

**Recommendations of the  
International Commission  
for the Protection of the Rhine (ICPR)  
on the Prevention of Industrial Accidents  
and the Safety of Industrial Plants**



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## Foreword

Accidents in industrial plants may have far-reaching transboundary effects on water bodies, they may in particular limit their use as drinking or industrial water and damage the aquatic ecosystem. An impressive example was given by the disastrous fire in Schweizerhalle in 1986 which led to a serious pollution of the Rhine. For several days, fishery and drinking water production had to be stopped even 1000 km downstream, in the Netherlands.

In response to this event the ministers of the Rhine bordering countries agreed that all production and storage sites in the Rhine catchment area where larger amounts of substances hazardous to water are liable to occur must meet safety standards preventing any water pollution by such substances.

The International Commission for the Protection of the Rhine (ICPR) entrusted the working group "Prevention of Industrial Accidents and Safety of Industrial Plants" with this task. In the last years recommendations for measures in the relevant fields of safety in plants where substances hazardous to water are handled were formulated.

An analysis of accidents along the Rhine has revealed a considerable reduction of accidents in plants where substances hazardous to water are handled.

Safety measures are not specific to a drainage area. The target of the documentation in hand is to make the recommendations elaborated by the Rhine bordering countries accessible to the public.



## Introduction

The subsequent recommendations describe the technical and organisational measures to take when operating plants where substances hazardous to water are handled.

The recommendations are formulated against the background of the equivalent regulations in force in the ICPR member states and experience made with accidents in the Rhine catchment.

The recommendations are based on a concept controlling potential chemical danger by phased technical and organisational safety systems.

## Recommendations

Against the background of this safety concept and experience made with accidents the working group "Prevention of Industrial Accidents and Safety of Industrial Plants" drafted recommendations specifically for the following fields relevant for safety aspects:

- Definition of substances hazardous to water
- Authorisation procedures for installations of industrial accident relevance
- Overfill safety systems
- In-plant pipeline safety
- Aspects of joint storage
- Sealing systems
- Wastewater split flows
- Transshipment
- Fire protection strategy
- Plant monitoring
- Internal alarm and hazard control planning



## Definition of substances hazardous to water

Substances hazardous to water possess at least one of the following properties within the meaning of EC Directive 67/548/EEC:

- very toxic (T+)
- toxic (T)
- corrosive (C)
- harmful to health (Xn)
- hazardous to the environment (N)
  - or harmful to aquatic organisms (R 52)
  - or may cause long-term adverse effects in the aquatic environment (R 53).

### Figure 1

*A precise definition of the specific hazardous properties of a substance is of primordial importance for the executing authorities and for the technical standards required for industrial plants where substances hazardous to water are handled.*



## Authorisation Procedures for Installations of Industrial Accident Relevance

The essential common features in the structure and development of authorisation procedures for industrial plants liable to produce accidents are:

- Written application for authorisation
- Application documents include the following:
  - a description of the project
  - plans and maps
  - information on the substances handled (quantity, hazardousness etc.)
  - the technical, organisational and personnel safety measures planned
  - a description and assessment of potential impacts on the public and the environment
- Co-ordinating body responsible for the conduct of the authorisation procedure
- Disclosure of application documents for inspection by the public
- Participation of technical and territorial authorities
- Written notice of approval
- Right of appeal for public and applicant
- Duration of authorisation procedures is usually about 6 - 8 months



**Figure 2**

*The authorisation procedure provides for close co-operation of authorities, applicants and the citizens and associations concerned. It is thus granted that aspects of accident prevention are taken into account from different points of view. In cases of new technical findings additional instructions may be given.*

## Overfill Safety Systems

### 1. Scope

Containers may not be filled with substances hazardous to water unless an overfill safety system is used.

### 2. Exceptions

Exceptions to the overfill safety systems requirement may only be made if it is ensured (case by case) that overfilling of the container is prevented by other means (e.g. manual filling with self-closing nozzle).

