Second Draft

Checklists for Refineries

Part 2: Requirements on the structure and equipment of production plants

An element of a

UNDP/GEF Danube regional project

"Activities for Accident Prevention - Pilot Project – Refineries"

(RER/03/G31/A/1G/31)

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Recommendations for refineries

The recommendations for refineries are divided into two parts.

Part 1 deals in general with the question of safety management.

Recommendations for technical safety requirements on the structure and equipment of production plants regarding the protection of seas and waters are given in part 2.

Part 2 Recommendations for requirements on the structure and equipment of production plants

The following checklists verifies the safety standard of production plant, in particular that of a refinery on the basis of recommendations fort he requirements on the structure and equipment of production plants.

For this, recommendations were presented for the following areas:

1. Stability
2. Observables, space between plant components
3. Resistance
4. Dome shaft, other shafts, protective channels
5. Accessories, safety devices, safety precautions
6. Secondary containments, Drain pans, collecting basins
    - Sizes and arrangement
    - Tightness, resistance
    - Rainwater
7. Production plants handling solid substances
8. Fire protection
9. Prevention of explosion
10. Additional requirements on plants with positive and negative internal pressure
11. Flare system
12. Armatures with flame arrester

13. Cooling and heating systems

14. Loading and unloading of ships

For detail text of the recommendation see „Recommendation for Refineries” an element of a UNDP/GEF Danube regional project "Activities for Accident Prevention - Pilot Project – Refineries" (RER/03/G31/A/1G/31) point 6.2.

Checklists for monitoring the implementation of the recommendations

General details of the plant under review

Operational classification:

❒ Existing secondary containment Volume: m^3

Name of material (substance):
(More details in Checklist No. 1 „Substance“)

WRI:

Plant material grade:

Remark:

1 Stability

1.1 Was the plant installed or erected by a specialised company and was any attention paid to a perfect foundation for the plant?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

1.2 Was the soil condition taken into consideration?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

1.3 Could any sign of declivity, inclination, sinking and restrain be observed which might endanger the safety of the tanks or their equipments?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

1.4 Is there any proof of the stability?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

1.5 Is the plant located in a flood area?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

1.5.1 If yes, is there any safety proof against the force of buoyancy?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:
- Training and instructing the personnel on how to recognise declivities, inclinations and restrains
- Regular checks to help recognise existing problems in time

Medium term:
- Ask for expert opinion about building site with special attention to the condition of the ground of the building site and the expected load on the building site's ground

Long term:
- If necessary put additional measures for the foundation in place

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

2 Observable, space between plant components

2.1 Is the space between single shell container, pipelines and all other plants and the surrounding walls and also between one another such that the detection of leakages and the monitoring of state of the facilities including the secondary containments possible at all times by simple visual inspection?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

2.2 Are leakage indicator installed at suitable points to release acoustic and optical alarms when a critical liquid level is reached?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:
- *Training and instruction of the personnel to check the plant regularly and how to react whenever there is a danger of overfilling*

Long term:
- *Installation of suitable leakage indicator which sends out acoustic and optical alarm whenever there is leakage of water hazardous substances*

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

3 Resistance

3.1 Can the tightness of an existing plant be ascertained (as far as possible) during a visual inspection?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

3.2 Is the plant erected in such a way that mechanical damages e.g. being bumped by vehicles or other means of transportation and other mechanical influences (e.g. cranes, excavator, conveyors) is not possible?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

3.3 Are the plant components according to their intended purpose of use sufficiently resistant to water hazardous substances?

a) towards mechanical stress

❒ Yes ❒ No ❒ Not applicable

Are proof available?

❒ Yes ❒ Yes ❒ Not applicable

b) towards thermal stress?

❒ Yes ❒ No ❒ Not applicable

Are proof available?

❒ Yes ❒ No ❒ Not applicable

c) towards chemical stress?

❒ Yes ❒ No ❒ Not applicable

Are proof available?

❒ Yes ❒ No ❒ Not applicable

d) towards biological stress?

❒ Yes ❒ No ❒ Not applicable

Are proof available?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

3.4 Are the check intervals and the wall thickness chosen such that the stability of the plant is guaranteed even when there is a decrease in the wall thickness caused by material erosion?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

3.5 Are plastics used and are they sufficiently resistant according to their intended purpose of use?

a) towards mechanical stress?

❒ Yes ❒ No ❒ Not applicable

b) towards thermal stress?

❒ Yes ❒ No ❒ Not applicable

c) towards chemical stress?

❒ Yes ❒ No ❒ Not applicable

d) towards biological stress?

