The importance of the Safety Management System in the prevention of NATECH risks on the Italian territory

P2SAC - Purdue Process Safety and Assurance Center

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ISPRA - Italian National Institute for Environmental Protection and Research

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 industrial establishments SMS-PMA 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

Introduction
- The Seveso directive in Italy
- NaTech risks/Seveso directive

Natural hazards as significant cause of industrial accidents
- Natural events (Floods and Lightning)
- Industrial accidents
- Dangers and measures

Conclusions

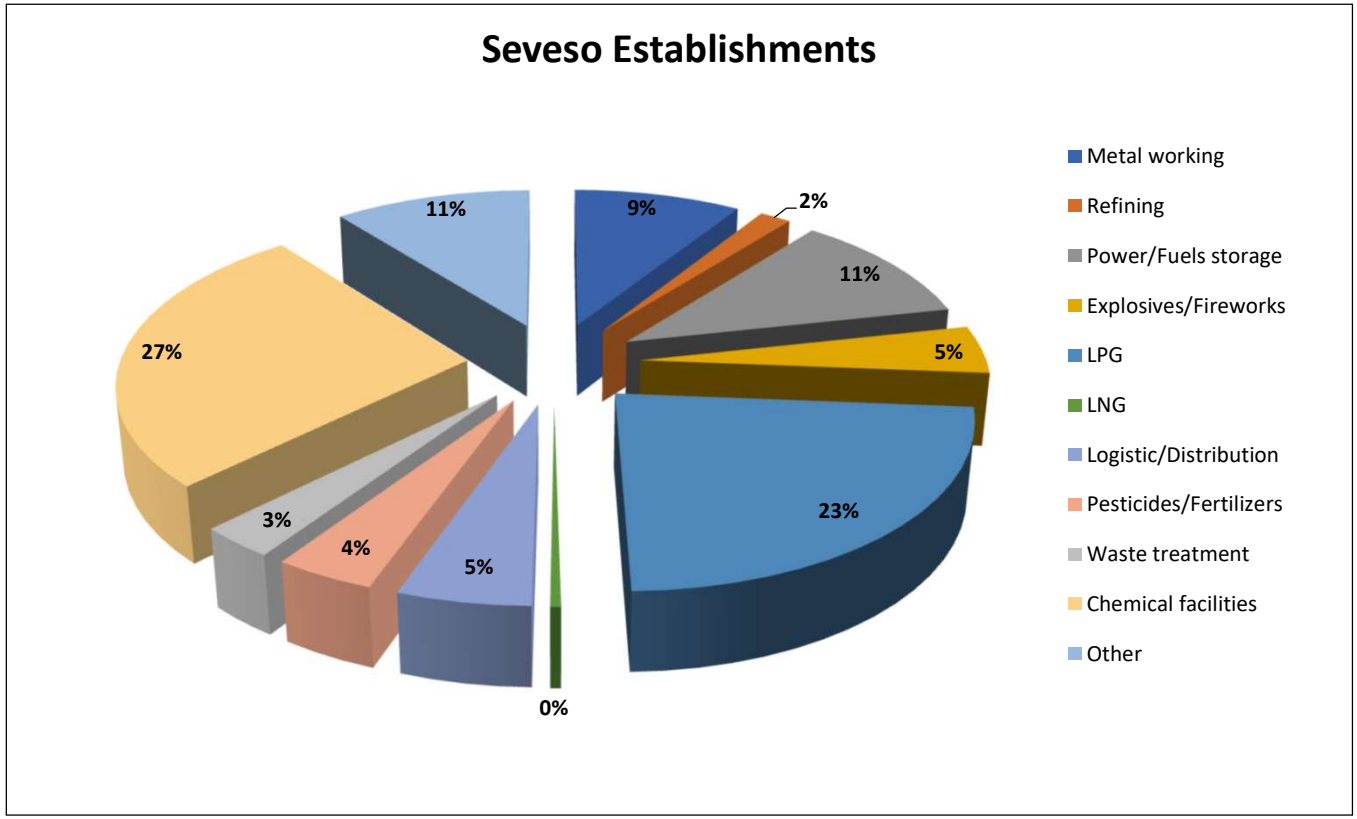
- Introduction

The Seveso directive: scope and principles

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

- Depending on the amount of dangerous substances present, establishments are categorized in Lower Tier (LT) and Upper Tier (UT) *(increasing safety measures according to the quantities)*
- "Presence of dangerous substances": the actual or anticipated presence of dangerous substances in the establishment, or of dangerous substances which it is reasonable to foresee may be generated during loss of control of the processes, including storage activities

