Ageing of hazardous installations

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Current supporting partners and collaborators
What is ageing?

“AGEING IS NOT ABOUT HOW OLD YOUR EQUIPMENT IS; IT’S ABOUT WHAT YOU KNOW ABOUT ITS CONDITION, AND HOW THAT’S CHANGING OVER TIME”

(Plant ageing RR509 HSE, UK 2006)
Aspects of ageing

Ageing is a multi-aspect phenomenon

- Equipment
- Memory/expertise
- Procedures/technology
The challenge

From the day of their construction:

• Older facilities see significant developments and changes in engineering, policy and regulations, and in the overall socio-economic conditions under which they operate.

• Introduction of legislative frameworks, the development of new safety standards and new operating procedures following new discoveries in science and engineering - need for an upgrade in many of the facilities.
Equipment – physical ageing

- Modifications/ Change of use
- Obsolescence
- Degradation – fiberglass and concrete, too
- Wear and tear
- Control systems manual/electromechanical
- Electrical and electronic systems
- Safety systems; standard and provision
- Retrospective HAZOP; procedural fixes
- Corrosion under insulation
People

- Fluctuation
- Loss of corporate memory
- Change in role
- Retirement – loss of continuity
- Reorganisation
- Transfer of knowledge
- Lack of knowledgeable expertise from suppliers
- Third party workers
- Perception that knowledge can be bought in
Procedures

• Documents
• Operating procedures
• Standards
• Loss of records for inspection and maintenance
• Failure to update map/drawings/contact list
• Change in ownership/reorganisation
• Loss of documentation about design
• Operating procedures obsolete
Common issues

• The engagement of third party personnel – insufficient knowledge
• Missing or incomplete documentation on the design, operation and history of the facility
• Loss of knowledge about the design and operation of the plant
• Inappropriate design of the equipment (premature ageing)
• Inadequate inspection plans
• Inspection body reduces frequency of inspections
• Lack of Hazard identification/risk assessment
# How to measure - metrics

<table>
<thead>
<tr>
<th>Elements</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge and competence</td>
<td>Conformance with ProcessSafety related role competency requirement</td>
</tr>
<tr>
<td>Engineering and design</td>
<td>Deviations to safety critical elements (SCE)</td>
</tr>
<tr>
<td></td>
<td>Short term deviation to SCE</td>
</tr>
<tr>
<td></td>
<td>Open management of change on SCE</td>
</tr>
<tr>
<td></td>
<td>Demand on SCE</td>
</tr>
<tr>
<td></td>
<td>Barriers failing on demand</td>
</tr>
<tr>
<td>Systems and procedures</td>
<td>SCE Inspections Performed Versus Planned</td>
</tr>
<tr>
<td></td>
<td>Barriers fail on test</td>
</tr>
<tr>
<td></td>
<td>Damage to primary containment detected on test/inspection</td>
</tr>
<tr>
<td></td>
<td>SCE maintenance deferrals (approved corrective maintenance deferrals following risk assessment)</td>
</tr>
<tr>
<td></td>
<td>Temporary operating procedures (TOPs) open</td>
</tr>
<tr>
<td></td>
<td>Permit to work checks performed to plan</td>
</tr>
<tr>
<td></td>
<td>Permit to work non-conformance</td>
</tr>
<tr>
<td></td>
<td>Number of process safety related emergency response drills to plan</td>
</tr>
<tr>
<td>Assurance</td>
<td>Number of process safety related audits to plan</td>
</tr>
<tr>
<td></td>
<td>Number of non conformances found in process safety audits</td>
</tr>
<tr>
<td>Human factors</td>
<td>Compliance with critical procedures by observation</td>
</tr>
<tr>
<td></td>
<td>Critical alarms per operator hour (EEMUA, 1999)</td>
</tr>
<tr>
<td></td>
<td>Standing alarms (EEMUA, 1999)</td>
</tr>
<tr>
<td>Culture</td>
<td>Open process safety items</td>
</tr>
<tr>
<td></td>
<td>Number of process safety interactions that occur</td>
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</tbody>
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Engineering & design

- Deviations to SCE
- Short term deviation to SCE
- Open management of change on SCE
- Demand on SCE
- Barriers failing on demand
Engineering & design ageing

- Corrosion
- Erosion
- Obsolescence
- Fatigue
- Worn equipment
Systems & procedures

- SCE inspections performed verses planned
- Barriers fail on test
- Damage to primary containment detected on test/inspection
- SCE maintenance deferrals
- Temporary operating procedures
- Permit to work checks performed to plan
- Permit to work non conformance
- Number of process safety related emergency response drills to plan
Systems & procedures-ageing

- SCE fit for purpose
- Obsolescent emergency response plan and operating procedures in place
- Inspection programme is not updated
- Switch from analogue to digital
Assurance

• Number of process safety related audits to plan
• Number of non conformance found in process safety audits
Assurance - ageing

- Audits should address aspects related to ageing
- Follow-up after audit and implementation of findings
- Monitoring sign of ageing
- Record data
Human factors

- Compliance with critical procedures by observation
- Critical alarms per operator hour
- Standing alarms
Human factors - ageing

- People can age
- Lack of transfer of knowledge
Culture

- Open process safety items
- Number of process safety interactions that occur
Culture - ageing

- Process knowledge is maintained and transferred
- Keeping records of installation specifications
ISC Safety Lore

- Case studies
- Key learning points
- „What can I do” session
- An mp3 podcast of all Lores

https://www.icheme.org/knowledge/safety-centre/resources/safety-lore/
https://soundcloud.com/user-182199992/talking-safety-lore-dec-2018
Case study - corrosion

- A pipe in the crude distillation unit ruptured, releasing flammable hydrocarbon process fluid.
- The flammable liquid partially vaporized into a large vapor cloud engulfing nineteen employees.
- After two minutes the flammable portion of the vapor cloud ignited.
- All of the employees escaped, narrowly avoiding serious injury.
Key learning points

- Poor operating procedures in regard to mechanical integrity.
- Operator overlooked:
  - Pipe wall thinning due to sulphidation corrosion
  - Over a period of 35 years, the piping component lost 90% of original wall thickness near the rupture.
- A team of experts on site in sulphidation corrosion but not involved in decision making within the unit affected.
- Lack of hazard identification.
- Inherently safer design – material selection.
- Ineffective inspection.
Challenges

- Plant integrity – recognition of ageing assets.
- Maintenance – inspections and testing needs to adapt to the equipment; changes in age and condition are constant
- Leadership – auditing, monitoring, prioritising.
- Competence – skills, knowledge and expertise relevant are present and taken into consideration.
- Identification of SCE and have them documented.
- Resources – knowledge is transferred and maintained.
- MoC – change of ownership and other changes.
- Being an intelligent customer – third party workers.
- Hazard identification and risk assessment – understanding degradation methods and address in.
- Design – archive of old plant layouts, maps, documents and parameter settings.
Strategies

Replacement strategy and assessing remaining life

- Understanding the base line conditions/performance
- E.g.: function, availability & reliability
- Check if historical data is available about degradation rate
- Involvement of experts on the related field.
- Understanding maintenance records data – what do they tell us?
- Setting priority in measuring performance – not same rigour to address everything.
- Consider audience – CEO look for data to support financial decisions; operations managers look for data to support replacement strategy.
Questions

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