MJV for Seveso Inspections on

RISK MANAGEMENT AND ENFORCEMENT FOR AGEING SITES

10-12 April, 2019, Malta

Ageing of hazardous installations in Italian Seveso establishments: accidents, results of inspections and good practices

Romualdo Marrazzo

Service for Risks and Environmental Sustainability of Technologies, Chemical Substances, Production Processes and Water Services and for Inspections

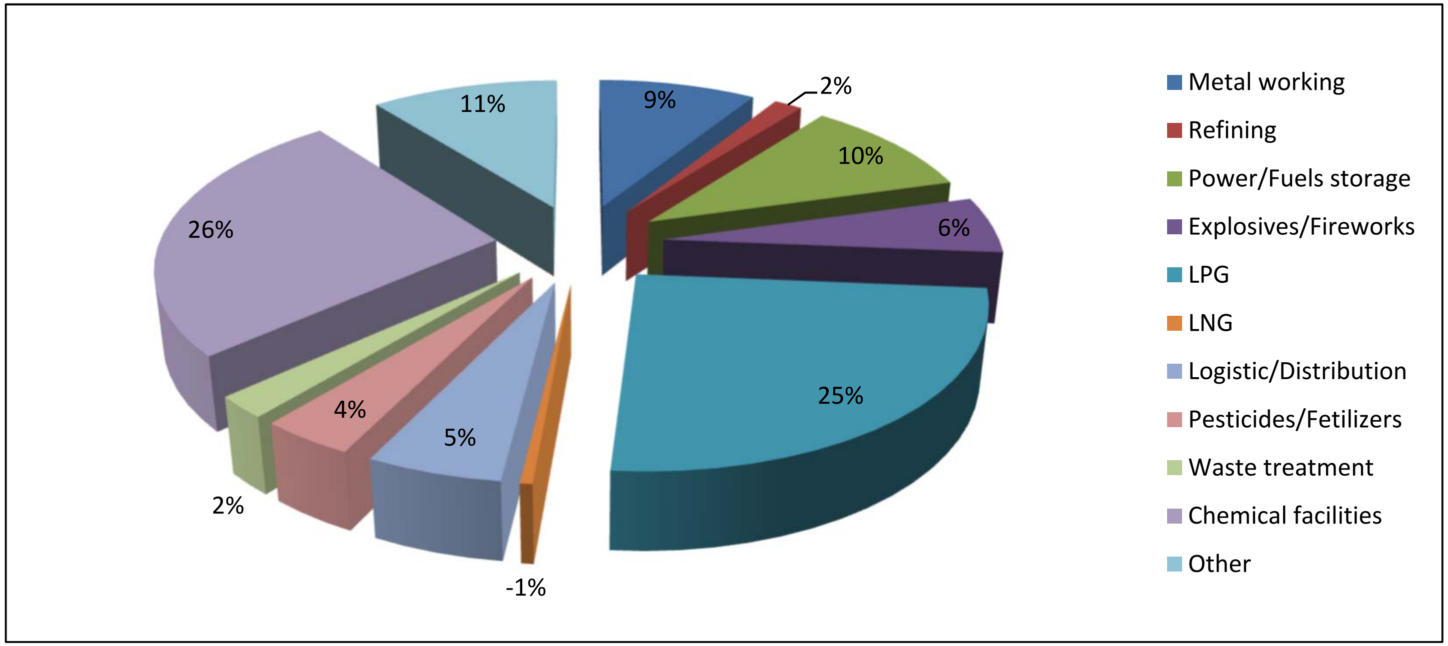
ISPRA - Italian National Institute for Environmental Protection and Research

Introduction and Background

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 (last: D. Lgs. 105/2015)
  - 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)

