Position Paper

for an

International Seminar
„Sandoz Incident and 25 Years After“

Federal Environment Agency

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Introduction

The name Sandoz is synonymous with a series of major chemical accidents, for instance Feyzin (France) 1966, Flixborough (England) 1974, Seveso (Italy) 1976, Bhopal (India) 1984, Frankfurt-Höchst (Germany) 1993, Toulouse (France) 2001 or Kolontar (Hungary) some weeks ago, that had far reaching impacts on man and the environment. 25 years have passed since the "Sandoz" incident in 1986, an opportune time to take stock and also to define and discuss shortcomings that still exist in transboundary river basins with regard to:

- plant safety at chemical production sites,
- effectiveness of notification and information systems,
- availability of disaster control measures,
- implementation of after care measures for revitalization.

This paper also seeks to answer the question as to whether the Sandoz accident could have been prevented in light of the technical and organisational requirements that chemical plants have to comply with today.

Section A

1 Background

1.1 The Disaster

On 1. November 1986 a major fire broke out in a warehouse belonging to the former company Sandoz in Schweizerhalle (8 km above Basel city centre), situated directly on the Rhine. The thick smoke, the strong smell and the unknown composition of the burning gases led the authorities to sound sirens early in the morning to alert the residents of the area. A curfew lasting several hours was also imposed.

The warehouse was originally intended for storing machines and equipment and had been approved for this purpose in 1977. It was then converted to a storage facility for various chemicals without installing any further fire safety systems. An automatic sprinkler system was not installed, although an insurance company had criticised this lapse in a risk analysis carried out as early as 1981. It had also pointed out that a fire would result not only in air pollution but would also cause water contamination through chemicals. Sandoz opted for another insurance company that did not identify this risk and was cheaper.

About half a million people in the near vicinity of the factory narrowly escaped an inferno. About ten metres from the main site of the fire there were chemicals such as sodium, acid chlorides and other water-sensitive materials, which would have reacted explosively like bombs on contact with water from the sprinklers. Phosgene had been stored just 250 metres away.

Based on a theoretical reconstruction of events, the official investigation into the matter came to the conclusion that the cause of the fire could have been the incorrect usage of a shrink gun while packaging pallets containing Prussian blue, thereby causing smouldering.

The warehouse contained about 90 chemical substances amounting to a total of 1.350 tonnes. Among these there were 20 pesticides. The water from the fire extinguishers washed about 30 to 40 tonnes of chemicals into the Rhine because there were no firewater containment barriers. One must also assume that during the fire, partial combustion - especially of plastics - resulted in the formation of dioxins (also of what is known as the Seveso dioxin), which then entered the Rhine along with the firewater. In addition to this, the neighbouring chemical firm of Ciba-Geigy decided to "piggy back" on the accident and release 400 litres of Atrazine, a pesticide, into the Rhine, thinking this would go unnoticed.

Fortunately there was no acute impact on human life. However, an undefined cocktail of toxic substances entered the Rhine with the firewater, where it caused large scale fish mortality. The contamination plume in the Rhine could be traced analytically right up to the Netherlands. A number of waterworks along the Rhine that obtained drinking water largely from river bank filtrate had to shut down. The drinking water supply was therefore temporarily suspended.

Over 100 tonnes of dead fish floated down the river. Water fleas, fly larvae and water snails were completely destroyed, especially in the upper Rhine valley. The river sediment was contaminated for long stretches. A comparative study by the environment ministry in Mainz revealed the extent of the damage. Prior to the disaster, live eels contained 0.01 mg of the insecticide thiometon per kilo of body weight on average. After the disaster the concentration found in dead eels was 27 times higher. The concentration even rose to 70 times the normal figure for the insecticide disulfoton, which is especially difficult to degrade. Overall, the ecological balance was severely disturbed.

The dynamic flowing water system and organisms recovered within a few months of the incident as a new generation of microorganisms from tributaries and streams re-entered the river. On the other hand, the outlook for the regeneration of fish stocks remained dismal for many years.

1.2 The Environmental Situation at the Time of the Incident

The environmental situation in the early 1970s was entirely governed by a medium-based [1]approach. In view of the environmental damage that was becoming more and more obvious, the focus was on after care measures, i.e. remediation of the impacts and restoration of the ecological balance. The potential hazards emanating primarily from the chemicals industry were either not recognised or were downplayed because the self-regenerating ability (ability of the substratum to decontaminate itself, self-purification ability of water bodies) was over estimated. Till into the mid 1970s, the entire length of Rhine was literally regarded a sewer that was injurious to health.

There was hardly any awareness about the magnitude and variety of chemical substances and products. It was only after the occurrence of some major chemical accidents, e.g. Flixborough, Seveso and Sandoz as well as the Chernobyl disaster, coupled with coverage by the media along the lines of "*Seveso is everywhere*" that the chemicals industry was brought into the popular debate. Every month, literally, the "*substance of the month*" was discovered and highlighted with information on all its hazardous properties.

It was only in the mid 1980s, spurred also by the disasters, that there was a shift to the precautionary principle that had, in fact, been proposed in the environmental programme of the federal government in 1971. This principle can be summed up as below:

> *A precautionary approach means to act in awareness of human fallibility.*
>
> *A precautionary approach means to act on well-founded suspicions.*
>
> *A precautionary approach means to reverse the burden of proof, not in the legal, but in a methodological sense. Whosoever releases a substance/product into the environment must prove that it is harmless.*
>
> *A precautionary approach means using the best technology to safely prevent any hazards for man or the environment.*
>
> *A precautionary approach means to prevent as far as possible the spread or dilution of substances in the environment.*
>
> *A precautionary approach means conducting research to detect hazards as early as possible.*

Germany and in fact all other European industrialised countries found themselves facing an ecological crisis that had been caused primarily due to the contamination of the environment by hazardous substances. This situation resulted in the formation of the *Green Movement*, which was able to establish itself politically within a short span of time. The Greens were uncompromising in highlighting environmental problems and demanding a rational and consistent environmental policy. At that point, however, the Green Movement was anti technology.

Policy makers and the administration on one side were ranged against industry on the other like irreconcilable foes. Industry had not learnt its lessons in the ten years after Seveso (1976). The German chemicals industry reacted with a PR strategy that was a mix of repentance and self righteousness. Industry was ready to review all existing safety measures within the parameters of the tried and tested "independent responsibility" approach. The objective was to have voluntary agreements so as to forestall the legal machinery and the pressure for state intervention. Lobbying activities were therefore also focussed on adapting government regulations to the needs of the industry.

The tendency of chemical companies was to barricade themselves and to keep under wraps anything that did not send out fire or smoke signals into the sky. Sandoz, however, was in no position to conceal anything

This attitude clearly emerges from a paper of a reputed German chemicals manufacturer during this time:

> *"The water authorities and/or police should be voluntarily informed when the danger of water contamination cannot be prevented using in-house means and also in cases where it can be prevented through in-house means but is visible to outsiders."*

In retrospect, the only explanation for this attitude is that chemical engineers and managers proceeded on the valid assumption that chemical science had saved mankind from many ills and that it was responsible for revolutionary successes in improving living conditions.

However, the accidents lifted the veil from the dangers associated with chemicals production. In addition to production factors, such as pressure, temperature, yield and plant safety, the environmental relevance factor was still waiting to be discovered. The awareness about which materials/products are produced under which conditions was only slowly emerging.

Since the problems could no longer be swept under the carpet, the European industrialised nations found themselves forced to adopt relevant legal regulations for protecting the environment. However the paths they followed were different.

Thus since the mid 1970s, countries that were closely linked to the sea through their riverine waterways adopted an environmental quality approach. This meant that the authorities would intervene only when the harmful impacts were visible. Consequently when contamination in water bodies became apparent, the authorities were constantly on the look-out for the polluter. With regard to air pollution, a policy of "*high chimney stacks*" was pursued to resolve environmental problems through dispersal over a wider area. The result was crossborder forest dieback ("Forest Decline").

The threat posed to the environment and the hazards for human life in our industrial society were unmistakably highlighted by the Sandoz incident. The incident also illustrated the importance of precautionary measures, not piecemeal but as part of an overall concept. The overall concept must encompass warehousing and other secondary facilities as an integral part of the production process and implement the same high level of safety standards for these facilities as for the production process. An appropriate, plant-specific safety concept must be planned around the hazard potential of substances so as to prevent an uncontrolled material transfer from technical systems. The Sandoz case is a negative example in this regard. The warehouse did not in any way comply with the adequate safety system for the production process. Fire and explosion protection were implemented through disaster control. There were no measures in place for soil and water protection.

At about the same time, the issue of soil and water contamination through contaminated sites such as old landfills and contaminated industrial sites came into public focus. In 1983 the public debate in Germany on this issue was kicked off due to the Hamburg-Georgswerder landfill where there was dioxin contamination of the oily phase of the site leachate. This problem, especially concerning contaminated industrial sites, arose because

of the modus operandi of industrial plants over several decades. The approved technology was single-wall construction[2] of plants and plant components such as storage tanks, pipelines, reactors etc. All installations that did not require direct access were placed underground. In many cases these installations were even built over as industrial production expanded and land was limited. Leakages remained undetected, resulting in large scale ground water contamination.

Germany opted for the emission standard approach early on. This implies that emissions are to be limited at source so that no harmful impacts can occur. In practice this resulted e.g. in the shutting down of production plants if they could not be retrofitted, or a change in production processes if hazardous emissions were anticipated. The emission standard principle also required emissions to be minimised for intended and unintended production operations. Thus, technical systems had to be sealed tightly and made so secure that uncontrolled material transfer into the open cycle of the environment was not possible during intended and unintended operations. This also laid the foundation for the demand that the manufacture of products intended for the market and the solid, liquid, gaseous and energy wastes originating during production should form one unit from a scientific, technical and legal perspective[3]. This was an important development, especially to manage the problem of waste. Environmentally friendly product development was expected to simultaneously address the issues of disposal and optimisation of material flows. This was the beginning of a holistic, integrated approach to environmental protection. The precautionary principle was achieved through this strategic approach.

In this sense, there were two divergent strategies in Europe: the environmental quality versus the emission standard approach. This debate dominated the work of the European Commission for several years and can only be regarded as having been concluded with the adoption of the European Water Framework Directive in 2000.

At the administrative level, which at that point was caught up in setting up its environmental units, there was insufficient qualified staff to be able to monitor industrial plants with respect to their safety. The organisational processes and coordination between various administrations also functioned only partially. For instance, the Rhine alarm[4] at the time of the Sandoz incident was not issued by Switzerland, although a transboundary warning and alert system formally existed in the form of the International Commission for the Protection of the Rhine, established in 1963, and the Additional Agreement of 1976. In fact, the alert was issued by Baden-Württemberg.

1.3 The Legal Situation to Avoide Harmful Events

On the situation in Germany should be shown as an example how the necessary measures were legally taken up and implemented in the face of severe damage events and to prevent such occurrences.

The authorisation of industrial plants in Germany was substantially in accordance with the Federal Immission Control Act (BImSchG) of 1974, which was enacted to protect against

harmful impacts on the environment through air pollution, noise, vibrations and similar phenomena. The Act was adopted at a time when industrial emissions had been recognised to be a serious problem not just for human health but also for the environment. The regulation of emissions using the instruments of the industrial code has come up against its limits.

The Act, which was initially geared towards the medium air (air pollution), has been supplemented following the integrated environmental approach of the European Union and is now directed at comprehensive environmental protection. This distinguishes it from several other environmental laws that are still oriented towards specific environmental media.

One of the key methods of limiting immissions is to limit emissions. A statutory limit on emissions is always an intervention as regards the freedom of action, and in this case the freedom of trade. Therefore a limit on emissions must not be imposed simply for the sake of imposing limits but must be based on their harmfulness, i.e. the impact they have on the environment and human health. The Act serves to prevent existing or imminent hazards and also has a precautionary function for plants that require official authorisation.

The Act stipulates requirements that all industrial plants must comply with, not just large industrial plants. Specific plants, known as "*Installations Requiring a Permit*" are subject to more stringent approval requirements due to the higher risk potential. The plants are not mentioned in the Act itself but are listed in a final list of various types of plants under the 4th Directive for the Implementation of the Federal Immission Control Act. The size of an industrial plant or its production output, that is whether it exceeds specified threshold values with regard to pollutant discharge, material throughput etc, to a large extent determines whether it is obliged to obtain authorisation or not.

The operator of an *Installation Requiring a Permit* according to the BImSchG must comply with the operator's obligations (*basic obligations*). One of the primary obligations is to ensure the prevention of harmful environmental impacts and other hazards as well as annoyances and also to take precautions to prevent these from occurring (*precautionary principle*). This precautionary principle is technology-related, i.e. the precautionary measures must be state-of-the-art. Since these measures are constantly evolving (improving) as technology advances, the parameters of the precautionary principle also keep changing. This obligation is consequently referred to as a *dynamic obligation*. It allows improvements in preventive technologies to be incorporated in new supplementary instructions that are in line with the latest technological status, thus facilitating a *dynamic* adjustment of the state and operation of a plant to technical progress relating to hazard precautions. To a lesser extent this also applies to plants that do not require official authorisation.

