The basics of verification

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Introductions

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Agenda

• The Offshore Installation (Safety Case) Regulations 2005 and associated legislation
• Tea/coffee break (10 mins)
• OSCR requirements for verification schemes
• The role of the independent and competent person (ICP)
• The role of the duty holder
• The role of the technical authority
• The role of the regulator
• The value of verification
• Summary
• Questions / further discussion
The Offshore Installation (Safety Case) Regulations 2005 and associated legislation
Brief history

- Introduced in UK in 1992
- Followed Cullen enquiry into Piper Alpha disaster
- Replaced previous prescriptive legislation with “goal setting” regime
- Introduced concept of the safety case, requirements for identification of major accident hazards and safety critical elements and establishment of written schemes of examination
- Supported by other legislation - DCR, PFEER, PSR, MAR
- Revised in 2005
- Methodology increasingly adopted outside UK legislative environment
Associated legislation

- Health and Safety at Work Act 1974 - HSAW
- Offshore Installations (Prevention of Fire, Explosion and Emergency Response) Regulations 1995 - PFEER
- Offshore Installations and Wells (Design and Construction) Regulations 1996 - DCR
- Pipeline Safety Regulations 1996 - PSR
- Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995 - MAR
Associated legislation

- HSAW
- OSCR
- PSR
- DCR
- MAR
- PFEER
OSCR - key features

- Concept of duty holder
- Safety Case
- Identification of major accident hazards
- Identification of safety critical elements (SCEs)
- Setting of performance standards for SCEs
- Written schemes of examination
- Independent verification requirements
Key features

- Major Accident Hazards
Key features

1. Major Accident Hazards
2. Safety Critical Elements
Key features

1. Major Accident Hazards
2. Safety Critical Elements
3. Performance Standards
Key features

1. Major Accident Hazards
2. Safety Critical Elements
3. Performance Standards
4. Written Schemes of Examination
Key features

1. Major Accident Hazards
2. Safety Critical Elements
3. Performance Standards
4. Written Schemes of Examination

VERIFICATION
Focus on major accident hazards
Major accident hazard (MAH) - definition

- A fire, explosion or release of a dangerous substance resulting in **death or serious personal injury** to persons on the installation or engaged in an activity in connection with it
- Any event involving major damage to the structure of the installation or plant affixed thereto or any loss in the stability of the installation
- The collision of a helicopter with the installation
- The failure of life support systems for diving operations in connection with the installation, the detachment of a diving bell used for such operations or the trapping of a diver in a diving bell or other subsea chamber used for such operations; or
- Any other event arising from a work activity resulting in death or serious personal injury to **five or more persons** on the installation or engaged in an activity in connection with it
Safety studies necessary to arrive at MAH list

- HAZID: Major Accident Hazard Identification
- QRA: Quantitative Risk Assessment
- FEA: Fire and Explosion Analysis
- SGIA: Smoke and Gas Ingress Analysis
- EERA: Escape, Evacuation and Rescue Analysis
- ESSA: Emergency Systems Survivability Analysis
- Dropped object study
- Ship collision study
Major accident hazard (MAH) - examples

- Flammable gas release
- Flammable liquid release
- Explosion
- Loss of well control
- Helicopter crash
- Failure of primary structure
- Ship collision
- Loss of stability
Major accident hazard (MAH) - not

- Slips, trips and falls
- Fall from height
- Production interruption
- Fabrication yard accident
- Installation incident
- Environmental incident
Safety critical elements

“Cause, prevent, control or mitigate”
Safety critical element – definition

“such parts of an installation and such of its plant (including computer programmes), or any part thereof –

- the failure of which could cause or contribute substantially to; or,
- the purpose of which is to prevent or limit

the effect of a major accident”

Safety critical element – examples

- Hydrocarbon containment
- Overpressure protection
- ESD
- Flare and blowdown
- Emergency power
- Escape routes
- Jacket primary structure
- Natural ventilation
- High speed rotating equipment
# MAH / SCE Matrix

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**Key**
- **P** Prevention - Reduce likelihood, failure of which could cause or contribute to a MAH.
- **D** Detection - Detect the occurrence of a MAH or preceding events.
- **C** Control - Limit escalation through MAH scale, intensity and duration.
- **M** Mitigation - Mitigate the effects or consequences.
- **ER** Emergency Response - Assist in escape, evacuation and rescue.
- **S** Support - Provides support services to interconnected SCE’s.
Safety critical element vs safety critical

- It is important to distinguish between a high-level SCE and items of safety critical equipment – these are often confused
- A gas compressor, for instance, is an item of safety critical equipment
- It may be related to a number of SCEs (hydrocarbon containment, overpressure protection, high speed rotating equipment)
- A number of (unwieldy) verification schemes have made the mistake of identifying particular items of equipment as SCEs. This makes for a very large number of SCEs and is very difficult to manage.
Performance standards

“What an SCE must achieve”
Performance standard – definition

A performance standard is a statement, which can be expressed in qualitative or quantitative terms, of the performance required of a system, item of equipment, person or procedure, and which is used as the basis for managing the hazard.