### 3. Technical requirements

Before the permitted filling level is reached, the overfill safety system must either cut off the filling operation automatically or release an acoustic alarm. (The permitted filling level must be determined taking into account the additional amount delivered during the time required for cutting off the supply.)

### 4. Inspection

Efficiency of the system must be guaranteed at all times.

**Figure 3**

*Overfilling recipients frequently triggers off accidents. Overfill safety systems efficiently prevent these causes and are therefore tremendously important elements of safety technique to avoid accidents.*





## In-plant Pipeline Safety

1. Pipelines must safely enclose substances hazardous to water.
2. Pipelines must be adequately dimensioned in accordance with the physico-chemical properties of the substances handled. Impermeability must be demonstrated by means of generally recognised testing procedures.
3. Pipelines must withstand the mechanical, thermal, chemical and biological loads resulting from their use and must be resistant to ageing.
4. Movements and inclinations of the pipelines must not endanger their safety and impermeability.
5. Pipelines must be protected to the necessary extent from mechanical damage, e.g. caused by colliding vehicles.
6. Verification of impermeability and corrosion resistance should be subject to repeated checks by independent experts.
7. Proof is required that the rate of attrition within the verification intervals does not result in any inadmissible weakening of the pipelines and in particular that localised corrosion is ruled out.
8. Where the material of the pipelines is itself not sufficiently impermeable, suitable coatings are to be applied or equivalent safety measures must be taken.
9. Safety aspects must be taken into account in the layout of pipelines (underground/above-ground).
10. Special safety measures are to be taken for pipelines in which the substances transported cause electrostatic charges.
11. In the case of underground pipelines, any detachable connections and valves are to be located in monitored leakproof inspection shafts. The technical construction of such pipelines should comply with one of the following requirements:
  - they must be double-walled; any leaks in the pipeline walls must be indicated automatically by an approved leak indicator, or
  - they must be designed as suction lines in which the liquid column is interrupted in the event of leaks, or must be fitted at regular intervals with precautions against the escape of the products transported, or
  - they must be equipped with a suitable external sleeve or be laid in a conduit; any escaping substances must be visible in a monitoring device.

If, for safety reasons, none of these requirements may be fulfilled, only adequate safety measures may be taken.



12. Design, assembly, inspection, maintenance of and alterations to the pipelines must be executed and documented professionally.
13. Pipelines must be marked appropriately.
14. The position and layout of the pipelines must be documented.



*Figure 4*

*In-plant pipelines are installations transporting substances hazardous to water within a plant site. Pipelines include not only the pipes, but also fittings, valves and flanges.*



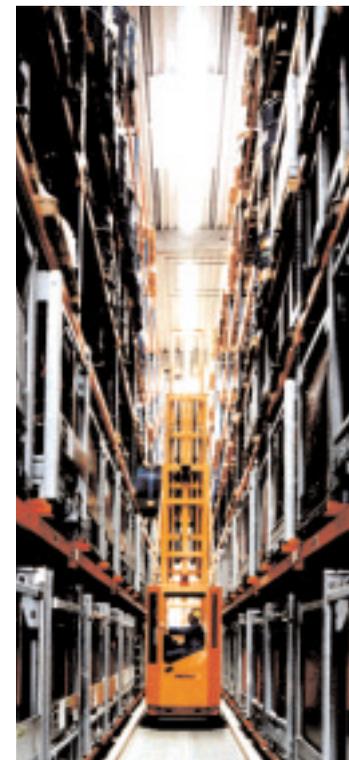
## Joint Storage

1. Dangerous substances and preparations must be kept in orderly storage appropriate to their properties.
2. Dangerous substances and preparations may not be stored together if this may give rise to hazardous situations (toxic substance releases, explosions, fires or strongly exothermic reactions).
3. The following table shows which substance categories may never be stored together:

	<b>E</b>	<b>F/F+</b>	<b>O</b>	<b>T/T+</b>	<b>Xn/Xi</b>	<b>C</b>
<b>E</b>	+	-	-	-	-	-
<b>F/F+</b>	-	+	-	-	-	-
<b>O</b>	-	-	+	-	-	-
<b>T/T+</b>	-	-	-	+	+	-
<b>Xi/Xn</b>	-	-	-	+	+	-
<b>C</b>	-	-	-	-	-	+

<b>E</b>	<i>explosive</i>
-	<i>may not be stored together</i>
<b>F/F+</b>	<i>highly flammable/extremely flammable unless special safety measures</i>
<b>O</b>	<i>oxidising have been taken</i>
<b>T/T+</b>	<i>toxic/very toxic</i>
<b>Xn/Xi</b>	<i>harmful to health/irritant</i>
+	<i>may usually be stored together</i>
<b>C</b>	<i>corrosive</i>

4. When substances are stored together the safety measures must be geared to the most dangerous substance.
5. Large quantities of combustible material (pallets, packaging material etc.) which are by their nature conducive to the rapid development and spread of fires should be stored separately unless special safety measures have been taken.
6. Autoigniting substances and substances that form toxic, flammable or combustible gases with water must normally not be stored together with other dangerous substances.
7. Pressurised gases, cryogenically liquefied gases, and fertilisers containing ammonium nitrate must not be stored together with toxic substances.
8. Corrosive substances in fragile containers, polychlorinated biphenyls and organic peroxides may not be stored in tanks with a single collecting chamber together with other combustible substances unless this is done in such a way that they cannot influence each other in the event of an accident.



**Figure 5**

*Joint storage is the case if substances:*

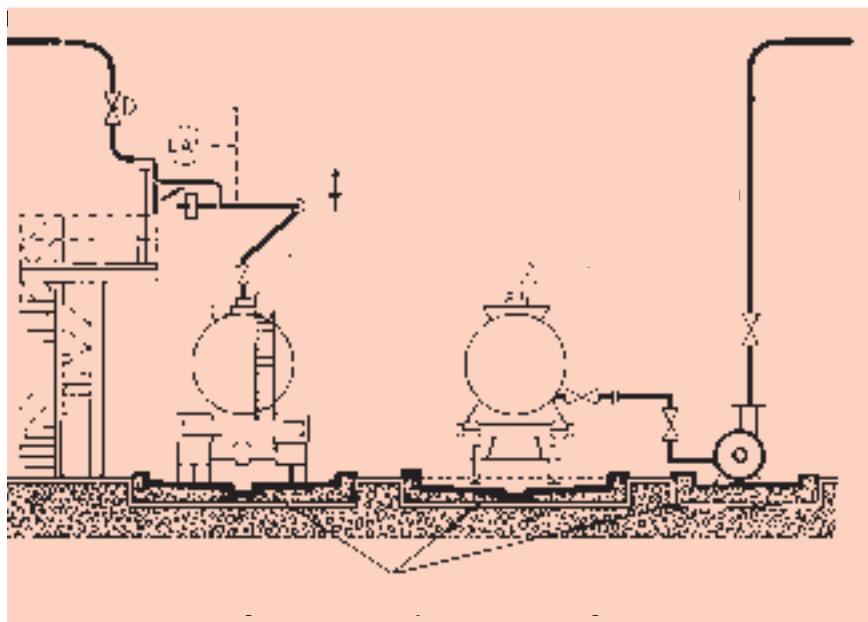
- a) *are stored together in the same room or*
- b) *when stored in the open air, are stored without a solid and fireproof wall or without an adequate safety gap (magnitude 8 –10 m), or*
- c) *are stored in a common collecting chamber or in a divided tank.*