❒ Yes ❒ No ❒ Not applicable

e) towards ageing?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

3.6 Are the plants made of materials without sufficient corrosion resistance?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

3.6.1 If yes, are they provided with suitable interior coating or lining?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Example of measures:

<u>Short term:</u>
- *Testing the walls in regard to the necessary design pressure.*
- *Measuring the wall thickness at selected parts with ultrasonic method as a proof of a sufficient wall thickness (computational check).*
- *Visual check of the interior wall at selected parts*
- *Checking the available documentation.*
- *Shortening the check intervals*

<u>Medium term:</u>
- *Pressure and tightness tests.*
  - *Test medium: **Water**.*
    Test pressure: 1.3 x maximum allowable operating pressure.
  - *Test medium: **Nitrogen or Air** (take precautionary measures).*
    Test pressure: 1.1 x maximum allowable operational pressure.
- *If the pressure test is not possible due to technical safety reasons: use non destructive tests such as e.g. wall thickness measurement with ultrasonic method.*
- *Coating or lining of the plant component*

<u>Long term:</u>

- *Written documentation of the suitability and durability of the plant components in the plant documentation as a result of achieved test results and the positive operational experience.*
- *New plants: Proof of the durability before installation by the installer or manufacturer.*

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

4 Dome shaft, other shafts (pits), protective channels

❒ relevant ❒ irrelevant

4.1 Are the following protective devices water-proofed and resistant to liquid?

Note: The requirements of the recommendation of point 6.2.4 paragraph 1 are seen as fulfilled for other shafts, protective channels or protective pipes made of concrete if the substances hazardous to water being released into them can only penetrate at most two-third of the crack free zone of the sealed surfaces and walls until the released substances hazardous to water is detected and eliminated. The crack-free zone is calculated from the material thickness minus those areas with shrinkage cracks and the torn tensile area. In this case, the damaged sealed surface should be repaired immediately after the eliminating the released hazardous substances.

a) Dome shafts of underground tanks?

❒ Yes ❒ No ❒ Not applicable

b) Other underground shafts?

❒ Yes ❒ No ❒ Not applicable

c) Protective channels?

❒ Yes ❒ No ❒ Not applicable

d) Protective pipes?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

4.2 Can it rain into the dome shafts, other shafts (pits) and protective channels?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

4.3 Is the formation of condensation possible?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

4.4 If this is not possible, is the removal of existing water done regularly and are they analysed and disposed off in a safe manner?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

4.5 Are the dome shafts, other shafts (Pits) and protective channels connected to drainage facilities?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

4.6 Are the dome shafts, other shafts (Pits) and protective channel checked regularly?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:

- *preventing the entry of rainwater (e.g. by covering the shafts (Pits))*
- *Closing the point of connection to the drainage facility*

- *Inspections*

Medium term:
- *Sealing existing shafts*
- *Insulation of areas where the formation of condensation is possible*

Long term:
- *additional installation of liquid-tight shafts (Pits)*

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

5 Plant components, Safety devices, preventive measures

5.1 Are the following safety devices for preventing dangerous over- and under-pressure in plant components, especially in tanks and pipelines available?

a) Aerating and venting devices?

❒ Yes ❒ No ❒ Not applicable

b) Safety valves?

❒ Yes ❒ No ❒ Not applicable

c) Bursting disc?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.1.1 Are these devices suitable for preventing dangerous over- and under-pressure in plant components?

a) Aerating and venting devices?

❒ Yes ❒ No ❒ Not applicable

b) Safety valves?

❒ Yes ❒ No ❒ Not applicable

c) Bursting disc?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.1.2 Are the following safety devices installed in such a way and equipped with additional devices to collect inevitably released water hazardous liquid in a safe way?

a) Safety valves?

❒ Yes ❒ No ❒ Not applicable

b) Bursting disc?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.2 Are the shut-off devices easily accessible?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.2.1 Are the shut-off devices easy to operate?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.3 Are automatic safety devices for fire outbreak and accidents such as slide gate valve, flaps or pumps available?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.3.1 Do they have source of energy independent of the endangered plant or are they equipped with additional device that guarantees their operation when there is failure of the normal energy supply?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.3.2 Are these safety devices equipped with a secured feedback device?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.4 Are double wall tanks present?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.4.1 Are underground tanks equipped with the following leakage monitoring devices?

a) By means of leakage indicator liquid whereby no water hazardous substances are used?

❒ Yes ❒ No ❒ Not applicable

b) By means of under-pressure devices?