The Italian situation: 1000 Seveso sites



The control of the risks related to ageing in D. Lgs. 105/2015

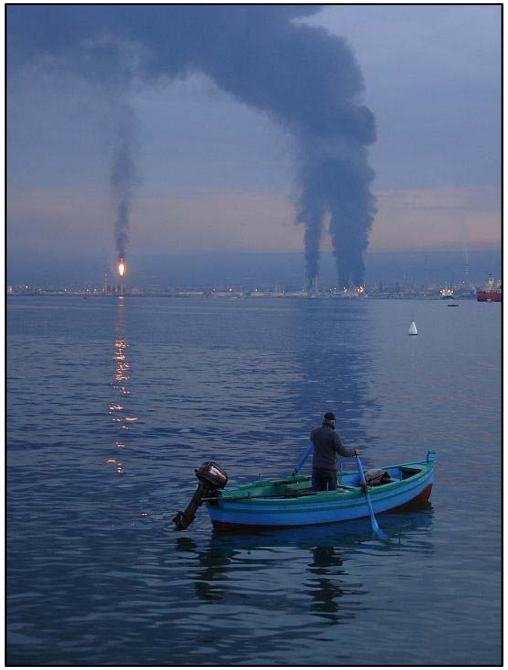
- ***<u>Annex 3 (information on the SMS-PMA)</u>***
  - Operational control issue is among the elements to be taken into account for the purpose of implementing SMS: ...management and control of the risks associated with ageing equipment installed in the establishment and corrosion...
- ***<u>Annex B (GL for SMS-PMA implementation)</u>***
  - Among technical content of SMS, operational control is a key element: ... In addition, plans for monitoring and controlling the risks of ageing (corrosion, erosion, fatigue, creep) of equipment and installations, that can lead to LOC of dangerous substances, must be provided, including necessary corrective and preventive measures ...
- ***<u>Annex H (Criteria for conducting inspections)</u>***
  - Check-list for SMS-PMA inspections ("ageing" item)

Some industrial accidents occurred at chemical and petrochemical Italian establishments

Refinery plant, Priolo Gargallo (SR)

Date: 30/04/2006	**Title**: Fire and explosions in piping		
Synthetic description: 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 and then a series of explosions			
Causes: Age (over 25 years) and state of preservation of the pipe in relation to the progressive corrosion phenomena, which led to the pipe drilling			
Organizational factor / Description		**Actions taken**	**Expected / Planned actions**
Emergency planning - Consequences analysis, planning and documentation		Internal emergency plan activation with major risks emergency forwarding. Intervention of refinery and neighboring establishments fire departments and local Fire Brigade	Internal emergency plan check
Identification and evaluation of major hazards – Planning for plant and management compliances to risk reduction and updating		Investigation to find out the causes of the accident. Visual inspection and basic design of corrective actions. Necessary reconstruction activities	Specific risk analysis. Planned and/or required compliances following CA examination. Check of the pipeline inspection plan

Fires and explosion at the refinery plant



The pipeline rack after the event

Refinery plant, Taranto

Date: 01/05/2006	**Title**: Leakage through the tank bottom		
Synthetic description: Leakage of oil through a large lesion at the bottom of a floating roof tank and subsequent release of a significant amount of oil inside the containment basin			
Causes: High corrosion and deteriorated area			
Organizational factor	**Description**	**Actions taken**	**Expected / Planned actions**
Operational control - Identification of installations and equipment subject to maintenance plans	Release of oil inside the containment basin	Tank insulation. Covering the spilled oil with foam to limit the vapor emission. 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

