HSE

Health and Safety
Executive

External corrosion management

Inspection project

A report by the Offshore Division of
HSE's Hazardous Installations Directorate

Contents

Preface

This report has been produced to communicate the findings of the External Corrosion Management Inspection Project carried out in the offshore industry between 2007 and 2010 by the Health and Safety Executive's Offshore Division.

The report is available on the Health and Safety Executive's Offshore Oil and Gas website at www.hse.gov.uk/offshore/corrosion.htm.

Glossary

GRP	Glass Reinforced Plastic
HOC	HSE Observation and Communication
HSE	Health and Safety Executive
IChemE	Institute of Chemical Engineers
ICP	Independent Competent Person
IMT	Inspection Management Team
KP3	Key Programme 3 (Installation Integrity)
MCDR	Mechanical and Corrosion Defect Report
OSD	Offshore Division
RAR	Remedial Action Request
SCE	Safety-Critical Element

Executive summary

One of the findings from the HSE-initiated Key Programme 3 (KP3) on offshore asset integrity,[1] which ran from 2004 to 2007, was that in over half of the installations inspected the 'state of plant' element was considered to be poor. The KP3 report identified the need for operators to have a better understanding of the potential impact of degraded, non-safety-critical plant and utility systems on safety-critical elements in the event of a major accident.

The report also stated that as the scale of plant degradation increases, so the pressures on resources create tensions between the need to remedy basic fabric problems and the need to carry out safety-critical repairs.

Objectives

In addressing this issue, HSE's Offshore Division (OSD) undertook the External Corrosion Management Inspection Project from July 2007 to March 2010.

The objective of this project was to assess whether dutyholders have effective maintenance management systems for components such as walkways and stairways, piping and pipe supports, cable trays and fittings, bolts, flanges and valves for both safety-critical and non-safety-critical applications.

Its aim was to reduce risks from external corrosion by improvements to dutyholder management systems and the physical condition of offshore installations. The project focused on the maintenance of a defined set of plant and equipment types used in either safety-critical or, more particularly, in safety-related applications.

The inspection programme comprised seven documented templates covering the offshore physical condition of the relevant plant and equipment, and the key management controls that contribute toward their effective maintenance. Like KP3, the performance of each template element was scored using a traffic light system to compare both dutyholder and industry performance across all inspections.

The project completed a programme of 30 dutyholder inspections. Each consisted of an onshore inspection of the management system controls for external corrosion and an offshore inspection of at least one of the dutyholder's installations to examine their implementation. A key part of the offshore inspection was an evaluation of the physical condition of the defined plant and equipment types.

Main findings

The physical condition of installations visited varied significantly from good to poor. The project also witnessed a broad spectrum of dutyholder attitudes toward improving and maintaining the physical condition of the relevant plant and equipment types. Some demonstrated proactive commitment by refurbishing as part of major upgrade projects, whereas others showed insufficient commitment to addressing their situation.

Dutyholders did use performance indicators but these were focused on safety-critical aspects of inspection and maintenance and failed to specifically measure the condition of safety-related plant and equipment. This made it difficult to assess whether the condition of safety-related plant and equipment was improving or deteriorating. The concern is that simply using performance indicators for safety-critical reporting may actually disguise a progressive deterioration.

Most dutyholders demonstrated effective inspection regimes. They also demonstrated encouragement of the offshore workforce to participate in anomaly identification. However, a number of dutyholders were found to be failing to achieve their planned maintenance programmes.

During the project the majority of offshore installations inspected were considered to require improvement to the physical condition of the relevant plant and equipment types to varying degrees. On six occasions, when both the physical condition was considered poor and there was insufficient commitment from the dutyholder to improve the situation, an Improvement Notice was served.

At the start of the project, few of the dutyholders inspected were using measurable acceptance criteria for external corrosion of items such as gratings, bolts, cable trays and valves and continued to rely on subjective decisions by inspectors. However, in June 2008 the Energy Institute, commissioned by Oil & Gas UK, published guidance[2] that provides a set of simple quantitative performance standards for repair/replacement decision making of the relevant plant and equipment. On four occasions dutyholders who failed to adopt these or provide equivalents were also served Improvement Notices. Overall, a total of ten Improvement Notices were served on eight dutyholders during the project.

Throughout the project, every dutyholder was given detailed feedback on the inspection findings. The project also worked closely with the Oil & Gas UK/Energy Institute Corrosion Management Working Group. All key concerns and findings emerging from the project were fed into this group, which developed appropriate 'good industry practice' guidance for subsequent publication[2, 3, 4] by the Energy Institute. The published guidance provides dutyholders with practical advice on the relevant management controls to enable the effective maintenance of safety-related plant and equipment.

Recommendations

As a result of the project findings, OSD has decided to undertake a further programme of external corrosion inspections that will carry on into 2011. These will:

- follow up on the poorer performers identified in the project;
- undertake inspections of dutyholders not covered in the original project; and
- monitor the effective implementation of the published industry guidance.

This report provides the background to and execution of the project. It also provides an analysis of the traffic lights obtained from the project, the underlying generic findings, examples of good and bad industry practice and an overview of the key issues identified from the project.

Introduction

1 Between 2004 and 2007, OSD undertook an inspection initiative known as Key Programme 3 (KP3).[1] This was a comprehensive appraisal of asset integrity management of the UK's offshore installations, and the programme focused on the effective management and maintenance of safety-critical elements (SCEs). The purpose of these parts of an installation is to prevent, control or mitigate major accident hazards (MAHs), and the failure of these could cause or contribute substantially to a major accident.