❒ Yes ❒ No ❒ Not applicable

c) By means of over-pressure devices with non water hazardous gases?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.4.2 Are only non water hazardous substances or substances with low water hazard class used as leakage indicator liquid for double wall over-ground tanks and heat transfer media for heat pumps?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.5 Are plant components like stirred reaction tank or distilling column equipped with level indicators?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.5.1 Does this include independent level alarm devices (minimum, maximum)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.5.2 If not, can the level be monitored by simple visual inspection or is the technical safety not relevant due to the process design (e.g. applying overflow principle)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.6 Are overfill safety devices used?

See also checklist 2 „Overfill safety device“

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.6.1 If not, is there no danger of overfilling due to the process design (e.g. applying overflow principle)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:

- *If no aeration or venting device is installed, open the tank or install a venting device.*
- Training and instructing the personnel to check the measuring devices for level control regularly and how to react in case of imminent overfilling.
- Execute filling process with at least persons.
- Make sure the level of the tank can be monitored directly during process.
- Control and monitoring of over- and/or under-pressure by the personnel.
- Instruct and induct the personnel on how to react when the pressure exceed or is below the allowable operating pressure.
- *Regular examination (checks) of the efficiency of the safety valves*

Medium term:

- Installation of a certified overfill safety device.
- *Installation of a device for monitoring the internal over- and under-pressure*
- *Installation of safety valves or bursting discs*
- *Make sure that dangerous substances being released by safety valves are disposed off in a safe way. (e.g. released into a separate tank for such purposes)*
- *Replace water hazardous substances with non hazardous substances as leakage indicator liquid*

Long term:

- *Revise the concept for operating the shut-off devices and implement the concept such that shut-off devices are easily accessible and easy to operate and they should be installed near the tank to allow for a quick response in case of leakages*
- *Change leakage indication method (e.g. replace liquid method with under-pressure method)*

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

6 Secondary containments, collecting basin, collecting pans

❒ relevant ❒ irrelevant

6.1 Size and arrangement

6.1.1 Are such plant components where dripping can not be avoided placed in extra collecting pans?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.2 Are the secondary containment installed near the plants they belong to?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.2.1 If not, can water hazardous substances be transported to them in case of accidental release in a safe way?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.3 Are in-house water treating plant used as collecting facilities when materials from the production plant are contaminated with water hazardous substances in case of accidental release?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.3.1 If yes, can materials contaminated by water hazardous substances be collected in an in-house collecting device in the sewage system?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.3.2 Can the material contaminated with hazardous substances be treated or disposed off in a safe way?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.4 Are tanks containing water hazardous substances arranged in a secondary containment in such a way that the material can react with one another or cause an unwanted reactions in case of leakages which can lead to the failure of the tank or secondary containment or are they arranged in different area of the same secondary containment?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.5 Is the plant encased or otherwise secured against losses due to sprinkles or drips?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.5.1 If not, is it guaranteed that the corresponding secondary containment or collecting surface is large enough to safeguard the entire area from losses due to sprinkles and drips?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.6 Determination of secondary containment's size

6.1.6.1 Volume of the tanks arranged in the secondary containment

Total volume of the tanks present in the secondary containment .....m^3

10 % of the total volume of the tanks presents in the secondary containment .....m^3

Volume of the largest confined operational unit within the plant facility .....m^3

6.1.6.2 Size of the necessary secondary containment

Water Risk Index of the plant WRI (see checklist 1 „Substance") .....

WRI	Requirements	Calculated volume
≤ 2	No retention capacity above the operational requirements	----
2 ≤ 3	Retention capacity for the amount of water hazardous liquids that could leak out before suitable safety precautions could take effect (e.g. closing up the defective plant component or sealing up the leak)	.....m^3
> 3	Retention capacity for the amount of water hazardous liquid that could leak out during operational disturbance without considering counter-measures **Note**: Measures for retention purposes that does not depend on human decision but only on structural or technical safety precautions. To determine the volume, the volume of the largest confined plant unit within the whole complex can serve as a basis: All leakages at the most unfavourable situation must be retained.	.....m^3

6.1.6.3 Is the existing secondary containment more than 10 % of the total volume and more than the volume calculated under 6.1.6.2?

