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Checklists for surveying and assessing industrial plant handling materials and substances, which are hazardous to water

№ 13

Storage facilities

For our Environment

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№ 13

Storage facilities

by

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Recommendations of the International River Basin commission for storing substances hazardous to water

Storing is the process of keeping substances hazardous to water in containers (tanks, tank container and other vessels) to serve as a depot for consumption or source of supply to others. This also includes serving as a point of storage, if loading or offloading processes does not start within 24 h or the next working day. If this working day is a Saturday, then the time limit ends on the next working day. Storages are grouped according to types in:

- Overground and
- Underground storage.

In such cases the following recommendations are made:

1 For reasons of fire, explosion and environmental protection, liquids hazardous to water should be stored in such a way that accidental release is ruled out. Storage equipments should be tight, stable and sufficiently resistant to possible physical and chemical influences

2 Single shell containers and pipelines are generally not allowed. This, however, does not apply to solid and liquid substances that are hazardous to water.

3 If liquids hazardous to water are stored in one or several containers in overground storage, the containers should be placed in a secondary containment. This does not apply to storage units where other adequate environmental safety measures have been taken to prevent mechanical damages to the container shell and there is a proof for this (e.g. double shell container with leakage indicator and small barrel storage: these are barrels and storage units with containers of less than 0,02 m^3 volume).

4 Secondary containment should be large enough to accommodate all the stored products in instances of accidental discharge. They should be able to contain at least:

1. The volume of the units placed in it or the volume of the biggest tank if several units are placed in the containment, it should be able to retain at least 10 % of the whole volume of all units placed in it; communicating containers are considered to be one container;

2. When storage is done in movable containers:

    a. with a total capacity of up to 100 m^3, then it should be able to accommodate 10 % of the volume of all containers or at least an equivalent of the volume of the largest container,

    b. with a total capacity above 100 m^3 to 1000 m^3, then it should be able to accommodate 3 % of the volume of all containers or at least 10 m^3,

    c. With a total capacity of up to 1000 m^3, it should be able to accommodate 2 % of the volume of all containers or at least 30 m^3.

3. The requirements on containment capacity of a secondary containment of Storage units with small barrels are seen as fulfilled when substances are stored outside in containers or closed packages secured against damage and climatic influences or in closed rooms where damages

can be repaired with simple operational means and these rules are stated in the operating instructions.

4. The containment of fire-fighting water should be considered when calculating the entire capacity of the secondary containment.

5 Single-shell tanks, pipelines and other equipment must have enough space between them and walls and other structural components to make instant detection possible at all times by simple inspection. If for justifiable reasons this is not possible, then one or several leakage probes should be installed at a suitable point whereby an acoustic and optical alarm would be released each time the level reaches a critical stage.

6 Tanks should be installed in such a way as to avoid displacement, inclination and constraint which could affect its safety and that of its equipment.

7 The stability of overground tanks must be guaranteed to withstand the effect of fire for duration of 30 minutes.

8 In open-air storage for overground tanks, measures for the protection of the tanks against lightning are required.

9 When underground tanks are installed in the ground, it must be ensured that they are intact before installation and are embedded with suitable filling material. Moreover, they should not be exposed to corrosive agents and mechanical stress and their position should be stable.

10 The tanks should be installed in a way to ensure adequate protection against all possible external danger.

11 In case of a possible displacement of the plant due to groundwater, static water and flood, the tank should be secured with suitable means against the force of buoyancy.

12 As a measure of safety against the effects of fire, adequate distance and if necessary security zones should be maintained between open-air overground tanks and neighbouring plants and buildings, depending on the type of tank as well as amount and danger class of the stored flammable liquid substances.

13 Units for storing flammable liquid substances should be installed and equipped as well as maintained and operated in such a way as to guarantee the safety of the personnel and the public, especially in case of fire outbreak and in cases where the liquids are heated beyond their flash point and there must be also taken measures against a danger of explosion.