2 Part of the KP3 inspection scope was to establish the inspector's opinion of the 'Physical State of Plant'. Whereas management system elements of the programme were related solely to SCEs, this element was based on the inspector's opinion of the condition of the installation overall, including fabric, structure, safety-critical and non-safety-critical plant and systems. A guidance booklet[5] was produced by the OSD Corrosion Topic Specialist Team to assist inspectors in making judgements about the condition of plant and improve consistency. The KP3 report findings were as follows:

'For more than 50 per cent of installations inspected the State of Plant element was considered to be poor. Companies often justified the situation with the claim that the plant, fabric and systems were non-safety-critical and a lower level of integrity was justified. This claim disguises a poor understanding across the industry of potential interaction of degraded non-safety-critical plant and utility system with safety-critical elements in the event of a major accident. In addition, as the scale of plant degradation increases the pressures on resources increases creating tensions between the need to remedy basic fabric problems and carry out repairs critical to integrity.

The human factor effects of the degradation of structures, hand rails, steps, gratings, piping, vessels, nuts and bolts on crew motivation, morale and their role in preventing major accidents, appears not to be properly understood or, ignored by senior management. Fabric maintenance is very poor on many platforms, showing inadequate long-term planning by the operators for the lifetime of installations, a lack of regard for the working environment of offshore workers and the risks to the individual of injury. The poor condition of many platforms has increased the risks of injury to personnel from dropped objects, hand lacerations and falling through gratings.'

3 In order to address this particular concern, OSD carried out the External Corrosion Management Inspection Project during the period July 2007 to March 2010. The project completed a programme of 30 dutyholder inspections. Each consisted of an onshore inspection of the management system controls for external corrosion and an offshore inspection of at least one of the dutyholder's installations to examine their implementation. A key part of the offshore inspection was an evaluation of the physical condition of the defined plant and equipment types.

4 A summary of the project's emerging findings was provided in a letter to the Oil & Gas UK Chief Executive in February 2009 and was also subsequently published in the HSE KP3 Review report[6] later in 2009.

Inspection programme

Scope

5 The project was limited to production installation dutyholders. It was focused on the maintenance management of the following sample of plant and equipment types in safety-critical but, more particularly, safety-related applications:

- walkways and stairways;
- wiping and pipe supports;
- cable trays and fittings;
- bolts, flanges and valves.

6 When identified by the offshore inspection, the scope of plant and equipment was extended to include further types, eg secondary and tertiary steelwork, lighting equipment and cladding.

Methodology

7 Each inspection involved an initial onshore inspection to evaluate the relevant management system elements and subsequently an offshore inspection of an installation to evaluate:

- the implementation of the management system; and
- the physical condition of the relevant plant and equipment on the installation.

Inspection templates

8 To ensure a focused and consistent approach by the project team inspectors, inspection templates were developed for the following onshore and offshore elements of the project.

Onshore:
- Senior management/company culture
- Performance indicators
- Maintenance plans
- Performance standards
- Offshore workforce awareness and participation

Offshore:
- Offshore physical condition

9 Each template contained a question set, which was used as the basis for interviews both onshore and offshore with dutyholder personnel. Before the start of the project, the templates were made available to the industry[7] on the OSD website. Dutyholders were made aware of the templates before any inspection.

Traffic lights

10 The project adopted a traffic light system, similar to that used by KP3, to enable the results of each inspection to be summarised and to simplify presentation of findings to both inspectors and industry. Each template is provided with a traffic light box, as shown below:

NON COMPLIANCE/ MAJOR FAILING	ISOLATED FAILURE/ INCOMPLETE SYSTEM	IN COMPLIANCE/ OK	NOT INSPECTED

11 Though the primary function of the traffic lights is to facilitate data analysis and presentations, each traffic light also reflected the following level of statutory compliance and subsequent level of enforcement action for the particular template:

Traffic Light	Criteria
NON COMPLIANCE/ MAJOR FAILING	Non-compliance with legislation Major failing of system (hardware or management); or Partial failure with a history of failure **MINDED TO SERVE A NOTICE**
ISOLATED FAILURE/ INCOMPLETE SYSTEM	Isolated failure of a well-defined system Incomplete procedures/systems **RECOMMENDATIONS IN THE LETTER TO DUTY HOLDER**
IN COMPLIANCE/ OK	Tested or inspected but with no significant issues found Complies with regulations etc
NOT INSPECTED	Not tested or no evidence There are concerns or information is unclear – re-inspect at later date **Issues in this category should include an explanatory note**

12 The project enforcement policy differed from KP3 only in that when the dutyholder received a RED for the offshore physical condition template an Improvement Notice was served.

Reporting

13 During the offshore inspection feedback on any issues, key findings and good practices were provided to offshore management and safety representatives. Feedback of all project inspection findings was also subsequently provided to dutyholder senior management onshore. This was followed up by an inspection letter and enforcement action when appropriate.

Inspection follow-up

14 All matters raised by the project inspector through an inspection letter or enforcement action are followed up and closed out to the satisfaction of the inspector.

Consistency

15 The project team consisted of the same three Inspection Management Team (IMT) inspectors and two corrosion specialists. All project inspections were carried out by one IMT inspector, supported by a specialist when required. To assist project inspectors in their judgements, each template provided relevant HSE publications[5, 8, 9, 10, 11] and published 'good industry practice'.[2, 12, 13]

16 To ensure even greater consistency, regular project team meetings were held to review inspection findings and subsequent enforcement actions. A key contributor to these discussions was the project requirement to obtain, as part of the offshore inspection, photographic evidence of its physical condition to justify the traffic light marking for offshore physical condition.

Inspection findings

17 All inspection reports were reviewed to identify generic issues and examples of 'good practice'. All traffic lights were subsequently transferred to a matrix showing the inspection results for each dutyholder/installation as individual lines.