Since the mid 1970s, Germany at least has learnt its lessons under pressure from the environmental movement and has adopted many laws and ordinances for dealing with the problem of material pollution and making industrial plants safer. Consequently, after a four year delay, the key legislation – the Major Accidents Ordinance – was passed in 1980 in response to the Seveso disaster. Two years later, additional implementation regulations

were issued. These, however, restricted its scope[5] to specific plants (Annex I), specific substances (Annex II) and threshold quantities. However, an exemption was also provided for. This has transposed the requirements of the EU Seveso II Guideline in national law. The rationale for the Hazardous Incident Ordinance of 1980 states:

> *"Industrial development has resulted in the construction and operation of industrial plants that can create significant hazards due to their size and the presence of large amounts of hazardous substances. In view of the fact that the industrial plants considered here are often located close to densely populated areas, it is evident that there is need for regulations directed at ensuring the safety of industrial plants in which certain hazardous substances are either present or may be produced in the event of a disruption.*

The Major Accidents Ordinance defines an incident as a hazardous incident if it may result in "a danger to man and the environment". However, this pertained only to endangering the life of the plant's personnel. Health risks for a "large number" of people or for objects of great value outside the plant were not considered. Moreover, only production facilities fell under the purview of the Ordinance, not e.g. warehouses. The Major Accidents Ordinance also did not include certain hazardous substances such as solvents from chlorinated hydrocarbons, polystyrol, PVC (which releases highly toxic gases when burnt) and toxic base chemicals such as ammonia, vinyl chloride, toluene diisocyanate (source of the Bhopal disaster). With regard to the Sandoz incident, only two of nine highly toxic substances that were stored in the warehouse were listed in Annex II.

After the Sandoz incident there was a demand that the scope of the Major Accidents Ordinance, which was targeted only at air pollutants, should be widened to include water polluting substances and the installation of containment barriers for liquid substances and firewater. Smaller plants and secondary facilities such as warehouses should also be brought under the purview of the Ordinance. However, there was still no demand for risk assessments of the hazard potential for humans and the environment.

As late as 1976, when the Ordinance was adopted, the chemicals industry rejected risk assessments as superfluous because they were considered excessive, even for hazardous chemical plants, since the plants already had safety instructions and emergency plans. The Major Accidents Ordinance was consequently urgently in need of revision following the Sandoz disaster, since the issue of plant safety had not been sufficiently thought through.

The German Major Accidents Ordinance of 1980 served as a model for the Seveso I Directive of the "EC Directive 82/501/EEC on the Major Accident Hazards of Certain Industrial Activities" adopted two years later. The objective was to

- prevent major accidents involving hazardous substances,
- reduce the consequences after an accident.

The impetus for this was provided by the series of accidents in chemical plants that attracted worldwide attention. The Major Accidents Ordinance of 1980 as an instrument for improving plant safety was amended for the first time in 1991 and extended to cover all

plants requiring official authorisation according to the BImSchG.

1.4 The Consequences

During the major fire at the Sandoz chemical plant in Schweizerhalle near Basel it soon became evident that the issue of firewater had so far been inadequately addressed. The heavily contaminated water from fire extinguishers, for which no containment barriers had been erected, resulted in large scale fish mortality in the Rhine. This major incident was the main trigger for the adoption of a Firewater Containment Directive.

The Firewater Containment Directive stipulated the requirements for the scale of firewater containment systems during the the storage of water-polluting substances. This was to prevent the pollution or contamination of water bodies located close to plants where water-polluting substances are either handled or where they may be produced in the event of a fire.

At the European level it was considered appropriate – especially in light of the Bhopal disaster in 1984 – that the Seveso I Directive should be more stringently implemented and also revised and extended. It was therefore replaced with the Seveso II Directive in 1996.

This Directive contains a list of substances that have been classified as hazardous. There are special requirements for companies that possess specified quantities of such substances:

- The company/plant must be registered with the relevant official body.
- It must regularly prepare safety reports.
- It must have internal and external emergency plans.
- Adequate safety distance must be maintained from residential areas and nature reserves.
- The safety measures must be made public.
- Serious accidents must be notified as soon as possible and relevant measures must be adopted.
- The company must be monitored on a regular basis.

Another new feature of the Seveso II Directive is that it is applicable not only to specific facilities/installations but for the entire operations of a company that deals with hazardous substances/substance groups in quantities that are relevant from a disruption perspective. For this purpose

- the threshold quantities were lowered,
- a safety management system was required,
- an investigation of potential chain reactions was required,

- the scope of information to the public was widened,
- the guidelines for official monitoring were expanded,
- the preparation of external and internal emergency plans was required,
- the monitoring of the setting up of hazardous enterprises was required,
- the obligation to report accidents and "near accidents" was introduced.

An integrated approach to the entire issue of plant safety, however, first found expression in the IPCC Directive 96/61/EC (Integrated Pollution Prevention and Control).

The objective of the integrated concept is to prevent emissions into the air, water and soil as far as possible, and to reduce these where prevention is not possible. The goal is to achieve a high level of environmental protection. In addition, the formal requirements for authorisation procedures at the European level for environmentally relevant industrial plants are to be harmonised.

The IPCC Directive employs the concept of Best Available Techniques (BAT). The BAT concept is equivalent to the state-of-the-art approach that has been traditionally applied in Germany. The best available techniques are compiled for each affected industry through exchange of information between the Member States, industry and environmental associations and published in BREF notes.

The Hazardous Incident Directive was thoroughly revised in 2000 since the Seveso II Directive had to be transposed in national law. This resulted in technical and organisational requirements for companies. The plants had to comply with the latest standards of safety techniques. Thus, the required measures have to be implemented to prevent hazardous incidents from occurring. If a hazardous incident does occur, the measures in place must reduce any further impact as far as possible. Such measures include pressure relief[6] systems, spill containment systems, high quality seals, fire control systems, process control engineering and sprinkler systems. Operators are required to carry out a systematic assessment and evaluation of their plants so that they can take the appropriate steps. Apart from selecting the appropriate measures, the operator must also carry out testing and maintenance of plant components in line with the best available technologies. The type and quantity of hazardous substances must be notified to the competent authority for all plant operations. In addition to these basic obligations there may be further obligations depending on the substance inventory. Companies in such cases are required to prepare a safety report, an internal alarm and hazard prevention plan and also to inform residents and the general public about the correct response in an emergency. Information must be provided to the disaster control authorities to enable them to prepare external emergency plans for the general population.

2 Was the Sandoz Disaster Preventable by the Standards in Place Today?

Looking at the general situation 25 years ago, the safety philosophy for industrial plants and the precautionary measures for preventing harm to man and the environment, especially water bodies, were not very highly developed. The focus was solely on optimising production processes. There was no question of conscious and operational risk management.

From a current perspective, even though there is still considerable scope for improvement in what has been achieved so far, there is no doubt that the Sandoz disaster could not have occurred today in the form it did then. Among the industrial nations, especially in the EU region, there have been tremendous improvements with regard to plant safety and hazard management. The philosophy of redundant safety systems (intended and unintended operations) has been largely implemented as part of an integrated approach through official plant authorisation procedures and retrofitting requirements. Even the official controls of the plants and warning and alert plans as well as measures[7] for personnel and equipment are now of a level that in all probability would have prevented the extent of damage caused in the Rhine in the present case.

3 Conceptual Approach to Risk Management

A **plant** includes all equipment necessary for the production process, all ancillary facilities such as storages of raw materials, hazardous substances, intermediate products, final products, wastes, sewage treatment plant, sewers, pipelines for the transport of substances, and all transport facilities for the transport of materials, intermediate products, final products and wastes.

A **secure plant** must be both in the intended and not intended operation dense, stable and resistant against to be expected mechanical, thermal and chemical effects. Water-polluting substances must be quickly and reliably identified and retained. The same requirements are for fire-fighting water in case of fire.

These requirements for a secure plant can be realized by a **two-barrier concept**, which consists of technical and organizational elements. There the first barrier represents the direct containment of substances at all facilities of a plant. This first barrierr is relevant for the actual production process and is evident because the production process has to run economically and optimal without interruptions and losses. The second barrier is relevant in case accidents or incidents, which cannot be excluded or to avoide leakages. There the entire substance flow is to be considered from the entrance into the plant up to the outcome from the plant. A substance flow analysis through the entire plant is thus a basic prerequisite for a secure plant in order to ensure at every point of the plant and for each activity a safe plant.

The strategy of this concept is „zero emission". And a zero emission can be achieved in the plant-related handling with substances by technology and organization at any time. It is merely a question of socio-political consensus and economic costs. Immission-oriented approaches regarding the requirements of a secure plant are irrelevant in the connection. They only play a role in case of an accident or an incident or of leakages, where waters are affected. Because the severity of an accidental influx is assessed both on the basis of physical, chemical and toxicological properties of these substances and on the quantities of substances coming into the waters. From this in the view of the waters, warning and alarm thresholds are to be defined.

All arising **production-related emissions** such as gaseous, liquid and solid wastes can be discharged to the corresponding media air and water and deposited in landfills according to the conditional approval of discharge conditions for the plant. For this purpose, the requirements laid down in the relevant laws and ordinances are to be observed. These requirements are based in EU member countries regarding the waters on the objectives of the Water Framework Directive (WFD), which are based on an immission-oriented approach. All first abstract stated objectives such as *protection of ecosystems, promoting sustainable water use, long-term protection of resources, etc.* are concretized on definitions of the *desired state of the waters*. This has to be at the end of both chemical and in environmental terms *„good"*. The definition *„good"* is immission-related. The condition of the waters is characterized by concentration data for the water body and the achievement of the goal that a certain concentration or environmental quality standard (EQS) is met.

Each plant has a different potential risk for human beeings and the environment. Therefore, to realize a secure plant an **active risk management** is to operate, which includes all activities from strategic planning to contingency planning to technical restoration of the status quo. For this, the time-causal flow chart of the **„Safety Chain"** may be used for the path of **„surface waters".** The differentiated scheme of the „Safety Chain" claims to include all essential fields of action of risk management for the path of surface waters. It is solely based professionally to ensure a secure plant. It is independent of the water bodies and thus not immission-related. It is more independent of political and regional responsibilities as well as regional and regional groupings.

The „Safety Chain" is a logical model that is derived mutatis mutandis from the structure of the UNECE Industrial Accidents Convention or the OECD Guiding Principles for the prevention and management of chemical accidents. It also contains all the elements that are directly compatible with the required management plans and measures programs in the area of the European Union under the WFD. These elements can therefore be used directly for the management plans and action programs. Further, the „Safety Chain" also is the basis for actions in the river basin institutions. Of course, it is also the basis for all river basins and transboundary river basins in countries outside the EU area. The „Safety Chain" provides a common platform for both the licensing and monitoring authorities and river basin commissions, as well as for operators of plants.

The „Safety Chain" is orientated on a timing pattern in the 3 major categories

„Precautionary Risk Management", „Crisis Management" and „After Care Management", each with two subcategories (**Fig. 1**). They range from the strategic preparation for the incident on the damage control to the aftercare. There are always feedbacks from the various experiences in different areas.

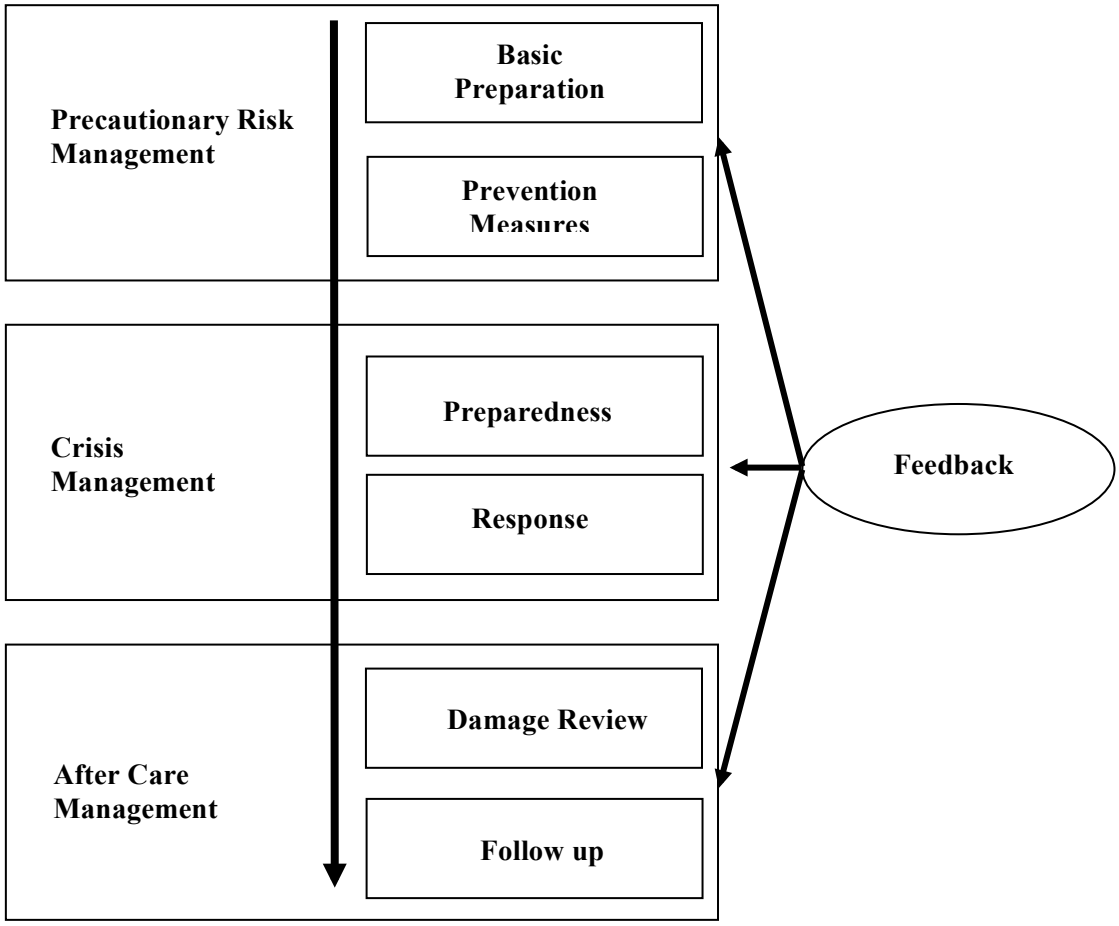

Fig. 1: Structure of the „Safety Chain"

The **Fig. 2-7** further concretize the subcategories. A distinction is to be made whether the authorities and/or the operators (authority ▭ operator ▨) are responsible for certain areas. In the following, the individual modules are described in its essential aspects.