Capacity of the existing secondary containment .....m^3

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.6.4 Is the retention capacity replaced by a double wall for the tank, equipped with a leakage indicator?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.6.5 Is the plant installed in or over aboveground waters where a retention facility can not be constructed due to the type and design of the plant?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.1.6.5.1 If yes, is it guaranteed that leakages which can not be prevented by monitoring and maintenance measures are duly stipulated in the operating instructions so that they can be detected immediately and disposed off in a safe way?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:
- *A temporary enlargement of the secondary containment with in-house means.*
- *Preparing an operational instruction in which the safe and professional method of handling such situation and the type of quick response are described (means personnel etc.)*
- *Providing sufficient binding agent*

Medium term:
- *Erecting of protective wall against spraying*
- *Providing alternative collecting basin if drip leakages can not be prevented.*

Long term:

- *Providing adequate collecting basins and secondary containments if there is a possibility of dangerous water hazardous substance being released due to e.g. Leakage, overfilling and other event.*

6.2 Tightness, Resistance

6.2.1 Is the secondary containment, drain surface or lowest point of the draining surface made of non-metallic porous material?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.2.1.1 Is at most the two-third of the wall thickness of sealed surfaces and walls penetrated by accidentally released water hazardous substance within the time of detecting the pollution and removing the released substance?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.2.2 Are the secondary containments sufficiently durable toward the released substances?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.2.2.1 Has the tightness and resistance of the containment towards the substances been verified?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.2.3 Are the surfaces and walls of the containment penetrated by pipelines and cables?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.2.3.1 If yes, is the penetration implemented in such a way that the surfaces are impermeable for liquids?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:
- *A temporary enlargement of the secondary containment with in-house means.*
- *Preparing an operational instruction in which the safe and professional method of handling such situation and the type of quick response are described (means personnel etc.)*
- *Providing sufficient binding agents*

Medium term:
- *Proofing the tightness and resistance of the containment towards the water hazardous substances being handled in the facility (literature, laboratory, on site check, documented experience of the operator)*

Long term:
- *Ensuring the tightness and durability of the sealed surface (For requirements of tightness see Checklist No. 5 „Sealing systems“, Recommendation 1/Point 1)*

6.3 Rainwater

6.3.1 Can rainwater flow into the secondary containment?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.3.1.1 Is the rainwater definitely removed after being tested?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.3.1.2 Does the secondary containment have additional freeboard height of 5 cm to contain rainwater?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

6.3.1.3 If the secondary containment has drain connection for draining rainwater, is the leakage of water hazardous substances through them ruled out?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:
- *Preparing an operating instruction where the method for removing rainwater is stipulated.*
- *Instructing the personnel on how to handle contaminated rainwater*
- *Always close the slide of the water draining point*

Medium term:
- *Enlargement of the secondary containment by providing a freeboard height of 5 cm*

Long term:
- *Remove water draining point if there are other possibilities of disposing or containing rainwater.*

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=70	RC=140

7 Production plants handling solid substances

❒ relevant ❒ irrelevant

7.1 Are water hazardous solid substances stored or handled at all operational and weather conditions on durable and impermeable floor? (see also checklist 5 „Sealing systems“)

Note: A floor is durable and impermeable floor in the sense road construction when composite paving stones and similar layers are used. When solid substances in form of paste are stored in a closed room without packing, then the durability and permeability of the floor should be specially monitored.

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

7.2 Are the substances packed in tight and durable container or packages which are protected against damages and influence of the weather?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

7.3 Are the substances stored in rooms or on floors which are protected against all weather influences?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:
- *Repairs of the damaged sealed surface and the roof*
- *Regular visual inspection of the sealed surface*
- *Preventing rainwater by raising the border of the sealed surface (upward lip for the sealed surface)*

Medium term:
- *Erecting sufficient roof over the sealed surface (the roof must be at least 2/3 of the headroom of the sealed surface)*

Long term:
- New sealed surfaces (floor) should be built or erected

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=30	RC=60

8 Fire protection

❒ relevant ❒ irrelevant

8.1 Are plants handling combustible liquids equipped with sufficient fire preventive facilities (e.g. Fire extinguisher and sprinkling facilities)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.1.1 Are the type and design of the fire preventive facilities stipulated in cooperation with the authorities in charge of fire prevention?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.2 Are the fire preventive facilities always operational at all times? Especially the calculated amount of water required for fire fighting and cooling measures must be guaranteed.

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.3 Can the material for the following plant components withstand the effects of a fire outbreak for at least 30 minutes?

a) Tank / plant components

❒ Yes ❒ No ❒ Not applicable

b) Pipeline

❒ Yes ❒ No ❒ Not applicable

c) Containing facilities

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.4 Are suitable measures put in place to prevent fire outbreak from the neighbourhood from spreading into the plant or a fire outbreak from the plant itself?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.5 Are the fire preventive facilities chosen according to the type and amount of combustible liquids being handled?
Are the following points taken especially into consideration?