Parallel work streams

18 In parallel with the inspection programme, work has been undertaken to raise industry awareness of the project and any generic issues identified through a combination of presentations to industry fora,[14, 15, 16] publication of magazine articles,[17, 18, 19] progress reports to the Oil & Gas UK Chief Executive and Oil & Gas UK Health and Safety Forum, and contributions to the HSE KP3 Review report.[6]

19 The project has worked closely with the Oil & Gas UK/Energy Institute Corrosion Management Working Group throughout. All key concerns and findings emerging from the project were fed into the group, which developed appropriate 'good industry practice' guidance for subsequent publication[2, 3, 4] by the Energy Institute. The Energy Institute and Oil & Gas UK have also provided a masterclass and are to provide a training workshop to promote the use of these documents by industry.[20, 21]

20 The Working Group is currently developing guidelines for publication on 'coating management and use of key performance indicators' and it is hoped that it will continue to provide further related education materials and guidance relating to external corrosion.

Analysis of findings

Overall project statistics

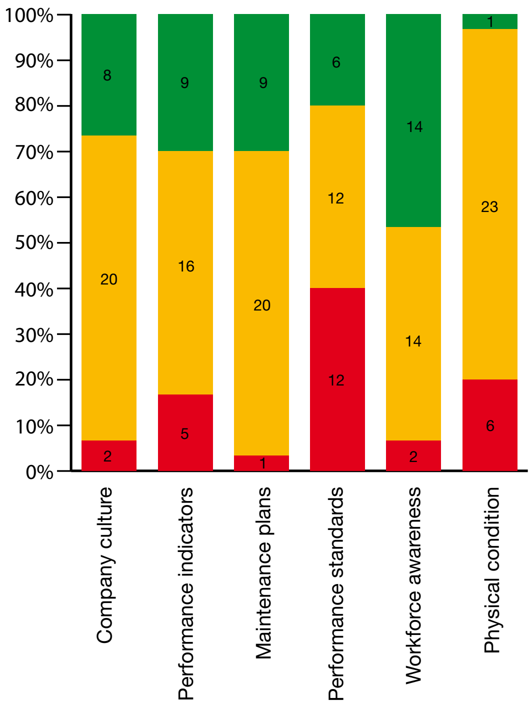
21 Between July 2007 and the end of March 2010, the project undertook 30 onshore inspections. Offshore inspections were carried out on 32 manned and four normally unmanned installations. The offshore inspections included both fixed and floating installations. During the project, two installations inspected subsequently changed ownership, no follow-up inspections were undertaken of the new dutyholders. Table 1 provides the overall dutyholder traffic light matrix. Dutyholders may obtain their installation number(s) if they wish to carry out their own analyses.

Table 1 Traffic light distribution by dutyholder

Inspection	Company/ Management Culture	Performance Indicators	Maintenance plan	Performance standards	Offshore Workforce awareness	Offshore physical condition
1	Amber	Green	Green	Red	Amber	Amber
2	Green	Green	Green	Amber	Amber	Amber
3	Green	Green	Green	Amber	Green	Red
4	Amber	Amber	Amber	Amber	Green	Amber
5	Amber	Amber	Green	Green	Green	Amber
6	Amber	Amber	Amber	Amber	Amber	Amber
7	Amber	Red	Amber	Red	Amber	Green
8	Green	Green	Amber	Amber	Amber	Amber
9	Green	Green	Green	Green	Green	Amber
10	Amber	Amber	Amber	Amber	Amber	Amber
11	Red	Amber	Amber	Green	Amber	Amber
12	Amber	Amber	Amber	Amber	Amber	Red
13	Amber	Amber	Amber	Red	Green	Red
14	Amber	Amber	Amber	Red	Green	Amber
15	Amber	Red	Amber	Red	Amber	Amber
16	Amber	Amber	Amber	Amber	Green	Amber
17	Green	Amber	Amber	Red	Green	Amber
18	Red	Amber	Amber	Red	Amber	Amber
19	Amber	Green	Green	Green	Green	Amber
20	Green	Green	Green	Green	Amber	Amber
21	Green	Green	Green	Green	Green	Amber
22	Amber	Red	Amber	Red	Amber	Red
23	Green	Green	Amber	Amber	Amber	Amber
24	Amber	Red	Amber	Red	Amber	Red
25	Amber	Amber	Amber	Amber	Green	Amber
26	Amber	Amber	Green	Amber	Green	Amber
27	Amber	Amber	Amber	Red	Green	Amber
28	Amber	Amber	Amber	Amber	Green	Amber
29	Amber	Amber	Amber	Red	Green	Red
30	Amber	Red	Red	Red	Red	Amber

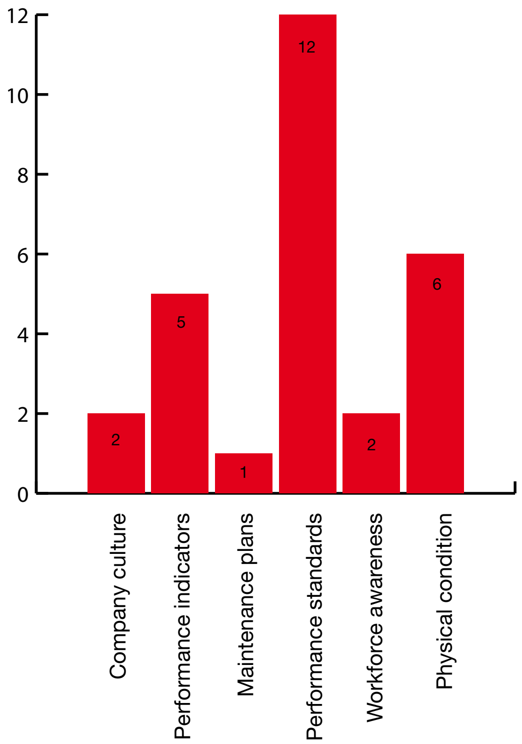
22 Figure 1 shows a full breakdown of traffic light distribution for each element. Company culture, performance indicators, maintenance plans and performance standards indicate an average of 70% of dutyholders where there was scope for improvement. Offshore physical condition particularly stands out, as over 90% of dutyholders need improvement, some needing to address significant issues. However, offshore workforce awareness and participation indicates a better performance by industry.