- It is the means by which suitability is established.
- There are many formats in use.
- It is a statement of what the SCE must do, NOT what it does.
- It is defined in terms of functionality, availability, reliability, survivability and interactions (FARSI).
Performance standard

Sets measurable standards for the performance of SCEs required to prevent, detect, control, mitigate or recover from a major accident event.

- functionality - what is it required to do?
- availability / reliability - how likely is it to perform on demand?
- survivability - does it have a role to perform post event?
- interactions - do other systems require to be functional for it to operate?
- usually also includes statements as to scope (extent) and an indication of the SCEs Role in MAH prevention, control or mitigation.
- criteria must also be SMART (Specific, Measurable, Achievable, Realistic and Timely)
Performance standard - example

Example Performance Standard
Performance standard development

- Will continue throughout (at least) the detailed design phase
- Low-level, measurable criteria (e.g., valve closing times) may not be available until late in the process when detailed study work is complete
- Process of performance standard development forces consideration of role of SCE in MAH prevention (Involvement of design contractor very beneficial in this respect)
- Separate standards may be developed for “initial” and “operational” suitability
- Performance standards may legitimately change during the life of an installation
Written schemes of examination
Written schemes of examination

- Document those measures to be taken (either in terms of testing or other examination) in order to assure that the SCE meets or can be expected to continue to meet, its performance standard.

- Written schemes may be produced for any number of items of safety critical equipment or systems, not necessarily one per SCE.

- In order that the scheme overall can be readily understood, and be auditable, it is usual to incorporate all the relevant schemes of examination in a matrix.

- Requirements of the written schemes should be incorporated into maintenance management system job cards.
WSE and verification matrix

- Example WSE: Written Scheme
- Example verification matrix: Verification Matrix
OSCR requirements for verification schemes
Regulation 19 – the requirement for verification

The duty holder for an installation shall ensure that:

- a record of the safety critical elements and specified plant is made
- comment on that record by an independent and competent person is invited
- a verification scheme is drawn up by, or in consultation with, such a person
- a note is made of any reservation expressed by such person as to the contents of that record or that scheme
- the scheme is put into effect
- that these matters shall be completed:
  - in the case of a production installation, before completion of its design
  - in the case of a non-production installation, before it is move into UK water with a view to its being operated there
Verification scheme - definition

A suitable written scheme for ensuring that the safety critical elements and specified plant are or, where they remain to be provided, will be suitable; and where they have been provided, remain in good repair and condition i.e. that they will perform, and remain able to perform, in accordance with the performance standards set for them.
Matters to be provided for in a verification scheme (OSCR Schedule 7)

- The principles to be applied by the duty holder in selecting persons to perform functions under the scheme and to keep the scheme under review
- Arrangements for the communication of information necessary for the proper implementation, or revision, of the scheme to those persons
- The nature and frequency of examination and testing
- Arrangements for review and revision of the scheme
- Arrangements for the making and preservation of records showing:
  - the examination and testing carried out
  - the findings
  - remedial action recommended and performed
- Arrangements for communicating the above to an appropriate level in the duty holders management system
Means of verification

- Examination, including testing where appropriate, of the safety critical elements and specified plant by independent and competent persons
- Examination of any design, specification, certificate, CE marking or other document, marking or standard relating to those elements or that plant by such persons
- The examination by such persons of work in progress
- The taking of action following reports by such persons
Scheme review and revision

The duty holder shall ensure that, as often as may be appropriate:

- the verification scheme is reviewed, and where necessary revised or replaced by, or in consultation with, an ICP; and
- a note is made of any reservation expressed by such person in the course of the review

This is an obvious driver for continuous improvement
The role of the ICP
ICP main tasks

- Review and comment on list of SCEs
- Review and comment on the verification scheme overall (this will include performance standards, written schemes of examination, and any of the “matters to be provided for …”)
- Execution of verification activities specified in the scheme
- Reporting results of those activities
- Participating in the regular reviews and/or revisions of the scheme required by OSCR

These roles will almost certainly require the skills and competency of more than one person
Verification vs assurance

- A duty holder will specify any number of assurance measures (which may include examinations, tests or maintenance routines) which can be expected to contribute to assurance that an SCE will be suitable.
- An ICP will verify that those measures have been carried out and can be expected to be effective. In addition, an ICP will carry out certain tests, examinations or reviews directly.
- A verification scheme must address the intended nature and frequency of verification activities.
- Lloyd’s Register generally specifies these activities in a series of written schemes of examination (WSEs), one for each SCE, detailed and tracked on a verification matrix.
Nature and frequency of examination

