 Discipline Specialists is to ensure that the TR and associated safety critical equipment is designed, commissioned, operated, inspected and maintained to an appropriate standard.

ED 3.2 Specialist Inspectors will do this by:

- encouraging industry to take proactive steps to manage the integrity of safety critical assets such as TRs effectively;
- ensuring a targeted, proportionate and consistent programme of inspection agreed with offshore operators in their intervention plans;
- sharing lessons learned from investigations / inspections; and
- promoting the development and sharing of improved health and safety practices across the industry.

The inspection of TR integrity management should include examination of a broad range of activities. These include: TR design; commissioning; maintenance; inspection and demonstration of adequate integrity against impairment in relation to an installations Major Accident Hazard (MAH) consequence assessment; safe operating parameters; and the hardware/equipment and the wider management systems put in place by the duty holder.

Success criteria are listed under the inspection topics (see appendices); these cover the key issues that inspectors should consider when carrying-out inspections against each core intervention issue. In some instances, not all of the success criteria will apply so inspectors should make a judgement regarding which of these are relevant in each case. If the relevant success criteria cannot be met, inspectors should assess how serious the consequences of failure to comply could be. This will inform their decision making in terms of the performance ratings that they assign and the enforcement action they take (if any) based on the findings of the inspection.

This IG can also be used as a tool to help operators assess their own performance, for example by carrying out gap analyses against the success criteria listed or using them to identify safety performance indicators (SPIs) for TR integrity management.
This will enable operators to proactively identify and take steps to rectify any potential weaknesses in their arrangements for maintaining TR integrity.

When carrying out inspections covered by this guidance inspectors should:

- check the key issues against their success criteria in Appendices 1 to 4;
- use the generic performance descriptors in Appendix 7 and the worked example in Appendix 8 to:
  - determine the appropriate performance rating; and
  - the initial enforcement expectation to use alongside the EMM.
- consider how and when the issues raised during an inspection are to be closed out and recorded using the COIN issues tab;
- assess the extent to which senior management leadership influences front-line safety.
- where occupational health, safety and welfare concerns are encountered during an inspection, deal with such issues as a matter of routine and apply existing standards to determine what action to take in each case according to HSE's EPS and EMM.

Inspectors should use the HID generic performance descriptors to determine the appropriate performance rating for each of the four core intervention issues covered by this IG. The appendices also give guidance on the initial enforcement expectation and should be used alongside the Enforcement Management Model (EMM). The local factors that apply in each case will ultimately determine whether there should be any enforcement action. Consideration also needs to be given as to how and when the issues raised during an inspection should be closed out. Inspectors must adhere to the relevant operational guidance (e.g. on use of the COIN issues tab).

Background

Duty holders are required to ensure *all foreseeable* integrity threats (Major Accident Hazards) are identified and their potential for TR impairment assessed. From this assessment, suitable and sufficient performance standards should be established for the components systems identified as safety critical. These elements and systems require adequate maintenance and inspection to sustain the specified integrity. Otherwise, the TR may fail to provide the protection required, during a major incident to prevent significant loss of life. Duty holders should also demonstrate that the TR has sufficient integrity to ensure impairment is as low as reasonably practicable (ALARP). The level of unreasonable impairment (risk) is indicated in APOSC is greater than $1x10^{-3}$/yr. This value has been established as a surrogate for societal risk it therefore includes **all** events capable of preventing TR functionality within the established time required for its survival.

The fabric and systems that make up a TR require adequate attention during their design and installation. During their operational life, they are subject to a range of degradation mechanisms and change. Unless carefully managed and recorded, what is considered to be the TR will become increasingly unclear, particularly in terms of its ‘relevant boundaries’ and operational extent. The significance of this is that the TR is likely to fail to perform as required and may not provide the expected level of protection to its occupants against impairment from Major Accident Hazard (MAH) events as identified in the Operational Safety Case (Reg’12 or PFEER Reg’5 assessments).

Factors such as the severity and duration of hazard exposure and the TR’s resistance to impairment from such exposure are key issues[1]. The progressive deterioration of this resistance to impairment is referred to as 'ageing' and can be minimised by an adequate and appropriate integrity management program of test, inspection, maintenance, repair and replacement of relevant SCE’s.

A knowledge and understanding of TR integrity estimation is constantly evolving. At the same time, improved techniques to enable smoke, fume and noxious substance ingress to be estimated against the expected survivability are being developed. These are discussed later. One of HSE's important roles as a regulator is to ensure that duty holders harness this knowledge and make use of available technology and evaluation techniques to ensure ongoing control of risk to a level that is ALARP. In practice, this means that HSE expects duty holders to have arrangements in place to define and determine TR impairment resistance and then stay up-to-date with new techniques, technologies and systems and where appropriate to apply these to existing, as well as to new, temporary refuges.

1. See Offshore Information Sheets – 2/2006 & 3/2006: HSE Semi Permanent Circular “Indicative Human Vulnerability for use in Offshore Risk Assessment” and Appendix

TR Integrity Management

For all persons onboard an offshore installation, the consequences of poor TR integrity management can be catastrophic. This is therefore an obvious priority for HSE and duty holders.