## Sealing Systems

1. Sealing systems must possess an appropriate degree of impermeability having regard to the physico-chemical properties of the substances handled, and this must be verified by generally recognised testing procedures.
2. Where the material of the collecting troughs, chambers or areas is not itself sufficiently impermeable, suitable sealing methods such as a coating, laminates or plastic sheeting are to be used or equivalent safety measures are to be taken.
3. The installation of the sealing systems must be executed according to the state of the art.
4. If the substances hazardous to water are flammable liquids, the sealing systems used in the collecting chambers must be fire-resistant.
5. In the event of an accident, impermeability must be guaranteed for at least as long as is necessary to detect the loss, remove the substance and repair the leak.
6. Verification of impermeability should be subject to regular checks by independent experts.
7. When handling substances whose behaviour in relation to the sealing system is not known, the surfaces potentially affected are to be inspected regularly for substance leaks and penetration. If this is not possible, additional safety measures are to be taken.
8. Penetration of pipelines and cables through sealing systems on floors and walls is basically to be avoided.
9. When assessing the collecting trough, chamber or area, the criteria shall also apply to the joints.

**Figure 6**

*Sealing systems are the leakproof and resistant parts of collecting troughs, chambers or areas which may come into contact with substances hazardous to water in the event of accidental leaks. Sealing systems are intended to prevent such substances hazardous to water from penetrating the collecting troughs, chambers or areas.*





## Wastewater split flows

1. Accidentally contaminated wastewater split flows must be identified at an early stage by means of monitoring. The timing of the monitoring must be geared to the necessary control measures.
2. Accidentally contaminated wastewater split flows must be retained as closely as possible to the source; if necessary it must be possible to cut off the sewers.
3. Accidentally contaminated wastewater split flows should not be mixed with other wastewater.
4. Steps must be taken to ensure that substances which constitute a fire or explosion risk cannot find their way into the wastewater system, unless the system is protected against such dangers.
5. Suitable retention facilities of adequate size must exist for accidentally contaminated wastewater split flows. Such facilities must be impermeable for the expected time of exposure.
6. Measures (e.g. holding ponds, re-circulation of wastewater) must be provided for preventing contamination of waters in the event of an accidental reduction in the purification capacity of the treatment plant.



