Webinar. Technical Working for Seveso Inspections (TWG 2)

*"Ageing and Primary Containment Maintenance on Seveso and other Hazardous Sites"*

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# Analysis of accidents and good inspection practices for the management of ageing of industrial plants in Italy

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# The role of ISPRA for industrial control

- ISPRA has a national role as a technical body supporting the Ministry of Environment in the national implementing of the Seveso Directives for the prevention of major accidents
  - Definition of technical contents of laws and decrees to control Major Accidents
  - Set-up of the National Inventory of major accident hazards establishments and other related data-bases
  - Inspections of upper-tier establishments SMS on regular basis or after an accident
  - Support for international activities (EU, OECD, bilateral cooperation)
  - Technical coordination and addressing of Regional Agencies for the Protection of Environment (ARPA)
  - Collaboration with other Authorities competent for industrial risk (Ministry of home affairs – National Fire Brigades; Department of civil protection; Ministry of infrastructures)

# Program and themes

1. Introduction
2. Industrial accidents and plant aging
3. Italian law, national standards and guideline
4. An approach to good practices
5. The analysis of inspections
6. Conclusions

- Introduction and background
- Risks related to ageing

# 1. Introduction

# Introduction and background

- The Italian implementation of the Seveso III directive (2012/18/EU) is the D.Lgs. 105/2015, aiming at the prevention of major accidents involving dangerous substances
  - Site Operators are obliged to take all necessary measures to prevent major accidents a/o limit their consequences for health and environment
  - Depending on the amount of dangerous substances present, establishments are categorized in lower and upper tier

# Control of the risks related to ageing

- As part of the implementation of the Safety Management System for Prevention of Major Accident (SMS-PMA), the D.Lgs. 105/2015 imposes
  - Monitoring and control of risks related to ageing of equipment and systems that can lead to loss of containment of hazardous substances, including the necessary corrective and preventive measures

- Ageing mechanisms as potential contributors
- Some national cases

# 2. Industrial accidents and plant aging

# Ageing mechanisms as potential contributors

- Main results of the analysis of some industrial accidents, which recently occurred on the national territory at "Seveso" establishments (refineries and chemical plants), identified
  - Mechanisms related to aging, as significant causes, both in technical and organizational terms

# Fire and explosions in piping

| Description | Causes | Actions | Expected/Planned |
|---|---|---|---|
| Release of **crude oil** from transfer **pipe** in the **underpass** of the road that crosses the plant, that developed a **fire by accidental triggering** which subsequently **involved the adjacent piping** belonging to different operators and then **a series of explosions** (Domino Effect) | **Age (over 25 years)** and state of preservation of the **pipe** in relation to the **progressive corrosion** phenomena, which led to the pipe drilling | **Visual inspection** and **basic design** of corrective actions. Necessary **reconstruction** activities. | Specific **risk analysis**. Planned and/or **required compliances** following Competent **Authorities** examination. Check of the **pipeline inspection plan** |

# Leakage through the tank bottom

| Description | Causes | Actions | Expected/Planned |
|---|---|---|---|
| Leakage of **oil** through a large **lesion** at the **bottom** of a floating roof **tank** and subsequent **release of the total amount** of oil inside the containment **basin** | High **corrosion** and **deteriorated** area | Tank **insulation**. **Transferring** the product to **another tank** with temporary pipes | Tank **out of service**. Carrying out the **remediation and maintenance** of the basin and the tank. **Double bottom** insertion |

# Spill of sulphuric acid from a supply pipe in an underground channel

| Description | Causes | Actions | Expected/Planned |
|---|---|---|---|
| A **spill** occurred in the **buried channel** housing the **pipeline connecting 6 storage tanks** of sulphuric acid. This spill of **H2SO4 in the subsoil** caused the structural **failure of one tank** and the relative **rotation of the base** of the containment **basin** | Advanced **corrosion** in a section of this **pipeline not accessible** to the controls.<br>It has been supposed a **duration of the spill** in the subsoil of about **40 days**, for a total of H2SO4 spilled from the pipe equal to **about 45 t** | H2SO4 **tank emptied** of the product.<br>Supply **lines intercepted** and further **tank isolated**.<br>Monitoring and **verification of the deformation** of structures.<br>The **perimeter wall** of the containment **basin** has been **reinforced**, in order to ensure the seal of the basin itself | Scheduled **maintenance on H2SO4 tanks**.<br>**Monitoring of corrosion** of these tanks and of the loading pipes, for the **calculation of the corrosion rate** in the short and long term and of the **residual life** (new procedure) |