Integrity management begins with design and construction: a primary activity is the establishment of appropriate design / operational performance standards. For example:

- **Porosity**- The external surface of a TR contains many penetrations, holes and leakage paths to the outside. As the wind impinges on any of the TR faces the differential pressure induced on the windward face produces a net influx of environmental gas into the TR such that the TR “breathes” as a result of this and the lower pressure produced on the leeward side. Porosity is normally described in terms of the TR ‘Air Change Rate’ (ACR), normally carried out under specific weather conditions, or ‘Equivalent Air Change Rate’ (AC/h_{eq}) which is determined by manipulating the air change rate recorded during an appropriate pressurisation test. TR’s are porous and they will leak!

- **Blast Resistance**: the highest over pressure that the TR can withstand before critical structural loss of integrity occurs (by calculation at the design phase).

- **Thermal Radiation Impairment**: Where possible this defines the maximum intensity of radiation that the TR can withstand before its structure or, more likely, internal temperature results in impairment before a specified period of exposure. This also includes the provision and maintenance of appropriate Passive Fire Protection (PFP) to internal or external surfaces of the TR to ensure adequate survivability. Note: insulation is typically fitted to the inside of TR for environmental and energy saving reasons. PFP is applied when a potential exposure to thermal radiation from MAH events, the type and application of such protection may be specific to the type of event (i.e. jet or pool fire) identified. Typically, heat transfer standards are defined by the fire resistance rating as detailed in the appropriate international standards (i.e. for "A", "H" and "J" rating thermal radiation resistance).

- **Internal effects impairment**: this includes events such as fire (heat and combustion products) and cumulative effects during a MAH such as heat rise, O2 depletion and CO2 intensification (See SPC 30 and its annex for more detail).

- **Other external events** that impair the TR without affecting the integrity of the installation such as structural degradation and failure may include: helicopter crash and/or non process fire; and vessel impacts at vulnerable locations that have sufficient energy to render the TR unfit to perform its primary function.

TR Impairment Frequency (TRIF) is the sum of all TR impairment event probabilities. This allows comparison with the surrogate societal risk criterion stated in APOSC.

TR Impairment through smoke, fume hazardous or noxious gas ingress
Following any MAH event, it is foreseeable that a "porous" TR is likely to be exposed to smoke, fumes and hazardous or noxious gases. Contaminated external air will mix with the air captured in the TR (from HVAC shutdown). Any contaminants carried with this air will begin to increase in concentration inside the TR as the two atmospheres gradually equilibrate. Eventually, the contaminants will reach the same concentrations inside and outside of the TR. It is assumed that once these contaminants reach equlibrium levels, persons inside the TR will become impaired. This could occur in less time that the stated endurance period.

The minimisation of TR impairment is dependant on the presence of adequate Safety Critical Elements (SCE's), including components and/or systems, that should be identified, evaluated, specified, inspected and maintained to ensure that they meet specific Performance Standards (PS's). Such systems include but are not limited to:

- **HVAC**: particularly:

    - All external Inlet, outlet and ductwork integrity.
    - All external fire damper / louvre closure effectiveness (including louvre seal condition and actuation systems (automatic and manually activated) – see HSE Information Note (I.N.) 1/2006.
    - Flammable/Toxic gas and smoke detection – see HSE I.N. 5/2008.

- ESD shut down effectiveness including overall response time; time from gas at HVAC inlet, to detection, notification (to emergency control), and effective emergency action completed.
- Confirmation of ESD action and notification of failure(s) to emergency control.
- Overall reliability (often described as probability of failure on demand).
- HVAC over pressurisation. Where over pressurisation is possible there is an increase propensity for door /frame and associated seal damage and reduced life span.

Other factors contribute to the overall porosity of the TR and these should be treated in a similar manner when present. These include, but are not limited to (and may or may not be present on an installation):

- External doors, seals and framework including “Air Lock” systems.

- Cable & pipe work penetrations.

- Waste water pipes and liquid seals.

- External windows and frames (external means external to the TR see below).

- External cladding/sheeting corrosion & degradation. Note: “external” means external to the TR - it does not always just apply to surfaces exposed to the environment. Where the TR is separated from other areas of an installation, it is essential to ensure adequate materials and standards of sealing are employed: decorative or internal panels may be unsuitable for this purpose. For example, a TR can be separated from utility systems sharing the same overall structure; as in an FPSO where the engine room and power generation may be part of the superstructure. In such circumstances, a DH should ensure the TR is protected against impairment from any events that could occur in such locations. Historical records would indicate that engine room and generator engine fires are foreseeable.

Other systems also contribute to smoke & fume impairment detection, prevention and mitigation from external & internal events and include:

- Automatic fire detection and suppression systems.

- Smoke & gas detection at access/egress points, muster areas and emergency control centre(s).

- Fire fighting equipment (dry risers, hoses and portable FFE).

- TR Oxygen generation / supply or CO_2 scrubbers (not typical at present on the UKCS).

- Electrical equipment condition checks.

- Control systems to prevent the presence of flammable or combustible materials (as an alternative to fire suppression systems).

Note: use of the fire-teams as an alternative to any of the above is considered a lowering of safety standards and contrary to the hierarchy of risk control and therefore, not acceptable.