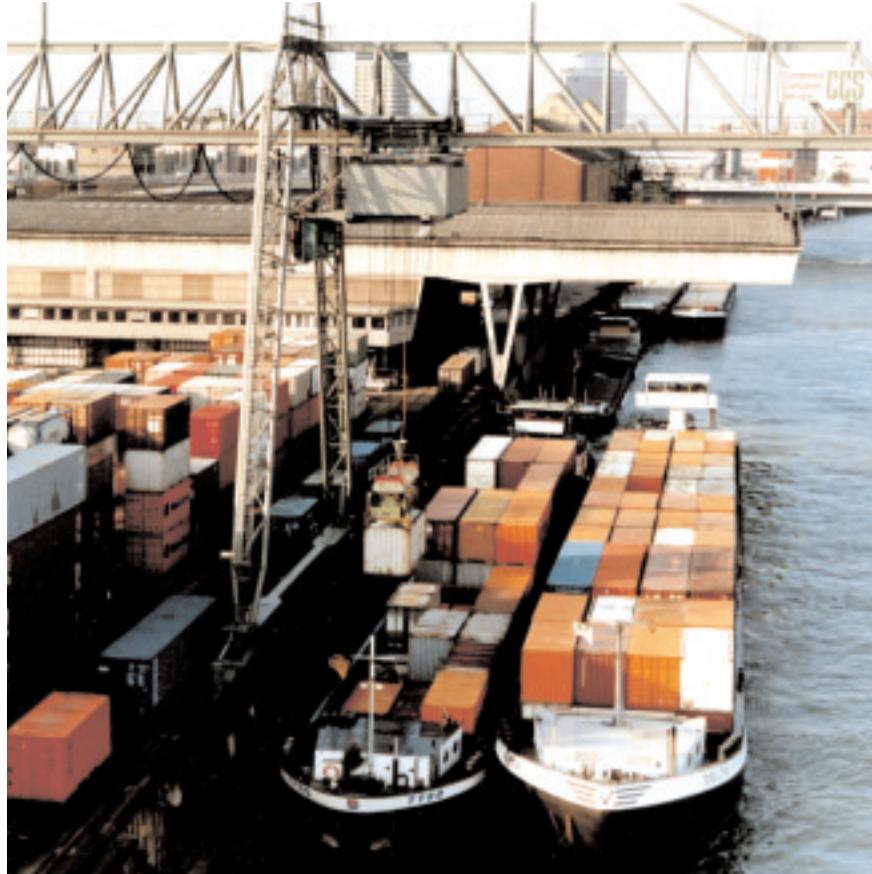
**Figure 7**

*Wastewater split flows are the continued and discontinued flows of industrial wastewater (such as wastewater from production plants, ancillary plants and laboratories), cooling water and rain water.*

*As a basic principle, care should be taken when designing wastewater systems to ensure that wastewater is avoided as far as possible by means of suitable technology (e.g. use of air cooling, water-free vacuum systems, etc.), environmentally friendly production methods and alternative process management. Open cooling water systems should be avoided.*

7. The wastewater systems must be leakproof and resistant with respect to the expected physical, chemical, thermal and biological loads.
8. The internal and external countermeasures and the information and reporting duties in hazard control planning must be defined for possible accidental contamination of wastewater split flows.
9. Safe disposal of accidentally contaminated wastewater split flows must be ensured.
10. The functioning of the technical and organisational measures taken must be verified by means of regular checks.

## Transshipment



1. Transshipment sites must be resistant to the expected mechanical loads and be sufficiently impermeable and resistant to escaping liquids. In assessing the adequacy of impermeability and resistance, account may also be taken of precautionary/organisational measures.
2. In cases of transshipment by means of pipelines, there must be automatic safety systems in place that cut off the flow of material in the event of an accident and thereby prevent the escape of substances hazardous to water.
3. It must be possible to identify escaping substances hazardous to water.
4. Transshipment sites must have collecting facilities capable of accommodating the volumes of liquid that can escape until
  - suitable measures or
  - automatic safety systems take effect.
5. Contaminated rainwater and fire fighting water resulting from an accident must not enter waters directly. It must be subjected to suitable treatment.

6. Transshipment sites must
  - be clearly marked;
  - be identified as a safety zone while transshipment is in progress.
7. Equipment suitable for immediate use must be kept ready at transshipment sites to prevent the spread of substances. Equipment for removing the substances is also necessary.
8. When loading and unloading inland waterway vessels, special care must be taken to observe the checklist under 151412 ADNR.
9. Transshipment of substances hazardous to water in the riparian zone of a waterway should be avoided, especially in the case of new installations.
10. The contracting parties should advocate that in cases of transshipment of dangerous goods the transshipment receptacles (e.g. containers) are clearly marked with corresponding danger symbols.

**Figure 8**

*Transshipment is the link between transport and storage. The recommendations relate to the necessary technical and organisational measures at the transshipment point that are intended to prevent substances hazardous to water from entering surface waters.*

*The "transshipment" sector covers the stationary parts used for loading/unloading from ships, lorries or railway to land (storage facilities and warehouses) or vice versa.*



## Fire Protection Strategy



The individual fire protection measures comprise:

- constructional measures and facilities,
- detection and notification of fires,
- mobile and stationary fire fighting equipment,
- provision of suitable fire fighting agents in adequate quantities,
- administrative measures such as storage facility rules, fire prevention plans, training of plant personnel,
- a well trained and equipped fire brigade that is familiar with the special aspects, e.g. a fire in a pesticide store, and
- the facilities and measures for containing contaminated fire fighting water.

Individual descriptions are given of safety measures which prevent the escape, ignition and explosion or limit the escape of substances or which serve fire fighting purposes.