The national situation



In Italy, about 1.000 sites fall under Seveso directive (50% of UT and LT)

https://www.rischioindustriale.isprambiente.gov.it/seveso-query-105/inventario_listatolist.php

The compliances for the establishments

LOWER TIER	UPPER TIER
Notification of his own position and information to the competent Authorities	
Adoption of a **Safety Management System** for the Prevention of Major Accidents (SMS-PMA)	
Information to Authorities following a **major accident**	
	Producing a **Safety Report** (SR) containing the risk analysis
	Drawing up an **Internal Emergency Plan** (IEP)

NaTech risks and Seveso directive

NaTech are technological accidents, such as fires, explosions and toxic releases that can occur inside industrial establishments following natural disasters

- The evaluation of the effects of natural events on Major Accident Hazard establishments requires a systemic and multidisciplinary approach

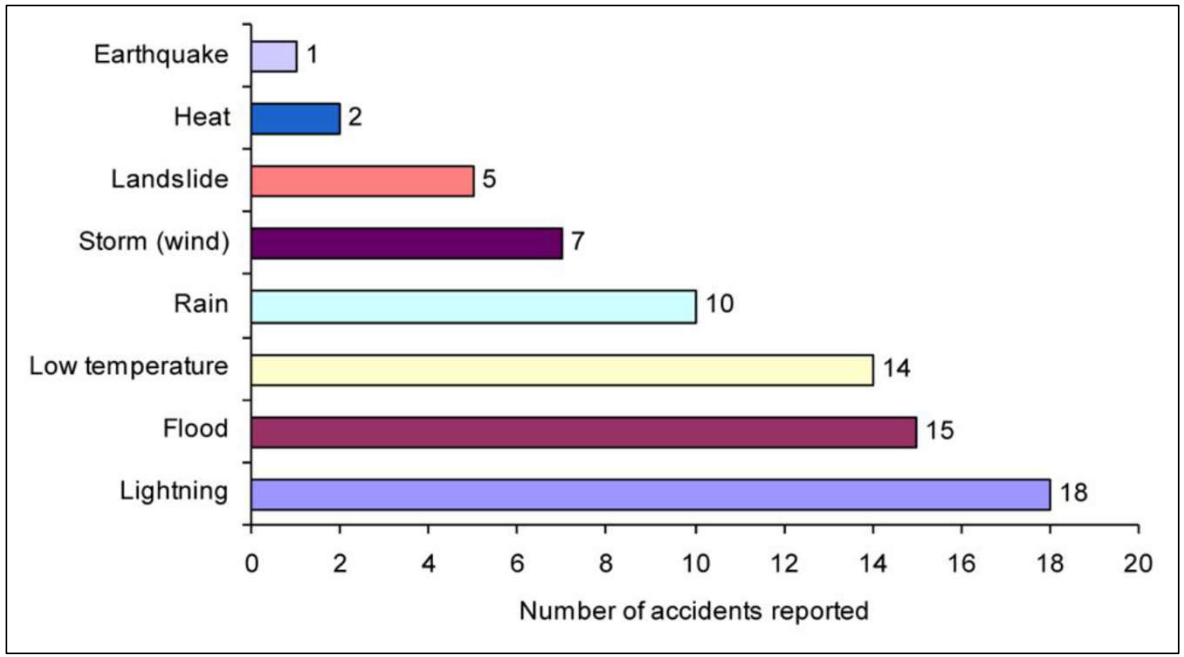
The Seveso III Directive imposes obligation for the site operator and control activities

- Identifying the hazards and assessing the major risks to take the NaTech risks into account
- Checks to be carried out during inspections for the evaluation of the implementation of the SMS-PMA

- Natural hazards as significant cause of industrial accidents

Accidents vs. Extreme natural events

From 1985 to today in the EU countries there has been an average NaTech accident per year



Source: JRC, 2014

Floods, with consequent landslides, and lightning are the most common and widespread natural danger in our country

Vulnerability to natural hazards

Industrial equipment and plants	*Natural hazards for adverse conditions*
Gas, fuel oil and coal thermoelectric power plants	Floods
Pipelines for the transmission and distribution of gas, oil pipelines	Floods (Landslides)
LPG depots	Floods
Mineral oils depots	Floods, lightning, strong winds, storms
Refineries and chemical and petrochemical plants:	
• Process columns	Strong winds, storms
• Above ground tanks	Strong winds, storms, floods, lightning
• Mounded tanks	Floods
• Pipelines (also underground)	Floods
• Motors, pumps, compressors	Floods
• Control room and instrumentation	Floods, lightning
• Warehouses of packed products	Floods
Service utilities commonly found in industrial plants whose failure can lead to hazardous situations: boilers; refrigeration systems; cooling towers; power supply; water treatment; torch systems	Strong winds, storms, floods, lightning, changes in water availability, increases in water temperatures and decreases in the availability of cooling water
Toxic products depots	Floods
Warehouses of phytosanitary products	Floods
Coastal depots, plants and terminals	Sea storms, sea level rise