TR design compliance and the identification and assessment of integrity management arrangements

The design of the TR (and any modifications to it) must be appropriate for its use. The design specification should take into account the operating regime for the TR, the conditions under which it is required to function and the environmental extremes to which it will be exposed.

TR design is the starting point for establishing effective arrangements for ongoing inspection, testing and maintenance activities. For example, maintaining the integrity and demonstrating the fitness for service of a TR that is not designed with an appropriate ACR blast resistance or PFP requirement can be a significant challenge. If fitness for service cannot be assured, the TR cannot be deemed appropriate. Whilst these design considerations may not have been considered in the past, design specifications that required a TR to meet a specific equivalent air change rate is provided in I.N. 2006 and should be encouraged.

Another key design consideration is the TR's survival time and related safety features (SCE's) e.g. those provided to prevent impairment of its occupants. Typically, a TR will not be designed to provide ABSOLUTE protection to its occupants, as low probability / high hazard events may result in TR impairment within the specified survival time.

Relevant Legislation

- **Health & Safety At Work etc Act 1974** This is the primary piece of legislation covering work-related health & safety in the UK.

- **The Management of Health & Safety at Work Regulations 1999** These set out broad general duties that apply to most work activities. They require employers to assess the risks to employees posed by all work activities to enable the provision of preventative and protective measures.

- **The Offshore Installations and Wells (Design and Construction etc) Regulations 1996** places goal-setting duties on installation owners and operators to ensure the integrity of an installation throughout its lifecycle.

- **The Offshore Installations (Safety Case) Regulations 2005** (SCR05) create a range of duties on duty holders, many of which relate directly TR integrity, survivability and impairment evaluation and estimation.

- **The Prevention of Fire, Explosion and Emergency Response Regulations 1995** (PFEER) creates additional duties and of these, the following are key requirements, which have been the subject of HSE enforcement activity or where failure to comply has been a significant factor in the loss of the required TR integrity.
  - **Regulations 4** places a general duty on a duty holder to take appropriate measures with a view to protecting persons on the installation from fire and explosion; securing effective emergency response.
  - **Regulation 5** requires an assessment to enable the adequate performance standards for the TR to be established for protecting persons in the event of fire or explosion.
  - **Regulation 13** requires the TR to appropriately protect persons during a MAH (fire/explosion) and remain effective during such an emergency.
  - **Regulation 19** requires the TR to be adequate for purpose (link with DCR) and be maintained in an efficient state, efficient working order and in good repair.

- **The Provision and Use of Work Equipment Regulations 1998** (PUWER) **Regulation 6** imposes duties relating to the inspection of work equipment (including HVAC systems) and maintaining records of these inspections.

- **The Supply of Machinery (Safety) Regulations 2008** places duties on machinery suppliers and manufacturers to ensure that all new machinery placed on the market or put into service is safe. This includes second hand machinery which is new to the European market (imported from outside the EEA and put in service in Europe for the first time.

Organisation

Targeting

Inspections should be carried-out in accordance with ED duty holder intervention plans.

Timing

Inspectors should undertake TR inspections as part of the agreed ED Offshore Intervention Plan; when intelligence indicates intervention is necessary, or as part of an investigation following an incident.

Resources

Resource for the undertaking of TRI interventions will be agreed as part of the ED Offshore Work Plan or by agreement between discipline specialist team-leaders and inspection management team-leaders, as appropriate.

Recording & Reporting

The duty holder performance ratings should be entered on the Inspection Rating Form (IRF) tab of the relevant installation Intervention Plan Service Order. Findings should be recorded in the normal post inspection report and letter.

Further References

Links required for:

1. http://www.hse.gov.uk/offshore/assessment.htm

    I. I.N. 1/2006 (re-issue due 2014)
    II. I.N. 5/2008
    III. HSE RR997 – Modelling smoke and gas ingress into offshore temporary refuges.
    IV. OIS 2/2006
    V. OIS 3/2006

2. "Guidance on Integrity Testing for Offshore Installation Temporary Refuges". Energy Institute Guidance Note, ISBN 085293 644 3 (awaiting publication)[1,2&3].
3. SPC/tech/osd/30: "Indicative human vulnerability of the hazardous agents present offshore for application in risk assessment of major accidents" (and the supporting document)
4. Fire test standards (e.g. ISO Standard (Jet-fire) 22899; Parts 1&2)

Contacts

ED Offshore: ED 3.2 Specialist inspectors

Notes:

1. The impairment assessment does not differentiate between infiltration (through " large" gaps) and permeability (through "small" gaps) as this may be difficult to delineate and in practice, could not be measured. So from the point of a testing methodology it's probably not important.
2. LBL methods are all designed for onshore facilities where a degree of leakage is required to maintain air quality. So all the assumptions work in the opposite direction to offshore environments – i.e. either a 1/4 or 1/20th rule gives a low value of air leakage rate. This is conservative if you want air leakage (for good air quality) onshore; but non-conservative if you want air tightness (for personnel protection) offshore.
3. The "air tightness" value is an indicator only, and is not intended to be used in further calculations. For such purposes the single, simple measurement is considered appropriate: usually air changes at 50 Pascals. Such a simple test is sufficient to assure that the fabric of the envelope is "tight" (e.g. below the required air changes at 50 Pa). However, a more detailed approach is required to determine TR impairment potential.