Figure 1 Traffic light distribution by template



23 Figure 2 shows the RED traffic light distribution for each of the elements – a total of 27 were given. Performance standards (12) received twice as many as any other element, performance indicators (5) and offshore physical condition (6) being the next most frequent.

Figure 2 RED traffic light distribution by template



24 Improvement Notices were served on eight dutyholders throughout the project. Table 2 provides a breakdown of the number and distribution by element of the Improvement Notices.

Table 2 Improvement Notices served

Template element	Number of notices
Offshore physical condition	6
Performance standards	4
TOTAL	**10**

Generic project findings by element

Company/senior management culture

Background

25 The objective of this element was to establish that the dutyholder had adequate management processes to ensure effective control of external corrosion.

The project sought to establish that:

- the relevant policy and strategies adequately addressed external corrosion – in particular that appropriate emphasis was placed on safety-related (non-major-accident hazard), as well as safety-critical plant and equipment;
- the policy and strategy were clearly linked to a defined target field/asset life of the installation, which was realistic and justified and also that the policy/strategy recognised the likelihood of field/asset life extension, and had prepared actions necessary in the event of such an extension;
- every level of management and supervision had clearly defined roles and responsibilities for external corrosion and were provided with adequate resources to deliver such responsibilities;
- there were arrangements for acceptance by each level of management responsible for the physical condition of the installation regarding external corrosion of safety-critical and safety-related plant and equipment;
- regular audits and reviews were undertaken to ensure the effectiveness of the management system to control external corrosion.

Findings

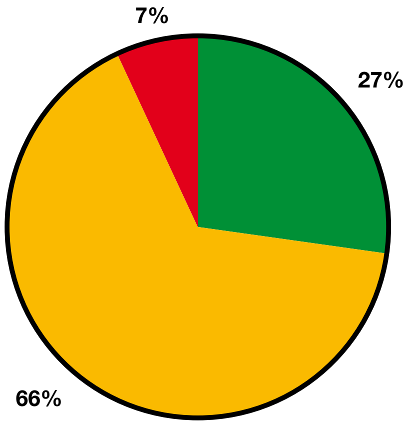
26 Overview: the traffic light distribution for this element includes:

- policy;
- strategy;
- roles and responsibilities;
- independent auditing.

27 Figure 3 shows the traffic light distribution for this element. The main reasons for the AMBER/RED distribution were:

- the failure to demonstrate effective recognition of safety-related plant and equipment in a risk-based culture;
- the lack of relevant independent audits undertaken for external corrosion.

Figure 3 Company/senior management culture



Additional points

28 Policy: the majority of dutyholders were found to encompass safety-related plant and equipment within a risk-based culture. The project concern is that in risk-based regimes, where the emphasis is on safety-critical plant and equipment, this can cause safety-related plant and equipment maintenance to become the 'poor relation'.

29 Though a number of dutyholders provided verbal assurance that safety-critical and safety-related plant and equipment were treated equally, relevant corporate documents failed to endorse this position. In fact, one dutyholder demonstrated a minimalist approach to maintenance of safety-related plant and equipment. This manifested itself in lower performance standards and a policy of repair to safety-related plant and equipment only when it had a 'significant impact on safety'.

30 Evidence also suggested that there is a difference in culture within the production installation industry. Installations that interface with marine culture place greater emphasis on continuous painting programmes within their risk-based maintenance regimes. One dutyholder of a floating installation considered the appearance of his installation to be an important selling point to prospective clients.

31 Strategies: dutyholders were found to be faced with different issues such as:

- life extensions into the 2020s and beyond;
- significant maintenance backlogs;
- varying degrees of external corrosion.

32 This resulted in a number of different strategies to address the challenges, for example:

- continuous painting and anomaly repair programme;
- provision of permanent offshore-based painting teams;
- implementing annual 'three-month' maintenance campaigns;
- planning in relevant maintenance work when bed space became available due to breaks in other operational activities;
- implementing a short-term programme to upgrade walkways, wind walls, handrails and a longer term programme to remove redundant plant and equipment;
- provision of extra accommodation in the form of temporary living quarters or additional accommodation installations, eg flotels;
- undertaking dry-dock repairs.

33 Some dutyholders have implemented multi-million pound upgrade projects. The focus of such projects is primarily on refurbishment of safety-critical equipment. The projects have also provided the opportunity to upgrade the safety-related aspects of the installation – but in one or two instances it seems this opportunity has not been fully exploited.

34 Once major upgrade projects have been undertaken, it will be for the installation-based systems to ensure continuing fitness for purpose. Where major projects were underway it was not always possible to be assured that such systems would be able to maintain the condition following project completion.

35 All dutyholders could demonstrate strategies relating to corrosion, but only two demonstrated documentation which transparently addressed the types of plant and equipment identified by this project.

36 Roles and responsibilities: these were well defined for safety-critical plant and equipment but in some instances the roles and responsibilities for safety-related plant and equipment were not clearly defined. It also became clear that the responsibility for safety-related types can cross a number of groups within the organisation, which can increase the possibility of communication breakdown at the interfaces.

37 Audits: independent audits provide a key role in the review process and can therefore help management to improve the system. Very few dutyholders had audit programmes in place for external corrosion. Where audits were undertaken they failed to cover both the safety-critical and safety-related aspects of plant and equipment to ensure the full and effective integration of both into the corrosion management system.