3.1 Precautionary Risk Management

The Precautionary Risk Management is principle at the beginning of the risk management for a plant and is to operate consistently, even if there is no incident occurred. This is a

strategic area of action within both plant-related and area-related measures play a role. Measures of the Precautionary Risk Management therefore include all strategic measures

- to prevent and control the release of pollutants from technical installations and other potential sources,
- to protect human beeings, environment, property values and any other protected goods

in case of accidents, incidents and other unexpected contaminations.

Core of the Precautionary Risk Management (**Fig. 1**) are the „Basic Preparations" and „Prevention Measures". With the results and information from these steps, then the tailored measures for each concrete plant in a river basin can be implemented to ensure risk prevention and to ensure an appropriate crisis management.

3.1.1 Basic Preparations (Pro Action)

With the „Basic Preparations" (**Fig. 2**) a basis is created, which are required for the effective implementation of the subsequent steps. Here, the relevant legal and evaluation basics are to be defined. They are the requirement profile that must be submitted to a secure plant. Further, the competent authorities and institutions are to determine which are relevant for the plant. Goal of this step is to conduct a specific and continuous **risk analysis** in detail, from which the real and potential hazards and risks posed by the plant within a planning area emerge. Therefore, the relevant protected goods within the planning area are to be included. This then the resulting risk situation is derived.

The risk analysis is therefore an important tool for perception of existing risks and thus contributes significantly to the already increasing awareness of risk and reducing potential damage.

The **inventory of sources of risks** forms the basis for the implementation of measures for incident preparedness and crisis management. A source of risk can be a plant or an activity or a situation, which is able to trigger a damaging event.

Precautionary Risk Management

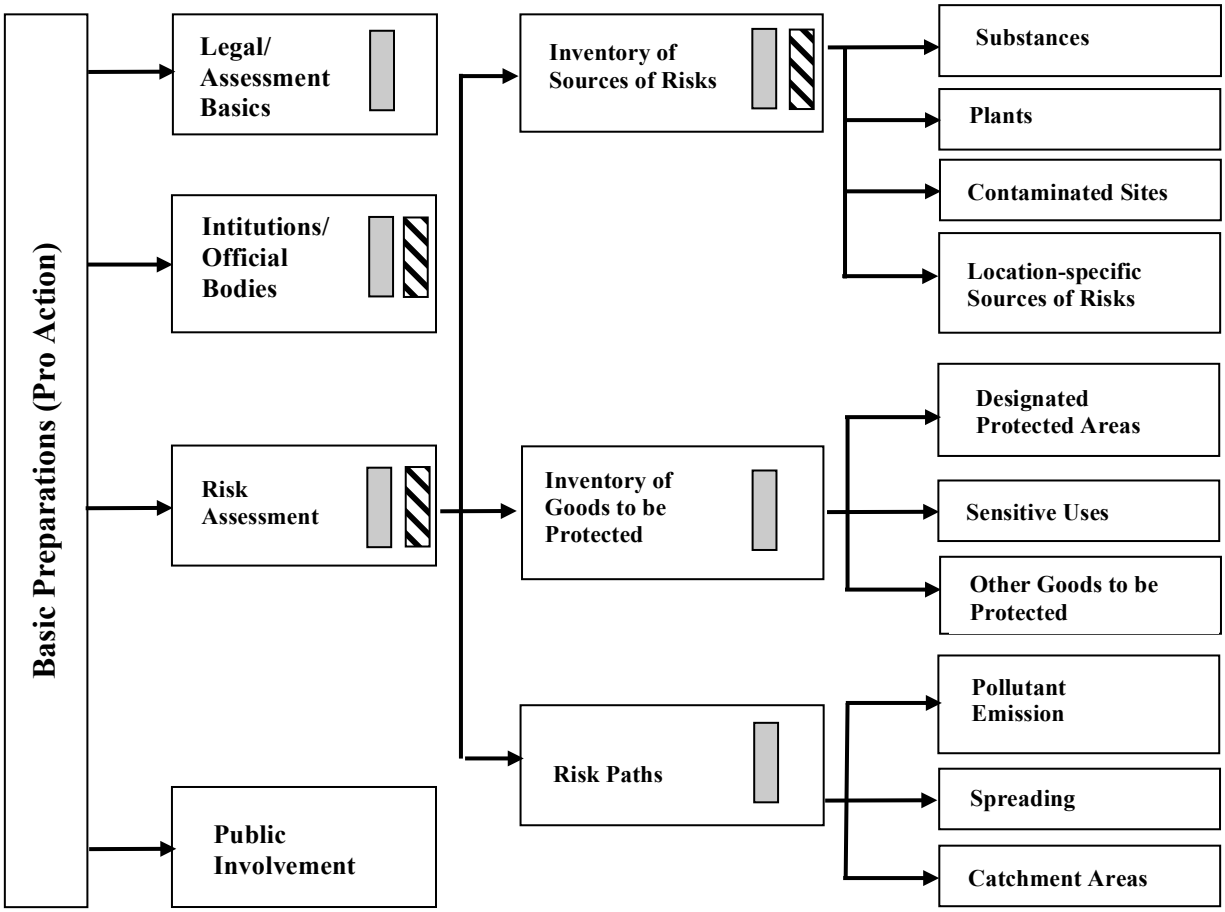

Fig. 2: Category "Precautionary Risk Management" – Basic Preparations (Pro action)

For the inventory of sources of risks first, the *type and state of the technical plant* and any related substance inventory are important. It is secondary, under which conditions under the plant can develop effects. Plant-related sources of risks can be effective without external influence or in connection with the influence of environmental factors or by interference by unauthorized persons. Contaminated areas and contaminated sites are equally attributable to these sources of risks. The environment-related sources of risks on the other hand, play a role only if their existence at the location of plant-related sources of risks is to be expected or is likely.

In addition to the inventory of the sources of risks factors are to be recorded, which can lead to the release of the substance. Depending on the type of release the course of an event

can vary and can lead to more or less dangerous consequences. A plant-related source of risks can become effective as a result of the release of harmful substances by the following aspects:

- constructive or technical failure of plant components, failure of certain parts of the plant or individual technical elements, failure of the plant supply of electricity, compressed air, process or cooling water, malfunctioning of monitoring equipment, etc.

- improper use or disregard of safety rules in the operation or during maintenance and repair services,

- out of control reaction processes caused by involved substances.

With the inventory of plant-related source of risks, a risk register is created with both the operator and the authority an overview the entire inventory of hazardous substances and potential water pollutions in the considered area.

The Water Hazard Classes used in Germany, which characterize the impact properties of a substance permit, in conjunction with the system of **Water-Risk Index** (WRI), the information about the potential danger of an inventory of substances by an index number. With the inventory of the *Accidental Risk Spots* by the IKSD, the system was already applied to river basin level.

In addition to technical facilities *contaminated sites* are classified as surces of risks that can lead to unexpected pollution in the waters. Potential contaminated sites are for example presumed on abandoned industrial or landfill areas and that were previously not subject to specific safeguard measures to prevent outcomes of substances.

In addition to internal factors also external factors are important which result of environment-related sources of risks. They come across from the outside to the operating area and can lead to a impairment of the intended operation or the functionality of safety measures. They can be divided into the following categories:

- nature-related sources of risks such as flood events, earthquakes, landslides and wildfires,

- adjacent operating areas or plants in the catchment area if a spread over can happen by fire, explosion or critical release of hazardous substances,

- traffic areas in the sphere of influence.

With the *inventory of protected goods* specific profile of potential impacts/risks will be created. So, the risk will increase emanating from a source of danger, if there are special protection objects in their particular area.

Protected areas denote areas which, due to environmental protected goods or special use

potential have high vulnerability to external influences. Following types of protected areas are considered:

- areas for the abstraction of water intended for human consumption,
- areas for the protection of economically important species,
- waters for social recreation,
- areas for the protection of habitats or species in which the status of water is more important protective factor, including Natura 2000 sites.

Also *sensitive uses* such as residential areas or areas of people with permanent residence of the population are potentially at risk through technical systems.

Other *protected goods* are the link between multiple sources of risks, which in case of emergency interdependent (prevention of domino effects).

In the case of damages, special attention should be paid to the *risk paths* in order to detect reliably, through which the paths the pollutants may reach the protected goods and which objects are at risk in each case. There plays the propagation speed and range of contaminants are very important role.

For the analysis of the risk paths it is important to know by which critical paths the pollutant leaves the isolated loop of the plant. Thus, for example, to assess whether the entire inventory of substances or only partial quantities are involved and at what speed (spontaneous release of the entire inventory of substances, gradual release up to the beginning of the interruption process, etc.) runs the process. Differences can be in:

- release by leakage, overflowing, filling, etc.
- release by explosion or fire; in case of using fire-fighting water is to observe the propagation behavior of the substance,
- release by accident, flood, etc.

Depending on the type of release the spread is via the paths of water, soil or air, which ultimately leads to a discharge into groundwater or surface water.

The plant-specific conditions give in connection with the transport medium information about the expected distance traveled by the contaminant, and which way it will do most likely. In the following, examples of some possible propagation paths are:

- release after leakage: pollutant contaminate unsealed soil on the site, discharge and spread in the groundwater body,
- release after fire: pollutant mixes with fire-fighting water, waste water discharge within the sewage system and possible entry into the water cycle after passing

through the public sewage treatment plant,

- release by accident: pollutant mixes with flood water and is spread over to large areas, further spread over soil, groundwater, surface runoff,

- release after leakage through the air, entering waters with precipitation.

The above shown examples make clear that it is to be expected a different range of effectiveness for a certain event in all cases. This is largely how big can be this radius in the worst-case scenario.

3.1.2 Prevention Measures

The preventive measures ensures for each river basin a coordinated crisis management and an adequate risk prevention for both area-specific and individually for each plant. Distinction is made between territorial and plant-related measures (**Fig. 3**). For the crisis management must be adapted to both technical planning tools and preventive measures of organizational, technical or operational specific kind.

Area-related measures under the precautionary risk management are allocated in the planning and implementation in the tasks of the responsible authorities. Technical instruments, such as pollutant spread models are usually here specifically used to support the operational preparedness of specific risk issues. Spatial planning and land-use planning as well as flood control are common tasks of the public sector, complemented by aspects of precaution from accidental water pollution.

This aspect was initiated as a precaution against accidents with the implementation of the Seveso II Directive, which also provides land use planning. As a key point there are required adequate spacing between plants and potentially affected protected objects.

Flood protection is initially intended as a public task, which takes place independently of a risk prevention management. In particular, the flood risk management plans are understood as an instrument to take into account with regard to an integrated implementation of flood protection measures and territorial aspects for the protection of plants.

The **plant-related measures** are a priority within the risk management. Within the operational structures, it is primarily for the operator of a plant to realize an adequate backup of the existing sources of risks and to protect themselves against external threats as far as possible.