Appendices

- Appendix 1: TR Design compliance and the identification and assessment of integrity management arrangements.
- Appendix 2: TR Safety Management System (SMS).
- Appendix 3: Implementation and maintenance of the TR management process.
- Appendix 4: Emergency Planning and Preparedness.
- Appendix 5: Inspection Issues.
- Appendix 6: Performance assessment criteria.
- Appendix 7: Performance indicators.
- Appendix 8: Example of performance rating.

Appendix 1: TR Design

It is not always possible to design and maintain a TR such that absolute integrity can be achieved. HSE has suggested a maximum TR impairment frequency (TRIF) of $1x10^{-3}$/yr (one in a thousand chances per year – see APOSC). However, this value relates to the sum of ALL events that can result in TR impairment on an installation as it intended as a surrogate societal risk criterion. Typically, the "types" or "groups" of MAH that could defeat TR integrity may include (but not limited to):

- Hydrocarbon event from topside (including pipe work on bridges);
- Hydrocarbon event for a well;
- Hydrocarbon event from a riser;
- Hydrocarbon event from a subsea pipeline within 500m of the installation;
- Non process fire at any location on the installation;
- Non process hydrocarbon or flammable material event;
- Severe weather including storm, wave, snow & extremes of temperature;
- Aircraft impact;
- Dropped or swinging load / object Ship Impact;
- Earthquake, subsidence or seabed scour;
- Attendant installation collapse; and
- Structural failure due to Fatigue/Corrosion or other causes.

The TRIF is likely to be comprised of a large spectrum of MAH events. Therefore, it is considered reasonable to recommend that each of the combining MAH "groups" should provide a much lower contribution to this overall value for the MAH profile and consequences for a specific installation.

Regarding the composition of the overall TRIF, it is recommended that each MAH "group" contribute an impairment probability of **no more than** an order of magnitude less than the overall TRIF impairment criterion (i.e.$1x10^{-4}$/yr). For individual MAH scenarios in each group the contribution to the overall TRIF should be significantly less. Where these conditions are not satisfied, a sufficiently detailed justification for exceeding these values should be available for scrutiny.

The MAH profile and its consequences to the TR require careful consideration for integrity challenging events such as blast, pool/jet fire, smoke (i.e. from pool fires), flammable clouds (from both process and non-process loss of containment events) and toxic/noxious gas (i.e. H2S, CO, CO2, NO_x or SO_2). TR's close to such events may require design enhancements such as increased PFP, blast resistance or minimal ACR on shut-in to ensure the required survivability (endurance time and impairment frequency). Where catastrophe is possible and uncertainty prevails the principle of safety-by-distance should be given detailed consideration against the application of a range of high specification SCE's to the TR that are likely to impose significant efforts to ensure their effectiveness.

Safe-by-distance measures are intended to provide the necessary separation from MAH events and include consideration of the provision of a TR/Accommodation on a separate platform bridge-linked to production and /or wells jackets.

In order to obtain an appropriate survivability, TR integrity should increase as hazard exposure potential and severity increase. TRs that can only foreseeably be exposed to low levels of harm, may be designed, operated and maintained to lower standards than TRs with a high risk of exposure.

Whilst the ACR's values described in I.N 1/2006 are reasonably achievable within the industry, they are best considered as a means to demonstrate that the TR achieves a reasonably low level of porosity in "shut-in" mode (i.e. all the penetrations are sealed, the doors and windows fit and there are no gaping holes in the walls). Therefore, such a pressurisation test is considered as suitable and necessary commissioning test, a means of periodic condition assessment and degradation trending and a validation test after any significant change. It does not prove TR survivability and endurance against **all** the MAH's it is to be exposed to. Depending on the hazard profile of an installation such an air change rate can be greater, less than or in the region of the value needed. This will be determined and demonstrated by the TR integrity assessment.

Success criteria:

- TR is designed to an appropriate survivability with all relevant SCE's identified and defined (doors, door frames/seals closure & locking devices, windows, penetrations/glands, water seals, external iso-surface, etc.), HVAC, detection systems (fire, gas, smoke & fume) ESD and information to MMC's.
- TR is designed for inherent integrity e.g. suitably selected separation from MAHs, appropriate materials and methods of construction.
- TR integrity assessment is available that includes establishment and use of actual ACR, blast resistance, PFP requirements and HVAC performance.
- Design of TR incorporates suitable integrity management for **all** SCE's.
- Design allows TR and all associated equipment to be adequately maintained, inspected (including **all** HVAC perimeter dampers/louvers and their associated driving mechanisms – mechanical, electro-mechanical, pneumatic) and tested to current industry good practice; See HSE I.N. 1/2006.
- Where applicable, appropriate reassessment of TR integrity has been undertaken in response to any change in the hazard profile of the installation.
    - Reaffirmation of ACR to demonstrate continued fitness for purpose at appropriate time intervals.