38 Good practice: Annex C of the Energy Institute's *Guidance for Corrosion Management in Oil & Gas Production and Processing*[2] provides a checklist for corrosion management auditing.

Performance indicators

Background

39 This element's objective was to establish whether appropriate external corrosion performance indicators were in place, to provide management with a clear understanding of the physical condition of the relevant plant and equipment, particularly when used in safety-related applications.

40 The project sought to establish:

- that performance indicators existed which provided unambiguous information on the physical condition of the installation regarding external corrosion to enable each level of management to fulfil its responsibilities;
- that performance indicators, where appropriate, included targets and trending for both safety-critical and safety-related external corrosion;
- the form of the performance indicators:
  - they may be linked to statutory requirements, eg
    - the number of incidents and failures caused by external corrosion for safety-critical/safety-related plant and equipment (this needs effective arrangements for the reporting and root cause assessment of incident and failures);
    - reservations or comments regarding good repair and condition of safety-critical plant and equipment identified by the Independent Competent Person; or
  - they could be:
    - concerns expressed by the workforce;
    - visual information, eg installation photographs or videos;
    - personal visits to the installation.

Findings

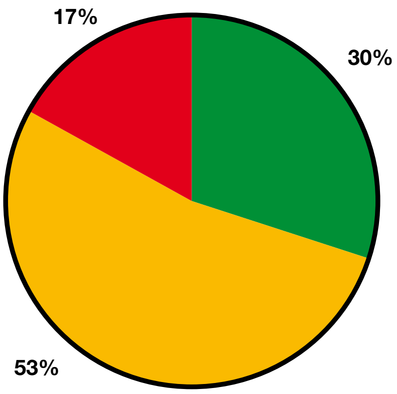
41 Overview: the traffic light distribution for this element includes:

- leading and lagging performance indicators to reflect installation physical condition;
- targets and trending for performance indicators;
- root cause analysis of incidents and failures.

42 Figure 4 shows the traffic light distribution for this element. The main reasons for the AMBER/RED distribution were that:

- the performance indicators used failed to effectively separate out safety-related from safety-critical plant and equipment;
- lack of targets and trending for safety-related plant and equipment;
- lack of effective root cause analysis of safety-related incidents and failures.

Figure 4 Performance indicators



Additional points

43 Leading and lagging performance indicators: dutyholders have performance indicators to monitor progress of maintenance programmes, but these are focused on safety-critical plant and equipment. The following leading and lagging indicators could also be considered appropriate for use with safety-related plant and equipment:

- Mechanical and Corrosion Defect Reports (MCDRs);
- Remedial Action Requests (RARs);
- number of safety incidents relating to corrosion;
- percentage completion of:
  - painting;
  - inspections to schedule;
  - work pack completion certificates;
  - repair orders;
  - maintenance backlog.

44 Most dutyholders measure the total plan, ie safety-critical plus safety-related (with no differentiation between the two) – in some instances maintenance backlogs did not appear to include safety-related maintenance. The measures used also tended to refer to the annual programme, as opposed to the total programme.

45 Targets and trending: very few dutyholders were able to demonstrate targets and trending for safety-related plant and equipment. However, one dutyholder was found to be using the following performance indicators and targets for safety-related plant and equipment:

- percentage completion of area inspections to schedule (target 90%);
- percentage completion of annual painting programme (target 90%);
- number of safety incidents from external corrosion (target 0).

46 Root cause analysis: few dutyholders effectively investigate to determine the root cause of failures of safety-related plant and equipment. A reason given was that the existing techniques available were too complex and time consuming. A simplified root cause analysis technique has been provided in Energy Institute industry guidance.[2]

47 Good practice: Energy Institute industry guidance[2] provides the following:

- Section A5.4.6 Failure Investigation and Root Cause Analysis has a simplified methodology for root cause analysis;
- Section 6 Monitoring and Measuring Performance has examples of performance indicators.

48 The Oil & Gas UK Corrosion Management Work Group is currently preparing further guidance on performance indicators for external corrosion.

Maintenance plans

Background

49 The objective of this element was to establish that the dutyholder had in place:

- appropriate plans and procedures to ensure that the relevant plant and equipment remained in an efficient state, in efficient working order and in good repair with respect to external corrosion;
- that such plans and procedures were being complied with.

50 The project sought to establish that:

- documented plan(s) existed and defined a programme of maintenance for external corrosion that ensured, in a health and safety context, that all relevant plant and equipment on the installation remained in good repair and condition;
- the maintenance plan addressed:
  - the age of the relevant plant and equipment and their function in the defined field/asset life;
  - the short- and long-term requirements to enable effective resourcing over the life of the installation;
- the programme clearly defined what needed to be done and when it needed to be done and, though prioritised on a risk basis, adequately addressed the relevant plant and equipment in both safety-critical and safety-related applications.
- the relevant plant and equipment when safety-critical was clearly identified and included within the verification scheme;
- maintenance activities were scheduled to ensure that the relevant plant and equipment ‘remained in an efficient state, in efficient working order and in good repair’, ie in compliance with performance standards;
- though failure to complete such work to the plan would not necessarily mean that such plant and equipment failed to comply with the performance standard, when the plan was not achieved, the dutyholder demonstrated that it continued to comply with the performance standard until the rescheduled maintenance activity was completed. This principle applied equally to the relevant plant and equipment in both safety-critical and safety-related application;

- where such rescheduling involved safety-critical plant and equipment, the dutyholder had arrangements in place with the Independent Competent Person (ICP) to verify that it remained in good repair and condition until the rescheduled maintenance was carried out;
- rescheduled maintenance activities were recorded as backlogs to enable trends and resourcing requirements to be evaluated.