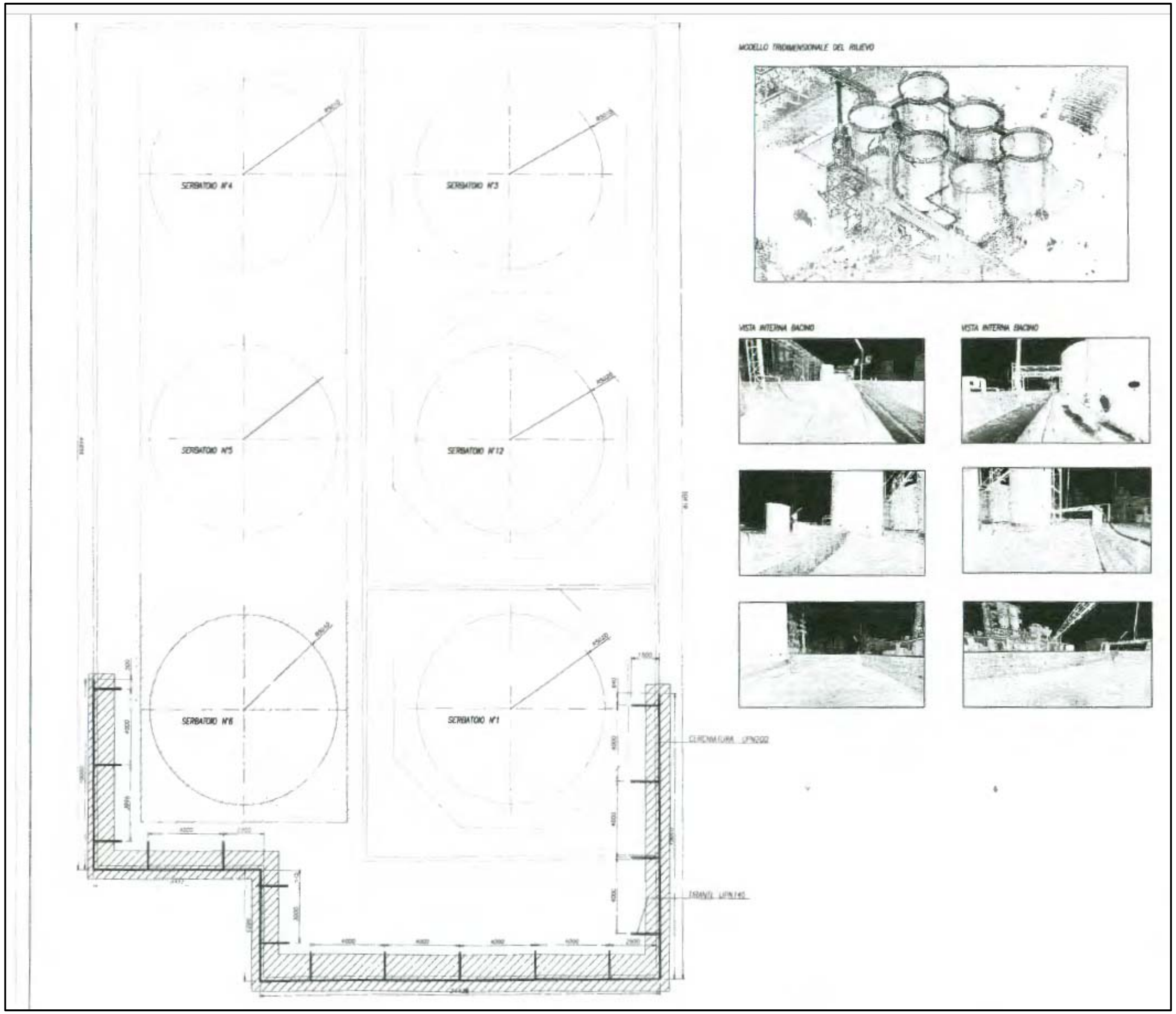
The containment basin after the event: the rupture area