Appendix 2: TR Safety Management System (SMS)

For TRs, the relevant statutory provisions requires that all major accident risks have been evaluated and measures have been, or will be, taken to control those risks.

The TR SMS needs to consider the interfaces between design, construction, operation and maintenance. Key elements of the SMS are leadership, commitment, accountability and competence. Both adequate organisation and sufficient resource are necessary to implement the operator's policy with respect to the effective control of major accident hazards.

The duty holder must demonstrate that the TR SMS is adequate. Verification that this requirement is being met is an important element of HSE's regulatory approach.
Success criteria (for ease of reference these are subdivided under the headings 'Plan-Do-Check-Act' used in many business management system models)

- **Plan**:
  Effective leadership and commitment to continuous improvement is required in the management of major hazard risks influencing TR integrity.

  Up to date TR integrity assessment that identifies risks control measures and describes arrangements, behaviours and systems that exist in practice.

  Organisational responsibilities documented e.g. via an organogram.
  People with key responsibilities in the SMS understand their role and are resourced to carry it out effectively.

  A suitable Competency management system should be in place.

  There should be effective communication and co-operation at Technical Authority interfaces.

  Ownership and responsibilities for all TR SCE's should be clearly understood and documented. It is particularly important that the SCE's are "owned" by someone competent in that element or system and not the default managing discipline.

  Arrangements should be in place to ensure that TR integrity can be demonstrated at all stage of an installation's life cycle (described elsewhere in this document).

  Suitable and sufficient arrangements should be in place to manage control room activities relating to TR integrity performance during an emergency.

- **Do:**

TR should be operated to an appropriate integrity level.

Procedures should exist for verification, maintenance and inspection of the TR as a safety critical system comprising of interdependent SCEs, management of change and modifications; non-routine operations.

Human factors should be considered and steps taken to minimise the risk of human failure.

- **Check:**
  SMS includes process to test and review the performance of the management system and keep senior management informed regarding safety performance, e.g. via KPIs.

  SCE performance failures investigated, lessons learned and shared within organisations and with other industry groups e.g. OGUK, Step Change etc as appropriate.

  A programme of SMS audits should be undertaken.

- **Act:**
  Audit findings, KPI data and other information regarding safety performance reported to a senior level and acted upon.

Appendix 3: Implementation and maintenance of the TR management process

This issue concerns the ongoing routines, processes and procedures that need to be in place to ensure TR integrity. A range of equipment, instruments, devices and techniques have been developed for the establishment of performance, operation, inspection, testing and maintenance of a TR. Inspectors will expect duty holders to consider and, where appropriate, utilise improved techniques and technologies (i.e. boroscopic examination of external boundary dampers).

Lack of initial and subsequent ACR estimation, ageing and poor specification, design, commissioning, inspection, maintenance and SCE identification continue to risk the integrity of TRs. Inspectors should expect operators to take steps to minimise the risk of such factors.

Success criteria:

- Periodic ACR testing should confirm that the maintenance regime is effective but this should not be used as a diagnostic tool to find faults. Failure of a TR leakage test is confirmation that the maintenance regime has failed. Proactive monitoring should be established to allow performance trending of the TR HVAC and general TR condition. TR pressure devices should be installed and pressurisation values monitored, recorded and assessed to indicate loss of performance. It may also be pertinent to note the ‘initial’ position of the pressure control damper or pressure relief damper. If either is adjusted to maintain the desired positive pressurisation, a possible increase in ACR or loss of HVAC performance should be investigated. A properly maintained TR should typically pass a leakage test. A suitable condition-based inspection and maintenance programme should be in place showing that the number of defects found is not generally increasing.

    - TR maintenance and inspection includes measures to identify, quantify, evaluate and prevent potential degradation due to ageing.

    - SCE’s are clearly and adequately identified.

    - Appropriate SCE performance standards in place.

    - Maintenance and inspection routines established.

    - Maintenance and inspection records available and analysed.

- **Ageing management:**
  Degradation management programmes should be in place with suitable monitoring and review, e.g. taking into consideration: TR Porosity (i.e. ACR testing) door/door & window seal degradation, penetration and seal inspection/maintenance, external surface condition monitoring, drain seal maintenance, HVAC damper and ESD systems test and maintenance etc.

Performance of all SCE’s (i.e. HVAC ESD) should be monitored, levels of protection maintained to an appropriate standard and prompt remedial action (including deviation assessment) taken where problems identified e.g. where time to damper closure are found to be outside SCE PS requirements.

Condition management arrangements should cover PFP and structural elements condition, with clear deviation assessment, categorisation and action criteria.

- **Inspection**

If HSE Information Notes and other relevant guidance (i.e. ACR estimation) is not used, alternative arrangements should be in place to achieve equivalent standards of performance.

Where established performance standards are not being achieved, a detailed justification is required to demonstrate the adequacy of the TR integrity. For example, the I.N.1/2006 (equivalent) ACR of 0.35 AC/Hr for existing TRs and 0.25 for new builds are intended as “commissioning” values. There should be periodic activity to demonstrate that the condition of the TR “external iso-surface” (including the fabric and all penetrations) is of a reasonable standard.