Floods

Many productive activities are vulnerable in the event of adverse weather conditions with following floods (and eventually landslides)

Every manager of a Seveso establishment must prepare in advance to limit the impact that a flood could have

- Dedicated planning that takes into account a possible major accident
- Provide through the adaptation of its SMS-PMA the necessary measures to prevent or limit the consequences

- Directive 2007/60/EC relating to the assessment and management of flood risks (Floods Directive - FD)

Industrial accidents following floods

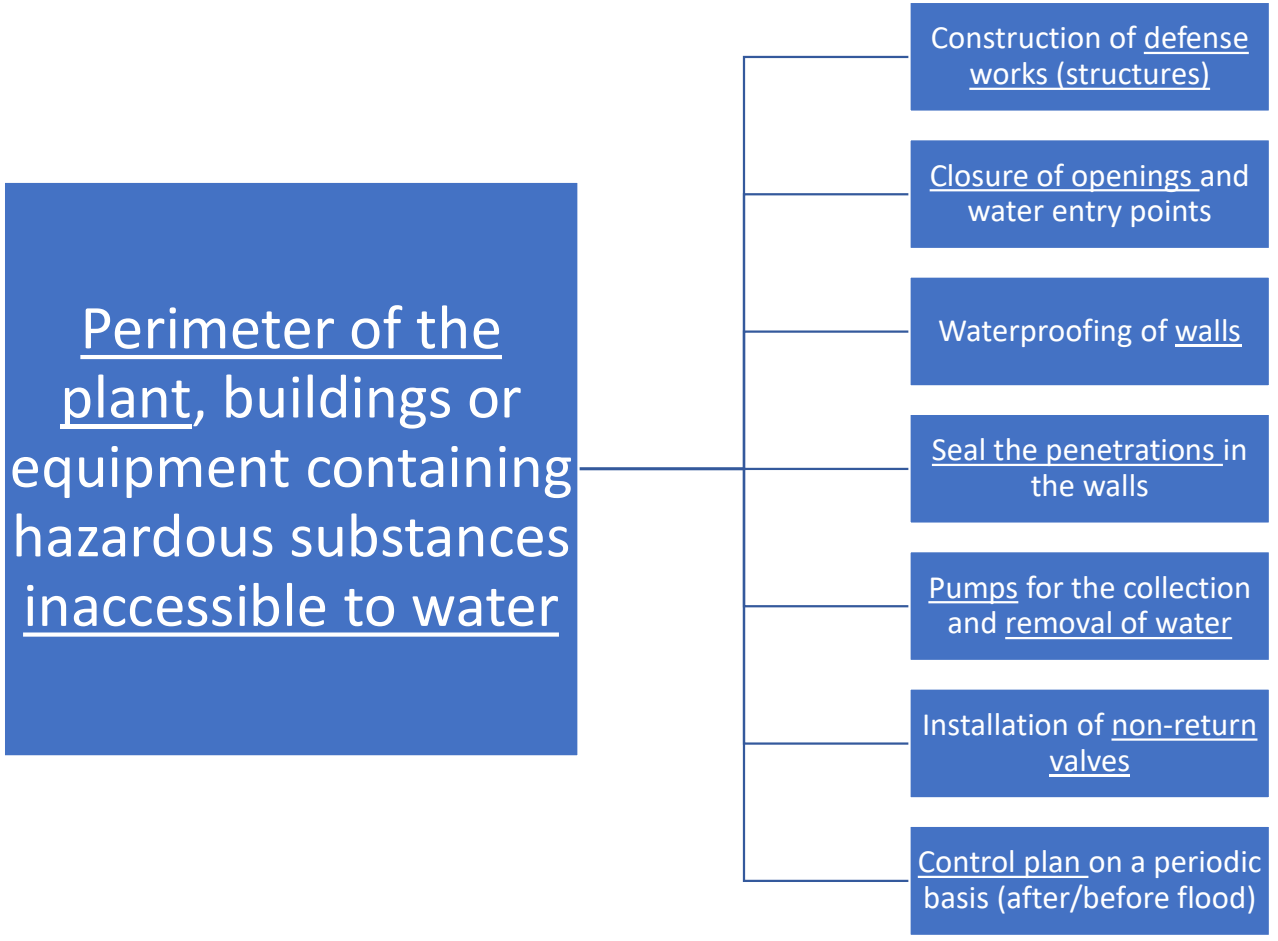
Following continuous torrential rains which lasted several days, the plants of a refinery located in a port area flooded

