CHEMIPPR PROJECT

RISK MANAGEMENT SCOPE – TURKEY

TESICNOR 2017/09

OBJECTIVE OF THE COURSE

The purpose of Risk Management course is to **give tools** to the student to **define and detect the main risk situations** associated with **major industrial accidents**, and collect all necessary and suitable data to use the **methodologies** related to **analysis and assess these risks.**

In order to provide right background, the **SEVESO Directive** is, in this region, the most important code to take into account. The SEVESO Directive aims to prevent major industrial accidents involving dangerous substances and limit the consequences to people and/or the environment.

BUT, WHAT IS RISK MANAGEMENT?

Definitions by ISO 31000 – Risk Management – Principles and Guidelines

WHAT?

Risk management

Coordinated activities to direct and control an organization with regard to Risk (Risk: Effect of uncertainty on objectives).

HOW?

Risk management process

Systematic application of management policies, procedures and practices to the activities of communicating, consulting, establishing the context, and identifying, analyzing, evaluating, treating, monitoring and reviewing risk.

WHAT FIELD?

Major Accident

An occurrence such as a major emission, fire or explosion resulting from uncontrolled developments in the course of the operation of any establishment covered by Seveso Directive, and leading to a serious danger to human health or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances."

ISO 31000 –
Risk Management –
Principles and
Guidelines

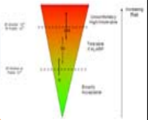
RISK MANAGEMENT PROCESS

RISK ASSESMENT: STEPS

Tesicnor

STEP 1: RISK IDENTIFICATION | STEP 2: RISK ESTIMATION | STEP 3: RISK EVALUATION

Risk in a specific location = Accident frequency x Damage



HAZARD IDENTIFICATION METHODOLOGIES	SCENARIO LIST & IDENTIFICATION OF DANGEROUS PHENOMENA	FREQUENCY OF CRITICAL EVENTS & ITS MODIFIERS	CONSEQUENCE AND VULNERABILITY MODELLING	OUTCOMES RISK ESTIMATION	DEFINITION OF SCREENING CRITERIA
Checklist, standards, HAZID, HAZOP, FTA, What if?,,,	Critical events / Lost of containment identification and generation (qualitative and quantitaive) of the event tree associated and its consequence and vulnerability modelling			Individual & Societal Risk	RISK ACCEPTANCE CRITERIA

RISK ASSESMENT

Tesicnor

STEP 1: RISK IDENTIFICATION

HAZARD IDENTIFICATION METHODOLOGIES

The level and extent of risk identification activities vary depending on the scale of the installation and the stage in the installation life cycle when the identification and assessment process is undertaken.

- **for simpler installations**, e.g. industries with limited process facilities, it may be possible to **rely on application of recognized codes and standards** as a suitable base which reflects industry experience for this type of facility; ISO Standards (for example ISO/TC 67/SC 9 Liquefied natural gas installations and equipment.
- for installations which are a repeat of earlier designs, evaluations undertaken for the original design may be deemed sufficient to determine the measures needed to manage hazardous events; Checklists,…
- for installations in the early design phases, evaluations will necessarily be less detailed than those undertaken during later design phases, and will focus on design issues rather than management and procedural aspects. Any design criteria developed during these early stages need to be verified once the installation is operational. PHA, HAZID, What If?,…
- complex installations, e.g. large production industries incorporating complex facilities, are likely to require detailed studies to address hazardous events such as fires, explosions, toxic releases, environmental impact, structural damage, etc.; HAZOP, FMEA, QRA…

STEP 2: RISK ESTIMATION

Risk in a specific location = Accident frequency x Damage

SCENARIO LIST & IDENTIFICATION OF DANGEROUS PHENOMENA

Tesicnor

RISK ASSESMENT

Historical records (MARS Database,…), BEVI,…

A scenario describes **the conditions that might lead to a major accident and the potential consequences**, which in most cases is the loss of containment (LOC) also known as the critical event (CE), of a hazardous substance, or the change of state of a solid substance, combined with particular conditions that eventually lead to a dangerous phenomenon as fire, explosion, and/or toxic release.