- Will be determined with some recognition of the risk associated with failure of an SCE to perform
- May be determined on the basis of some kind of quantitative assessment or by qualitative means
- Must reflect any assumption or requirement which may be inherent in a particular Safety Integrity Level (SIL) rating defined in the performance standard
- Again, must be expressed in measurable terms

Note that this is the introduction of a risk based element to verification. Identification of MAHs and SCEs is based purely on consequence.
Breadth and depth of examination

- **Breadth** tailored to be holistic and focus on performance standard requirements
- **Depth** tailored to account for:
  - historical failure rate data
  - avoidance of duplication of examination by others
  - product type approval/certification, EU conformity
  - proven design or product
  - complexity of design or manufacture process

- “End to end” testing is preferable and should be considered
The role of the duty holder

“Responsible for OSCR compliance”
The role of the duty holder

- Has overall responsibility for OSCR compliance
- Is subject to criminal sanctions under both OSCR and HSAW
- Production and submission (to HSE) of the Safety Case
- Identification of MAHs and SCEs
- Setting appropriate performance standards for SCEs and specified plant
- Implementation of the verification scheme
- Selection of an appropriate ICP
- Recording and acting on the results of examinations under the scheme
- Review and revision of the scheme
The role of the technical authority
The role of the technical authority

Plainly, the role of the duty holder as defined by OSCR cannot be fulfilled by one person within an organisation. A wide range of competencies and experience is required. While not defined in OSCR, it has become common practice for duty holders to appoint a number of technical authorities, with responsibility for particular SCEs, or groups of SCEs, probably along discipline lines.

Typically, a technical authority will be responsible for ensuring the continued suitability of those SCEs under his area of concern, including:

- selection and maintenance of appropriate performance standards
- ensuring that assurance and verification activities are carried out
- dealing with any recommendations or reservations expressed by the ICP
- technical review of any proposed changes to those SCEs
- interface between ICP and any third-party (i.e. design contractors)
- participation in management of change processes
- participation in verification scheme reviews
The role of the regulator

“UK Health and Safety Executive”
The role of the regulator

The UK Health and Safety Executive (HSE)

In general, responsible for:
• enforcement of the regulations – serving of improvement notices etc
• recommending prosecutions under the regulations if necessary
• upkeep and amendment of the regulations
• issuing guidance to the regulations
• review and acceptance of safety cases
• carrying out inspections
• may suspend or demand revisions to a safety case
• may grant exemptions to the regulations where appropriate
The value of verification

“Delivery of asset integrity assurance”
The value of verification

- Are the verification requirements of OSCR simply a piece of legislation which has to be complied with, but adds no value?
- Could be!
- Shouldn’t be!
- Realising the value of the verification process depends very much on the relationship between duty holder and ICP, both at an organisational level and between individuals responsible for executing aspects of the verification scheme
- It requires will and effort!
What OSCR provides

A cohesive framework for the delivery of asset integrity assurance focused clearly on major accident prevention. Based on:

- identification of MAHs
- identification of SCEs
- setting of performance standards for those SCEs
- written schemes of examination
- independent verification
- review and continuous improvement
What the ICP brings

**Independence**
- from duty holder’s internal issues and politics
- from design/EPIC contractor’s drivers
- from the delivery process

**Competence**
- in specific issues related to performance of SCEs and implementation of codes and standards
- in verification and the safety case philosophy in general

**Experience**
- across a range of duty holders, types of project and types of asset
- with a range of design contractors, vendors and fabricators
What is needed from the duty holder?

- Recognition of the value to be gained from both the process and the independence and experience of the ICP
- Determination to utilise this value
- Early engagement and consultation with the ICP
- Regular two-way feedback on verification activities
- Organisation structured to take advantage of the principles of OSCR:
  - responsibility for verification defined
  - technical authorities appointed
  - senior management awareness
  - infrastructure which supports status reporting for SCEs
What are the difficulties?

- Independence can be seen as a blocker to involvement – this is a tightrope which the ICP must walk
- Third parties (i.e. design contractors) must be engaged in the process, not see it as a threat
- While preserving independence, ICP must recognise project and duty holder drivers and the potential consequences of recommendations
- Poorly defined SCEs and performance standards may lead to poorly defined and executed verification activities
- Duty holders must visibly own the verification process – it must not be seen as a purely ICP activity
Summary

- The Offshore Installation (Safety Case) Regulations 2005 and associated legislation
- OSCR requirements for verification schemes
- The role of the independent and competent person (ICP)
- The role of the duty holder
- The role of the technical authority
- The role of the regulator
- The value of verification
Questions / further discussion
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