UNECE Convention on the Transboundary Effects of Industrial Accidents

Project under the Assistance Programme

Follow-up to the training session on evaluation of safety reports and joint inspection for Croatia, Serbia and the former Yugoslav Republic of Macedonia

Final Report

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With the participation of the beneficiary countries Croatia, Serbia and the former Yugoslav Republic of Macedonia.

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1. Project context

UNECE Industrial Accidents Convention

The 1992 United Nations Economic Commission for Europe (UNECE) Convention on the Transboundary Effects of Industrial Accidents (further referred to as UNECE Industrial Accidents Convention) is designed to protect people and the environment against industrial accidents. The UNECE Industrial Accidents Convention aims to prevent accidents from occurring, or reducing their frequency and severity and mitigating their effects if they do occur. To achieve this, however, is a complex process. The UNECE Industrial Accidents Convention requires States to put in place industrial safety policies, legislation, standards and procedures for its implementation, and obliges States to identify and address shortcomings and challenges in their existing policies. Given the difficulties that certain countries in Eastern Europe, the Caucasus, Central Asia and South-Eastern Europe face, the Conference of the Parties to the UNECE Industrial Accidents Convention launched the Assistance Programme in October 2004. The Conference of the Parties also adopted the Strategic Approach for the Assistance Programme to provide beneficiary countries with a mechanism for identifying their priority needs in strengthening implementation of the UNECE Industrial Accidents Convention.

The aim of the Assistance Programme and its Strategic Approach is to enhance countries' efforts in implementing the UNECE Industrial Accidents Convention, and in particular towards the establishment of the necessary policies in the six priority areas of work which include: (a) identification of hazardous activities; (b) notification of hazardous activities; (c) prevention; (d) preparedness; (e) response and mutual assistance; and (f) informing the public and public participation.

Countries participating in the Assistance Programme have been reviewing their implementation in these six priority areas of the UNECE Industrial Accidents Convention. The reviews led to the decision to organize a training session on integrated approaches to major hazard prevention, which was held in Prague in February 2009. As a result of the training session, the participants concluded that establishing an integrated system for inspections and introducing a culture of safety was crucial to minimizing the risk of major accidents.

Safety inspections in Serbia, Croatia and the former Yugoslav Republic of Macedonia – Development of an SSS checklist[1] in the preceding project

In the follow-up to a training session in February 2009, a project was designed that has provided Croatia, Serbia and the former Yugoslav Republic of Macedonia with support to improve the knowledge of their public experts in the areas of safety reporting, and in particular on:

- The validation of the content of the safety reports;
- The methodologies applied in these reports, in particular for:
    - Selection of the possible major accident scenarios;
    - Calculation of probability for scenarios; and
    - Assessment of the extent and severity of the consequences (modelling of consequences).

The countries were also interested in learning from good practices in setting up an effective major accident prevention regime. For Croatia and Serbia this was especially important, because it would enable them to review the newly developed regulations and procedures vis-à-vis good practice.

The project was accepted for implementation under the UNECE Industrial Accidents Convention's Assistance Programme by the Bureau of the Conference of the Parties of the Convention. It received financial support through the Advisory Assistance Programme of the German Federal Environment Ministry for the Environment, Nature Conservation and Nuclear Safety Protection in the Countries of Central and Eastern Europe, the Caucasus and Central Asia. Technical supervision for the project was provided by the German Federal Environment Agency.

The implementation of the project was divided into two phases:

- A preliminary phase consisting of a preparatory meeting (Sofia, 16-17 November 2009) and preparatory work for the training session.
- A training session on the evaluation of safety reports, including the preparation of a checklist system for evaluating reports (Belgrade, 8-10 February 2010).

The project was successfully implemented from 16 November 2009 to 31 May 2010.

During the training session the countries were given recommendations to enhance their procedures for the evaluation of safety reports. Subsequently, Croatia and Serbia have adopted the recommendations, mostly through legislation. In the case of the

[1] SSS stands for "Simple Score System" and serves as a yardstick that assigns a numerical value for the safety level of an installation or parts of it.

former Yugoslav Republic of Macedonia, the framework laws have been adopted; however, the by-laws needed for the effective enforcement remain to be put in place.

Additionally, the countries, in cooperation with international experts, developed during the project the SSS checklist to be used to evaluate safety reports, to better understand their content as well as to review and improve existing procedures for safety reporting. Individual follow-up by each of the three countries started immediately after the training session.