14 The quantity of flammable liquids in storage facilities should be limited with regard to fire outbreak.

15 The ban on joint storage should be observed.

16 Containers and all other components of the plant that can act as transmitters should be installed in such a way as to not constitute electrical polarities which can lead to the formation of explosive sparks, dangerous corrosion or a hazard to human.

17 Plants and plant components must be secured against electrostatic charges, which can lead to dangerous discharging processes. The process of filling a container should be carried out in such a way that danger of electrostatic charges does not occur.

18 Units for storing flammable liquids must be equipped with adequate fire protection devices. The necessity of fire protecting devices applies to storage in containers of all kind in open space as well as in rooms.

19 Units used for storing solid substances hazardous to water must fulfil the following criteria:

a. They must have a bottom that is resistant and impermeable to the substances under all operational and climatic conditions and
b. the substances:
   a) should be stored, filled and transshiped in tight containers or packages, these containers or packages should be protected against damages and other climatic influences, or
   b) should be stored in a room. Closed rooms are considered as spaces which are protected against climatic influences and entry of water or other liquids to avoid release of substances.

20 Storage units should be equipped with persistent and clearly readable signs to indicate the kind of substances hazardous to water they handle and at which operational pressure.

Checklist for monitoring the implementation of the recommendations

General details of the surveyed storage

Name of operation:

❒ Underground ❒ Overground ❒ Outdoor ❒ in a room
❒ Drum storage ❒ Tanks

❒ Secondary containment Volume: m^3

Container's Individual volume: m^3

Total volume: m^3

Name of substance (compound):
(for further details see Checklist No. 1 „Substances“)

WRI:

Material of container:

Remarks:

1 Stability of the storage unit

1.1 Could the tightness of the storage tanks be ascertained during a visual inspection (as far as possible)?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

1.2 Was the tightness of the container established with a generally approved testing method according to the latest technical requirements, and were these results documented in a written form?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Examples of actions:

Short-term measures:

- Repair of leaking parts of container and replacement of packing
- Examining container wall in regard to designed pressure.
- Gauging wall thickness at selected points with the aid of ultrasonic devise to prove that the thickness was sufficient (by calculation).

Medium-term measures:

- Pressure and tightness tests.
  - Test medium: **Water**.
    Test pressure: 1,3 x maximum allowed operating pressure of the container.
  - Test medium: **Nitrogen or Air** (observe safety precautions measures).
    Test pressure: 1,1 x maximum allowed operating overpressure of the container.
- If the pressure test is not possible due to safety reasons: perform such tests that will not cause deformation, for example gauging of the wall thickness with ultrasonic device should be applied.

1.3 Could any sign of declivity or sinking be observed on the storage unit as a result of a weak foundation?

❒ Yes (not available) ❒ No (available) ❒ Not applicable

❒ Action ❒ No action

1.4 Is there any record on the structural static of the unit?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Examples of actions:

Short-term measures:

- Testing of the right position of defined fixed points.
- Test regarding regulation on support constructions.

Medium-term measures:

- Repair of supporting constructions.

1.5 Are the containers sufficiently resistant to substances hazardous to water?

a) Resistant to mechanical stress?

❒ Yes ❒ No ❒ Not applicable

b) Resistant to thermal stress?

❒ Yes ❒ No ❒ Not applicable

c) Resistant to chemical stress?

❒ Yes ❒ No ❒ Not applicable

d) Resistant to biological stress?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:

Short-term measures:

- Testing of the tank wall with regard to required design pressure.
- Measurement of wall thickness at specified parts of the tank with ultrasonic device to prove that the thickness was sufficient (through calculation).
- Visual inspection of the inner wall at specific parts of the tank
- Checking available tank documents.

Medium-term measures:

- Pressure and tightness tests.
  - Test medium: **Water**.
    Test pressure: 1.3 x maximum allowed operational pressure of the tanks.
  - Test medium: **Nitrogen or Air** (observe safety precaution measures).
    Test pressure: 1,1 x maximum allowed operational pressure of tanks.
- If the pressure test is not possible due to safety reasons: Test that will not cause deformation, for example measurement of wall thickness with ultrasonic device should be applied.