### 1. Retention facilities

- 1.1 Collecting troughs for escaping dangerous substances  
Collecting troughs for escaping dangerous substances must be adequately dimensioned and must be impermeable and resistant.



## 1.2 Fire fighting water retention facilities

Fire fighting water retention facilities must be impermeable and resistant. Their size should take account of the following parameters:

- Hazardousness of the substances stored (e.g. hazard to water, fire risk),
- Readiness of fire brigade,
- Fire protection infrastructure (fire detection system, fire extinguishing system),
- Area of storage facility section,
- Height of goods stored, storage density and storage quantity,
- Nature of storage facility (e.g. open-air, indoors).

If active delivery systems (e.g. pumps) are required to make the fire fighting water flow into the available fire fighting water retention facilities, such systems must comply with increased safety requirements.

## 2. Constructional fire protection measures

Non-combustible building materials should always be used. The building should be divided into fire cells and zones separated by fire-resistant means.

## 3. Fire detection system

The fire detectors should be arranged in order to detect a fire sufficiently quickly and reliably. Account must be taken of factors that can influence rapid fire detection, such as room height, subdivisions of the roof area (e.g. height of roof trusses), surrounding conditions and all possible sources that can result in false alarms.

## 4. Fire fighting water supply

Adequate supplies of fire fighting water must be ensured.



**Figure 9**

*The fire protection strategy is divided into individual measures that make the occurrence of a fire largely improbable, ensure early detection of a fire that has nevertheless occurred, combat it by suitable means, prevent it from spreading by constructional measures and prevent consequential damage by collecting the fire fighting agent.*