Precautionary Risk Management

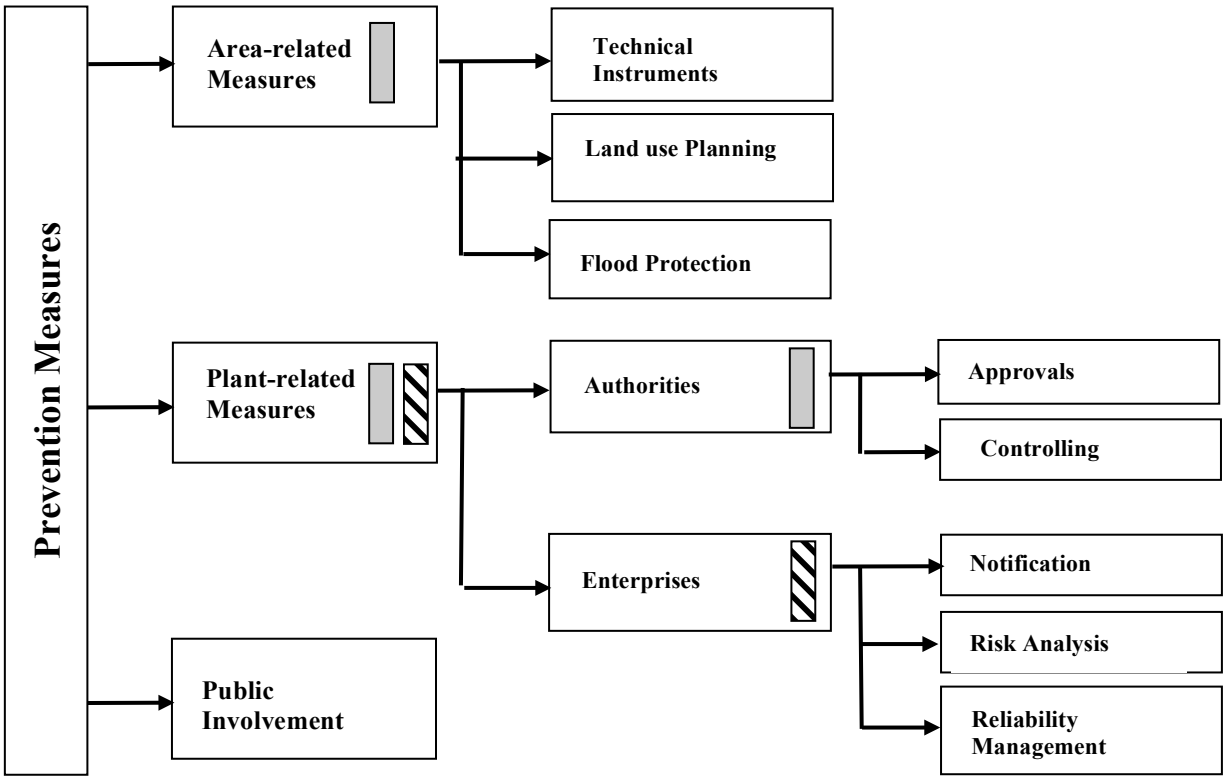

Fig. 3: Category "Precautionary Risk Management" – Prevention Measures

Strategies for implementing prevention measures may follow different approaches, their effectiveness may be at different levels:

- reduction of the existing risk potential,
- precaution against the force of push factors (event causes),
- precaution for the limitation and control of event impacts.

The *Action-field of the Authority* in the area of the plant-related measures include in particular measures which require the operator to a specific action or to verify this. As a preventive tool comes into play here mainly the approval. Furthermore, it is checked by regulatory control, whether the operator meets with its security obligations sufficiently and whether the legal requirements are met.

For the implementation of agency-side control a „plant-related water conservation inspection" (PCI) is to provide, which can lean on the concept of „Safety Chain". The PCI is used to determine whether a relevant part of the plant can be classified as *water protection compliant*. In particular, the following aspects are examined:

- security of installations that are eligible for a release of pollutants into account
- facilities for the retention of fire-fighting water,

- effectiveness of existing warning and alarm devices and other systems to minimize damages,
- soil and groundwater contamination.

The main *duties of the enterprises* aim to identify the existing risks and to eliminate or control actively the available possibilities. Here, the operator has the obligation to indicate when plants put into service, be changed or abandoned. The operator must explain in particular the security measures as a result of a previous *risk analysis*. This results in the *security management* of an enterprise which requires a continuous process of periodic review and thus resulting in changes and improvements.

3.2 Crisis Management

The „Crisis Management" in the „Safety Chain" (**Fig. 1**) includes the areas of „Crisis Management Instruments" (**Fig. 4**) and „Measures in Case of Emergency" (**Fig. 5**). While you can define for the first section instruments, measures in respect of a damage event are not to generalize because they depend on each event individually.

3.2.1 Crisis Management Instruments

Essential instruments of disaster preparedness are early warning and emergency plans. **Early Warning Systems** need first, a suitable *organization* (distribution of the measuring devices, networks of stations with each other, etc.) and the other a technical equipment[1] for *event detection* and *assessment of warning and alert relevance*.

Early warning systems are to set up at

- the operator (emissions-related monitoring),
- state bodies (immission-related monitoring).

In the state-run early warning systems can be divided into *regional* and *river basin-relared* organizations, while they differ in terms of technical equipment little. However, they differ in their organization and competence.

For the *immission-related* detection and assessment of damage events measuring devices are to install along the waters, to identify „anomalies" in the water quality and to rate them later to as „natural" or „accident-based". Therefore immission-related and substance-related warning and alarm thresholds are to be defined, to which one event can be classified as „normal" or „unusual/accidental", so that an alarm decision can be made.

[1] The technical details are also referred to the report of the EASE-project /1/.

A registered procedure by means of detection of unusual prominence must not necessarily point to an accidental discharge to waters. It may also be natural for example by a sudden drop in oxygen concentration by a heavy rain event.

For a comprehensive water monitoring stations are to set up as so-called *survey monitor stations*, which control the major river sections continuously. Basically, the aim is to connect individual stations and regional monitoring networks[2] to a common „information and evaluation platform".

Inventories show that at the enterprise level *„systems for early detection and early warning"* only available in large plants, which are under the Seveso II Directive. They have usually a continuous „online monitoring". There, it is essentially about the identification of events and their evaluation. On the basis of a so called alarm-index[3], that can be determined from detected abnormalities, an alarm relevance can be recognized.

In the damage event and the triggering of an alarm, the prediction of the spread of pollutants in the waters of particular importance. For this purpose, appropriate simulation models to be developed and made available. As an example to simulate the spread of pollutants with the aim to predict the consequences of accident events quickly, the program ALAMO[4], a predictive model, is available. It provides a simple and fast prediction of the temporal and spatial distribution (transport times and concentrations) of dissolved substances. This should enable the riparians to be able to organize the right measures in time to minimize or to avoid damages entirely.

[2] One example is the information platform „Undine" (data bases for classification and assessment of hydrological extremes) /2/. It was developed as a consequence of the Elbe flood in 2002.

[3] The project developed under EASE /1/.

[4] ALAMO (Alarm model Elbe) /3/ was developed as a model for predicting the spread of pollutants in the Elbe. Similar tools are also available for the Rhine and the Danube regions.

Crisis Management

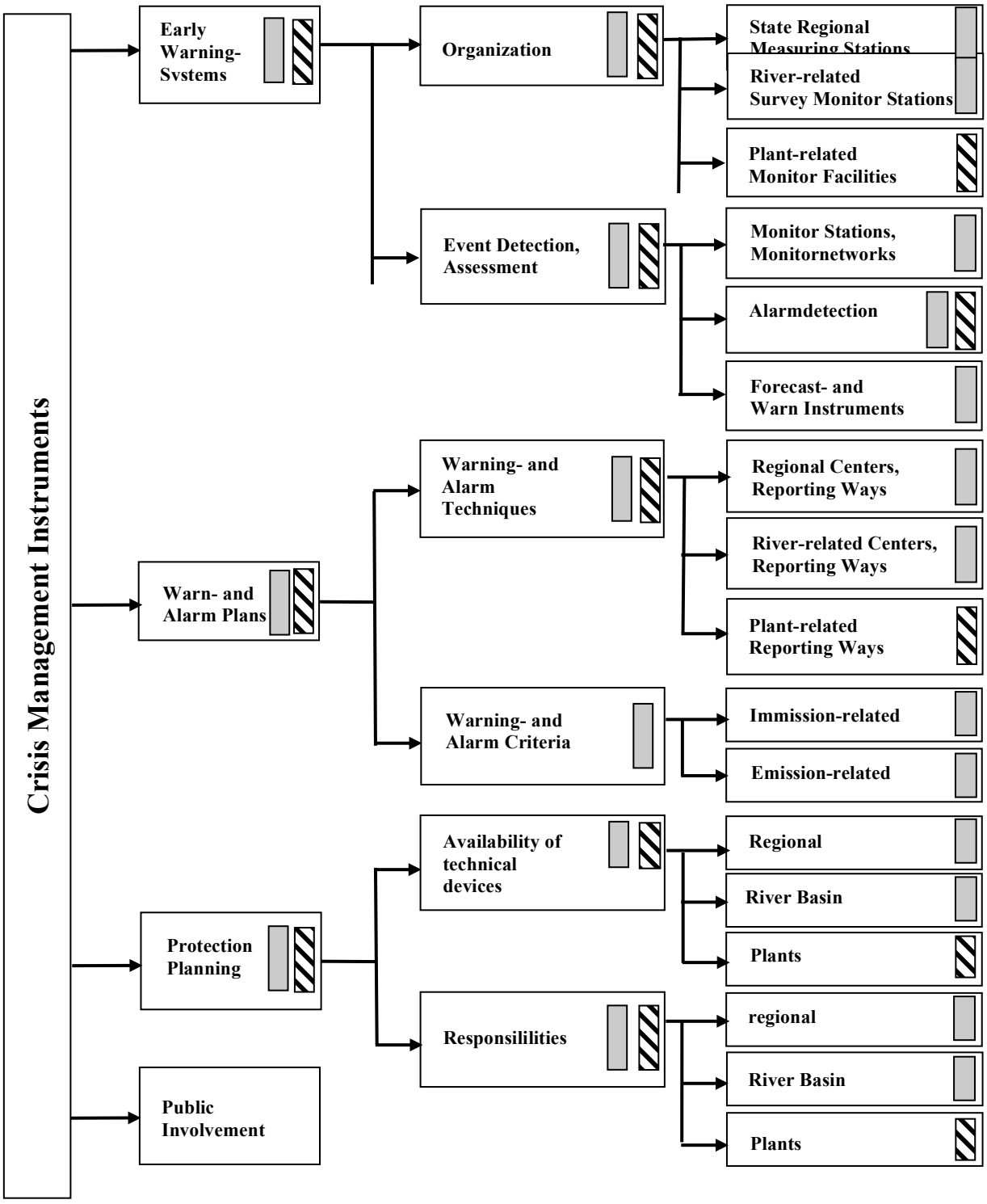

Fig. 4: Category „Crisis Management" –Crisis Management Instruments

The preparation of **warning and alarm plans** first need appropriate criteria and substance-related thresholds associated with the release of significant amounts of pollutants or unexpected water pollution in the form of quantities of substances, substance loads and concentrations. Exceeding those, trigger alerts or at least emergency actions. Instead of determining the specific substance, alternatively the detection of changes in other parameters or effects may be a cause for an alarm setting. There is to distinguish between criteria that apply on the part of potential issuers (*emission-related* warning and alarm criteria) and those found responsible for the water monitoring application (*immission-related* warning and alarm criteria).

Emission-related warning and alarm criteria can be defined on the basis of water hazard classes (WHC) as used in Germany. The changes arising from the adoption of the GHS Regulation 1272/2008/EC are not contrary to the concept.

Immission-related warning and alarm criteria are deduced using appropriate factors generally recognized as legally binding standards that are based on concentration data. Water and water quality standards are available as single substance or substance group related specific benchmarks or limits on the quality of surface waters. They are generally related to protected goods (eg ecology, aquatic life communities, fisheries, drinking water, etc.).

The **protection planning** covers all organizational and technical measures that can be of reacted in the event of an incident quickly and appropriately. It is orientated river basin-wide as well as to plant-related sources of risks and protected goods along the river basin. This, responsibilities and obligations are to settle. Further technical facilities and devices as well as acting staff is to provide and keep in readiness. This must be the goal, to align it river basin-wide, regardless of national borders. This requires the realization of an institutional collaboration and networking (national and international) of authorities in the areas of plant security for water pollution control and for homeland security/disaster protection.

3.2.2 Measures in Case of Emergency

This part of the „Safety Chain" deals with the measures (**Fig. 5**) to be taken in a particular event occurs immediately. These measures include the operation of the alarm and the short-term reactions, such as harm reduction measures to protect human beeings and animals, of uses and other protected goods as well as the immediate damage repair. There are no measures in the strict sense of the management planning. Three areas are to provide:

- alarming process: i.e. the regulated course of the procedures laid down in the warning and emergency plans,
- reaction process: i.e. all short-term measures to
  - damage control (regional, river basin-based, plant-related),

- rescue/protection of uses and protected goods,
- damage repair (short-term measures until the onset of follow-up measures),

➢ crisis communication.

