1 - MAHB - **Common Inspection Criteria**:

'Maintenance of Primary Containment Systems'

2 - New book from the Center for Chemical Process Safety **(CCPS):**

'Dealing with Aging Process Facilities and Infrastructure'

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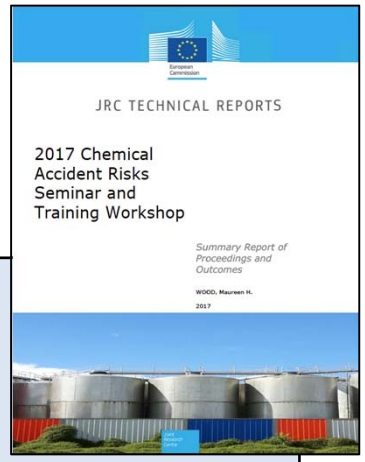
JRC MAHB Chemical Accident Risks Seminar - Ispra 2017

- Extract from the Report Summary:



3) Mechanical integrity

- Mechanical integrity is still a main cause of concern
  Examples: …UK …Italy …SMEs
- Risk assessments and risk-based decisions are often constructed on false assumptions about mechanical integrity
- Failure to recognise mechanical vulnerabilities has an enormous impact on the safety of the entire process
- Many accident scenarios feature mechanical integrity as the critical factor, or "weak link" in process safety

"Mechanical integrity may be an old issue, but it remains possibly the most fundamental principle of chemical process risk management"

Screenshot of MAHB Publications web page

European Commission

European Commission > JRC Science Hub > MINERVA

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Publications o

SITE INDEX: Lessons learned bulletins - practice exchanges - Special studies and rep Directive implementation - Land-use plannin - Scientific articles - IChemE Loss Preventic

NEW Publications and Report

Lessons Learned Bulletin # 13 – Incidents involving liquefied natural gas (LNG)

Link

Seveso In Practice R Petroleum Liquefied sites

seveso common INSPECTION series criteria

Pressure Relief Systems

This publication of the European community on Common Inspection Criteria is intended to share knowledge about technical measures and enforcement practices related to major hazard control and implementation of the Seveso Directive. The criteria have been developed by Seveso inspectors to aid in dissemination of good enforcement and risk management practices for the control of major industrial hazards in Europe and elsewhere.

This particular issue highlights a number of issues that are critical for successfully reducing risks through efficient and correct pressure relief systems. Poor design, inadequate maintenance and improper operation and training can all lead to the failure of pressure relief systems. Many major process accidents and incidents have been caused by relief system failures. Note that this document is not intended as a technical standard nor as a summary or replacement of any existing standards on the matter.

DEFINITION AND SCOPE

In this document, the term "Pressure Relief Systems" is defined as a combination of:

- One or more pressure relief devices (PRD)
- The inlet piping, i.e., the piping from the protected vessel to the inlet of the pressure relief device
- The outlet or discharge piping, i.e., the piping from the outlet of the pressure relief device to the atmospheric venting point, the flare, the blow down tank or any other system designed to handle the relief flow

Pressure relief devices protect a vessel against overpressure. A pressure relief device can be a pressure relief valve or a rupture disk.

A pressure relief valve is designed to automatically reclose and prevent the flow of fluid when pressure has dropped below the set pressure. There are various types of pressure relief valves: spring-loaded pressure relief valves, safety (relief) valves, balanced pressure relief valves, pilot-operated pressure relief

Figure 1. Reactor with a pressure relief system (U.S. Chemical Safety Board, 2018)

pressure relief device actuated by inlet static pressure and designed to function by bursting the rupture disk that is installed in a rupture disk holder. The rupture disk device includes the rupture disk and rupture disk holder.

A pressure relief system may consist of only one

CIC - MAINTENANCE OF PRIMARY CONTAINMENT SYSTEMS *FINAL DRAFT – Sep 2018*

Purpose

Provides guidance to inspectors on **assessing the adequacy of the arrangements** made by operators of Seveso III establishments for **maintaining primary containment systems:**

- the **technical and organisational measures**
  - described in the Major Accident Prevention Policy (in the Safety Report of upper tier operators)
- the **implementation of these technical and organisational measures**
  - through the operator's Safety Management System (SMS) of upper tier operators
  - and through appropriate means, structures and management systems, proportionate to major-accident hazards, for lower tier operators

It provides **a framework for inspection** and a means **to assess an operator's performance using defined success criteria**