The proximity and nature of hazards impinging on a TR, and its required endurance time, should determine the level of porosity that should not be exceeded to provide an acceptable endurance time and potential impairment frequency. The duty holder must demonstrate the actual porosity (as determined by appropriate testing) is adequate by a TR integrity assessment.

Maintenance and inspection deviation records for all relevant SCEs should feed into remedial action plans with appropriate priority assigned. Progress on close-out of deviations should be monitored, regularly reviewed and re-prioritised as appropriate.

- **Testing**

TR, ESD and detection/status information systems should be inspected and tested at appropriate intervals. Test data should be recorded to enable performance trending and planned intervention before PS failure. Data should be easy to extract and evaluate.

TR porosity testing should be carried-out approximately every two years (CBM can be applied here), or after significant change, once the initial “commissioning bench mark” test has been performed.

Internal fire detection/response/mitigation prevention systems should be tested and inspected to an appropriate regime.

- **Damage prevention - TR SCE's**

  Effective integrity and damage assessment and appraisal process in line with industry good practice:

  - TR SCEs should be protected from fire, impact and explosion.
  - Redundancy and survivability.
  - Common mode failures should be addressed and prevented.
  - Inlet/outlet ductwork and dampers should be protected from corrosion, erosion and impact damage.
  - Damage to detectors, door-frames and seals, windows etc should be assessed and adequately controlled.

- **Other**

  Risk assessments carried-out in relation to areas of non-compliance with current TR standards, e.g. high consequence areas, and any necessary special precautions (e.g. more frequent monitoring) should be implemented.

  Key operating parameters (e.g. TR HVAC positive pressurisation, ACR and ESD S/D) should be monitored, logged and acted upon, where appropriate.

  There should be a coherent and ongoing mechanism for ensuring effective oversight and decision making in relation to the integrity management arrangements (e.g. reaffirmation of impairment assessment using actual ACR).

Appendix 4: Emergency Planning and Preparedness

MAH incidents can be very serious and warrant a carefully planned and rehearsed emergency response. To this end, the installation OIM must be aware of the time to impairment of a TR in a particular MAH scenario, to ensure realistic timescales are applied to the need for evacuation and escape based upon a realistic TR survivability for a particular circumstance. Planning for emergencies following MAHs is an explicit requirement of PFEER.

It is essential that the relationship between the TR survival time and the time it takes to effect appropriate emergency actions for complete evacuation or escape are commensurate. Where actual times taken to carry out the activities exceed the TR survival time the emergency plan should enable early identification of such circumstances to enable instruction and use of secondary or tertiary means of evacuation or escape. In order to enable this, the duty holder should ensure the TR is capable of meeting its overall survivability performance standard. MAH events that are likely to impair the TR in less than the specified endurance period should be clearly identified in the emergency response plan.

PFEER requires that duty holders prepare adequate equipment, plant, processes and procedures for dealing with the prevention and consequences of a major accident. Procedures should cover issues such as; monitoring, controlling, mitigating and planning for evacuation and ultimately escape, as necessary. The duty holder must ensure that any individuals with emergency response roles are suitably prepared for a real emergency. The emergency procedures should be reviewed and if necessary, revised in the light of any lessons learned from drills or exercises.

Success criteria:

- Adequate emergency arrangements in place.
- MAH emergency plans and procedures tested, reviewed and revised periodically and in the light of lessons learned from tests.
- Competence of key personnel in emergency procedures is assured e.g. via emergency response course.
- Adequate consideration of emergency response in control room design e.g. TR HVAC damper status and TR atmospheric condition status (flammable/toxic gas build up, temperature and Oxygen concentration).
- Installation personnel carry out checks on the effectiveness of emergency shutdown procedures, including operation and testing of external door closure and HVAC shut down.
- Effective control room interface and communications between offshore personnel.

- The OIM is aware of the integrity of the TR, its survivability and those MAH events that are likely to impair the TR in less than its established survival time.

Appendix 5: Inspection Issues

Key Areas		Notes
Issue	**Key Matters**	
TR Design	Is there sufficient information to demonstrate the TR has been adequately designed, constructed and commissioned in relation to its MAH performance?	The TR design should be based on the MAH profile of the installation (for production units) or the limits of its protective envelope (for installations such as MODU's, Flotels and attendant vessels defined as "installations"). Any variation in a MAH profile that increases risk to persons should be subject to an appropriate assessment and identification of required RRM's. ED Offshore's policy on risk criteria is fully described in **OIS2/2006**.
TR Integrity Assessment	Has a TR integrity assessment been carried out? Is it up to date and available?	It is essential that responsibility for the TR, its function and condition is allocated to a person of adequate technical expertise, typically a Technical Authority or high level of responsibility within an organisation.
	Does the assessment fully address all identified MAH scenarios that have the potential to impact on TR integrity?	
	Has TR impairment been measured against a set of appropriate harm criteria (i.e. that provided in SPC30 or an equivalent)?	
	Has the duty holder defined a TR survival time? Is this realistic to enable occupants to monitor, control, mitigate or plan for evacuation and escape during a MAH?	
	Do all individual MAH's with the potential to impair the TR within its defined survival time have an estimated frequency of less than $1x10^{-4}$/yr? Is the overall TRIF less than $1x10^{-3}$/yr?	
	What is the equivalent ACR used to establish and demonstrate the adequacy of the TR against impairment; and has the actual ACR been determined and demonstrate to be at least this value?	
TR Performance	Have performance standards for the TR (and all associated SCEs) been identified and clearly established?	