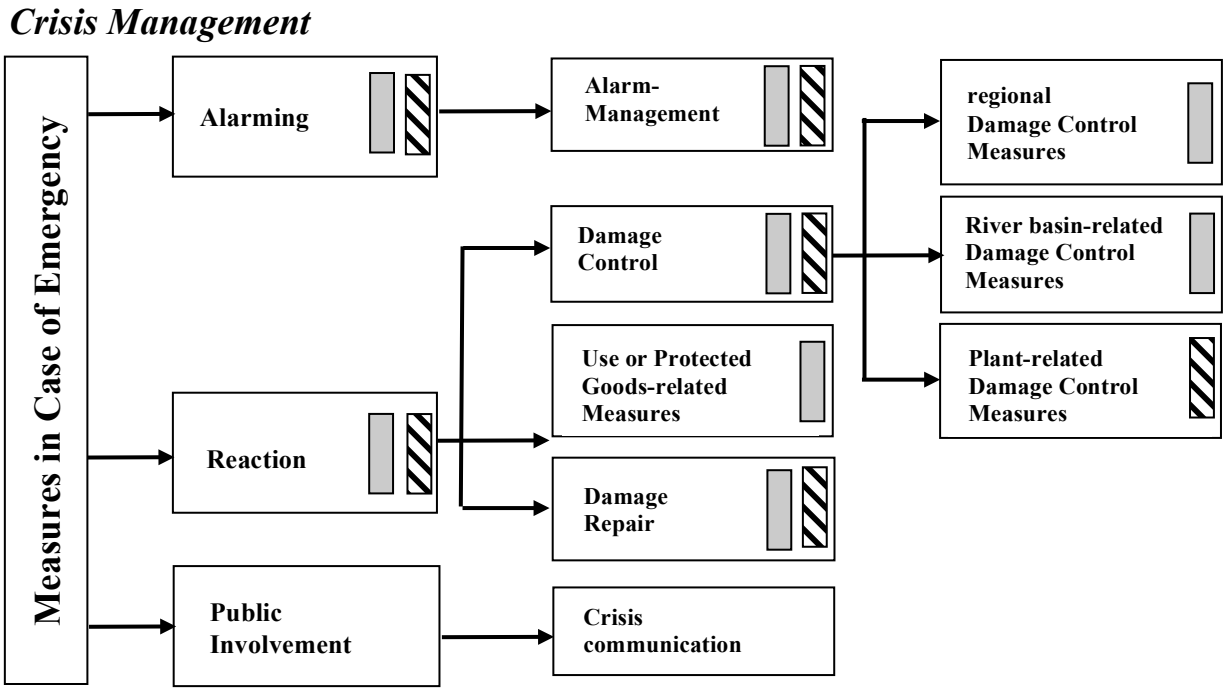

Fig. 5: Category „Crisis Management" – Measures in Case of Emergency

3.3 After Care Management

The after care as a result of an accident event means all measures subsequent to the immediate repair action. Here, the areas of „*damage review*" and „*follow-up measures*" are to distinguish (**Fig. 1**). The evaluation of an event that occurred at all stakeholder levels is as much a focus as the long-term elimination of the damage, the targeted monitoring of this process and the revision of the general concept regarding the identified weaknesses and failures („lessons learned").This approach may also get importance with regard to *„accidents that were not reasonably foreseeable"*. Following the occurrence and management of such an event is to examine whether the classification of the *„unpredictability"* of future events of the same type can be maintained.

3.3.1 Damage Review

The **damage review** (**Fig. 6**) follows the course of an event to the immediate activities of crisis management. Having been fighting for the causes of the incident and brought under control and the spread of the acute release of pollutants has been interrupted, the factors and circumstances must be analyzed, which led to the development. It is to find out how severe the impact and the damage to be assessed effectively.

The analytical damage review is

- to prevent future incidents of the same kind or at least mitigate the consequences and
- to estimate and to assess the damage extent.

In this case, both the **authorities** and **the operator of defective plants** are to be taken in to obligation.

The aim of the **official damage review** ultimately is the profit of knowledge regarding the secure handling of sources of risks in the field of safety-relevant plants. Of prime importance for the authorities are such events whose impacts cause negative consequences for human beeings and the environment. beyond the shere of influence of the operator. For this, the *operational safety management* is to analyze and evaluate. The authority registers in cooperation with the operator of the plant the circumstances of the event, the operational safety management regarding the lack of actions, malfunctions or failures that have contributed to the initiation and propagation of the incident.

Even the *official crisis management* is to be analyzed with regard to the proposed allocation of tasks and the effectiveness of the various instruments and bodies for crisis management. Based on the findings from the evaluation consequences can be drawn for the improvement of emergency planning or for a change of use of crisis management instruments.

The recording of the *damage extent* is ultimately the completion of damage review. This concerns with relevant damages to the environment with regard to the protection of waters as an integral part of the event analysis in addition to damages to persons and belongings.

After Care Management

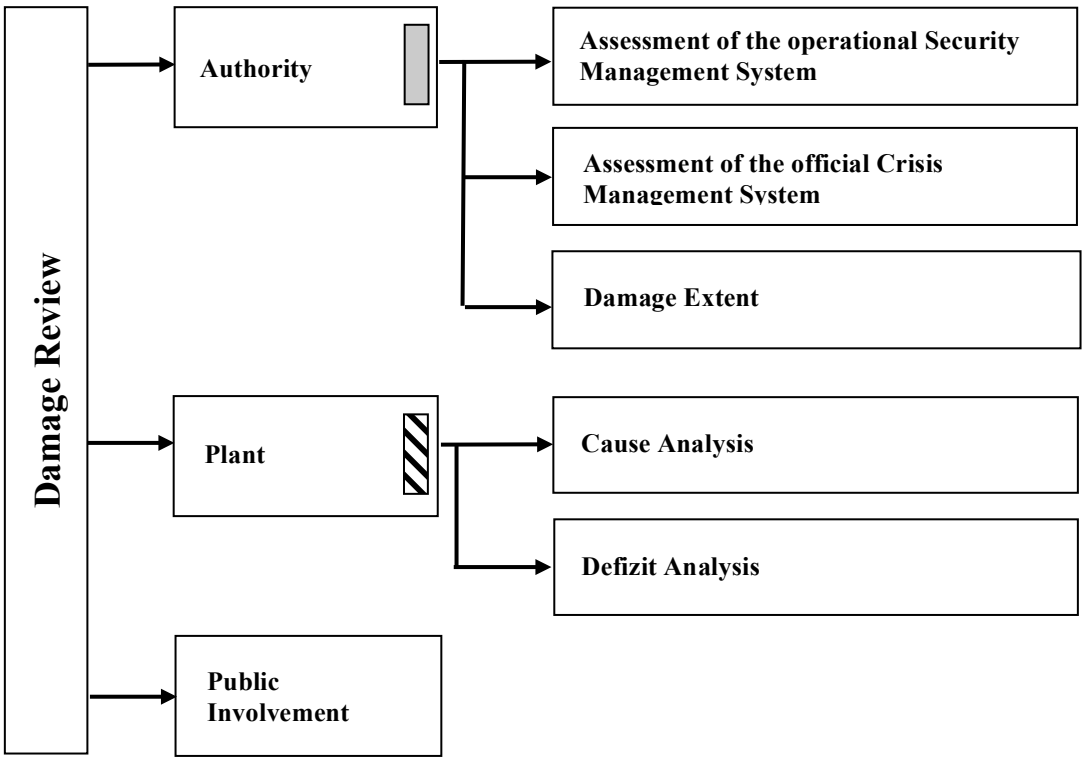

Fig. 6: Category „After Care Management"– Damage Review

Regarding the arised environmental damages, especially to waters, shall be registered and analyzed

- pollutant spread (Which media on which paths are affected with what affected area?)
- spheres of influence (Which protected goods were affected?)
- extent and direct consequence of environmental damages (In whatever form, the environmental damages (contamination, species extinction etc.) express? Is the natural function of a protected good endangered from the impairment and can be expected a regeneration without intervention? Did uses (eg drinking water extraction) temporary or long term be stopped?)
- expected long-term effects (Are expected to find beside temporary impairments long-term effects of exposure of the pollutant?)

Aim of the *operational damage review* is to determine whether there are technical and/or organizational or human error which led to the incident. The detailed findings are of great importance particularly significant for the development of the state of safety concerns and the intensity of the safety quality control. The *cause analysis* triggers automatically a deficit analysis with the aim of closing the gaps to make the plant safer fort he future.

3.3.2 Follow-up Measures

From the damage review results in the **follow-up measures** (**Fig. 7**) for the crisis management with the goal of reducing the likelihood of similar events for the future and to improve the efficiency of actions in the case of an incident further. For the arised damages has to be evaluated in addition to what extent these require a permanent monitoring and whether actions should be taken to restore the original long-term status of the affected water bodies. In this case, both the **authorities** and the **operator of the damaged plants** are to be hold to account.

The responsibility of the **authorities** are the analysis of events with „relevant" scope and the warranty that information from various events are collected in a similar manner. The aim is to question in connection to what extent the information gained can serve as a basis for a wider scope, so beyond the boundaries of the affected plant also serve can. Questioned here in detail is, whether the event considered is a special case which can not generalize because of its characteristics, or whether can be drawn from the findings conclusions for a variety of applications.

This leads to implications for risk prevention and crisis management. The damages caused in the affected waters may require that the further development of the status is placed under observation. This monitoring provides information on how long the water body is affected by the incident and whether the original status is restored through natural regeneration processes or whether additional long-term measures should be taken to remedy the arised damages.

Also, measures to restore the original status to be defined. Their predictability is limited in some way since the exact circumstances are not predictable. In this context, but strategically to determine who bears the responsibility in case of damage to restore. This can either be a competent authority or in cases where the polluter can be clearly detected, the polluter pays principle is required.

The **plant** must specify from the detailed analysis of operational structures and processes the technical and organizational security issues for the future to avoid the effect of triggering factors for one event.

After Care Management

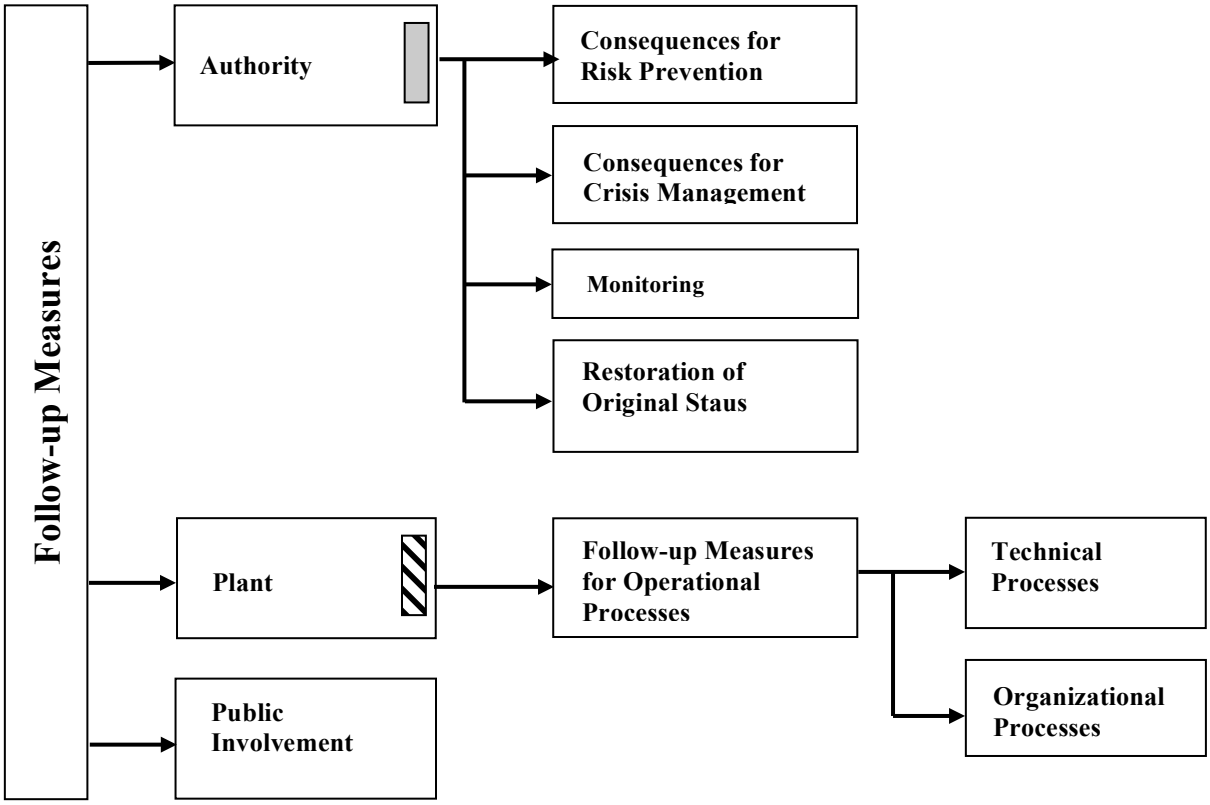

Fig. 7: Category „After Care Management" – Follow-up Measures

Depending on the situation may arise follow-up measures in the operational processes for the following aspects:

- Reduction of the vulnerability of single safety-related components, changes in operating procedures and maintenance intervals,
- customized service instructions as a result of previous operation error,
- Review and revision of the conceptual, operational risk prevention at regular intervals, conclusions from past events for its own operating area, enlargement of the scenarios beeing viewed, modification or extension of measures,
- regular inspection and review of in-house emergency plans in terms of new findings and identified deficiencies,
- adaptation of instruction, training and information activities.

The operator should be made responsible for this „quality management".

3.4 Public Involvement

An important element of the „Safety Chain" is the participation of the public that is demanding in all phases, since damage events don't remain usually hidden and because these events are always given a wide area in the media and press, radio and television. This basic principle should be observed regardless of the claims in the various legal regulations such as in the preparation of management plans, in the environmental impact assessments or in the approval processes. Public participation is an important tool in risk communication and crisis communication.