Findings

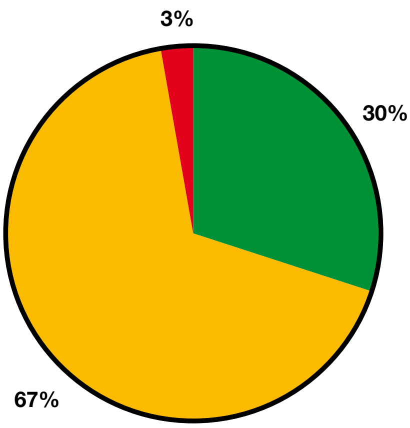
51 Overview: the traffic light distribution for this element includes:

- inspections plans;
- maintenance plans;
- progress of plans.

52 Figure 5 shows the traffic light distribution for this template. The main reasons for the RED/AMBER distribution were:

- failure to effectively separate out the safety-critical from the safety-related maintenance;
- failure to achieve planned maintenance activities;
- inadequate inspection regimes for cable trays and supports;
- poor maintenance of cladding.

Figure 5 Maintenance plans



Additional points

53 Inspection plans: where the types of plant and equipment sampled by the project were safety-critical, dutyholders were able to demonstrate effective inspection regimes – albeit the acceptance criteria were not necessarily clearly defined (see ‘Performance standards’). Piping, pipe supports, valves, flanges and bolts tended to be covered by planned inspection and walkways and stairways were generally covered by structural integrity inspections.

54 For safety-related applications of the same plant and equipment, a number of dutyholders have effective planned inspection regimes – some undertaking regular ‘area inspections’ to identify anomalies. There was also evidence of offshore worker participation in identifying anomalies.

55 A number of dutyholders failed to demonstrate effective inspection regimes for both safety-critical and safety-related applications of cable trays and supports; cladding also seemed to be low-priority. In safety-related applications such plant and equipment can create a dropped object hazard.

56 Maintenance plans: dutyholders, on the most part, demonstrated effective systems in place for scoping/quantifying and monitoring their risk-based maintenance and repair programmes of plant and equipment. The main focus of maintenance plans was found to be on safety-critical plant and equipment, with variable dutyholder approaches to that which is safety-related, sometimes only addressing this issue at a local level with low priority. In some instances it was impossible to separate out safety-related from safety-critical maintenance and therefore be in a position to monitor and manage the effective progress of both parts.

57 Whereas inspection plans were mainly in place for safety-critical and safety-related plant and equipment, the evidence showed that on a number of occasions dutyholders had failed to take action on the anomalies identified from the inspections, particularly those of safety-related plant and equipment. There was clear evidence that some anomalies (including high-priority defects) remained outstanding over several years.

58 Most dutyholders focus on short/medium term up to a maximum of five years. Only one dutyholder had developed a whole life plan.

Performance standards

Background

59 The objective of this element was to establish that rejection criteria for external corrosion of components were clearly defined and could be measured effectively and consistently.

60 The project sought to establish that:

- where dutyholders allowed components to degrade and/or corrode as part of a condition-based scheme, performance standards existed which defined the point at which the component needed to be repaired or replaced, ie rejection criteria;
- such performance standards were quantified so they could be measured effectively and consistently;
- the performance standards were supported by sound engineering justification and were consistent with the basis of design, taking account of any changes to service conditions;
- where components were part of the installation's safety-critical elements (SCEs), the components were verified against such performance standards by an Independent Competent Person.

Findings

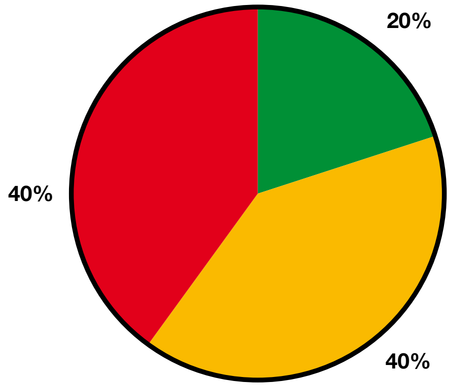
61 Overview: the traffic light distribution for this element includes: quantitative performance standards for:

- walkways and stairways;
- piping and pipe supports;
- cable trays and fittings;
- bolts, flanges and valves.

62 Figure 6 shows the distribution of traffic lights for this element. The main reasons for the RED/AMBER distribution were:

- failure to have quantitative performance standards for all the relevant plant and equipment;
- subsequent failure to either use the performance standards provided in the industry guidance,[2] published in June 2008, or provide equivalents.

Figure 6 Performance standards



Additional points

63 Quantitative performance standards: certain dutyholders were able to demonstrate quantitative performance standards for some of the types of plant and equipment covered by the project. However, some of them relied solely on subjective judgement and therefore could not demonstrate the ability to measure rejection criteria consistently.

64 A number of dutyholders, though unable to demonstrate the full set of performance standards at the time of the inspection, provided assurance that they would either adopt the standards provided in industry guidance[10] or provide equivalents. Based on this assurance, several dutyholders, prior to publication of the guidance, were given GREEN traffic lights. Once the guidance has been published, the project expectation is that performance standards will be in place.

65 Good practice: Energy Institute industry guidance[2] provides the following:

- Annex B9 – Atmospheric external corrosion performance standards.

Offshore workforce awareness and participation

Background

66 The objective of this element was to establish the awareness and participation of the offshore workforce in identifying and reporting external corrosion.

67 The project sought to establish that:

- as external corrosion can be seen by general visual observations while undertaking other activities around the installation, the dutyholder used the valuable source of opportunistic inspection by the workforce;
- the workforce were made aware of external corrosion and provided with appropriate training and a reporting system to enable effective identification of corrosion that may be of concern;
- arrangements were in place to ensure the effective awareness and participation of the workforce regarding external corrosion of the relevant plant and equipment.