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Scope *(non-exhaustive list):*

- Pressure vessels (including Heat Exchangers, Columns Reactors, Fired Heaters etc)
- Atmospheric storage tanks
- Rotating equipment (pumps, compressors, turbines etc)
- Valves
- Piping systems (pipe, fittings, flanges, supports etc)
- Pipelines inside the Installation (above ground or buried)
- Technology-specific containment systems: eg Driers; Filters; Condensers; Cooling Towers; Refrigeration systems, Powder Handling Systems; Underground Storage; Cryogenic Storage Vessels; Oil & Gas Wells, Wellheads, Flowlines; Mine Tailings Disposal Ponds; Dams
- Supporting structures for the above

NOT in Scope *(though important not to overlook…):*

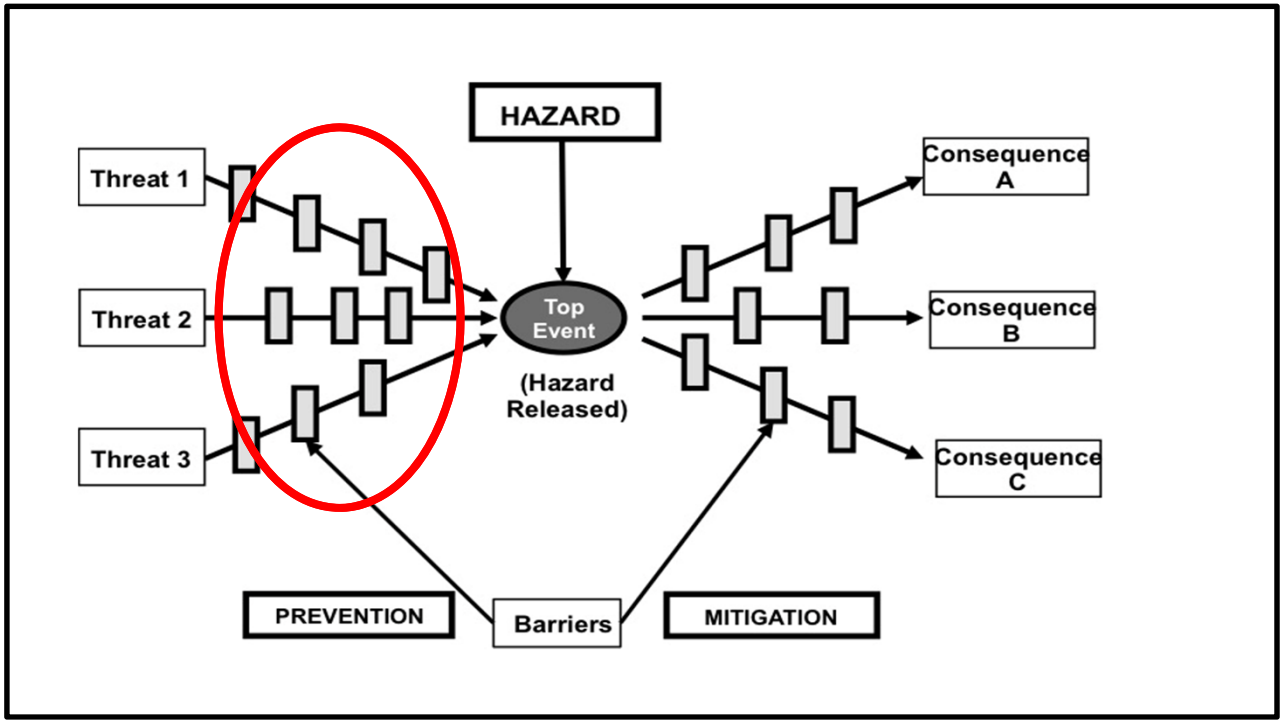
- Instruments, Control Systems, Alarms & Automatic Shutdown Systems associated with the above, including sensors, process connections, transmitters, tubing & fittings, cabling systems etc (REFER TO CIC ON INSTRUMENT SYSTEMS)
- Relief systems (Pressure Relief Valves, vent and flare systems) (REFER TO CIC ON RELIEF SYSTEMS)

CIC - MAINTENANCE OF PRIMARY CONTAINMENT SYSTEMS *FINAL DRAFT – Sep 2018*

Some particular known weaknesses:

- Small bore piping and instrument tubing
- Pump seals
- Bolted joints / flanges
- Corrosion Under Insulation (CUI) and corrosion under pipe supports
- High process temperatures, aggressive chemicals or high cycling rates (temperature or pressure)
- Obsolescence of Electrical, Controls & Instrumentation (EC&I) equipment
- Equipment items which are difficult to access
- Newly installed equipment
- Auxiliary items not directly involved in production such as:
  - Secondary / back-up pumps
  - ESD systems
  - Calibration of alarms and trips
- Temporary and experimental equipment
- Responsibility for shared plant such as internal connecting pipelines within an installation

Barrier-based approach – the left hand side of the Bow tie



Preventive barrier types:

- **passive** or **active**

- **Hardware**
- **Human** or
- **Combined hardware and human**

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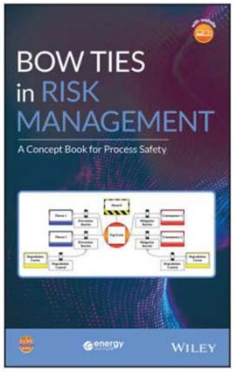

The Role of Inspections

…is to verify the adequacy of **Technical Measures** and **Organisational Measures**

A) Technical Measures

1. **Justification and reasoning behind maintenance programs**
   e.g. balance of preventive and reactive maintenance; frequency and scope of maintenance interventions

2. **Arrangements for periodic examination and assessment of Safety-Critical Elements**

3. **Competence of maintenance staff**

4. **Safe systems of work, integrating Human Factors good practice**

The Operator is expected to describe the above in the **Safety Report / MAPP**
and provide full details within their **management system**

Expectations: 1 - Justification and reasoning behind maintenance programs

- **An Asset Register** – listing all Safety Critical Elements (SCEs)
- **The Degradation Mechanisms** identified as credible for each SCE eg:
  - Corrosion; Erosion; Fatigue; Stress-corrosion; Creep; Embrittlement, Settlement;
  - Seismic; Physical impact; Over-stress; UV damage
  - Instrument drift; software failures
- **Justification for each SCE remaining in service**
- **Preventive Maintenance plans**
  - Defined interventions and intervals for each SCE based on:
    - Regulations; Industry standards; Manufacturers' instructions
    - Degradation data and trend analysis from records of **Operator's Inspection**, **Reactive Maintenance** and **Condition Monitoring Systems**
- **Quality management of maintenance work**
- **Records of all Preventive and Reactive Maintenance** for each SCE
- **Records of other maintenance-related issues**

Expectations: 2 - Arrangements for the periodic examination and assessment of SCEs

- **A periodic examination and assessment plan and records all SCEs**, based on
  - The Asset Register
  - Degradation mechanisms and rates (as determined in 'Expectations 1')
  - The principles of **Risk Based Inspection**
- **Inspection intervals**
  - to confirm that **minimum Performance Criteria** are met
  - based on the expected rate of degradation and the actual condition when last inspected
- **A process for and records of inspecting a SCE** and re-verifying its technical integrity if its Operating Limits have been exceeded beyond predefined values
- **Records of all examination and assessment of each SCE:**
  - Date, examination done and results
  - Historical trend analysis to identify degradation mechanisms and rates

Expectations: 3 - Competence of maintenance staff – including contractor personnel

- **Defined roles, responsibilities, accountability, authority and interrelation** of all people involved in **maintenance** and **inspection** of primary containment systems, based on an analysis of the safety-critical tasks

- **Defined competences required** of all the above people, based on
  - responsibilities
  - specific tasks and procedures
  - specific equipment worked on

- **Records of competence** assessments, including:
  - knowledge and proficiency tests
  - currency / recency of performing specific tasks
  - gaps and actions taken to address gaps (e.g training, experience, supervision, support)

Expectations: 4 - Safe systems of work, integrating Human Factors good practice

- **Safe working practices and procedures that:**
  - incorporate Human Factors good practice
  - Include work instructions and checklists etc.
  - are clear and easily accessible

- **and that cover the following:**
  - All tasks of maintenance and periodic examination and assessment
  - Supervision of contractors
  - Permit To Work
  - Isolation and making safe for maintenance and activities
  - Management of overrides
  - Communication within and between shifts, including handover
  - Fitness to work, including Fatigue management

The Role of Inspections

…is to verify the adequacy of **Technical Measures** and **Organisational Measures**

B) Organisational Measures - EXPECTATIONS:

- **Clear overall responsibility for Asset Integrity** of the Establishment (a named 'Asset Manager')
- A process and criteria for determining the Safety Critical Elements
- A process for incorporating plant changes, including changes in operating conditions, into the maintenance management system
- **Segregation of reporting lines and authorities** within Operator's management structure:
  - between 'Operations & Maintenance' and 'Operator's Inspection' / Integrity Tech Auth's
- **Direct access** of Operator's Inspection staff and Technical Authorities to the Asset Manager
- Use of **'Statement of Fitness'** issued by Asset Manager
- Regular frequent **audit of Asset Integrity** by the Operator
- Management review of the effectiveness of maintenance management
- Prioritisation and management of corrective actions
- Metrics

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3. COMAH Competent Authority Ageing Plant Operational Delivery Guide
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5. Best practice for risk based inspection HSE CRR 363/2001
6. Risk-based Inspection Methodology API RECOMMENDED PRACTICE 581 3rd Ed, 2016
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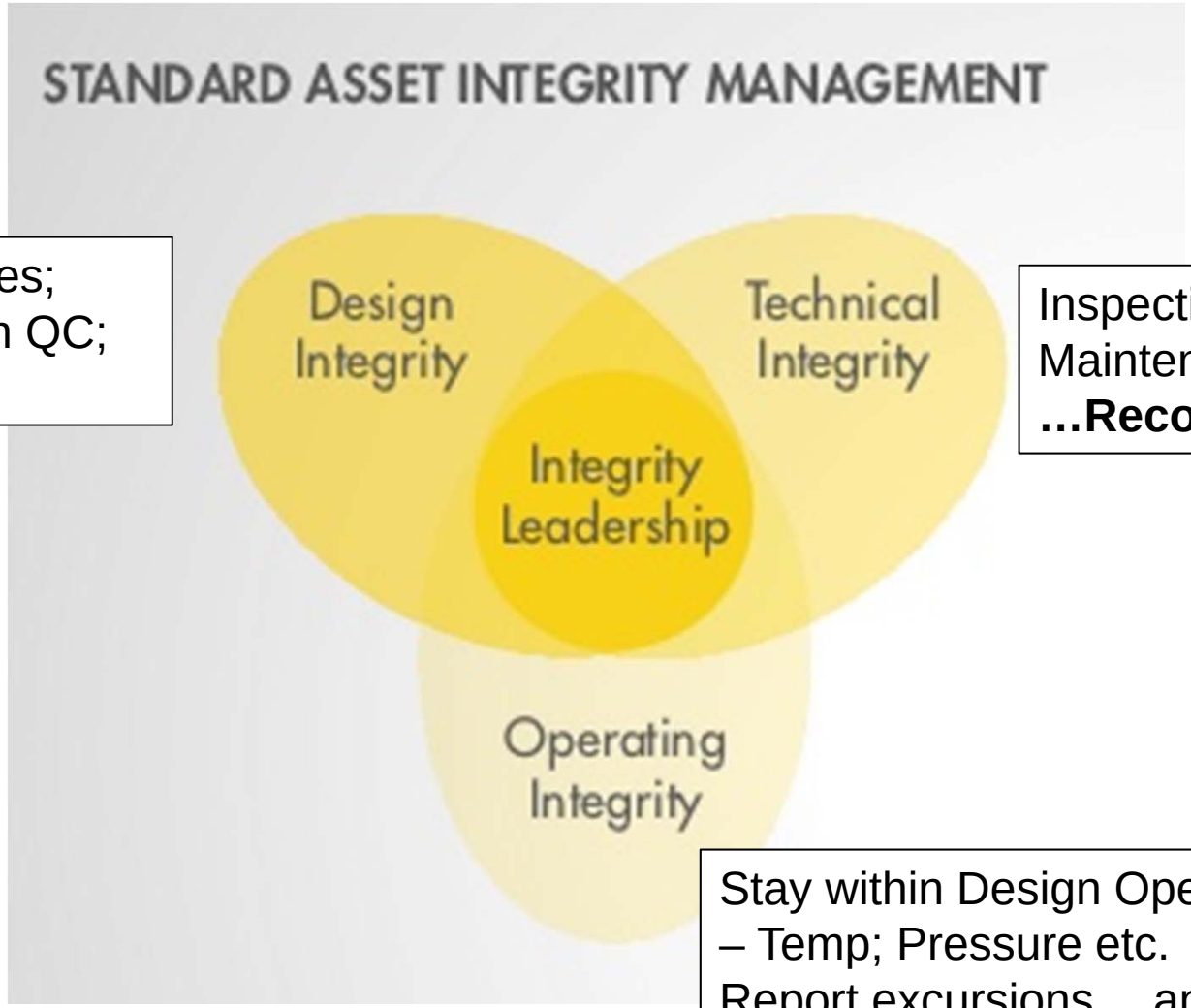
8. Energy Institute Human and Organisational Factors Guidance
9. HSE Guidance on Human Factors

Ageing … or Asset Integrity?