The lesion at the tank bottom

Chemical plant, Cagliari

Date: 25/05/2017	**Title**: Spill of sulphuric acid from a supply pipe in an underground channel		
Synthetic description: As a result of the accidental damage of a sulfuric acid (H2SO4) pipe, connecting the storage tanks (6 tanks above ground) with the buried tank in front of it, a spill occurred in the buried channel housing the pipeline itself. 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.			
Causes: Spill of H2SO4 in the subsoil, following a leak from a connecting pipeline, caused by advanced corrosion in a section of this pipeline not accessible to the controls. 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.			
Organizational factor	**Description**	**Actions taken**	**Expected / Planned actions**
Identification and evaluation of major hazards – Planning for plant and management compliances to risk reduction and updating	Investigation to find out the causes of the accident. Visual inspection and basic design of corrective actions. Necessary reconstruction activities	Initial report to the Authorities (24 h) and, subsequently, a technical report with: Causes; Actions taken; Effects/Consequences; Spread of pollutants; Measures to be implemented	H2SO4 control system "in and out" of the 4 tanks and the underground tank, with alarm system to CR. Waterproofing of the underground channel. New tank park, in which the content of H2SO4 is transferred from the 4 tanks left in operation
Operational control - Identification of installations and equipment subject to maintenance plans		Monitoring and verification of the deformation of structures. 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 and 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)
Emergency planning - Consequences analysis, planning and documentation	Emergency procedure concerning the transfer of the product between tanks	H2SO4 tank immediately emptied of the product. Supply lines promptly intercepted and further tank subsequently isolated	Review of the IEP for the management of fluid spills and modification of the format for communications to the Authorities concerned (IED-IPPC, Seveso, etc.)

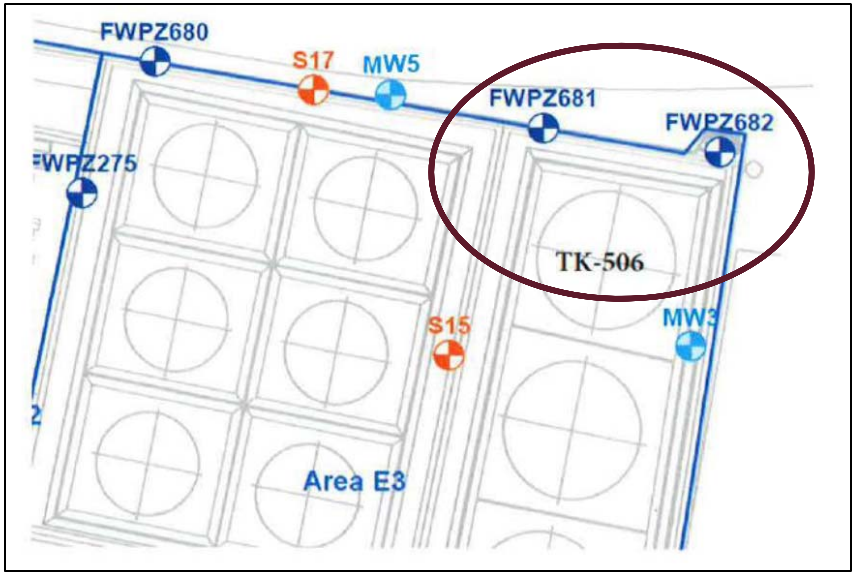
Tank park and containment basin



Refinery plant, Milazzo

Date: 07/03/2018	**Title**: Presence of diesel in piezometers near a storage tank		
Synthetic description: 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.			
Causes: Spill of diesel in the subsoil, following a leak from a storage tank, caused probably by 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)			
Organizational factor	**Description**	**Actions taken**	**Expected / Planned actions**
Identification and evaluation of major hazards – Planning for plant and management compliances to risk reduction and updating	Investigation to find out the causes of the accident	Technical report with: Causes; Actions taken; Effects/Consequences on the environment; Spread of pollutants; Measures to be implemented	Review of the procedure for the risk analysis on substance spills with environmental hazards (products involved, containment systems, distances from environmental receptors)
Operational control - Identification of installations and equipment subject to maintenance plans		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 (Method for the evaluation of the adequacy of the asset integrity management)
Emergency planning - Consequences analysis, planning and documentation	Emergency procedure concerning the transfer of the product	Diesel tank emptied of the product	Review of the IEP for the management of substance spills with environmental hazards