Long-term measures:

- Documenting the suitability and stability of the tanks in a container document based on the results of the test and positive operational experiences.
- New installations: Evidence of suitability and stability should be provided by the firm installing the container or its producer before installation.

Determination of the actual risk

Is the sub-point of the recommendation implemented?

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

2 Underground tanks and piping

❒ relevant ❒ not relevant→3

On pipelines see checklist No. 3 „Pipelines“

2.1 Are liquid substances hazardous to water stored in underground storage facilities or transported in underground pipelines?

❒ Yes ❒ No→3 ❒ Not applicable

2.2 Are the walls of the container and pipelines in question designed as single wall?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No Action

Remarks:

Examples of measures:

Short-term measures:

- Pressure and tightness test for underground tanks.
- Estimation of the durability with approved testing methods and computational evaluation to check if weakening of the static has taken place.

Medium-term measures:

- Replacement of underground tanks with over-ground tanks.

Long-term measures:

- Underground tanks should be placed and installed in a way to guarantee automatic detection of leakages and alarms.

Determination of the actual risk

Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=200

3 Secondary containment

❒ relevant ❒ not relevant→4

Note: *The point "Not relevant" is only for underground constructions*

3.1 Is a single shell tank installed in a secondary containment?

❒ Yes→3.3 ❒ No→3.2 ❒ Not applicable

❒ Action ❒ No action

3.2 Have other adequate measures been taken to keep the environment safe in case of failure of the tank walls and has it been demonstrated?

❒ Yes ❒ No ❒ Not applicable

If yes what measure?

❒ Double shell tanks with leakage indicator

❒ Small drums storage unit (these are vessels and small drums storage facilities with containers having volumes of about 0,02 m^3)

❒ Other (description)

3.3 Are the available secondary containments sufficiently tight and resistant to escaping substances?[1]

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Short-term measures:

- Testing of tank wall with regard to required design pressure.
- Measurement of wall thickness at specified parts of the tank with ultrasonic device to prove that the thickness was sufficient (through calculation).
- Build the required secondary containment as a temporary structure for example by covering the tank with earth barrier or using other forms of artificial barrier to check spreading and to temporarily seal the ground surfaces (e.g. clayey soil, covering the ground surface with foils)
- Visual inspection of the secondary containment
- Repair work

Medium-term measures:

- Renovation of badly damaged secondary containment.

Long-term measures:

- The tightness and stability of the sealed surfaces of a secondary containment should be guaranteed (requirements on the tightness, see Checklist No. 5 „Sealing systems“, Recommendation 1/Point 1).
- The sealed surfaces must be resistant to the dangerous substances at least for the duration of storage until the substances are disposed. This duration should be determined in collaboration with experts planning danger warning.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=200

4 Volume of the secondary containment

❒ relevant ❒ not relevant→5.

Note: This point “Not relevant” is only for underground and double-walled constructions.

4.1 Is this plant a storage unit for stationary tanks?

❒ Yes ❒ No→ 4.2 ❒ Not applicable

If yes then:

Total quantity of liquid that can be contained .....m³

10 % of the total quantity stored .....m³

[1] Secondary containment with cohesive base are only permitted for existing flat bottom tanks if the bottom of the tank is made of double wall and leak monitored or equipped with an equivalent safety device. Sole and barriers of the secondary containment must be made of at least 30 centimetres layer of cohesive soil, compressed and kept sufficiently damp in such a way that water hazardous liquid can only penetrate it at most 20 centimetres within 72 hours.

The largest tank in secondary containment (communicating tanks are as one tank) .....m³

Volume of the available secondary containment .....m³

Note: *Here it is necessary to consider the free containment only, and the amount of technical devices installed at the containment should be deducted.*

4.1.1 Is the volume of available secondary containment more than 10 % of the total volume of the whole storage unit and more than the volume of the biggest tank?