# Presence of diesel in piezometers near a storage tank

| Description | Causes | Actions | Expected/Planned |
|---|---|---|---|
| Following the **sampling at 2 piezometers**, located near a **storage tank** containing **diesel**, the presence of a **supernatant hydrocarbon** product of the same type in the tank was found. Spill of about **1000 cubic meters of diesel in the subsoil**, following a **leak** from a storage tank | **Corrosion in the single bottom** of the tank, although this had been subject to **maintenance work on the bottom in the previous 2 years** (application and welding of **overlapping sheets** on the existing bottom) | Construction of a **draining trench** north of the tank and commissioning of **new piezometers**. Update of the **operational protocol** for the hydro-chemical and piezo-metric **monitoring of groundwater** | Implementation of the **double bottom on all tanks of hydrocarbon** products, with **viscosity** lower than 12 ° E at 50 ° C, with a single bottom. **Review of the aging management program** of the tanks |

- National and technical standards
- Supporting for ageing evaluation

# 3. Italian law, national standards and guideline

# National and technical standards

- Tools for the implementation of an effective SMS (UNI 10617, 10616, 10672, 1226)
  - "State of the art" in the D.Lgs. 105/2015 and meet the requirements of the law and the ISO standards
- Technical standards, specific for pressure equipment (UNI/TS 11325-8, 11325-9)
- Risk Based Inspection (RBI) and Fitness For Service (FFS) methodologies
  - A targeted planning of maintenance operations and accurate monitoring

# Supporting for ageing evaluation

- Development of a method for a base evaluation of the adequacy of ageing consideration in the frame of the asset integrity management
  - It is useful for site managers (qualitative assessment) and for inspectors (evaluation of the implementation)
  - Role of Public Administration in addressing the control of risks associated with aging

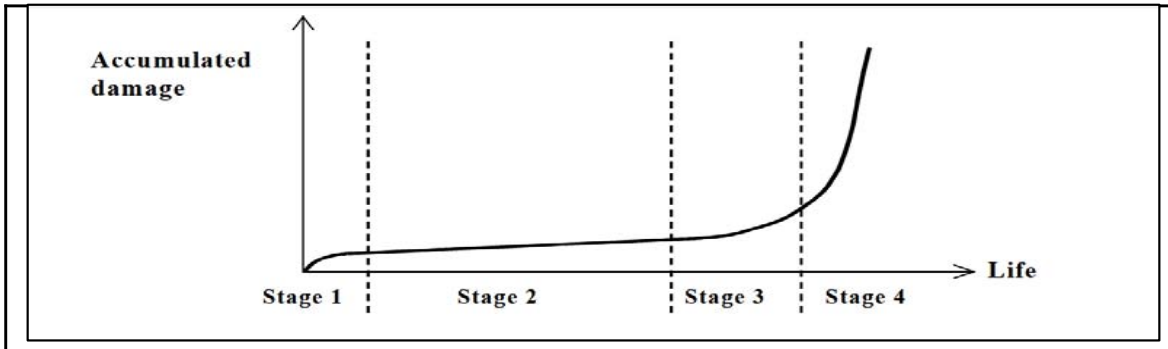
- Implementation of maintenance standards
- Influence of ageing on equipment
- Ageing and methodologies
- The primary containment system

# 4. An approach to good practices

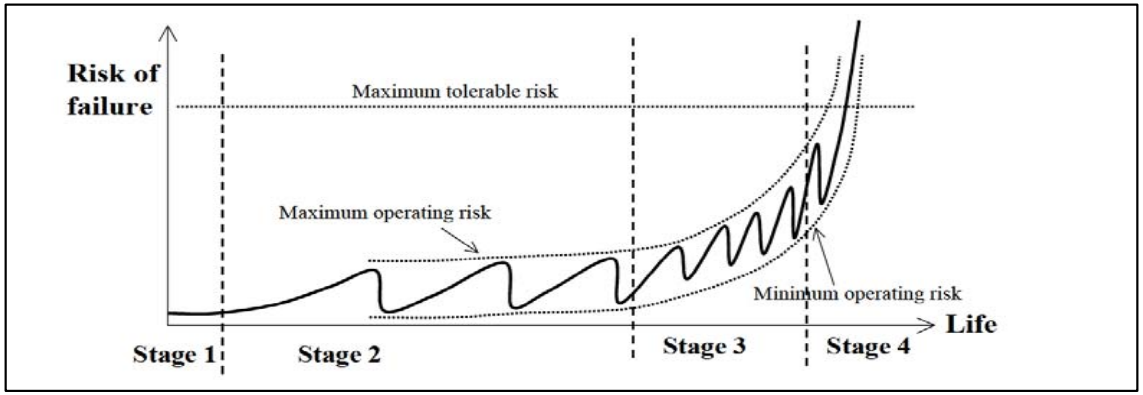
# Implementation of maintenance standards