A successful risk management requires a functioning risk communication throughout the entire chain of action of the „Safety Chain", ie exchange of views and information on risks between those responsible for risk assessment and risk management, econnomy, workers, science, the public, the media and other interested parties. Here, the involvement of the public in case of a specific arised damage event (crisis communication) is one aspect. In the area of control of accidental risks involving dangerous substances, this requirement can be deduced from the Seveso II Directive, also from the UNECE Industrial Accidents Convention and is already implemented in the Member States partially in various individual schemes.

Section B

4 Organization Structures for Transboundary Risk Management

With the Sandoz accident in particular having transboundary repercussions, river basins became the focus of attention. The International Commission for the Protection of the Rhine against Pollution (ICPR), founded in 1963, came into prominence. The *Convention on the Protection of the Rhine against Chemical Pollution*, which had come into force in 1976 as a binding agreement of international law, formed the basis of the ICPR's work. The Convention aimed at improving the condition of the Rhine and reducing chemical pollution in its waters. It however did not assume great significance for international cooperation within the framework of the ICPR, since the signatory states did not fully implement the Convention in their respective countries.

Following the Sandoz accident, the non-binding Rhine Action Programme was adopted in 1987 by the countries bordering the Rhine. The Action Programme aimed at improving the condition of the Rhine and its eco-system, and enabling the return - by the year 2000 - of more sensitive species such as salmon, which had grown extinct.

With due consideration to all earlier conventions, the representatives of the governments of the five Rhine-bordering states – France, Germany, Luxemburg, the Netherlands and Switzerland – together with the European Community signed the *Convention for the Protection of the Rhine* in 1999. From then on, the Convention formed the basis of international cooperation for the protection of the Rhine within the ICPR.

In doing so, the Contracting Parties formally reiterated their resolve to further protect the valuable character of the Rhine as well as its banks and floodplains by strengthening cooperation between themselves. Among the objectives set down by the Convention, particular emphasis has been laid on the preservation, improvement and sustained development of the Rhine ecosystem. This objective was adopted in view of the Rhine being one of Europe's most important waterways, which should ideally be suited for varied use even in the future. The restoration of the Rhine eco-system assumes yet another international dimension in light of the preservation and improvement of the North Sea.

The aims of this Convention are, among others:

- sustainable development of the Rhine ecosystem by maintaining and improving the quality of the Rhine's waters,
- ensuring the safety of plants and preventing incidents and accidents,
- maintaining, improving and restoring the natural function of the waters,
- conserving, improving and restoring the most natural habitats possible,
- ensuring an environmentally sound and rational management of water resources,
- taking ecological imperatives into account when implementing technical measures to develop the waterway, as for instance for flood protection, shipping or the use of hydroelectric power,
- ensuring the production of drinking water from the waters of the Rhine,
- general flood prevention and protection, with due consideration of ecological requirements,
- to help restore the North Sea in conjunction with the other actions taken to protect it.

To this end, the Contracting Parties shall be guided by the following principles:

- precautionary principle,
- principle of rectification, as a priority at source,
- polluter-pays principle,
- principle of compensation in the event of major technical measures,
- principle of sustainable development,
- use and development of the state of the art (best available techniques) and best environmental practice,
- principle of not transferring environmental pollution from one environment media to another.

To achieve the above aims while abiding by the said principles, the Contracting Parties undertake

- to step up cooperation and to inform one another of actions taken in their territory to protect the Rhine,
- to implement the international measuring programmes agreed upon by the ICPR and to inform the Commission of the results,
- to carry out analysis with a view to identifying the causes of and the parties responsible for pollution,
- to examine permits and adjustment of the plants to developments in the state of the art,
- to reduce risk of pollution from incidents or accidents and take requisite measures in the event of an emergency,
- to immediately inform the Commission and the Contracting Parties in the event of incidents and accidents or in the event of imminent flooding in accordance with the warning and alert plans coordinated by the Commission.

Subsequently, other river basin commissions modelled on the ICPR were established on the lines of the ICPR. These were:

- The International Commission for the Protection of the Elbe (ICPE) established in 1980
- The International Commission for the Protection of the Oder (ICPO), established in 1996
- The International Commission for the Protection of the Danube (ICSD), established in 1998
- The International Commission for the Protection of the Moselle and the Saar (ICPMS), established in 1961
- The International Meuse Commission (IMK), established in 2002.

In the UNECE region, there are some 100 major transboundary river basins and over 30 major lakes on which several countries border. In the past few years, agreements have been reached by the countries concerned on a number of these shared water bodies, and Commissions for the protection of water bodies institutionalised. Among the river basins that fall within EASTERN EUROPE, CAUCASUS AND CENTRAL ASIA (EECCA) are the„Prut River/Danube Delta (Republic of Moldova, Romania, Ukraine)", „Zapadnaya Dvina/Daugava River (Belarus, Russian Federation, Latvia)", „Zapadnyi Bug River (Belarus, Poland, Ukraine)", „Neman/Nemunas River (Russian Federation, Belarus, Lithuania)", „Narva River, Lake Chudskoye/ Peipsi (Russian Federation, Estonia)", „Dniester River (Republic of Moldova, Ukraine)", „Dnieper/Dnipro River (Russian Federation, Belarus, Ukraine)", „Pripyat River (Belarus, Ukraine)", „Seversky Donets River (Russian Federation, Ukraine)", „Kura-Aras River basin (Armenia, Azerbaijan, Georgia, the Islamic Republic of Iran, Turkey)", „Samur River (Azerbaijan, Russian

Federation)", „Irtysh River (China, Kazakhstan, Russian Federation)", „Ili River (China, Kazakhstan, Kyrgyzstan)", „Amudarya and Syrdarya Rivers (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan)", „Rivers Chu and Talas (Kazakhstan, Kyrgyzstan)", „Khodja-Bakirgan River (Kazakhstan, Tajikistan)", „Shakhimardan-Sai River (Kyrgyzstan Uzbekistan)", „Kunduz River, Kukcha River and other tributaries of the Pjanj River (Afghanistan, Tajikistan)", „Zeravshan River (Tajikistan, Uzbekistan)".

The corresponding commissions are, among others:

- Joint Finnish-Russian Commission on the Utilization of Frontier Waters,
- International Sava River Basin Commission,
- Interstate Commission for Water Coordination of Central Asia,
- Commission on the Use of Water Management Facilities of Intergovernmental Status on the Rivers Chu and Talas,
- Mekong River Commission.

Similar commissions have also been established in North, Central and South America as well as in Africa.

5 Status of Risk Management in River Basins

The international river basin commissions play an important role in developing and updating the state of the art in plant-based water pollution control. With the coming into force of the Water Framework Directive (WFD), the Commissions' range of tasks was extended to include the transnational coordination of guideline implementation. With that, these Commissions form an important bridge between hazard prevention and the WFD, in that they combine competencies in both areas of work.

5.1 Present Legal Basis

Instruments that exist today in the plant-based handling of environmentally harmful substances may be traced back to the

- Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration), 1972,
- The Rio Declaration on Environment and Development (Rio Declaration), 1992.

The objectives set down for the **UNECE region** in the above two declarations have been elaborated in specific terms in two UNECE conventions. They constitute the framework.

- Convention on the transboundary effects of industrial accidents („Industrial Accidents Convention"), 1992 (signed by 27 countries including the EU),

- Convention of the protection and use of transboundary watercourses and international lakes („Water Convention"), 1992 (signed by 36 countries including the EU).

Both conventions pursue the same general objective, namely to improve plant safety and prevent the transboundary transfer of pollutants from industrial accidents to water bodies

The **„Water Convention"** is intended to strengthen national measures for the protection and ecologically sound management of transboundary surface waters and groundwaters. The Convention obliges Parties to prevent, control and reduce water pollution from point and non-point sources. It also includes provisions for monitoring, research and development, consultations, warning and alarm systems, mutual assistance, institutional arrangements, and the exchange and protection of information, as well as public access to information.

The **„Industrial Accidents Convention"** aims at protecting human beings and the environment against industrial accidents by preventing such accidents as far as possible, by reducing their frequency and severity and by mitigating their effects. It promotes active international cooperation between the contracting Parties, before, during and after an industrial accident.

For the **EU region**, the European Commission issued a series of EU directives to achieve the objective of protecting man and the environment from potentially damaging industrial accidents. These are:

- Directive 96/82/EG, „Control of Major-Accident Hazards " (Seveso II-Directive),
- Directive 2008/1/EG, „Integrated Pollution Prevention and Control" (IPPC-Directive),
- Directive 2000/60/EG, „Water Framework Directive" (WFD),
- Directive 85/337/EWG „Environmental Impact Assessment Directive" (EIA Directive).

The **Seveso II-Directive** 96/82/EG replaced Directive 82/501/EWG of 1982, „Directive on the Major Accident Hazards of certain Industrial Activities" (Seveso I-Directive). It aims at sustainable risk management for dangerous installations and gives emphasis to environmental protection. For the first time it lists in its area of application substances regarded as being harmful to the environment, particularly for water. The Directive also included new requirements for safety management systems, contingency plans, land-use planning and a reinforcement of the provisions on inspections and a system for informing the public.

The **IPPC-Directive** 96/61/EG, recast in 2008, aims at a high level of technological protection (best available techniques) for certain industrial activities. For certain branches of industry, it contains measures for preventing or reducing emissions to air, water and soil as well as for avoiding and reducing waste. Furthermore, it sets down general principles governing the basic responsibilities of plant operators, their authorisation, terms of

authorisation, procedures for authorisation as well the information and participation of the public.

In this connection, the „Best Available Technique Reference Documents" (**BREF**) constitute a very important part of practice. The – as per the present state of the art – ecologically and economically most beneficial technologies and procedures are described and evaluated for individual types of plants and branches of industry. The **BREF** are to be applied by local licensing and regulatory authorities in all EU countries.

The **Water Framework Directive (WFD)** 2000/60/EG has several objectives such as the prevention and reduction of pollution of water bodies, promotion of the sustainable use of water, protection of the environment, improving the condition of aquatic ecosystems and mitigating the impact of floods and drought. The objective here is to achieve a good ecological and chemical status of all water bodies in the Community by 2015. It has also laid the foundations of a general crisis management for water bodies in accordance with Article 11 (3) l.

The Directive contains a list of the major pollutants that pose considerable risk to the aquatic environment. Besides, it also contains measures to limit these most frequently occurring substances as well as quality standards.

Further, a management plan as well as a measuring programme are to be drawn up for each river basin; these shall be examined after 2015, and then once again in six years. They aim:

- to prevent a deterioration in the status of all surface water bodies, to improve and restore them, achieve a good chemical status as well as good ecological potential by the end of 2015. Besides, pollution caused by the discharge and emission of hazardous substances shall be controlled,
- to protect, improve and restore the status of groundwater bodies, prevent their contamination and deterioration and ensure a balance between groundwater withdrawal and replenishment,
- to conserve protected areas.

The WFD stipulates that water bodies in the EU be managed within a uniform legal framework. Further, the management of water bodies shall no longer fall within administrative boundaries (national states, administrative regions and such like) but shall be tackled at the river basin level. Measuring programmes which form a part of management plans are a crucial instrument for realising the set objectives.

The basic measures as per Article 11 (3) l of the WFD shall include:

> *„ ...any measures required to prevent significant losses of pollutants from technical installations and to prevent and/or to reduce the impact of accidental pollution incidents for example as a result of floods, including through systems to detect or give warning of such events, including in the case of accidents, which could not reasonably have been foreseen, all appropriate measures to reduce the risk to*

aquatic ecosystems."

The EIA Directive (85/337/EWG), last revised in 2009, lays down that the possibly significant impact of public and private projects on the environment be measured and assessed through an environmental impact assessment.

These framework directives of the European Union have been transposed by the Member States into national law in order to give concrete shape to national plans, authorisations and the monitoring of installations.

Parallel to this, so-called river basin commissions have been established for transboundary watercourses. Some of them had already been in existence. Needless to say, they are also bound by the legal basis of the European Union and by national laws. In effect, elements of plant-based water pollution control have flowed into agreements, programmes or into the guidelines of international river basin commissions which then give concrete shape to collective action.

5.2 River Basins of the European Union

Based on European statutory regulations, the recommendations and activities set down by the river basin commissions for the transnational level aim at the improvement and harmonisation of precautionary measures to prevent severe contamination of water bodies caused by technical plants. The reason for these aspects assuming importance is:

- the occurrence of such incidents in the past

  Severe industrial accidents that have occurred in the past have made it clear that their impact is not restricted to within national boundaries. Consequently, precauionary measures at the purely national level are not adequate; rather, it is transboundary coordination that is required. It is only through such collective efforts that a uniform level of protection can be achieved.

- General plant-related water pollution control (with, for instance, separate provisions in the German Water Law since 1976)

  Emissions from even smaller plants could have a severely damaging impact on water bodies. Therefore Germany has for a long time been endeavouring to bring its experiences and insights to bear upon the harmonisation process underway in the international river basin commissions.