❒ Yes ❒ No ❒ entfällt

❒ Action ❒ No action

4.2 Is this a storage unit for movable containers?

❒ Yes ❒ No→ 4.3 ❒ Not applicable

If yes then:

Total quantity of liquid that can be contained in .....m³

10 % of the total quantity stored .....m³

3 % of the total quantity stored .....m³

2 % of the total quantity stored .....m³

Largest vessel in the secondary containment .....m³

Volume of the available secondary containment .....m³

Note: *Here it is necessary to consider the free containment only, and the amount of technical devices installed at the containment should be deducted.*

4.2.1 Is available secondary containment larger than what is required?

Total volume of unit $V_{tot.}$ in m³	Volume of the secondary containment
❒ ≤ 100	10 % of $V_{tot.}$, at least the volume of the biggest vessel
❒ > 100 ≤ 1000	3 % of $V_{tot.}$, but not less than 10 m³
❒ > 1000	2 % of $V_{tot.}$, but not less than 30 m³

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

4.3 Is the available unit small drums storage? (All the vessels under 20 Litres)

❒ Yes ❒ No→ 4.4 ❒ Not applicable

4.3.1 Are the substances stored outside?

❒ Yes ❒ No→ 4.3.2 ❒ Not applicable

❒ Action ❒ No action

4.3.1.1. Are the substances stored in the following reservoirs or containers?

a) tightly closed ❒ yes ❒ no
b) protected against damage ❒ yes ❒ no
c) in vessels resistant to atmospheric influence ❒ yes ❒ no

4.3.1.2 Were the three criteria answered positively from 4.3.1.1 a) till c)?

❒ Yes ❒ No ❒ Not applicable
❒ Action ❒ No action

4.3.2 Are the substances stored in closed rooms?

❒ Yes ❒ No ❒ Not applicable
❒ Action ❒ No action

4.3.3 Is it possible clean up after damages with simple operational means?

❒ Yes ❒ No ❒ Not applicable
❒ Action ❒ No action

4.3.4 Are the operational instructions available in writing regarding the way of storage and cleaning up after damage?

❒ Yes ❒ No ❒ Not applicable
❒ Action ❒ No action

4.4 Is there enough space available to contain additional volume of fire-fighting water in respect to the above method of determining the volume of the secondary containment? (see also Checklist 8 „Fire protection“)

❒ Yes ❒ No ❒ Not applicable
❒ Action ❒ No action

Examples of measures:
Short-term measures:
- Temporary enlargement of the secondary containment with own means
- Preparing operational instructions describing a professional safe storage method and methods of immediate cleaning up of damages (means, persons etc.)
- Supply of sufficient binding agents

Long-term measures:
- Installation of sufficiently dimensioned containment basin and secondary containment if there is a possibility of leakage of substances hazardous to water due to leakage, overfill or other incidents
- The tightness and stability of the sealed surfaces of secondary containment should be guaranteed (for the requirements on tightness see Checklist N. 5 „sealing systems“, recommendation 1/point 1).

Determination of the real risk
Is the sub-point of the recommendation implemented?

Yes	Partially	No
❒	❒	❒
RC=1	RC=100	RC=200

5 Distance

5.1 Is the space between single shell tanks, pipelines and other units and the surrounding walls and other constructions such that detecting leakages and the inspection of the state of the secondary containment is possible at all times by simple visual inspection?

❒ Yes ❒ No ❒ Not applicable

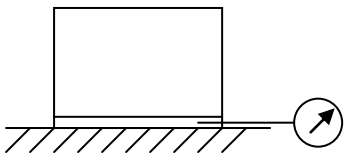
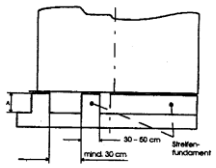
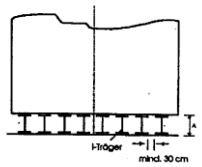
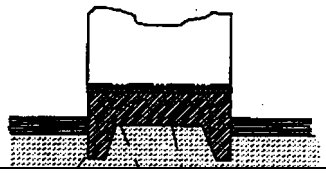
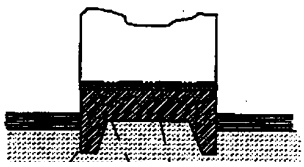
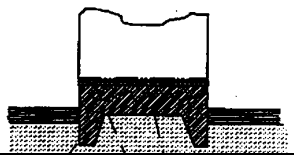
❒ Action ❒ No action