- ❒ Local and operational conditions
- ❒ Amount of combustible liquids
- ❒ The degree of danger

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.5.1 Are suitable facilities for informing the local fire-brigade e.g. fire alarm available?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.6 Which fire preventive facilities are employed in outdoor above-ground plants?

- ❒ Stationary fire preventive facilities
- ❒ Mobile fire preventive facilities
- ❒ Semi mobile fire preventive facilities (semi mobile fire extinguishing facilities are equal to mobile fire extinguishing vehicles and/or equipments which in regard to the rate of fire extinguishing agent and their storage as well as the alarm concept and response time equal to a semi mobile fire extinguishing facility)

8.7 Which fire-extinguishing agents are used?

- ❒ Air foam
- ❒ Carbonic acid
- ❒ Extinguishing powder
- ❒ Water

8.7.1 Are special preventive measures taken to avoid danger of ignition due to electrostatic charges when carbonic acid or extinguishing powder are used in explosive atmosphere (e.g. for making the extinguishing facility inert or for testing extinguishing facility)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.8 Are mobile sprinkling systems used?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.8.1 Are the following points taken into consideration when mobile sprinkling systems are used?

- ❒ The neighbouring plants or plant components next to the burning plant must be in a position to be cooled the required quantity of water irrespective of which direction the wind and the smoke from the fire is blowing.
- ❒ Connections to the water network (fire hydrants) meant for fire extinguish purpose must be sufficiently available and installed in such a way that they remain easily

accessible from all direction in case of fire outbreak and also for cooling of neighbouring plants and plant components.

❒ The facilities needed for cooling and the professional personnel needed for their operation must always be ready during to guarantee an effective cooling of the plants within the shortest time after the fire outbreak.

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.9 Are trips or operating panels (locations) available in sufficient quantity?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.9.1 Are they installed in such a way that they remain easily accessible in case of fire outbreak at any part of the plant installations?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.10 Are facilities for collecting fire fighting water available?

Note: Special facilities for collecting fire fighting water are not necessary if

a) Only non combustible water hazardous substances being handled and material for the plant installations and their corresponding buildings are not combustible and no other combustible substances are stored near the plant installations or
b) No fire outbreak is possible due to some other reasons or
c) The amount of expected fire fighting water and water hazardous substances during the fire outbreak is so small that it can be collected in a safe way with the existing collecting facilities and it has been acknowledged by the local authority responsible for such incidents.

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

8.10.1 Has the size of the retaining facility for fire fighting water been verified? (See checklist 8 „Fire protection strategy“)

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:

- Regular inspection to detect leakages and leaks and possible igniting sources
- Prohibition of smoking and using of naked fire and hot objects.
- Training and instructing the personnel on fire-fighting measures and how to response in case of fire outbreaks.
- Identify and distinguish area of the plant with an increase risk of fire and install "No smoking" and "Naked flames are forbidden" signs where appropriate.
- Check and if necessary upgrade the fire fighting equipment for combating fresh fire outbreaks.
- Make sure that sufficient fire-fighting water is available and specify measures for improvement if necessary.
- Check the present methods of alarming the fire brigade and verify the response time of the fire brigade. Further measures should be specified depending on the results of this check.

Medium term:

- Issue special regulations on how maintenance and services should be implemented in these areas.
- Measures to improve the supply of fire-fighting water, e.g. increasing the flow rate of existing hydrants, installing additional fire-fighting water hydrants.
- Measures to improve the alarming of the fire brigade by installing additional telephones or manually triggered fire alarm devices.
- Specify measures to reduce the time needed before the combating takes off in cooperation with the fire brigade.
- Provide additional measures to protect structural components or limit the effects of fires by installing fire-proofed protective walls or claddings.

Long term:

- Install automatic fire alarm devices with alarm transmission to the local fire brigade.
- Provide additional measures to protect structural components or limit the effects of fires by installing fire-proofed protective walls or claddings.
- Provide fire sectors and fire-proofed partitions for storage or production areas.
- When reconstructing existing buildings or building new ones, make sure that non-combustible building materials are used.