The **International Commission for the Protection of the Rhine against Pollution (ICPR)**, established in 1963, is the oldest institution for transboundary activities relating to a river. From the very beginning, the ICPR made an initial impact of sorts with respect to plant safety and accident prevention. Following the Sandoz accident of 1986 and the

damage done to the water quality and eco-system of the Rhine, efforts to frame safety recommendations for plants handling water-polluting substances *in no inconsiderable measure*, were duly intensified.

The main documents have been summarised in the „Recommendations of the International Commission for the Protection of the Rhine (ICPR) for preventing incidents and ensuring plant safety". Just the title alone indicates the extent and detail of the work undertaken by the Commission.

- definition of „substances hazardous to water",
- authorisation procedures for plants of industrial accident relevance,
- overfill safety systems,
- in-plant pipeline safety,
- joint storage,
- sealing systems in collecting chambers,
- wastewater split flows (accidental contamination of in-plant wastewater systems),
- transhipment of substances hazardous to water/transhipment points,
- fire protection strategy,
- plant monitoring,
- internal alarm and hazard control planning.

The **International Commission on the Protection of the Elbe (ICPE)** deals with plant-related hazard prevention. The aim is to harmonise safety standards across borders. To achieve this, the ICPE drew up a series of safety recommendations. These range from basic requirements of a general nature through requirements for specific sources of pollution to options for proceeding in the event of accidents and then on to:

- problem of fire-fighting water retention,
- improving strategies and techniques to fight accidents,
- basic structure of safety reports concerning hazards to water,
- operational alarm and hazard control planning,
- requirements for plants handling substances hazardous to water in flood areas,
- overfill safety systems,
- organisational measures and material-technical basic requirements for preventing accidents with floating substances hazardous to water,
- pipeline safety,
- basic requirements for plants handling substances hazardous to water,
- facilities for the storage of substances hazardous to water/harmful substances,
- equipment for tanks.

The **International Commission for the Protection of the Oder (ICPO)** deals with the requirements of plant safety and accident prevention. The focus of its activities is:

- international warning and alert plan Oder,
- international accident plan Oder,
- inventory of potential sources of accidents,

- precautionary measures,
- support in implementing the WFD in the area of the extraordinary pollution of water bodies.

The only publication on the safety recommendations of the ICPO is *„Requiremets for handling substances hazardous to water in flood areas"* (which is identical to the corresponding publication of the ICPE).

The **International Commission on the Protection of the Danube (ICPD)** is the largest international river basin commission with 13 Member States. The Commission's work has three areas of focus:

- inventarisation of potential accidental risk spots

  the risk potential of plants is assessed on the basis of a classification of the substances and substance mixtures in *water risk classes (WRC)* as used in Germany. Combined with the quantity of the substance involved, the WPC may be used to derive the so-called Water Risk Index (WRI), which represents a comparable reference value for the risk potential of plants.

- policy recommendations to the Member States for improving the safety standards of accidental risk spots,
- preparation of checklists for implementing and monitoring safety requirements in accidental risk spots.

Concrete recommendations made involve:

- safety requirements for contaminated or abandoned hazardous sites in flood-prone areas,
- best available techniques (which in terms of emission reduction are directed at specific industrial branches and contain some safety recommendations)

  - best available techniques in the food industry,
  - best available techniques in the chemical industry,
  - best available techniques in cellulose production,
  - best available techniques in the paper industry,
  - best available techniques in agriculture.

The **International Commission on the Protection of the Moselle and the Saar (ICPMS)** focuses on the „*prevention of accidents*", an area of work that addresses, among other issues, safety risks and precautionary measures. As early as in 1995, the safety recommendation „*on precautionary measures for the storage of oil and hydrocarbons in flood areas"* was drawn up. To a large extent, the document corresponds with the relevant recommendations of the ICPE and the ICPO.

The **International Maas Commission (IMC**) aims at achieving sustainable and integrated

water management for the international river basin of the Maas.

The major tasks before this Commission are:

- to harmonise obligations contained in the European Water Framework Directive
- to hand over expert assessments and recommendations to the parties for better flood protection
- to hand over expert assessments and recommendations to the parties for preventing and controlling water pollution caused by accidents (warning and alert systems)

Here, the main focus with regard to the Maas lies with the warning and alert system. To date, the IMC has not drawn up any plant-related safety recommendations.

5.3 Other River Basins in the UNECE Region

For the river basins listed in Chapter 4, the countries involved in each case adopted agreements and recommendations within the framework of their cooperation and are currently in the process of drawing up technical and organisational measures. The status of these measures varies greatly between the individual organisations. The measures are oriented to the instruments and documents for transboundary risk management, and were developed and introduced by the river basin commissions of the EU to denote policy direction. The focus of the work here is:

- to detect and assess industrial water risk potential,
- to undertake safety analysis in water-polluting industrial plants,
- to draw up international warning and alert plans,
- notification systems,
- to ensure the sustainability of transboundary risk management.

To this end, the organisatons were given technical support. Within the framework of the project commissioned by the Federal Environment Agency (UBA) „*Transfer of technology for plant-related water pollution control in Rumania, the Republic of Moldova and Ukraine*", the checklist method was evolved. It serves the purpose of applying and implementing safety recommendations from the river basin commissions and enables a plant to be assessed with regard to its safety requirements. The recommendations of the ICPE and the ICPR form the basis here, and are supplemented by the ICPD's safety requirements for contaminated sites. As in the case of the safety recommendations, the individual checklists can be used independently; they are intended for concrete functional units, branches or hazardous areas.

Industry-specific checklists shall be perceived as a further development of the recommendations made by river basin commissions. The checklists that have been prepared are for:

- analysing and assessing the state of plants handling substances hazardous to water and engaged in preparations in the cellulose and paper industry,
- checklists for the safety of refineries.

Likewise, a use-based and more advanced checklist method was evolved as part of another project commissioned by the German Federal Environment Agency, namely „*Development of transboundary cooperation for the prevention of accidents in the Kura river basin*". What resulted were three further checklists dealing with the temporary and permanent closure of hazardous plants as well as the safety of industrial tailings. The ICPD recommends the use of the checklist method to its Member States as the basic method for examining plants with a relevance for safety.

Section C

6 Risk Management within the UNECE

6.1 Objectives and recommendations of the UNECE Workshop in Hamburg, 1999

In 1992, two conventions were signed under the impact of chemical accidents in transboundary waters. These were the:

- Convention on the transboundary effects of industrial accidents („Industrial Accidents Convention"),
- Convention of the protection and use of transboundary watercourses and international lakes („Water-Convention")

In 1998, the first joint workshop for both Conventions was held in Berlin at Germany's invitation. Just a year later, a second joint workshop was held between 4th and 6th October 1999 in Hamburg, again at Germany's invitation. At the latter workshop, specific conclusions were drawn and recommendations for the Contracting Parties adopted, with the findings of the international river commissions that already existed also being taken into account.

The primary objective was to develop a long-term programme for implementing common provisions both from the Convention on the Transboundary Effects of Industrial Accidents as well as the Convention of the Protection and Use of Transboundary Watercourses and International Lakes, and to draft guidelines and recommendations for improving the technical standards for the safety of industrial plants in order to prevent the transboundary pollution of water.

The main areas of focus in the programme were:

- technologies, including safety measures and technical standards, in order to prevent transboundary water pollution through industrial accidents,
- early warning and alarm systems, including networks of contact points, to enable speedy and effective response,
- notification procedures and mutual assistance in the event of an industrial accident,
- methods for determining dangerous activities along transboundary rivers,
- promoting the exchange of safety equipment and further technological developments.

A long-term work programme for improved safety equipment in hazardous plants was adopted as part of the conclusions and recommendations (SEVESO II-plants). In this connection, a "long-term" period of five years was set down for implementation in industrial countries and ten years for countries in transition to the market economy, with the adjustment of the national legal systems, the establishment of administrative procedures and the implementation of technical measures for industrial plants and production processes also being included therein.

The „long-term" work programme involves the following areas:

- waste water,
- fire protection,
- transhipment,
- flood-prone areas,
- choice of site location.

The „short-term" measures adopted fell under the following areas of work:

- alarm criteria,
- information criteria,
- exchange of information,
- notification procedures,
- methods for identifying accidents,
- studies of impacts on the environment,
- common procedures.

It is also assumed that the exploration and transportation of oil by ship and in pipelines and tailings can potentially have a serious impact on transboundary watercourses in the event of an accident. Further, attention should also be paid to plants that lie below the quantity

thresholds set down in Annex I of the Industrial Accidents Convention – the so-called "small plants" – since these could also be the source of considerable risks to the water bodies. Therefore it is proposed that measures also be taken in future to examine these hazards and possible protective measures in transboundary water bodies.

6.2 Conferences Held and Resolutions Adopted

At the Conferences of the UN/ECE Water Convention that followed from 23rd to 25th March 2000 in Den Haag, and the UN/ECE Industrial Accidents Convention from 22nd to 24th November 2000 in Brussels, the recommendations of the "Hamburg Workshop" of 1999 were adopted:

- implementation of the agreement,
- fixing liabilities and responsibilities,
- introduction of the UN/ECE Industrial Accident Notification System as the early warning system,
- guidelines for determining hazardous activities with possible transboundary impacts,
- procedure for reporting and its monitoring,
- compiling and analysing the hazards posed by serious accidents that occurred in the industry in the past,
- pipeline accidents and pipeline safety,
- prevention of accidental water pollution in concurrence with the UN/ECE-Convention on the protection and use of transboundary watercourses and international lakes.

In the year 2000, the Joint Expert Group (JEG) for both Conventions was entrusted with the task of converting these recommendations into a work plan. It has, in the meantime, conducted 9 meetings.

At the first meeting of 18th-19th October 2001 in Berlin, the following points were adopted:

- Drawing up an inventory of already existing safety guidelines/best practices for the prevention of accidental transboundary water pollution and making these guidelines/best practices available to the competent authorities and focal points designated under this Convention.
- Assisting in the adaptation of these guidelines/best practices to the specific needs and circumstances in river basins in the UN/ECE region.
- Drawing up safety guidelines/best practices concerning installations or activities for which they are not available so far, such as: tailing dams, pipelines and the navigation of ships on rivers, to be used by UN/ECE member countries and/or joint bodies.

- Facilitating the exchange of information on the functioning of existing alarm and notification systems at national, regional and local levels within the framework of this Convention and the international river commissions (Rhine, Elbe and Danube) through joint consultations of points of contact and river alarm experts.
- Initiating of an international response exercise within the framework of this Convention and one of the international river commissions.
- Drawing up guidelines for establishing model cross-border contingency plans and disseminating them widely among UN/ECE member countries. This work will be based on experience gained with the pilot study to draw up a joint contingency plan for the Samos River shared between Hungary and Romania.
- Drawing up guidelines to identify dangerous facilities handling smaller amounts of hazardous substances than specified in Annex I to the Convention.

Alongside the JEG meetings, a series of workshops on special topics were conducted.

- from 8th to 9th June 2005, a workshop on "Pipeline accidents and pipeline safety" was conducted in Berlin,
- from 31st October to 2nd November 2005 on "Early warning and alarm systems" in Tbilisi,
- from 8th to 9th March 2006 on "Gas pipeline accidents and the safety of such pipelines" in Den Haag,
- from 12th to 14th November 2007 on the "Safety of tailings" in Yerevan (Armenia).

Drawing upon the results of these workshops, a series of outlines were prepared for recommendations and guidelines.

A special topic deals with questions of liability and financial compensation in the event of water pollution caused by an upstream polluter. For this, the "Protocol on Civil Liability for Damage and Compensation for Damage Caused by Transboundary Effects of Industrial Accidents on Transboundary Waters" was adopted. This protocol is a joint instrument to the Convention on the Transboundary Effects of Industrial Accidents and to the Convention on the Protection and Use of Transboundary Watercourses and International lakes. The objective of the Protocol is to provide for a comprehensive regime for civil liability and for adequate and prompt compensation for damage caused by the transboundary effects of industrial accidents on transboundary waters.

The protocol represents a declaration of intent. The enforcement of sanctions still remains largely open.

6.3 The achieved and the yet to be achieved

A questionnaire circulated in 2010 aimed at determining the status of work in the Contracting States of the "Water Convention" in order to identify the primary activities in the area of water pollution and industrial accidents, and orientate the work more closely to the needs of the concerned countries. The countries invited to participate were asked to express their most important needs with the help of the questionnaire and suggest specific action for water bodies and the prevention of industrial accidents in the transboundary context.

The questions posed were in the following areas:

- institutional structures for transboundary cooperation across the entire river basin,
- monitoring of water quality and quantity; classifications; inter-calibration; compatible data exchange,
- alarm systems, notifications, exchange of information,
- contingency planning and harmonisation,
- management for tailings,
- waste water treatment,
- fire protection,
- pipeline management,
- natural disasters (such as earthquakes, landslides),
- flood management,
- drought management,
- transshipment of hazardous substances along water bodies,
- location of hazardous industrial plants,
- studies of impacts, risk assessments,
- alarm exercises,
- basic safety measures.

The examination of the countries' responses throws up a nuanced picture. It is evident that aspects such as "alarm systems, notifications, exchange of information" along with "contingency planning and harmonisation" as well as "waste water treatment" have been identified by the participating countries as topics of paramount importance. While the last topic was for the most part mentioned by the non-EU countries as being a priority, the first two were mentioned both by the EU as well as the non-EU countries.