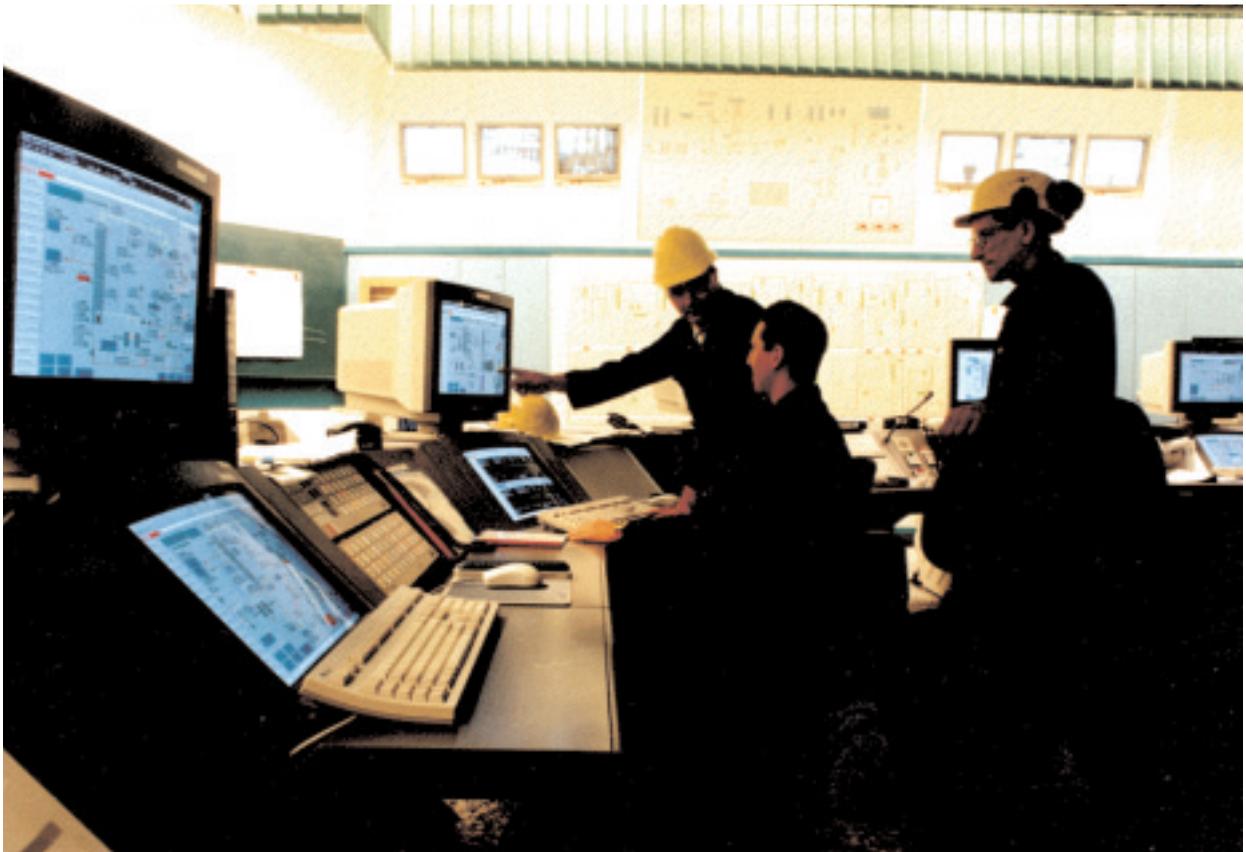
## Plant Monitoring

The following requirements are intended to ensure adequate plant monitoring:

1. The plant operator must define in-plant responsibilities for the taking and checking of safety measures.
  - The plant operator must guarantee the functional safety of the plant (this, for example, includes the wastewater treatment plant)
  - The plant operator must ensure permanent monitoring of the impermeability of the plant and its parts and the functioning of the safety equipment.
  - The plant operator must document in writing the regular checks undertaken on his own responsibility.
2. The plant operator must prepare a detailed report on the causes and consequences of an industrial accident for the competent authority. This must also state measures for avoiding any repetition.
3. The plant operator must report any accidental release of substances hazardous to water to the competent authority or alert centre without delay. Significant disturbances of normal operation must be documented and evaluated.
4. The operator should define the equipment for plant monitoring and the related instructions for action, especially with regard to the prevention of accidents on the basis of the state of safety technology and of experience. Particular account must be taken of the water hazard potential, the basic ways in which substance releases can occur, the precautionary measures and the special protection requirements of the waters potentially affected.
5. Depending on the substance releases that can potentially occur under industrial accident scenarios, chemical (e.g. substance concentrations, pH values), physical (e.g. temperature, conductivity) and biological (e.g. bacteriotoxicity) parameters in particular are to be monitored.

Any failure of measuring equipment of importance for plant monitoring must be identified immediately.
6. Internal monitoring measures must primarily be used wherever there is a need to prevent releases of substances hazardous to water, so that timely detection allows immediate counter-measures.
7. Monitoring by authorities shall above all embrace:
  - checking on the monitoring performed by the operator on his own responsibility,
  - verifying the extent to which monitoring by independent experts is arranged by the operator and whether orders must be issued on the basis of the monitoring findings, and
  - spot checks by the authority or checks by authorised third parties in installations.

8. Monitoring by authorities may also be ensured by independent experts who, for example, check that especially important parts of the installation are in proper condition before commissioning and thereafter at regular intervals.
9. The equipment for monitoring waters should be equipped such that accidental discharges of substances hazardous to water can be detected on a regional and supraregional basis by means of measurements.
10. Monitoring activities by authorities and independent experts should be co-ordinated in time and with regard to the monitoring tasks.