5.2 Are leak probes installed at suitable points that can send acoustic and optical alarms whenever there is a critical liquid level?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

5.3 Is one of the following type of installation for flat bottom tank chosen?

❒		Leakage monitored double wall bottom.
❒		Strip foundations, in order to make the inspection of the tank base from outside possible.
❒		Beam grillage/I-beam on joint-less concrete foundation, in order to make the inspection of the tank base from outside possible.
❒		Joint-less concrete foundation with additional barrier layer made of plastic raised above the sole of the secondary containment.
❒		Joint-less concrete foundation with additional barrier layer of metal plate made of stainless steel raised above the sole of the secondary containment
❒		Joint-less concrete foundation without additional barrier layer but a tank base made of stainless steel raised above the sole of the secondary containment.
❒		If a different type of installation is chosen, then the quick and reliable detection of leakages must be proved.

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:
Short-term measures:
- Training and instructing the staff to inspect the plant regularly and to take the right decision in case of risk of overfill.

Long-term measures:
- Installation of suitable leakage probes that can send acoustic and optical alarm when leakage of substances hazardous to water occurs.

Determination of the actual risk
Is the sub-point of the recommendation implemented?

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

6 Stability

6.1 Did a professional firm Installation of equipment

❒ Yes ❒ No ❒ Not applicable
❒ Action ❒ No action

a) Were the construction standards followed at establishing the foundation for a container?

❒ Yes ❒ No ❒ Not applicable
❒ Action ❒ No action

b) Were the soil structure considered during installation?

❒ Yes ❒ No ❒ Not applicable
❒ Action ❒ No action

6.2 Could the drifting, inclination and deformation of the tank which can endanger the safety of the tank or its equipment be noticed?

❒ Yes (available) ❒ No (not available) ❒ Not applicable
❒ Action ❒ No action

Remarks:

Examples of measures:
Short-term measures:
- Training and instructing the staff to recognise drifting, inclination and deformation of tanks.
- Regular inspections to identify existing problems.

Medium-term measures:
- Preparing experts opinion on the building site in regard to the soil condition and expected stress on the ground

Long-term measures:
- Per necessity, additional foundation measures should be applied when installing new units.

Determination of the actual risk
Is the sub-point of the recommendation implemented?

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

7 Stability when exposed to fire

7.1 Is the stability of the plant guaranteed after exposure to fire for 30 min?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:
Short-term measures:
- Supply of sufficient extinguishing agents
- Regular inspection of leakage and possible sources of ignition

Medium-term measures:
- If there is no guarantee that the plant could resist fire for 30minutes, its resistance should be improved by additional coating. (e.g. concrete)

Long-term measures:
- Install new plants in such a way that a fire resistance of 30 min is guaranteed.

Determination of the actual risk
Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=10

8 Lightning proofing

8.1 Have measure been taken to protect over-ground tanks installed outdoor against lightning?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:
Long-term measures:
- Plants components that are not covered on all sides with soil, masonry or concrete or other such materials must be protected with suitable protective devices from the danger of ignition caused by thunder. This applies also to storage in shelves. No lightning protection device is required for mobile tanks in outdoor storage.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=10

9 Installation of Underground tank

❒ relevant ❒ not relevant→ 10

9.1 Were the tanks intact before installation?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.2 Was the tank embedded and filled with suitable filling material?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.3 Is the tank protected against external corrosion?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.4 Is the tank designed to withstand eventual mechanical stress?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

9.5 Have the following points been confirmed by the professional firm:

❒ The intactness of the tank before installation?
❒ Installation of the tank according to the prevailing criteria?
❒ Protection against external corrosion and their safety?
❒ The static proof against eventual mechanical stress?