Findings

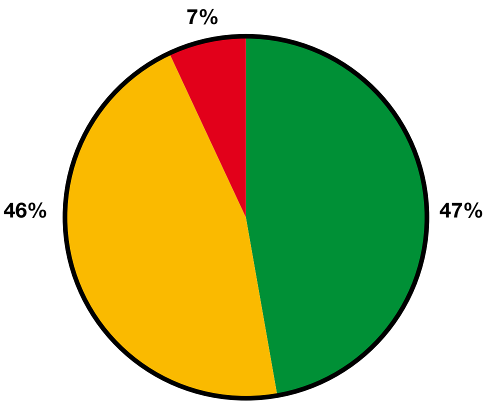
68 Overview: the traffic light distribution for this element includes:

- workforce participation;
- workforce awareness.

69 Figure 7 shows the distribution of traffic lights for this element. The main reasons for the RED/AMBER distribution were:

- failure to provide adequate feedback to the workforce;
- the lack of workforce awareness campaigns.

Figure 7 Offshore workforce awareness and participation



Additional points

70 Workforce participation: dutyholders demonstrated effective defect and incident reporting systems, such as Mechanical and Corrosion Defect Report (MCDR), Remedial Action Request, HSE Observation and Communication (HOC), Site Observation Card, Safety Observation System etc. In one instance a dutyholder also labelled the relevant items, indicating inspection/remedial action to be taken. Two further dutyholders were found to operate STOP DROP campaign/ cards – dropped objects – a hazard particularly relevant to the types of plant and equipment examined in safety-related applications. Dutyholders also demonstrated effective recording of actions required and close out of issues.

71 Dutyholders demonstrated effective workforce participation in the installation reporting systems. Though some dutyholders failed to provide feedback to the individual or workforce, the majority were able to demonstrate feedback via safety meetings and briefings, the supervisor or management, some also provided job tracking data on notice boards.

72 Workforce awareness: some dutyholders have provided information to the workforce in the past, one for example had produced a CD several years ago. But the majority failed to provide evidence of current campaigns or actions to raise awareness of external corrosion within the workforce.

73 The following are examples of ways individual dutyholders are providing information to the workforce:

- a company handbook on external corrosion;
- the HSE[5] and/or Energy Institute[3] corrosion handbooks;
- 'lunch and learn' session on corrosion;
- mini-presentations with posters and a separate notice board;
- a monthly newsletter which includes corrosion maintenance.

74 Good practice: this includes providing:

- company or industry awareness handbooks;[3, 4, 5]
- campaigns – posters, presentations, separate notice boards;

Offshore physical condition

Background

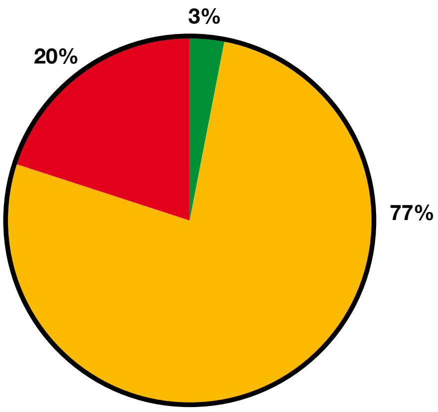
75 The objective of this element was to evaluate the implementation and effectiveness of the dutyholder arrangements offshore.

76 The project sought to establish the physical condition of the selected types of plant and equipment on an installation operated by the dutyholder.

Findings

77 Overview: Figure 8 shows the distribution of traffic lights for this element. All RED traffic lights related to mature installations – in three instances the installations had been operated throughout their life by one dutyholder whereas the remaining three had been taken over recently by a new dutyholder.

Figure 8 Offshore physical condition



Additional points

78 Patch painting: several dutyholders are undertaking patch painting programmes. Though the principle is sound, there has been evidence of poor surface preparation and coat application. Dutyholders should recognise the need for adequate quality control measures for this type of work.

79 Redundant plant and equipment: a number of examples have been found, particularly on older installations, of redundant plant and equipment remaining on board – a particular issue identified was inactive corrosion monitoring fittings. Dutyholders should consider removal more closely rather than continuing maintenance to prevent such plant and equipment becoming a hazard to safety.

80 Access and replacement: several dutyholders were also found to have created unnecessary difficulties such as the following:

- gratings were welded down – difficulty in removal;
- non-slip surface applied over the gratings – difficulty in inspection;
- inaccessible gratings below the accommodation – dropped object hazard.

81 Good practice: the project found the following examples of this:

- continuous painting programmes;
- replacement with corrosion-resistant materials, eg existing cable trays replaced with stainless-steel trays, replacement of existing gratings with GRP gratings;
- development of long-life paint coatings;
- encapsulation of flanges and bolts;
- use of lightweight scaffolding to facilitate access;
- protection around scaffolding against bad weather;
- removal of redundant plant and equipment;
- colour mapping of grating deck plans and handrails.