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=70	RC=140

9 Prevention of explosion

❒ relevant ❒ irrelevant

9.1 Have measures been taken to prevent the occurrence of dangerous explosive atmosphere?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.2 Have appropriate measures been taken to:

❒ Prevent the danger of ignition of explosive atmosphere
❒ Limit the danger of ignition of explosive atmosphere
❒ Limit the effects of an explosion to the barest minimum?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.3 Are measures taken to prevent contacts between areas in which dangerous explosive atmosphere in form of a mixture of air and combustible gases, vapours or fogs normally will not occur during normal operation or at most for a short period of time and sources of ignition expected during normal operation (sources of ignition which can occur during normal and hitch-free operation)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.3.1 Are additional measures taken to prevent contacts between areas in which a dangerous explosive atmosphere in form of mixture of air and combustible gases, vapours or fogs can occasionally be formed during normal operation and also

sources of ignition which could be expected due to operational disturbances (frequent operational disturbances)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.3.1.1 Are measures also taken to prevent contacts between areas in which a dangerous explosive atmosphere in form of mixture of air and combustible gases, vapours or fogs is continuously, frequently or present for a long period of time and also sources of ignition which can be present due to operational disturbances that occurs from time to time?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.4 Are equipments, plants and plant components installed in explosive areas operated only if they fulfil the requirements for the zone in which they are installed?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.4.1 If yes, has this been verified?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.5 Are protective systems[1] used in explosive areas (e.g. fire screen (flame arrester), explosion suppression systems, pressure relief systems, quick shut-off slide valve) only put into operation if they are suitable for such application?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.6 Are sources of ignition which can affect explosive areas present in the immediate vicinity of areas in which explosive atmosphere can be formed occasionally or continuously during normal operation and all other explosive areas beyond this area (e.g. operating a furnaces or processes where open fire is being used or working with glowing objects, working with naked fire as well smoking)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.7 Are such zones of explosive areas such as joints and protective pipes for cables as well as wall and roof penetrations for pipelines protected against the entry of combustible liquids and their vapours?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.8 Do tank vehicles or other Lorries ply only areas where no explosive atmosphere is formed or only occur for a short period of time during normal operation and do they ply these areas only so far they are necessary for the smooth operation of the plant?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.9 Are explosive areas kept free of substances and materials which according to their type and amount are capable of causing and spreading fire?

Note: It is for example prohibited to store building materials and other substance not required for the smooth operation of the plant close to the plant installations.

[1] All devices which can stop an explosion which is just about to start immediately and/or can limit the areas being affected after explosion and can be sold in the market as an autonomous system are considered as protective system.

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.10 Are compressed, pressure liquefied gases only stored underground in areas in which dangerous explosive atmosphere are occasionally formed during normal operation?

Note: This does not apply to fire protection facilities.

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:
- Regular inspections to detect leakages and leaks as well as possible sources of ignition
- Prohibition of smoking and using of naked fire and hot objects.

Medium term:
- Classification of explosion protection zones and documentation an explosion protection zone plan.
- Use of equipments which is allowed for use in the appropriate zones.
- Issue special regulations for maintenance and services in these areas.

Long term:
- Installation von devices for warning when explosive atmosphere is formed

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

10 Requirements on plants with internal positive or negative pressure

❒ relevant ❒ irrelevant

10.1 Is the plant equipped with a device for monitoring the internal positive or negative pressure?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

10.2 Can the permissible operating positive pressure be exceeded?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

10.2.1 Is the plant in which a positive internal pressure can occur equipped with safety device against excess pressure?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

10.3 Can the liquids or their vapours being released by safety valves be discharged safely?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

10.4 Can other safety devices to control excess pressure be installed instead of safety valves (e.g. bursting disc safety device)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

10.5 Is the permissible operating pressure of the plant less than the possible pressure from the pressure generator with more than 2 bars?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

10.5.1 Is a system installed in the pressure pipe which automatically reduces the pressure such that the permissible operating pressure of the plant can not be exceeded?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

10.6 Is the occurrence of negative pressure possible?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

10.6.1 Is the plant resistant to negative pressure?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

10.6.2 Is the plant equipped with a system to prevent the occurrence of a dangerous negative pressure?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

10.7 Is the fitting of each pressure pipes of a plant equipped with shut-off devices to be able to bring the plant to a safe mode and guaranteed un-pressured condition during maintenance work and services?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:
- *Checking and monitoring of the positive and negative pressure by the staff.*
- *Instructing the staff on actions to be taken when the pressure is above or below the permissible pressure*
- *Regular checks of the effectiveness of safety valves*

Medium-term:
- *Installation of a system to monitor the internal positive and negative pressure*
- *Installation of safety valves or bursting disc safety device*
- *Ensure the safe discharge of dangerous substances released from safety valves (e.g. into a separate average container)*