❒ Yes (marked with cross above) ❒ No (not marked with cross above) ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:

Short-term measures:

- Get confirmation from a professional firm
- Regular pressure and tightness test of underground tanks.
- Reduction of *the mechanical loads e.g. limitation of load or closing of roads in the vicinity of the tank unit.*

Medium-term measures:

- Installation of additional protection from corrosion

Long-term measures:

- If unsuitable filling materials were used- dismantle the tank and reinstall them taking the above mentioned points into consideration.

Determination of the real risk

Is the sub-point of the recommendation implemented?

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

10 Danger of mechanical damages

10.1 Was the storage unit installed in such a way that danger of mechanical damages, for example, through transportation and other mechanical influences

Examples of mechanical damages:

- As a result of incursion by a car and transport vehicles
- Damage made by crane, excavator, conveyer systems

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:

Short-term measures:

- Installing barriers against being damaged by vehicles or risk of mechanical damages:
  - Installation of guard rails made of steel beam or similar constructions,
  - Installation of barriers made of steel or concrete,
  - Installation of concrete wall,
  - heaping up of soil to act as earth dam.

Medium-term measures:

- Installing adequate barriers against being damaged by vehicles (as mentioned under short-term measures).

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=10

11 Floating of the storage unit

11.1 Is the storage unit secured against the force of buoyancy caused by increase in groundwater level, static water or flood? (See checklist No. 11 „Flooding due to high tide“)

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:
See also Checklist No. 11 „Flooding (due to high tide)“
Short-term measures:

- is the underground tank adequately secured against floating, can the following measures be applied:
  - increasing the earth covering with soil or
  - covering the tank with concrete slabs or
  - anchoring with steel bands that are secured in concrete slab.

Medium-term measures:

- Tanks and storage unit components should be secured with additional measures against floating, e.g. with:
  - Anchors made of steel bands at the bottom or shell,
  - supporting it with steel braces attached to the roof of the storage room.

Long-term measures:
When installing new underground units the underground components should be anchored with steel bands secured in a concrete slab.

Determination of the real risk
Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=10

12 Safety gap between outdoor overground tanks

❒ relevant ❒ not relevant→ 13

12.1 Is the safety gap between overground tanks and neighbouring plants, as well as other buildings sufficient to avoid reciprocal effects of fire?

❒ Yes ❒ No→ 13 ❒ Not applicable

❒ Action ❒ No action

12.2 Are the following aspects considered?

❒ Type of tank
❒ Volume of flammable liquid stored
❒ Danger class

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:
Short-term measures:

- regular inspections of spill and leakages.

Long-term-measures:

- create adequate safety distance (e.g. for the storage of highly flammable liquids, a distances of at least 10 m to buildings will be enough).

Determination of the real risk

Is the sub-point of the recommendation implemented?

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

13 Protection from the danger of fire and explosion

13.1 Are measures taken to protect the personnel and public against the danger of fire and explosions?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.2 Is the surveyed plant one of the following plants?

❒ Storage of materials with a flash point below 21°C and a total quantity of more than 5000 tons

❒ Storage of combustible liquids and a total quantity of more than 10000 tons

❒ Yes (marked with cross above) ❒ No (not marked with cross) ❒ Not applicable

❒ Action ❒ No action

13.2.1 If yes, is it available at the plant a stationary fire extinguishing system of needed type and capacity?

❒ Yes→ 13.2.3 ❒ →No13.2.2 ❒ Not applicable

❒ Action ❒ No action

13.2.2 Are there semi-mobile fire extinguishing systems installed in place which is feeded with extinguishing agents? Would have to be first switched on by the fire brigades and do they fulfil the following conditions?

❒ Yes ❒ No ❒ Not applicable

13.2.2.1. Does the fire extinguishing system correspond the following conditions?

❒ A registered in-house fire brigade department which can offer help within a maximum time of 5 min. after alert must be available **and**

❒ The early detection of fire outbreaks and immediate alerting of the in-house fire brigades must be guaranteed

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.2.3 Are outdoor plants constantly monitored or supervised by personnel for 24 hours a day?

Note: constant monitoring or supervision by the personnel is also considered as being guaranteed if the supervision is done by operating, mechanical, fitter or maintenance personnel who are trained accordingly.