- Preventive, scheduled, or corrective maintenance of critical equipment or lines may be performed in accordance with the Risk Based Maintenance (RBM) Policies/Practices
  - They shall minimize the risk of loss of functionality
- Ageing is not strictly related to the age of the equipment, but to its changes over time
  - It can lead to significant deterioration and/or damage to initial conditions, compromising functionality, availability, reliability and safety

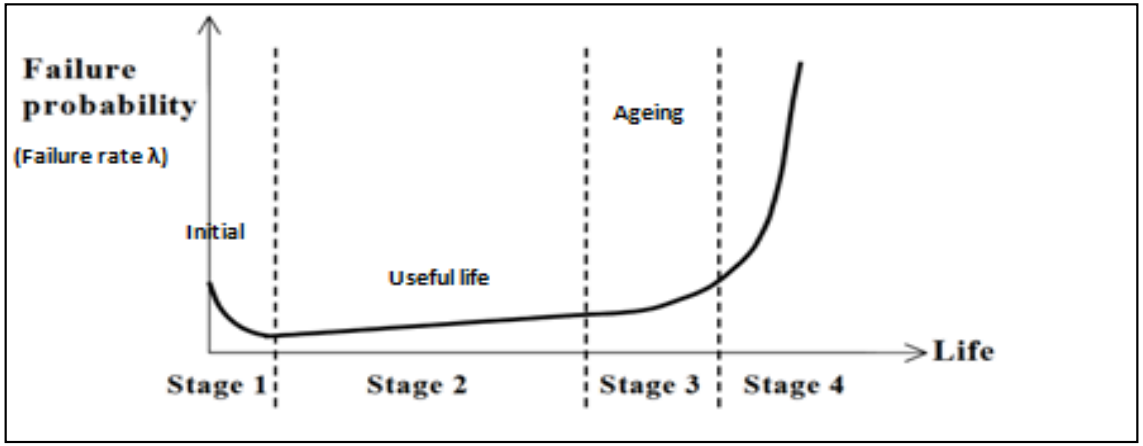
# Influence of ageing on equipment




Variation of accumulated **damage during the service**




Effect of **periodic maintenance** on the risk of failure, varying **between tolerable risk and operating risk**




Model for the **probability of failure** of a population of equipment: the **"bathtub curve"** shows the typical **four stages of the progressive ageing**

# Ageing and methodologies

- It is possible to schedule a targeted maintenance-planning, based on the **RBI method**, which consists of specific inspection activities according to the actual operating conditions of the equipment
- Through the **FFS method** you can continue to maintain in operation, with accurate monitoring, equipment that has a structural degradation
- In addition, the "Management of Changes" is crucial
  - It is important to keep records of the operating history and problems encountered during the life

# The primary containment system

- A possible approach to ensure mechanical integrity
  i. Defining the degradation mechanisms
     - ✓ *Corrosion / Mechanisms not related to corrosion*
  ii. Defining and personalizing inspection technologies
     - ✓ *Liquid penetrant testing / Magneto-scope test / Vacuum box test / Ultrasonic (long range) / Spark test / Acoustic Emissions*
  iii. Determining the frequency of inspections
     - ✓ *Construction / Repair techniques and materials / Stored product / Previous inspection / Corrosion rates / Corrosion prevention systems / Potential contamination / Double bottoms or other systems / Leak detection systems with operating tanks*

- Non-compliances found on SMS

# 5. The analysis of inspections

# Non-compliances found on SMS

- The main findings of the inspections on the SMS, conducted in the last three years in Italy
  - Critical issues emerged regarding the aging and asset integrity problems of industrial installations
    - ✓ *Need to consider and analyze the problems of ageing (corrosion, erosion, fatigue) of equipment (no procedure)*
    - ✓ *No evidence of a plan for monitoring the ageing, unless it is in accordance with law obligations*
    - ✓ *Developed a well-structured Asset Integrity Management procedure, but partially implemented (no evidence)*
    - ✓ *Lack of a specific procedure containing: Analysis of degradation mechanisms; A fixed-term monitoring plan; Preventative and corrective actions*

- Risks of plant ageing and SMS implementation

# 6. Conclusions

# Risks of plant ageing and SMS implementation

- Plants are subject to degradation phenomena and the effects of operational changes
  - It is useful to know the performance decay rates to plan adequate maintenance activities, and to identify the most suitable NDTs for assessing the damage
- The correct implementation of the SMS plays a considerable role, in order to ensure safe operational continuity of equipment
  - The RBI and FFS methodologies can constitute a valid response in the management of asset integrity issues and its correlation with aging phenomena

*Questions…???...*

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# Thanks for the attention!