**Figure 10**

*In-plant monitoring must above all take effect where it is to be avoided that substances hazardous to water escape. Early detection must allow immediate countermeasures.*

## Internal Alarm and Hazard Control Planning

When drawing up an internal alarm and hazard control plan against the background of an accidental release of substances hazardous to water, the following points in particular should be taken into account:



1. The internal alarm and hazard control plan must ensure that once a hazard situation has been registered a rapid hazard alert is passed on to the internal and/or external body permanently designated for receiving alerts.
2. The internal alarm plan and hazard control plan must contain precise instructions related to specific plants and / or groups of plants for those persons or groups of persons in charge of passing on all messages in emergency cases.
3. Depending on the scale of the expected impacts, different alert levels must be fixed in co-operation with the authorities responsible for disaster control. To this end there is a need for co-ordinated, differentiated alarm procedures (e.g. Rhine warning and alarm system).
4. The plant operator must agree with the authorities as to who is responsible for which measures in the event of an industrial accident.
5. For the internal alarm and hazard control plan it is necessary to fix the persons in charge, their functions and responsibilities, their availability, meeting points and tasks for specific squads of the emergency forces. In addition, specific experts must be listed and alarm/ response times must be laid down.
6. Details must be fixed as to how the water users affected by an industrial accident are to be warned and alarmed and how the public is to be informed.
7. The following items of general information are necessary for the plant-specific hazard prevention plan:
  1. The internal alarm and hazard control plan must ensure that once a hazard situation has been registered a rapid hazard alert is passed on to the internal and/or external body permanently designated for receiving alerts.
  2. The internal alarm plan and hazard control plan must contain precise instructions related to specific plants and / or groups of plants for those persons or groups of persons in charge of passing on all messages in emergency cases.
  3. Depending on the scale of the expected impacts, different alert levels must be fixed in co-operation with the authorities responsible for disaster control. To this end there is a need for co-ordinated, differentiated alarm procedures (e.g. Rhine warning and alarm system).
  4. The plant operator must agree with the authorities as to who is responsible for which measures in the event of an industrial accident.



- List of available emergency resources
  - Description of the waters in the vicinity of the installation and any special uses (e.g. drinking water protection area)
  - Nature and quantity of substances in the fire cells of the plants and storage facilities, including safety data sheets and in-plant substance information
8. For every site of the plant or for parts thereof where there is reason to fear special dangers in the event of an accidental release of substances hazardous to water, the following information must be provided:
    - Fire brigade plans (special danger areas, permitted fire fighting agents etc.)
    - Water supply (e.g. fire fighting water, availability of cooling water)
    - Power supply (e.g. emergency power supply, no-load switches)
    - Drainage plans (e.g. shut-off devices, retention facilities and special hazard areas)
    - In-plant alarm and warning equipment
    - Emergency shut-down of hazardous installations (e.g. reactors).
  9. The key hazards for hazard control planning must be defined in terms of the principal substances hazardous to water and the principal hazardous technical facilities. The crucial factors here are
    - Nature and quantity of potential hazardous substances, substance impacts,
    - Spreading behaviour of substances, ways and means of controlling damage, possible further consequences
    - Nature of installation
  10. Description of the industrial accident scenarios and the corresponding consideration of the impacts for accidental release of substances hazardous to water into surface waters (in terms of space and time).
  11. Description of measures to contain industrial accidents (e.g. fire fighting water retention facilities, collecting tanks, fire fighting systems) on the basis of the relevant industrial accident scenarios such as
    - Leakage
    - Overfilling
    - Total failure of receptacles, containers, pipelines or other parts of the plant
    - Fire involving fire fighting water
    - Internal accidents during transport of hazardous goods.
  12. At regular intervals exercises must be held to practise behaviour in the event of industrial accidents and the measures to be taken.
  13. Plant-specific alarm and hazard control plans are to be updated at regular intervals.
  14. Steps must be taken to ensure that the competent authorities and personnel are informed about the alarm and hazard control plans.



**Figure 11**

*Internal alarm and hazard control planning is one of the fundamental safety duties of the operator of a plant of industrial accident relevance. It includes a description of the nature and sequence of the planned organisational and technical measures following the identification of a hazardous situation liable to cause an industrial accident or resulting from an industrial accident that has already occurred.*