	Are performance details: operating parameters (i.e. flow rate, closure time, detection speed, leakage rate, etc), reliability and availability values clearly identified and included in the performance standards?	
	Do the associated PMR's adequately underpin these performance standards and are key-data recorded, reported analysed and trended?	
	Are maintenance technicians sufficiently aware of the function of all SCE's and their relationship/importance to the performance of the TR as a system, to provide its required performance?	
TR Condition	Does the TR integrity, detection, mitigation and HVAC system(s) appear in a reasonable condition and fully functional?	This evaluation should also include internal systems such as smoke, fire & toxic fume detectors, isolation systems (i.e. Galley shutters) and sprinkler systems/fire reels.
	Is there an effective inspection regime in place for the TR external surface? Does an Offshore Inspection Engineer or equivalent administer this?	
TR pressurisation	If the TR is required to remain pressurised, are pressure indicators suitably located, available and operating?	Where a TR is not required to be pressurised an adequate ACR, linked to the TR impairment assessment is defined and demonstrated though an initial "porosity commission" test and subsequent revalidation at appropriate intervals.
Supervision (Technical Authorities or equivalent)	Do Supervisors have the necessary technical competence, interpersonal skills and diligence to ensure that procedures are followed correctly and to challenge performance standard failure(s)?	
	Is the frequency of visits proportionate to the risk? Are arrangements in place to cover supervisor absences? Does the general TR condition provide evidence of effective supervision?	

Appendix 6: Performance assessment criteria

EMM RISK GAP					
EXTREME	SUBSTANTIAL	MODERATE	NOMINAL	NONE	NONE
TOPIC PERFORMANCE SCORE					
60	50	40	30	20	10
Unacceptable	**Very Poor**	**Poor**	**Broadly Compliant**	**Fully Compliant**	**Exemplary**
Unacceptably far below relevant minimum legal requirements. Most success criteria are not met. Degree of non-compliance extreme and widespread. Failure to recognise issues, their significance, and to demonstrate adequate commitment to take remedial action.	Substantially below the relevant minimum legal requirements. Many success criteria are not fully met. Degree of non-compliance substantial. Failures not recognised, with limited commitment to take remedial action.	Significantly below the relevant minimum legal requirements. Several success criteria are not fully met. Degree of non-compliance significant. Limited recognition of the essential relevant components of effective health and safety management, but demonstrate commitment to take remedial action	Meets most of the relevant minimum legal requirements. Most success criteria are fully met. Degree of non-compliance minor and easily remedied. Management recognise essential relevant components of effective health and safety management, and commitment to improve standards.	Meets the relevant minimum legal requirements. All success criteria are fully met. Management competent and able to demonstrate adequate identification of the principal risks, implementation of the necessary control measures, confirmation that these are used effectively; and subject to review.	Exceeds the relevant minimal legal requirements. All success criteria are fully met. Management competent, enthusiastic, and proactive in devising and implementing effective safety management system to 'good practice' or above standard. Actively seek to further improve standards.
EMM INITIAL ENFORCEMENT EXPECTATION					
Prosecution / Enforcement Notice.	Enforcement Notice / Letter.	Enforcement Notice / Letter.	Letter / Verbal warning.	None.	None.

The following descriptors may be used to assist in determining the appropriate score for the duty holder.

a) **Unacceptable** - There is no system in place for demonstrating or managing TR Integrity or there is a significant impact of degraded Safety critical elements on TR integrity.

b) **Very Poor**- There is a system for managing degraded safety critical elements but either this has not been implemented or the outputs are such that the system is largely ineffective in maintaining SCE performance. TR integrity demonstration is available but is based on excessively optimistic claims of hazard intensity or TR performance (i.e. a lower than actual ACR) measures. SCE performance data is not recorded.

c) **Poor**- There is a system in place for managing and demonstrating TR integrity and this is being followed however, there are numerous examples where the system has not resulted in the implementation of effective control measures to ensure adequate SCE performance. SCE performance data is reported but not adequately assessed.

d) **Broadly Compliant**- There is a system in place, it has been fully implemented and used most issues considered have resulted in appropriate precautions being implemented. SCE performance data is recorded but not analysed.

e) **Fully Compliant**- There is a system that has been fully implemented and is effective in identifying appropriate control measures for all issues.

f) **Exemplary**- Meets the fully compliant standard but with evidence of class leading achievements.