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

11 Flaring system

❒ relevant ❒ irrelevant

11.1 Are positive pressure valves for organic substances like hydrogen and hydrogen sulphide pollution as well as gases which are produced during start ups and shut

downs procedures of the plant or produced during operational disturbance and emergency?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

11.1.1 Are these substances recycled back into the process through a gas collecting system?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

11.1.2 Are these substances burnt in the plant furnace and use for heating purpose?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

11.1.3 If the substance can not be utilized, are the gases fed to a flaring system?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:

- *Checking the possibilities of utilizing the waste gases being produced during start up and shut down procedure of the plant or produced during operational disturbance and emergency for the process or in furnace for heating purpose*

Long term:

- *Implementing a waste gas utilizing system and/or installing a flaring system*

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

12 Fittings with flame arrester

❒ relevant ❒ irrelevant

12.1 Are the opening ports of the plant components equipped with fittings having flame arrester to prevent naked flame entry into the plant?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Medium term:

- *Installation of fittings with flame arrester*

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=5	RC=10

13 Cooling and heating facilities

13.1 Are cooling and heating facilities in which water hazardous substance are being cooled or heated with water available (including evaporation and condensation)?

❒ Yes ❒ No ❒ Not applicable

13.2 Is the flow of water executed in a continuous mode (that is, taking water directly from the seas and rivers, process water or portable water supply and discharging them back into the seas and rivers after the cooling or heating process)?

❒ Yes ❒ No ❒ Not applicable

13.2.1 Is the water taken from the seas and rivers or process water or from the portable water supply network and discharged into a wastewater treatment plant?

❒ Yes ❒ No ❒ Not applicable

13.2.1.1 Is the wastewater treatment plant suitable for treating accidentally discharged water hazardous substances?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.2.2 Is the water being taken from the seas and rivers or from process water or from portable water supply network discharged directly into a sea or river after the cooling or heating process?

❒ Yes ❒ No ❒ Not applicable

13.2.2.1 Which water hazardous substance is being cooled or heated? (See also checklist 1 „Substances“)

Water hazardous substance .....

WHC .....

13.2.2.2 Which of these measures were taken?

- ❒ **D1** Direct stream cooling
- ❒ **D2** Direct stream cooling with a cooling water pressure which is distinct and controlled through the process pressure (cooling water pressure should also not be below the process pressure at any point in the cooling system during hydraulic processes)
- ❒ **D3** Direct stream flow cooling with condenser made of corrosion-resistant material and serviced regularly
- ❒ **Z** Intermediate storage with analytic control before discharging
- ❒ **E** Cooling with primary/secondary cycles (uncoupling)
- ❒ **K** Cycle cooling through closed circuit cooling systems
- ❒ **L** Plain air condenser
- ❒ **S** Special cooling process (e.g. Heat pumps, Absorption refrigerating system, Vapour compressor, Heat transformers)
- ❒ **A1** Analytical or other suitable method of monitoring the cooling water
- ❒ **A2** Automatic analytical monitoring of the cooling water (see below)
- ❒ **U1** Immediate disposal of the cooling water effluent to collecting facilities or to wastewater treatment plant as far as these are suitable for the disposal of the discharged substances or immediate disposal to a reserve condenser or putting the involved plant component out of production
- ❒ **U2** Automatic disposal of the cooing water effluent to collecting facilities or to wastewater treatment plant as far as these are suitable for the disposal of the discharged substances or automatic disposal to a reserve condenser or putting the involved plant component out of production

13.2.2.3 Were the best combinations of measures implemented regarding the WHC of the substances?

Existing substance	combinations of measures
❒ **WHC 1**	❒ D1 + A1 + U1
❒ **WHC 2**	❒ (D1 + A2 + U1) or (D2 + A1 + U1)

❒ **WHC 3** ❒ (D3 + A2 + U1) or (D2 + A2 + U2) or (Z) or (E) or (K) or (L) or (S)

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.2.2.3.1 Are the combinations of measures for higher water hazard classes implemented?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.2.2.3.2 Were the combinations of measures replaced by equivalent concept?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.2.2.3.3 Was the equivalency verified?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.2.2.4 Does the automatic analytic system (A 2) have the following characteristics?

❒ Leakages can be detected with good certainty and
❒ Leakages can be detected early enough

Note: It is sufficient if the analytic systems can predict the trend. Measuring of absolute concentration values with such systems is not necessary, but rather the recognition of a deviation from the normal condition is more important.

