European Commission Joint Research Centre – Major Accident Hazards Bureau

Good Practice Report on Risk Management and Enforcement on Ageing Hazardous Sites - A Summary

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Background

- Many EU chemical plants are more than 25 years old; some more than 50
- 60% of major accidents in the EU's eMARS database relate to technical integrity and, of those, **50% had ageing as a contributory factor**

- Therefore, a **workshop on inspection of ageing sites** was organised by the European Commission's Joint Research Centre (JRC) together with the Maltese Occupational Health and Safety Authority in Qawra, Malta, from 8-10 April 2019

The workshop aims were:

- Achieving a clearer understanding of ageing and its specific risks
- **Defining expectations for hazardous site operators** in managing these risks
- Sharing inspection strategies and enforcement methods **for monitoring and improving ageing risk management**

Risks of ageing are not only present on “older sites”

Ageing starts with the project to design and build the plant

Even quite “young” plants can develop ageing-related risks if:

- not maintained and operated properly
- changes are not managed properly
- design or construction flaws are not identified and corrected

Conversely very old plants can continue operating safely if:

- operations, maintenance, inspection and changes are all managed properly
- the procedures and other safety-critical documentation are kept up to date
- the design is routinely reviewed and modified to remain aligned with ALARP
- the organizational capacity, competence and culture remain adequate

*All of these are essential for the effective **Management of Asset Integrity,** and they all rely on effective **Leadership and Governance***

Strategic approaches to targeting ageing risk factors

1. Focus on **Asset Integrity Management** of **Safety Critical Elements (SCEs)**

   A **Safety Critical Element** is a part of a plant (including IT systems):
   a) whose failure could contribute substantially to a major accident
   or
   b) whose purpose is to prevent or limit the effect of a major accident

2. Focus on **Leadership and Governance**

   Ageing risks may be increased by **change in circumstances**, e.g., ownership change, prolonged economic downturn, reductions in staffing, inadequate management of contracting...etc

3. Make use of **JRC MAHB Guidance**

   JRC publications on Common Inspection Criteria provide technical guidance on managing a number of topics: Maintenance of Primary Containment Systems, Management of Change, Safety Instrumented Functions, Pressure Relief Systems...etc

How does ageing affect process safety risk?

- **Corrosion** is a major factor, **especially of piping** – including:
  - CUI (Corrosion Under Insulation)
  - CUPS (Corrosion Under Pipe Supports)
  - Small bore / instrument tubing
  - Bolting (e.g. galvanic corrosion from use of incorrect materials)
  - Underground / inadequate CP (Corrosion Protection)

BUT – It's not just about corrosion!

Risks of ageing take many forms:

- **Degradation of plant and equipment (especially 'SCE's)**
- **Obsolescence of technology**
- **Obsolescence of procedures** (and other safety-critical documentation)
- **People and organization**
- **Cyber security**

Degradation of plant and equipment (especially 'SCE's)

Important underlying factors that that lead to this ageing risk are:

- Inadequate **identification** of Safety Critical Elements (SCEs)
- Inadequate **monitoring of SCEs** - lack of Risk Based Inspection (RBI)
- Inadequate **Management of Change** (MoC)
- Improper operation of plant - outside the design intent

Risk management expectations:

Rather than viewing ageing as applying only to "old" plants, ***the asset integrity of all SCEs should be managed systematically, using RBI:***

- **Identify all the SCEs** of a plant, using a risk-based approach
- Maintain an **Asset Register** listing all the SCEs with their operating limits and minimum performance criteria
- Manage the condition of each SCE, taking account of its known **degradation mechanisms** and observed **degradation rates**

Obsolescence of technology

Important underlying factors that that lead to this ageing risk are:

- Inadequate **design review**
  (...is the design still ALARP?) [...atmospheric vents? overfill protection?...]

- Inadequate **procurement management**
  (are spare parts and OEM technical support still available for SCEs?

Risk management expectations:

- Routine plant design reviews against current standards, e.g. 'As Low As Reasonably Practicable (ALARP), Inherent Safety, Safety Integrity...
- Procurement strategy for SCEs that includes routine review of availability and quality management of spare parts and technical support
- Frequency of reviews **should be determined on a risk basis**

Obsolescence of procedures (and other safety-critical documentation)

Important underlying factors that that lead to this ageing risk are:

- Failure to transfer critical information to contractors
- Insufficient checking that procedures are followed in practice
- Incomplete/incorrect drawings, datasheets, construction QA/QC records etc
- Inadequate audit of procedures and other safety-critical documentation

Risk management expectations:

- An effective **document management system** for all safety-critical documentation, including:
  - Records of plant design and construction QA/QC
  - Plant operating procedures
  - Maintenance & inspection procedures and records for all SCEs
  - Management of change (MOC) records
  - Competence records, including contractor personnel

People and organization

Important underlying factors that lead to this ageing risk are:

- Inadequate **Organizational Management of Change**, for example for:
  - Changes in ownership; Changes in management
  - Downsizing / Loss of personnel due to retirement
  - Increased reliance on contractors
- Loss of **technical competence specific to the plant** and knowledge of the history of changes that have been made over time

Risk management expectations:

- Effective **management of the resourcing of safety-critical roles**:
  - Plant operators and maintenance technicians
  - First line supervisors
  - Professional engineers
  - Operations managers
  - Plant / site managers and other senior leadership positions
- Effective **Leadership and Governance**

Cyber Security

Important underlying factors that lead to this ageing risk are:

- IACS - Industrial Automation & Control Systems (DCS, PLC, SCADA...) are **increasingly web-based**, allowing remote access, ***greatly*** **increasing cyber security risks**
- IACS integrity can be compromised by similar ageing mechanisms as physical plant: degradation, obsolescence, loss of technical competence... and **IT systems tend to age more rapidly** than physical plant

Cyber attacks *on industrial plant are becoming more frequent...*

Risk management expectations:

- Effective management of IACS / IT integrity and security **within the SMS**, including:
  - Interfaces with old and new systems
  - Vulnerable equipment
  - Controls over passwords and systems access
- Wariness about potential IACS / IT weaknesses and **cyber attack vulnerabilities**

Monitoring, Promoting Improvement and Enforcement

The ***Good Practice Report*** includes these practical tools for for use by Inspectors:

- A list of **Potential signs of elevation of ageing risks**
- Example **Inspection Visit Plan and Checklist** for Ageing / Asset Integrity Management
- Example **Inspection Visit Agenda**

MAHB Good Practice Report on Risk Management and Enforcement on Ageing Hazardous Sites

GOOD PRACTICE REPORT

Risk Management and Enforcement on Ageing Hazardous Sites

This short report as a tool for use in inspecting EU Seveso and other hazardous sites to monitor and promote improvements in the management of risks associated with ageing of people, infrastructure, equipment and systems. It provides an overview of the various types of ageing and how it affects safe operation and risk. The report describes a number of practices and strategies that have been developed by operators and inspectors to heighten awareness and strengthen management of these risks. In addition, some examples of strategies for inspections of ageing hazardous sites are provided, including a sample agenda for inspections targeting management of ageing risk.

In the European Union, a substantial number of chemical processing plants and petroleum refineries began operations at least two decades ago including a considerable number that are more than 50 years old. A study conducted by the UK Health and Safety Executive in 2010 estimated that over 60% of the approximately 450 major accidents reported to the EU's eMARS database from 1996 to 2006 were related to technical integrity and, of those, 50% had ageing as a contributory factor.[1] Corrosion alone has been attributed as a cause of at least 20% of major accidents in petroleum refineries in EU countries between 1984 and 2012.[2] As indicated in Figure 1, it is a multi-faceted phenomenon consisting of different types of ageing risks that must be recognised and addressed. Moreover, there is clear evidence that ageing of hazardous sites is an important risk factor common to all industrialized countries and therefore, requires the serious attention of government authorities and in particular the relevant inspectorates. [3]

For this reason, a workshop on inspection of ageing sites was organised by the European Commission's Joint Research Centre (JRC) together with the Maltese Occupational Health and Safety Authority in Qawra, Malta, from 8-10 April 2019. The workshop aimed specifically at:

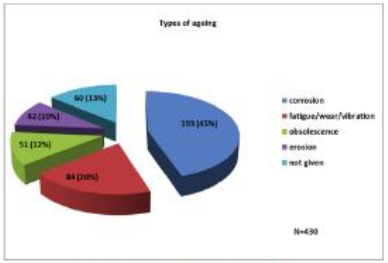

Figure 1: Types of ageing (JRC, 2016) [4]

- Achieving a clearer understanding of ageing and the specific risks associated with ageing
- Defining minimum expectations for hazardous site operators in managing these risks
- Sharing inspection strategies and enforcement methods for monitoring and improving ageing risk management

1. Risks of ageing are not only present on "older sites"

Ageing starts with the project to design and build the plant. Even quite "young" plants can develop ageing-related risks if not maintained and operated properly or if unmanaged changes are made, or indeed, if design or construction flaws are not identified and corrected.

Available from the JRC MAHB [Minerva website]