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.2.3.1 Are outdoor plants monitored by automatic fire alarm equipment?

❒ Yes ❒ No → 13.3 ❒ Not applicable

❒ Action ❒ No action

13.2.3.2 Is the automatic fire alarm equipment suitable (appropriate) for outdoor storage facilities?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.3 Are there enough points of alarm contacts or control?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

13.3.1 Are they installed in such a way to allow access from any angle in case of fire outbreaks?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks

Examples of measures:

Short-term measures:

- regular inspections of spill and leakages as well as sources of ignition
- Ban on smoking and using of open flames and hot objects.

Medium-term measures:

- Classification of explosion prevention zones and their registration in an explosion prevention zone plan.
- Utilisation of devices which are permitted in these zones.
- Issuing special regulations for maintenance work and servicing in these zones.

Long-term measures:

- Installation of devices for warning in case of formation of explosive atmosphere.

Determination of the real risk

Is the sub-point of the recommendation implemented?

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

14 Limitation of the effects of fire

14.1 Is the quantity of material stored limited with regard to fire-fighting capacity?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:

Short-term measures:

- The amount can exceed the designated value if adequate fire-fighting is guaranteed, e.g. a company-owned fire brigade, approved by the authority or permanent automatic fire extinguishing devices.

Medium-term measures:

- limitation of the amount stored in stationary tanks with flammable liquids to maximum 150 000 l and in movable containers or tank container to maximum 100 000 l.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=10

15 Prohibition of joint storage

15.1 Is the prohibition of joint storage observed? (See also Checklist No. 4 „Joint Storage“)

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:

Short-term measures:

- Recording of dangerous substances and finding out the dangerous properties which are important for determining safety measures.
- Provide temporary measures, such as e.g.:
  - mobile fire extinguishers,
  - heap up soil to act as earth dam,
  - construct simple partition walls made of bricks
  - If possible, change the order of filling each storage section.

Medium-term measures:

- Construct fire-resistant partition walls.
- Storage in the open should be with adequate safety distance or partitioning of the storage sections with fire-resistant walls.
- Change the order of filling each storage sections.
- Joint secondary containments should be partitioned with additional fire-resistant partition walls (sufficient retention volume must be available).

Long-term measures:

- If the substances are in different storage and the available partition walls are **not** fire-resistant or sufficient safety distance is not observed, then:
  - A fire alarm and device for transmitting the alarm to the fire brigade should be installed.
  -Installation of automatic fire extinguishing systems.
- Erect the containers (tanks) in different secondary containment or use double shell tanks.
- Provide stationary extinguishing systems for the tank storages
- Provide sprinklers for the exterior surfaces of the tanks.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=10

16 Avoiding electrical potential difference

16.1 Are all tanks and all other connected plant components earthed in such a way that no potential differences can be formed?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

16.2 Has any sign of corrosion on the piping and other joints been noticed during inspections?

❒ Yes (yes, was not noticed) ❒ No (No, was noticed) ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:
Medium-term measures:
- Ensure the earthen of all tanks and plant components.

Determination of the real risk
Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=10

17 Electrostatic charge

17.1 Can electrostatic charges which can lead to dangerous discharging processes occur?

❒ Yes (can not occur) ❒ No (No, can occur) ❒ Not applicable

❒ Action ❒ No action

17.2 Have measures been taken to reduce electrostatic charges?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:
Short-term measures:
- Verification of the conductivity (only if their resistance to the earth is more than 10^6 Ohm, then additional measures will be required to guarantee a resistance less than 10^6 Ohm). The surface ground of storages must be conductive with a resistance of maximum 10^8 Ohm. This is especially important for ground surfaces with a covering layer or seals made of plastic.

Medium-term measures:
- Ensure that all tanks and plant components are sufficiently earthed (also the tank being filled).