The two aspects "alarm systems, notifications, exchange of information" and "contingency planning and harmonisation" were identified primarily as problems that could only be dealt with at the international level and across the entire catchment area.

More active cooperation between neighbouring states in legal and technical matters was considered to be important. This also includes the organisation of workshops and the establishment of expert groups. The preparation of technical handbooks and political recommendations was mentioned most often. Some non-EU countries also stressed the lack of technical capacities for handling the two aspects mentioned above.

Other aspects having priority are transboundary cooperation in flood protection, the transfer of hazardous substances, alarm exercises and the setting up of institutional structures for transboundary water management (river commissions).

Yet another important subject concerns "basic safety measures" to prevent industrial accidents resulting in water pollution through specific processes, checklists and measures.

If one looks at the work programme for the period 2009-2010, it may be noticed that the following points are still in the process of being actively dealt with:

- monitoring the conduct of the Convention and support for the inaugural session,
- examining the contents and scale of the Convention,
- prevention of industrial accidents,
- fixing points of contact and notifying industrial accidents,
- fixing responsibilities and liabilities,
- cooperation in science and technology, reporting on industrial accidents of the past.

The following areas have been left largely unaddressed:

- transport of substances hazardous to water by ship,
- industrial accidents in "small" plants (quantity thresholds lie below the Annex I regulation of the Convention on Industrial Accidents).

Section D

7 Necessary Measures

Following the methodology of the „Safety Chain" (here for the path „surface water") as an action plan for an efficient solution of risk management which attempts to link the elements of risk management and crisis management, the result for the individual sections of the chain will be the following measures. The „Safety Chain" is a logical and exclusively technically reasonable approach and can therefore be used for a review as a kind of checklist on all levels (authorities, river basin commissions and enterprises) to determine which necessary measures have already been introduced and the quality they have. It is unlikely that findings from future accidents and emergency situations will change the structure of this approach significantly. Rather, future experiences reinforce the information basis on which the design of single areas can be further improved.

Looking for example the action areas for measures to be implemented in accordance with Article 11 (3) l WFD as

- to ensure the legal and organizational prerequisites for the implementation of concrete measures in the field of crisis management (legal basis, evaluation criteria, safety requirements, etc.),
- analysis of the potential risks (inventory of sources of risk), the protection of potentially affected goods being protected and assessment of risks,
- ensuring audit and monitoring of companies on the implementation and compliance of safety requirements resulting of Article 11 (3) l WFD by the authorities,
- design and implementation of emission and immission related early warning systems river basin-wide,
- design and implementation of river basin-wide warning and emergency plans,
- ensuring river basin-wide emergency planning (provision of technical equipment / devices and establishing accountability structures),
- implementation of structures for event recording and to assess the extend of damage,
- implementation od structures to ensure the inflow of evaluation results into future risk and crisis management („lessons learned"),

it is easy to read and that these fields of action can be realized on the „Safety Chain".

In the following, a catalogue of measures along the „Safety Chain" will be drawn up for the main areas (**Fig. 1**) which have no claim to completeness.

Precautionary Risk Management

Basic Preparations (Pro Action)

- check/create the necessary legal basis,
- check/create the necessary criteria,
- check/create the basic technical requirements,
- set up/commissioning of competent institutions and committees,
- analysis of potential dangers
    - taking inventories of the sources of risk in terms of
        - substances
        - plant site,
        - contaminated site,
        - vicinity-related hazards,

- taking inventories of potentially affected goods being protected in terms of
  - settled protection areas,
  - sensitive uses,
  - other goods being protected,
- assessing the risks of exposure pathways
  - release of pollutants,
  - spread,
  - areas of influence.

Prevention Measures (Prevention)

- provision of technical planning tools,
- obligation to integration of requirements (e.g. under Article 11 (3) l WFD) in the regional planning and area planning,
- area-based test for existing sensitivities and deficits,
- obligation of the licensing authorities for the integration of requirements (e.g. under Article 11 (3) l WFD) in the operating permit practice by permits/conditions/interdicts,
- checking and monitoring of plants on the implementation and compliance with safety requirements (inspection intervals),
- stimulation/promotion voluntary operationally measures („responsible care").

Crisis Management

Crisis Management Instruments

- conception and installation of immission-related (related to waters) early warning systems,
  - establishment of continuously working measurement stations,
  - establishment of river basin-wide measurement and communication networks,
  - development/implementation of event detection technology, assessment and forecasting tools,
- conception and installation of emission-related early warning systems in plants with connection to the river basin monitoring network and communication network,
- conception and implementation of river basin-wide warning and emergency plans
  - establishment of warning and emergency centers,

  - establishment and technical implementation of warrning and alarm channels,
  - definition of emission and immission-related warning and alarm thresholds,
- conception and implementation of desaster plans, accident management plans, etc.,
- provision of technical facilities and equipment for averting danger and damage control
  - at public level,
  - at enterprise level,
- ensure the readiness and function of the instruments of crisis management
  - at public level,
  - at enterprise level,
  - crisis communication across all levels.

Measures in Case of Incidents (Response)

- availability of qualified personnel and appropriate equipment,
- professional practice of accident and disaster control,
- functionality of alarming instruments, i.e. the regulated cousre of all defined actions fixed in warning and emergency operations plans,
- availability of short term measures to
  - damage control (regional, river basin-related, enterprise-related),
  - rescue/protection of uses and goods being protected,
  - damage repair (short-term measures until the onset of follow-up measures)
- crisis communication.

After Care Management

Accounting and Follow-up Measures

- establishing structures to ensure for an event
  - regulatory assessments of enterprise safety management,
  - assessment of regulatory crisis management,
  - assessment of effects occurred,
  - reasons and deficit analysis in enterprises,
- establishing structures that ensure a flow of the assessment results in the areas („lessons learned")

- danger prevention,
- crisis management,

➢ establishment of databases.

An evaluation /4/ of a large number of national, international and supra-national documents shows that in terms of the „Safety Chain" a serie of measures are implemented and reflected in relevant documents. These include:

➢ prevention of the release of significant amounts of pollutants from technical installations
  - basic requirements (IKSE),
  - storage (IKSE, IKSR),
  - overfill protection (IKSE, IKSR),
  - cover and seal (IKSR),
  - sewage and piping systems (IKSE, IKSR),
  - dealing with flood risk (IKSE, IKSO, IKSMS),
  - dealing with fire water (IKSE).

➢ Prevention against impact of unexpected accidental spills and/or its decrease by early discovery and early warning as well as by measures to reduce the risks to aquatic ecosystems (preparedness to an event)
  - other danger sources
    - pipeline safety (UNECE),
    - recommendations monitoring and early warning in enterprises (IKSE, IKSR),
    - recommendations for alarm systems and averting danger (IKSE, IKSR),
    - international warning and emergency plans (IWAP) of river basins,
    - list of dangerous plants (in principle available) (IKSE, IKSD),
    - recommendation for emergency planning (UNECE),
    - international warning and emergency plans (IWAP) of river basins,
    - measurement stations exist in principle on the Elbe, Rhine.
  - contaminated sites
    - contaminated areals (IKSD),
    - industrial tailings (UNECE).

8 The Deficits

The analysis /4/, especially in the field of international warning and emergency plans (IWAP) expels clear deficits. Thus, while a number of technical and organizational requirements and affiliated measures are in place, but they are unequal in their precision and depth and not uniform in all organizational structures. This can just lead to incalculable consequences in the area of a cross-border risk management, and is clearly further to develop, to coordinate and to harmonize.

However, as already a cross-border voting is required for the preparation of the documents, these recommendations and guidelines are to be interpreted as a safety standard to prevent accidental water pollution providently and to initiate the appropriate response measures in case of damage. Many of the recommendations relate to the prevention of releases from technical facilities. These documents reflect the expertise and thus form the state of the art in the field of risk prevention. At the same time they are an expression of multilateral consensus.

In the safety recommendations in principle, no concrete definition of the term *„technical facility"* is defined. Also the *scope* to whom the recommendations are adressed, is described incompletely. This leaves open, too, from what quantity threshold the application of the recommendation is relevant.

Overall, deficits are to be found less in the request scope of the recommended measures, but rather in the methodological approach, as these are effectively implemented and how this implementation can be ensured reliably. The most recent serious incident „dam crash of the red mud basin in Kolontar (Hungary)" makes the discrepancy between expectations and reality clearly. Although the „Safety Guidelines and Good Practices for Tailings Management Facilities (TMF)", which is addressed to the responsible authorities and operators of such facilities, is existing and which was adopted by the JEG in 2008, there seems an implementation has not yet taken place.

The preventive measures proposed in the safety recommendations are directed generally to the plant. The question open is, at what amount of a certain pollutant the security measures have to be met and therefore the plant comes under supervision. The aspect to look beyond the borders of each plant is, however, not considered sufficient.

Remains open, which other objects or activities can cause such contamination. In some documents this recommendation has been extended on contaminated sites and on the transport of hazardous substances. For the transportation of hazardous substances the safety of pipelines is under discussion. A similar contemplation relating to flexible transportation that use other transport routes (road, rail, waterway) is missing, which also in this context again is the question what relevance do have the masses transported in an emergency case.

From the inventory of warning and emergency plans of the Rhine, Danube, Elbe and Oder as well as other data from river basin commissions the following shortcomings can be identified:

1. For the immission-related approach the consideration of results from the observation of the water status by measurement stations, from chemical tests or by apparent observations of unusual water conditions (e.g. dead fishes) are to intensify, even where the technology (automated networked stations) is installed.
2. The emission-related warning and alert thresholds on the basis of the released amount of identified substances in connection with water hazardous classes (risk index) are to be harmonize further.
3. For the emissions-related assessment of the severity of accident events the consideration of the drainage situation in connection with the inflow amount of material has to be pursued further.
4. There are no rules/obligations for the implementation of immission-related „systems for early discovery" of accidental water events.
5. There are no environmental quality standards compatible with immission-related warning and alarm thresholds.
6. The integration of plant-internal and regional warning and emergency plans into IWAP has not been provided.
7. Quality management is regulated only rudimentary and should also include the areas of the reporting and reaction chain before and behind the responsibility of the actual IWAP as well as the basic rules for the follow-up of events („lessons learned").
8. The commonly used method of communication could be improved.
9. For event messages, for which the polluter (and hence the pollutants) are not known river basin-wide current inventory lists of potential sources of risk and substanaces are to be missing.
10. Operational early warning systems are widely unknown in the river basin commissions. Enterprises are not directly involved in the IWAP, but give off messages to the local competent authority in each case.
11. The communication with the public is not involved in the IWAP.

In particular, are missing:

- methodology for the effective implementation of the measures,
- current inventories of sources of risk,
- quantity thresholds and de minimis thresholds,
- uniform, legally robust approach in the EU under the terms of reference of IPPC and Seveso II Directive,
- river basin-related approaches,
- multilateral recommendations for alternate transportation of substances on road, rail, waterway,
- security considerations for external influences on plants and transport

means, particularly in pipelines,

- warning and emergency plans focused primarily on causes messages,
- emission-oriented alarm thresholds,
- immission-oriented alarm thresholds,
  As the damaging effect of substances not only dependent on quantities, but also dependent on concentrations a runoff-dependent factor should be introduced.
- immission-oriented water monitoring systems for early detection and early warning or if available, they are not integrated into a risk management system,
- unique, assigned responsibilities for the warning and emergency plans,
- criteria for reporting to the competent authorities,
- integration of enterprise-internal and regional warning and emergency plans into IWAP with river basin-wide uniform criteria for reporting to the IWAP,
- criteria for the following process at the end of the warning chain,

  Hierarchical consecutive reporting channels extending from the area of the accident site downstream into the direction to offices to be warning with „side steps" into the neighboring regions should be a minimum requirement for a functioning warning and alarm system.
- need of modernization for communication techniques,
- quality management systems for the entire reporting chain,
- criteria for information and public participation.

Special attention must be placed next to each appropriate instruments on the lack of qualified personnel, the availibility of adequate equipment, to the clear definition of responsibilities and the information and communication among the relevant parties.

Also be noted that there exists a large slope in the relationship between the nations and existing river basin commissions.

9 Literature

/1/ EASE – Entwicklung von Alarmkriterien und Störfallerfassung in Messstationen im Elbeeinzugsbiet für die internationale Gefahrenabwehrplanung
www.umweltbundesamt.de/anlagen/EASE

/2/ Informationsplattform „Datengrundlagen zur Einordnung und Bewertung hydrologischer Extreme" (UNDINE)
Bundesanstalt für Gewässerkunde (BfG), Koblenz
www.undine.bafg.de .

/3/ ALAMO -Alarmmodell Elbe - Vorhersagemodell für die Ausbreitung von Schadstoffen in der Elbe
Bundesanstalt für Gewässerkunde (BfG), Koblenz (siehe /1/)

/4/ „Strategien zur Umsetzung der Anforderungen aus Artikel 11 (3) l Wasserrahmenrichtlinie zur Prävention und Verminderung der Folgen unerwarteter Gewässerverschmutzungen aus technischen Anlagen"
Umweltforschungsplan des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit (Förderkennzeichen (UFOPLAN) 206 22 300)
www.alert-wfd.net