- Production was stopped due to the water level
- A violent fire followed, as well as several explosions
- The fire extinguished after 20 hours (2 dead and 4 injured)
- Extensive material damage resulting from the accident

The sequence of fires was caused by the flood that moved the exhausted oil, displacing it from the sewer system and coming into contact with the hot parts of the systems

- Implement effective procedures to prevent the rapid distribution of flammable liquids by alluvial waters
- Good maintenance practice is to make sure that the drains are clean so as not to obstruct the water drain

Lesson learned and good practices



Lessons learned and good practices

Location outside of flood hazard areas or above the maximum achievable water level	• Fire pumps, sprinklers, suppression systems and other fire suppression systems, with associated electrical equipment
Ensuring flood-proof, if the functionality is required during the flood for safety reasons or to ensure continuity	• Equipment critical to process safety, production or operations carried out in the building located at a lower level than the maximum achievable by the water
Protected by permanent immersion in water - submersible to 3 m depth in continuous immersion and in any case for more than one hour, resistant to a pressure of at least 10 bar in all directions	• Electrical equipment must be designed to work even if continuously immersed and have an electrical classification IP X8

Lightning

Every year Italy is struck on average by about 600.000 lightning, with an average density of lightning on the ground equal to approx. 2 discharges per year per km2

The SIRF (Italian Lightning Detection System) database gives the average number of lightning strikes to the ground per year and per square kilometer (s.c. “Ng”)

- The detection system consists of a network of sensors for the detection of lightning throughout the Italian territory
- It provides a value of "Ng" based on lightning data collected in over ten years of observations
- These data have high spatial and temporal precision

Industrial accidents following lightning

Following a thunderstorm, there was a significant interruption in the power supply of a refinery which resulted in the loss of cooling on a distillation column

- Some control systems were of the manual type; a lack of detection caused an increase in column pressure
- Safety valves, designed to protect equipment from overpressure, opened with a large volume of gas to be released into the atmosphere

The impact of lightning strikes on the power supply can be an indirect cause of loss of containment

- This element and the relative safety critical elements should be considered in the risk assessment

Fires involving storage tanks

Fires involving floating roof tanks are the most vulnerable to the effects of atmospheric discharges

It occurs when the lightning current passes between the shunts and the tank shell, with the formation of an electric arc that triggers flammable vapors

- Shunts are metal strips that electrically bond the shell and roof of the tank

The API RP 545 recommendation indicates:

1. Install "submerged" shunts between the floating roof and the shell every 3 meters
2. Electrically insulate all the components of the Sealing System
3. Install connection conductors between the floating roof and the shell every 30 meters, along the entire circumference of the tank

Main dangers caused by lightning

Fire damage	*Damage from overvoltage*	*Shock Wave Damage*
This is the greatest danger for systems and equipment, starting from storage tanks, up to cables and pipes	It is less known, but it can cause serious damage to the electrical and electronic control and process management systems	Lightning produces shock waves that can be destructive
A classic example is the burning of the roofs of the tanks, the destruction of electrical lines and equipment with consequent disruption and lack of power supply	The high stress to which the equipment is subjected compromises its correct functioning during normal operation and during any emergencies	The shock waves can severely damage concrete and brick/stone fireplaces and torches

Protection measures for equipment

Earthing and equipotential bonding	*Magnetic shielding and cable routing*	*Protection with SPD System*	*Insulating Interfaces*
The earthing system conducts and disperses the lightning current in the ground. The equipotential bonding network minimizes potential differences and can reduce the magnetic field	Local shields attenuate the magnetic field associated with lightning strike (direct, or close to the structure), thereby reducing induced pulses in internal lines	The Surge Protection Device System limits the effects of impulses within the structure, both of external and internal origin to the structure	Insulating interfaces limit the effects of conducted pulses on incoming lines

- Conclusions

NaTech risks and SMS-PMA

The site operator should develop appropriate measures to address natural hazards, so as to allow the maintenance of a safe control of the plants

From the analysis of industrial accidents, it is possible to focus the main types of vulnerable equipment

- The lessons learned are useful examples on how organizations could manage these problems, through specific procedures, good practices and methods

The SMS-PMA plays an important role to ensure the correct implementation of the prevention and protection measures against NATECH events

- Specific procedures for extreme weather conditions (rainfall, lightning, winds, temperatures)

Thanks for the attention!

Questions…???...

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