Appendix 7: Performance Indicators

Core intervention issue	Description of topic on IRF rating tab
TR design & design compliance, the identification, assessment and definition of integrity requirements and management arrangements for, Blast resistance, PFP, ACR, TRIF, HVAC ESD penetrations & seals external iso-surface. Establishment of a fit for purpose TR design, construction and commissioning	TR Design
TR safety management system (SMS): SCE identification, performance standard establishment, maintenance, test and inspection regimes	TR SMS
Implementation of the TR integrity management process: development and implementation of Planned Maintenance Routines (PMR's), inspection, test and delivery of effective SCE management	TR Integrity Management
Emergency planning and preparedness, by provision of an effective TR enabling the provision of a safe haven with sufficient information to effectively, Monitor, control, mitigate, plan for evacuation and escape in the event of a MAH	Emergency Response

Appendix 8: Example of performance rating

At a TR inspection several of the following concerns are identified:

a) Poor condition of external fabric: doors, windows, penetrations and seals/glands, corroded, buckling damaged and dis-bonding sheeting/cladding (including PFP).

b) Doors external to the TR (but not necessarily external to the accommodation) non-aligned, or failing to self-close. Doors or windows (including frames) buckled, seals damaged or ineffective.

c) Badly corroded HVAC ductwork external to the TR.

d) Lack of inspection hatches / boroscope ports to internally inspect the TR perimeter dampers/louvers (F&G dampers) condition or closure on ESD.

e) Lack of provision to observe/inspect/maintain perimeter dampers/louvers (F&G dampers) actuating mechanisms.

f) Limited or no positive perimeter dampers/louvers (F&G dampers) status information (open, closed or failed to close) provided at the emergency control centre.

g) Lack of Gas/Smoke/Toxics detectors in the HVAC inlet or present but not compliant with I.N. 5/2008.

h) Cable or pipe penetration glands missing or of inadequate specification or condition.

i) HVAC inlets (and exhausts) located close to process plant or turbine exhausts.

j) Process plant (and pipelines) close to the TR.

k) HVAC fire dampers located in fire rated walls (H or J ratings).

l) Lack of appropriately defined Performance Standards for the TR and all the above SCE's.

m) Inadequate maintenance and performance test data for HVAC ESD (lack of I.N. 1/2006 compliance).

n) No evaluation of TR ACR or failure to achieve 0.35 AC/hr (ac/h_{eq}) (or 0.25 AC/Hr (ac/h_{eq}) for new builds).

o) Excessive survival time (in excess of 90 minutes) claimed (from Safety Case).

p) Low ACR (0.5 AC/Hr or less) used in the SC TR impairment assessment without the actual, determined by test value defined and used.

q) High hazard ratings on the installation (from Hydrocarbon types (oil, gas & condensate and inventories – including pipelines, if appropriate.

r) Waste water seals not identified for maintenance – particularly for unoccupied areas where waste water facilities are present.

s) Communication between the TR and non TR areas through roof/floor voids, ventilation duct work or unsealed decorative separation panels.

t) HVAC ESD test failure by way of any, failure to detect, alarm, command shut down, respond to command, complete shut down actions fully, report shut down activity compliance and system conditions (i.e. confirm fans stopped dampers positive indication on closure.

u) Complete ESD functions on loss of power and remain in ESD state upon on any power restart - including those planned such as power loss followed by emergency supply provision, this should not allow SD systems to re-latch to the energised state.

The rating expectations are:

a) If the TR Design demonstrates many significant failings this may indicate a risk gap of at least "moderate" or potentially "extreme". An appropriate rating should be entered based on this intervention only.

b) For a given MAH event there is likely to be a significant affect on the TR occupants. The scale and probability of the TR impairment can be due to the deficiencies of the installation **Safety Management System**. As such, a rating of at least "Moderate" should be attributed to the issue due to the lack of adequate performance standards and SCE identification.

c) The **TR maintenance system** is ineffective even for those SCE's identified, requiring an entry of at least "moderate" against the maintenance issue as a matter that has a demonstrated a failure to maintain the TR adequately.

d) With little or no TR integrity status/ condition reporting and an inadequately specified and maintained TR it is unlikely that the TR will meet is availability performance standards such that the survival estimate will be significantly less for the significant MAH's and is likely to be impaired by a grater number of them. As such the **provisions for monitor, control, mitigate, plan for evacuation and escape in the event of a MAH** are likely to be inadequate and, again, an entry of at least "moderate" is required.

In determining the required level of intervention it is necessary to determine the relevance of the MAH profile current activities on the installation (i.e. the potential "Damage Force") and evaluate this against the estimated level of protection provided by the TR either as designed and as found at the time of inspection (the "damage resistance).

TR integrity due to the absence of relevant hazards but these are likely to occur in the future, such as drilling activities past shallow gas but yet to enter in to hydrocarbon containing strata, enforcement should prevent such activities until the risk gap has been adequately addressed.

Where it is obvious the TR has serious integrity deficiencies then immediate action will be required and prohibition of activities presenting MAH potential that would impair the TR and its occupants. Where immediate prohibition is undesirable, due to the need to safely halt such activities, a combination of hazard/risk reduction (pressure / inventory reduction) and consequence reduction (such as down manning) should be taken.

When further investigation/information/assessment is required to determine appropriate action, Discipline Specialist assistance should be sought at the earliest available opportunity preferably during the inspection, or soon after.

If key information or compliance with established standards, guidance or industry good practice is lacking then suitable enforcement is advised.

In all cases, if contractors are involved, these matters may justify a further intervention or rating under the Selection and Management of Contractors IRF line in COIN.