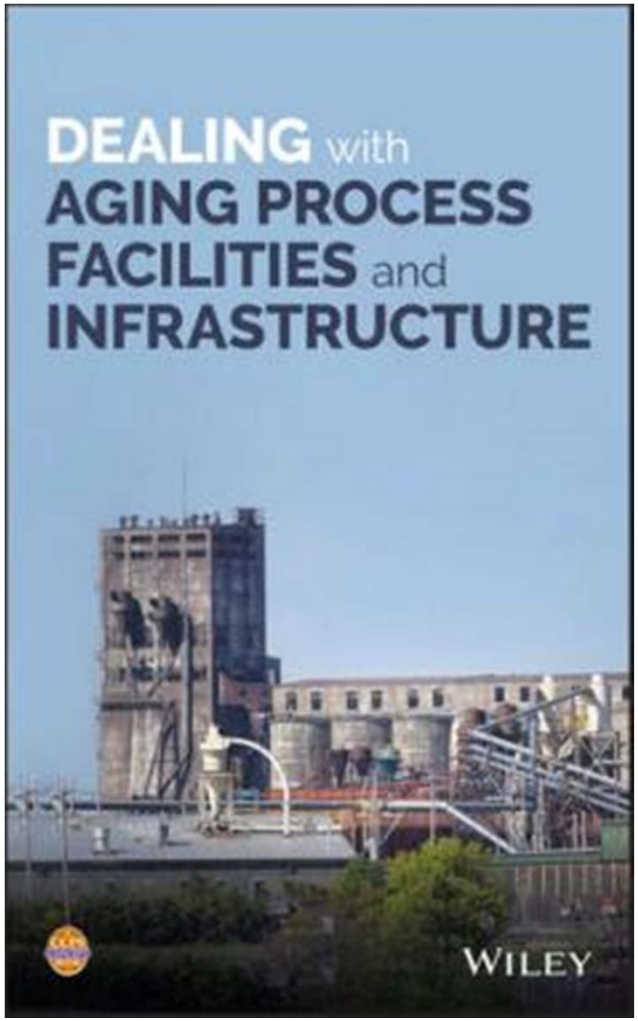
Design Codes;
Construction QC;
…Records

Inspection and Maintenance
…Records

Stay within Design Operating Limits – Temp; Pressure etc.
Report excursions… and manage!
…Records

NEW CCPS Book – Published April 2018

Available here as Hardback or E-book



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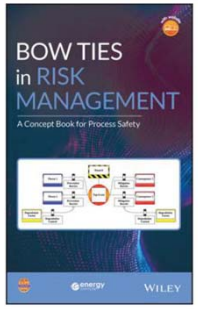

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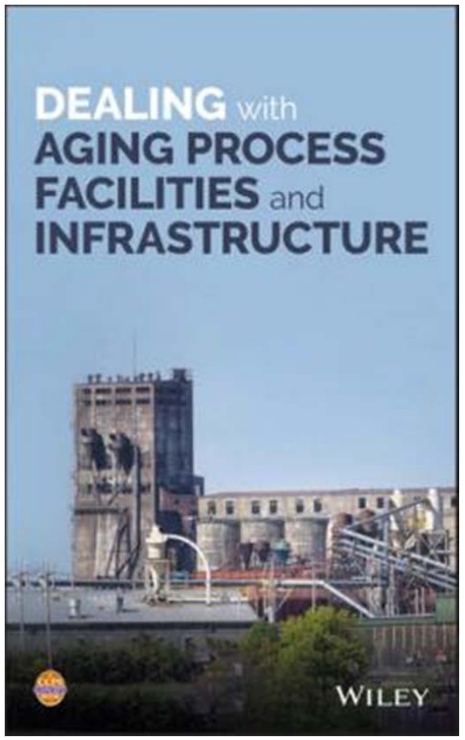

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