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.2.2.4.1 Is the measurement taken via a sensor in the stream of the cooling water?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.2.2.4.2 Is the measurement done with an automatic method quasi continuous outside of the stream of the cooling water?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:
- *Regular monitoring of the heating and cooling water*
- *Preparing an operating instruction in which the monitoring and if necessary, measures which should be taken in case of a leakage of water hazardous substances into the heating and cooling water is regulated*

Medium term:
- *Preparing a heating and cooling water strategy for implementing the recommendations*

Long term:
- *Implementing the recommendations*

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=30	RC=60

14 Loading and unloading ships

See also checklist 7 „Transshipment“

❒ relevant ❒ irrelevant

14.1 Is the transshipment process executed with pressure?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.1.1 Is the transshipment facility equipped with safety system having a quick shut-off device and which can interrupt the flow automatically both on the ship and land and disconnect the connection when and before the connecting pipe can be damaged due to the to and fro movement of the ship?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.2 Is the transshipment process executed by suction?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.2.1 Is it guaranteed that the content of the ship can not be lifted dry in case of damage to the suction pipeline due to lifting effect?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.3 Is the ship in a calm area of the sea (e.g. Bays or harbour basin)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.4 Are the vessels anchored in such a way when being refuelled that their to and fro movements with the highest expected water level fluctuation and movements is still within the permissible range of the filling pipeline?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.5 Are automatic dry coupling device which can avoid loss of liquids when uncoupling used for hose pipe (connection between land and ship)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.5.1 Are these automatic dry coupling devices checked regularly?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.6 Is an operating instruction including monitoring, maintenance and alarm plan put in place?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.6.1 Is it written in the operating instruction that the loading and unloading process can only be carried out by inducted and instructed personnel?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.6.2 Is this operating instruction being observed?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.7 Can an unauthorised operation of the plant be ruled out?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.8 Can an unauthorised using of the plant be ruled out?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.9 Is the process of refuelling being supervised by instructed/inducted personnel during the entire period of refuelling?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.9.1 Are the hoses and fittings and as the case may be also the hose connections visible enough?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.9.2 Are the hose connections being supervised by personnel to avoid overfilling in cases where no overfilling device is used?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.9.2.1 Do the supervisors utilize such suitable facilities such as video monitoring equipments?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.9.2.2 Was this method authorised by the authorising authority?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.9.2.3 Is it guaranteed that the above-mentioned job can be accomplished in the same way?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.10 Is the entire length of the mobile parts of the pipeline for the filling process visible at all times and sufficiently illuminated at night during filling process?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.11 Is it guaranteed that the approved nominal pressure is not exceeded at anytime?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.12 Can the substances leaking out when the coupling of the hose connections is disconnected by accident be collected with e.g. a collecting basin?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.13 Are binding agents with a high absorbing capacity and the ability to stay floatable after being spread on the leak available for eliminating losses due to drips and leakages caused by accident on land or water at every transshipment facility?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.13.1 Are equipments for spreading and collecting the binding agents after the absorbing process available?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.14 Are suitable facilities (e.g. oil barriers) which can prevent the spreading of substances on water or help to concentrate them for immediate use available at the transshipment facility?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

14.14.1 Are other equipments for removing the substances from the surface of the water available in addition to this?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remark:

Examples of measures:

Short term:
- *For the application of the checklist see checklist 7 „transshipment“*
- *Providing binding agents*
- *Preparing operating instruction for transshipment process*
- *Instruction on how to behave during transshipment process*
- *Secure the plant from being operated by unauthorised person (e.g. by locking up the operating station)*

Medium term:
- *Providing sufficient oil barriers*

Long term:
- *Providing the devices for removing the substances from the surface of the water*

Estimation of the real risk:

How is the implementation of the sub-point of the recommendation?

Yes	Partially	No
❒	❒	❒
RC=1	RC=30	RC=60

How do you estimate the risk?

For detail text of the recommendation see „Recommendation for Refineries" an element of a UNDP/GEF Danube regional project "Activities for Accident Prevention - Pilot Project – Refineries" (RER/03/G31/A/1G/31) **point 4.2.**

Sub-point of the Recommendation	Possible Risk category	Risk categories RC
1	1 / 5 / 10	
2	1 / 5 / 10	
3	1 / 5 / 10	
4	1 / 5 / 10	
5	1 / 5 / 10	
6	1 / 70 / 140	
7	1 / 30 / 60	
8	1 / 70 / 140	
9	1 / 5 / 10	

10	1 / 5 / 10
11	1 / 5 / 10
12	1 / 5 / 10
13	1 / 30 / 60
14	1 / 30 / 60

Average **R**isk of the **C**hecklist **(ARC)**