The diesel tank and the 2 piezometers



Ageing mechanisms as potential contributors to accidents

- The analysis of technical and organizational factors of such events highlights problems of asset integrity of hazardous installations
  - Deterioration/degradation caused by corrosion, erosion, fatigue
- Corrective actions taken by the authorities and operator
  - Internal emergency plan, investigation and risk analysis, checks on installations and plants (pipeline, tanks, basins, pumps, etc.)
- Methods used to assess industry's response to ageing
  - Remediation and maintenance, updating management procedures and operational instructions, specific planning for critical technical systems

The analysis of the SMS inspections

Recognition results

Examined 160 SMS inspection reports

In 20% of the cases, problems with the correct management of mechanical integrity were found

Some examples of non compliances

- Analyzing the problems of ageing (corrosion, erosion, fatigue) of equipment that can lead to losses of dangerous substances
- No evidence of a plan for monitoring the risks associated with the ageing of equipment, unless it is in accordance with law obligations
- Developed a well-structured Asset Integrity Management procedure, but partially implemented (no evidences)
- Lack of a specific procedure for monitoring and control of ageing. The procedure shall contain:
  - An analysis of existing or potential degradation mechanisms, a lifetime consumed assessment due to the identified damage mechanism
  - A fixed-term monitoring plan or, alternatively, a time-tracking plan and the techniques to use
  - A reference to preventative actions and any corrective actions

Conclusions and guidelines

Degradation phenomena and controls

- Plants are subject to degradation phenomena based on the level of static/dynamic stresses and the effect of materials compatibility with operating conditions
  - Knowing performance decay rates is useful for scheduling maintenance interventions with a correct frequency input
- The Seveso operator to comply with the regulatory requirements must consider the equipment changes in terms of deterioration and/or damage degree
  - The preservation of an equipment is related to the likelihood that a damage may occur
  - It's necessary to know the damage mechanisms in order to identify the best "non destructive control method" suited to prevent them

Risks associated with plant ageing

- It's basic to control and maintain risk at acceptable levels through management of equipment maintenance activities
  - Aimed at ensuring operational continuity
  - Ensuring the stability conditions to prevent LOC
- It's necessary to adopt risk assessment methods, maintenance-specific, to monitor and manage safety and reliability parameters

Maintenance and MOC

- Risk Based Inspection (RBI): Inspections according to the actual operating conditions of the equipment, in order to allow a targeted planning of the maintenance
- Fitness For Service (FFS): maintaining in operation, with accurate monitoring, equipment that has a structural degradation
- Management of Changes (MOC)
  - difficulty of identifying new corrosion risks for process and plant design changes
  - possibility that other modifications may also have a lesser impact on corrosion risk and therefore not recognized
  - important to keep records of the operating history and problems encountered during the life (running hours, duty cycles, operational excursions, changes in duty or process)

Examples of best practices: the primary containment system

- ***Defining the degradation mechanisms***:

  they depend on the type of tanks, on the nature of the fluids, which are the basis of the organization of the inspection activities

  – Corrosion: internal or external, localized or generalized

  – Mechanisms not related to corrosion: deformations, mechanical breaks, cracks on weld, yielding

Examples of best practices: the primary containment system

- ***Defining and personalizing inspect. technologies***:

  degradation mechanisms affecting both atmospheric tanks and pressure vessels can be identified by NDT

  - Visual Inspection (internal / External)
  - Liquid penetrant testing
  - Magnetoscope
  - Vacuum box test
  - Ultrasonic (long range)
  - Spark test
  - Acoustic Emissions

Examples of best practices: the primary containment system

- ***Determining the frequency of inspections***:

  factors that need to be considered

  - Construction features
  - Repair techniques and materials
  - Nature of stored product
  - Conditions found at the previous inspection
  - Corrosion rates
  - Presence of corrosion prevention systems
  - Potential contamination of soil, water, air
  - Presence of double bottoms or other systems to prevent LOC
  - Leak detection systems with operating tanks

Thanks for your attention!

Questions…?...

romualdo.marrazzo@isprambiente.it