Examples:

1. Catastrophic failure and a range of hole sizes, and time of the release:
   - Instantaneous release of entire content (storage tanks)
   - Release of entire contents in 10 min. in a continuous and constant stream (storage tanks).
   - Continuous release of contents from a hole with an effective diameter of 10 mm (storage tanks).
   - Rupture (pipeline).
   - Leak with an effective diameter of 10% of the nominal diameter, up to a maximum of 50mm (pipeline).
   - Rupture of 10 pipes at same time (Heat exchangers and condensers).
   - Outflow at the maximum outflow rate (pressure relief valve).
   - Rupture of loading/unloading arm or hose (loading activities)
2. Mischarging into reactors and storage tanks causing runaway reaction (particularly if causing release of toxic gas due to the reaction): filling into the wrong tank, failure in filling chronology,…
3. Overfilling of storage tanks giving rise to explosion such as at Buncefield or CAPECO (potential, unless eliminated by design, for VCE under conditions not previously expected to cause VCE
4. ¿Others…?

STEP 2: RISK ESTIMATION

Risk in a specific location = Accident frequency x Damage

SCENARIO LIST & IDENTIFICATION OF DANGEROUS PHENOMENA

Tesicnor

RISK ASSESMENT

Jet Fire: Ignition of a continuous leakage of flammable gases or vapors contained in pipes or containers with overpressure.

Pool Fire: It applies to a stationary diffusion flame combustion of a liquid in an open enclosure with given dimensions.

BLEVE: Boiling liquid expanding Vapour Explosion. It represents catastrophic failure of a container storing a liquid gas above boiling point at atmospheric pressure, and causing an immediate massive, liquid leakage into the atmosphere.

Vessel burst: Physical explosión because of excess of pressure

Toxic Release:

STEP 2: RISK ESTIMATION

Risk in a specific location = Accident frequency x Damage

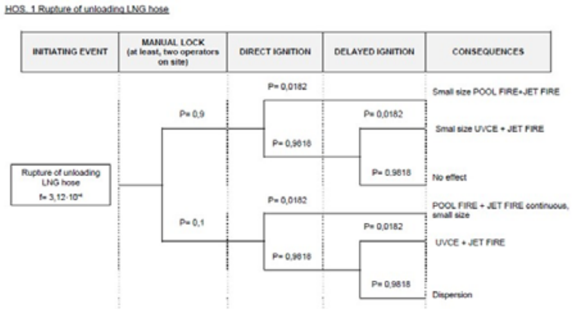
SCENARIO LIST & IDENTIFICATION OF DANGEROUS PHENOMENA | FREQUENCY OF CRITICAL EVENTS & ITS MODIFIERS

Tesicnor

RISK ASSESMENT

For each scenario (CE/LOC) there is a frequency of the initiating event and an EVENT TREE associated, concluding in different dangerous phenomena which probability changes because of the frequency modifiers.

Both, initiating event and modifiers (Bunds, detection and shut down sistems, operator supervisión, blocking systems, safety distances,...) frequency can be found in bibliographical references: BEVI, UKOOA, JRC,...



STEP 2: RISK ESTIMATION

Risk in a specific location = Accident frequency x Damage

SCENARIO LIST & IDENTIFICATION OF DANGEROUS PHENOMENA | FREQUENCY OF CRITICAL EVENTS & ITS MODIFIERS | CONSEQUENCE AND VULNERABILITY MODELLING

Tesicnor

RISK ASSESMENT

Consequence modelling

After calculating the frequency of a CE and the dangerous events associated (accident frequency) it is the turn to calculate the damage done by the dangerous phenomenon. This is done by doing a consequence modelling.

Physical-chemical variables are set for each of the dangerous phenomenon, whose magnitude can be considered sufficiently representative to assess the extent of chemical, mechanical and thermal phenomena triggered after the accident. Areas affected by potential accidents are determined based on the distance to certain physical and chemical variables representative of dangerous phenomena reach a certain threshold values.

Vulnerability modelling and criteria

The analysis of vulnerability due to hazardous phenomena associated with major accidents is done by applying the "Probit methodology."

This methodology involves the application of statistical correlations to estimate the adverse consequences on the population and other vulnerable elements (facilities and environment) of hazardous physical phenomena resulting from accidents.

Heat Radiation – fatal burns (without protective clothes)

$$Pr = k_1 + k_2 \cdot \ln(z)$$

$Pr = -14,9 + 2,56 \ln(I^{4/3} \cdot t \cdot 10^{-4})$

Pr: Probit equation value

I: Heat radiation W/m²

t: exposure time in sec.