Examples of good and bad practice

Walkways and stairways

Bad practice




Good practice

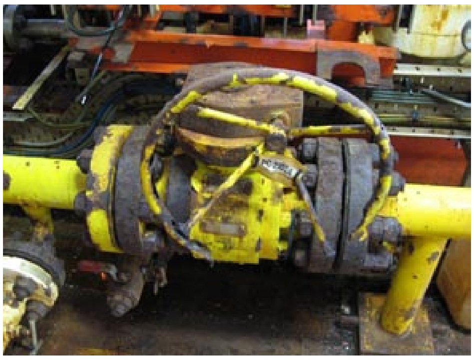

Piping and pipe supports

Bad practice

Good practice

Bolts, flanges and valves

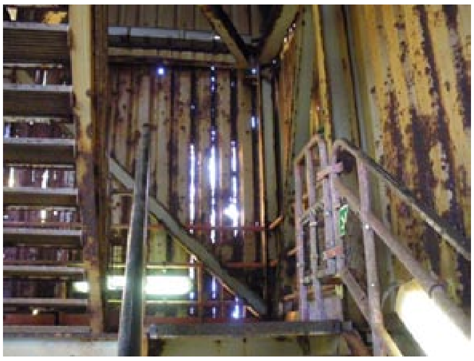
Bad practice

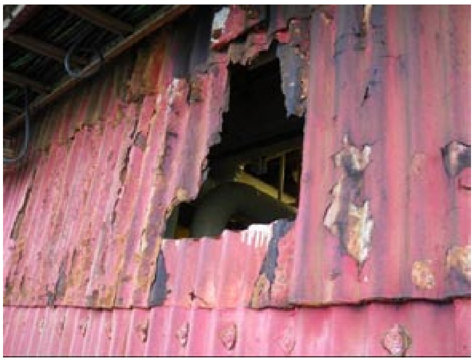


Good practice

Cable trays, lighting and cladding

Bad practice





Good practice

Overview

82 **Senior management/company culture:** the culture within the majority of dutyholders was found to be risk-based with safety-related plant and equipment appearing to be the 'poor relation'. This manifested itself with examples such as:

- corporate documents failing to acknowledge safety-related plant and equipment;
- poor definition of roles and responsibilities for safety-related plant and equipment;
- limited use of root-cause analysis for safety-related incidents and failures.

83 In exceptional cases, some installations were found to have a 'marine' culture; giving appropriate priority to planned maintenance, as opposed to risk-based maintenance.

84 **Performance indicators:** dutyholders demonstrated the use of a number of performance indicators. However, these were focused on safety-critical aspects of inspection and maintenance and failed to specifically measure the condition of the safety-related plant and equipment. So it was impossible to establish whether the condition of safety-related plant and equipment was improving or deteriorating.

85 The concern is that simply using performance indicators for safety-critical reporting may lead to the overall condition status of safety-related plant and equipment being unnoticed, therefore disguising a progressive deterioration. The lack of independent audits further limits the ability of dutyholders to undertake effective review of the relevant parts of the management system.

86 **Inspection/maintenance plans:** the industry was able to demonstrate effective inspection regimes for the plant and equipment in both safety-critical and safety-related applications. But there were a number of examples where inspection of cable trays, tray supports and cladding were found to be inadequate.

87 There were a number of examples of dutyholders undertaking regular 'area inspections' and acting upon anomalies identified by workers through the installation reporting systems. However, the major failing here was that while dutyholders were able to demonstrate effective inspection plans, a number were not taking the appropriate action to rectify the anomalies from the inspections.

88 Dutyholders demonstrated effective systems for scoping/quantifying and progress monitoring of maintenance requirements, but in a number of instances it was not possible to separate out safety-critical from safety-related ones. The maintenance plans were limited to short (annual) to medium (up to five years) term – only one dutyholder was found to have a whole life plan.

89 There were a number of examples of annual plans that contained carry over from the previous year and also plans which were not achieved. This questions the ability to prevent a progressively increasing backlog. In a risk-based approach, where inevitably additional safety-critical maintenance will be added to the plan, this will place greater pressure on carrying out maintenance of safety-related plant and equipment.

90 **Performance standards:** quantitative performance standards exist for some of the types of plant and equipment covered by the project. However, for the remaining types very few quantitative standards existed within the dutyholders that demonstrated clear rejection criteria for the components being inspected. Indeed, several dutyholders relied solely upon a subjective acceptance decision.

91 Though the Energy Institute industry guidance,[2] published in June 2008, provides a set of simple quantitative standards, some dutyholders failed to adopt these or provide equivalents. As a result, this particular element received the largest number of RED traffic lights and has also resulted in four dutyholders being served Improvement Notices.

92 **Workforce awareness and participation:** dutyholders demonstrated effective anomaly reporting systems and participation of the workforce in such systems. In some instances, however, dutyholders could improve their feedback to the workforce.

93 Some dutyholders are currently providing awareness information to the workforce, but the majority do not have any active programmes. An informed workforce can provide an invaluable additional resource in the identification of external corrosion.

94 **Offshore physical condition:** the project witnessed a broad spectrum of dutyholder attitudes toward improving and maintaining the physical condition of the relevant plant and equipment types. At one end of the spectrum, some demonstrated proactive commitment by taking the opportunity to refurbish as part of major upgrade projects, whereas at the other end some failed to demonstrate sufficient commitment to addressing their situation.

95 A number of offshore installations were found to require improvement to the physical condition of the plant and equipment types considered. On six occasions when the physical condition was poor, and there was also insufficient commitment on the part of the dutyholder to improve the situation, an Improvement Notice was served.

96 **Industry guidance:** the project worked closely with the Oil & Gas UK/Energy Institute Corrosion Management Working Group throughout. All key concerns and findings emerging from the project were fed into the group which developed appropriate ‘good industry practice’ guidance for subsequent publication[2, 3, 4] by the Energy Institute.

97 The published guidance now provides dutyholders with practical advice on the relevant management controls to enable the effective maintenance of safety-related plant and equipment.

98 **OSD intervention:** as a result of the project findings, OSD has decided to undertake a follow-on programme of external corrosion inspections until at least 2011. The focus of these inspections will be to:

- follow-up on the poorer performers identified in the project;
- undertake inspections of dutyholders not covered in the original project;
- monitor the effective implementation of the published industry guidance.

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