Determination of the real risk
Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=10

18 Fire fighting systems

18.1 Is the fire protection system available in the sufficient quantity? (See also Checklist No. 8 „Fire protection plan“)

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:
Short-term measures:
- Training and instructing the personnel on fire prevention measures and how to act in case of fire outbreak.
- Sections of the factory with high risk of fire should be marked. Areas where “smoking is prohibited” and “handling of open fire is prohibited” should be marked.
- Take stock of the fire extinguishers for combating fresh fire outbreaks and if necessary supplement them with, for example:
  - suitable portable fire extinguisher,
  - hoses for fire fighting water.
- Check whether the fire-fighting water supply is sufficient and define measures for improvement.
- Examining the possibilities of alarming the fire brigade and the response time before the combating begins. Further measures should be defined as a result of this examination.

Medium-term measures:
- Measures for the improvement of the fire-fighting water supply e.g. increase of the mechanical discharge capacity on the existing fire-hydrant, installation of additional fire fighting water.
- Measures for the improvement of alerting, e.g. with additional telephones or fire alarm devices which can be released manually.
- Reducing the response time in collaboration with the fire brigade.
- Additional safety measures to stabilise the steel construction or reduce the effects of fire by using fire-resistant protective wall or coating.

Long-term measures:
- Installation of automatic fire alarm devices with automatic transmission of the alarm to the local fire brigade.
- Additional safety measures to stabilise the steel construction or reduce the effects of fire by using fire-resistant protective wall or coating.
- Creating of fire sections and fire-resistant partitioned storage sections or production area.
- Non-flammable building materials should be used when changes are made to existing structures or new structures are installed.

Determination of the real risk
Is the sub-point of the recommendation implemented?

Yes	No
❒	❒
RC=1	RC=10

19 Storage of solid substances

❒ significant ❒ insignificant → 20

19.1 Are solid substances hazardous to water stored on durable and impermeable floor at all operating and climatic conditions? (see also Checklist No. 5 „Sealing systems“)

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

19.2 Are solid substances hazardous to water stored outdoors?

❒ Yes→ 19.2.1 ❒ No→ 19.3 ❒ Not applicable

❒ Action ❒ No action

19.2.1 Are the substances stored in containers or packages, which correspond following criteria?

container/packaging is tight	❒ yes	❒ no
container/packaging is protected against damage	❒ yes	❒ no
container/packaging is resistant to atmospheric influence and stored materials	❒ yes	❒ no

❒ Action ❒ No action

19.3. Are the substances stored in tight containers or packages, protected against damage, resistant to climatic influence and substances?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:

Short-term measures:

- Repairing of damages to the sealed surfaces and the roofing
- Regular visual inspection of the sealing
- Prevent the entry of rain water to the sealed surfaces by raising the edges of the containment.

Medium-term measures:

- Erecting of suitable roofing (the roofing must be at least 2/3 of the headroom)
- Store substances in tight tanks or packages which are protected from damages and climatic influences and are resistant to the substances stored.

Long-term measures:

- Build new sealed surfaces
- Store in tight silos.

Determination of the real risk

Is the sub-point of the recommendation implemented?

Yes	Partially	No
❒	❒	❒
RC=1	RC=50	RC=100

20 Markings (Labelling)

20.1 Are the storage units marked in accordance with the physical and chemical properties of the stored substances?

❒ Yes ❒ No ❒ Not applicable

❒ Action ❒ No action

Remarks:

Examples of measures:

Medium-term measures:

. Markings should be done according to valid regulations.

Long-term measures:

- Marking or labelling should be according to valid regulation and where necessary with regard to the operational pressure, temperature and stored substances.

Determination of the real risk

Is the sub-point of the recommendation implemented?

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

Summary of the Checklist

Sub-point of the Recommendation	Possible Risk category	Risk categories
1	1 / 5 /10	
2	1 / 200	
3	1 / 200	
4	1 / 100 / 200	
5	1 / 5/ 10	
6	1 / 5 / 10	
7	1 / 10	
8	1 / 10	
9	1 / 5 / 10	
10	1 / 10	
11	1 / 10	
12	1 / 5 / 10	
13	1 / 5 / 10	
14	1 / 10	
15	1 / 10	
16	1 / 10	
17	1 / 10	
18	1 / 10	
19	1 / 50 / 100	
20	1 / 5 / 10	

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