STEP 2: RISK ESTIMATION

Risk in a specific location = Accident frequency x Damage

SCENARIO LIST & IDENTIFICATION OF DANGEROUS PHENOMENA | FREQUENCY OF CRITICAL EVENTS & ITS MODIFIERS | CONSEQUENCE AND VULNERABILITY MODELLING | OUTCOMES RISK ESTIMATION

Tesicnor

RISK ASSESMENT

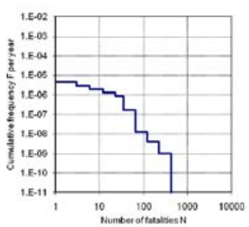
Individual Risk

Individual risk (or Cumulative Escalation risk) is the summation of risks from all the outcomes affecting any location and is usually calculated on a grid. Particularly in the present course individual risk has been determined the so-called, meaning the same as determining

This risk can be represented in the form of individual risk curves (Iso-contours for specific risk level).

Societal Risk

Societal risk expresses the risk that a group of people is simultaneously exposed to the consequences of an accident. This is expressed – using an 'FN curve' – as a relationship between the expected frequency of the accident, and the number of people who will die (or be injured) as a result of the accident. 'F' is the (cumulative) frequency of an accident involving more than N deaths.



Tesicnor

RISK ASSESMENT

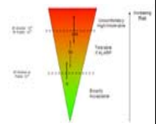
Screening criteria are the targets or standards used to judge the tolerability of an identified hazard or effect. They are used to judge the significance of the hazards and effects and together with the results from the risk analysis provide the basis for risk management decision-making. The ALARA (As low as reasonable achievable) or ALARP (As low as reasonable practicable) principle are always followed, even if the risk is tolerable.

Screening criteria can be qualitative or quantitative (regulatory, corporative,...)

There is **no harmonization** (not even in Europe) about the Screening criteria, **but internationally accepted criteria** for location-based (individual) risk for the general population **is 10^{-6} death per person per year.**

In the case study (risk for passengers) based on an IMO (International Maritime Organization) standard (MSC85/17/2), is 10^{-4} per year.

STEP 3: RISK EVALUATION



DEFINITION OF SCREENING CRITERIA

¿FOR WHAT DO WE USE IT?

RISK TREATMENT

The general hierarchy of risk-reducing measures is

- prevention,
- detection,
- control,
- mitigation,
- emergency response.

Prevention: by inherently safer design. Examples: reducing the hazardous inventories or the frequency or duration of exposure; substituting hazardous materials with less hazardous ones, segregate the process plant into smaller sections using ESD valves, processing at lower temperature or pressure, making the plant and process simpler to operate (human failure)...

Protection: Measures to restrict escalation of a hazardous event (detection), together with measures to protect personnel and measures to normalize the situation (control, mitigation and emergency response). Examples: Fire and gas detection systems, fire-water systems, active and passive fire protection, temporary refuge, evacuation systems, oil clean-up and recovery equipment and procedures, protective clothing, emergency drills, training,…

Factors that will influence the selection of measures to reduce the risk include

- the technical feasibility of the risk-reducing measure,
- the contribution of the risk-reducing measure,
- the costs and risks associated with implementing the measure,
- the degree of uncertainty associated with the risk, or the risk-reduction technique, including human factors.

CASE STUDY - QRA

The object of the case study is the development of the Quantitative Risk Analysis (QRA) of the Installation of a Gas Fueled Auxiliary Engine on board a Car-Ferry. **The object of the QRA is to determine the risk to people in the surroundings of the installation that is related to the presence of hazardous substances and for various purposes including the embarking/disembarking of passengers during bunkering operations and see if it is under the criteria of acceptability of individual risk set by MSC85/17/2 in 10^{-4}.**

Thank you!

Çok teşekkür ederim!

Kiitos paljon!

Muito obrigado!

SEDE CENTRAL

Pol. Mocholí, c/ Río Elorz, nave 13E
31110 Noáin (Navarra)
T: 948 214 040 F: 948 214 041

DELEGACIÓN

Pol. Camporroso, c/Montevideo, nº 3, nave 5
28806 Alcalá de Henares (Madrid)
T: 91 819 30 49