Despite the high practical value of the SSS checklist that was developed in the preceding project, the use of the checklist turned out to be problematic in countries just starting to implement the UNECE Industrial Accidents Convention and/or the European Union Seveso legislation.[2] It was therefore decided to further improve the SSS checklist during the follow-up to the project on evaluation of safety reports (see section 3.1). The Bureau approved the follow-up project for implementation under the UNECE Industrial Accidents Convention's Assistance Programme. The follow-up project, like the first project, received support from the German Advisory Assistance Programme.

From information made available by the three project countries concerning the level of implementation of the UNECE Industrial Accidents Convention and Seveso legislation, it became evident that all three countries have national legislation in place outlining actions to be taken in environmental emergencies. It is worth mentioning that the Croatian Act on Ratification of the UNECE Industrial Accidents Convention (OG, IA No. 7/99) is fully aligned with the Seveso II Directive.

The competent authorities for the evaluation of safety reports and safety plans/analysis designated by national legislation include:

- In Croatia, the Ministry of Environmental Protection, Physical Planning and Construction, and the National Protection and Rescue Directorate, supported by the Croatian Environmental Agency responsible for management of the register of installations with dangerous substances.
- In Serbia, the Ministry of Environment, Mining and Spatial Planning which can appoint a special technical commission (expert group) for the purpose.
- In the former Yugoslav Republic of Macedonia, the Division of Chemicals and Industrial Accidents and the State Environmental Inspectorate within the Ministry of Environment and Physical Planning, the Ministry of Labour and

[2] Following the Seveso accident in Italy in 1976, European Union (EU) legislation aimed at the prevention and control of such accidents was enacted. In 1982, EU Directive 82/501/EEC, known as the Seveso Directive, was adopted. On 9 December 1996, this Directive was replaced by Council Directive 96/82/EC, known as the Seveso II Directive. This directive was extended by the Directive 2003/105/EC.

Social Policy with its State Labour Inspectorate, and the Directorate for Protection and Rescue with its Inspectorate.

Croatia identified 45 hazardous installations in 2009, none of which fell under the UNECE Industrial Accidents Convention (in accordance with annex I), while Serbia identified more than 60 hazardous installations, 6 of which fell under the Convention. As for the former Yugoslav Republic of Macedonia, in follow-up to the earlier training on identification of hazardous activities, the country is now in the process of identifying hazardous installations to be classified under the Seveso II Directive and under the UNECE Industrial Accidents Convention.

When it comes to safety reporting, Croatia and Serbia have adopted legislation imposing on the operators of hazardous activities the responsibility for preparing and submitting safety reports. In the safety report, the operator has to demonstrate that policies are in place in their installation to prevent major accidents involving dangerous substances and to respond to the consequences of such accidents. The responsible authorities have to review the reports submitted. The two countries, at the time they requested the present follow-up project, were waiting to receive their first safety reports from operators and clearly expressed the need to receive training and information on good practices in this respect. The former Yugoslav Republic of Macedonia was a step behind; it was still in the phase of preparing secondary legislation related to the preparation of safety reports by operators. The authorities of the former Yugoslav Republic of Macedonia signalled to the UNECE Industrial Accidents Convention secretariat that their involvement in the project would be of great value in preparing the secondary legislation which should also refer to the necessary elements contained in a safety report.

All three countries are aware of the importance of on-site inspections in the process of checking and verifying information provided in the safety reports. Elements that should be checked during an inspection are, in particular: compliance with national legislation; the safety measures implemented; and the level of implementation.

In 2009, Croatia started to organize integrated inspections based on an agreement between inspection authorities. However, all three countries need further assistance, due to their lack of experience in implementing complex legislation in the field of prevention of major hazards. With regard to the follow-up project, areas for improvement that were targeted included administrative capacity, a lack of experience in the evaluation of safety reports and the coordination of and cooperation between different authorities.

2. Project goals

The main objective of the follow-up project was to strengthen the knowledge of the authorities in conducting inspections at installations with hazardous activities based on the conclusions of the safety report evaluation.

The detailed objectives for this project and its main activity, the on-site inspection, were to provide participants with the possibility to:

- Prepare for an inspection based on the results of the evaluation of a safety report;
- Discuss how to effectively perform inspections;
- Use the checklist during the inspections;
- Review the checklist system;
- Train future trainers who will assure, through national training programmes, an effective information transfer after the training.

3. Project implementation

The implementation of the project on on-site inspection was divided into three phases:

- A preliminary phase consisting of two preparatory meetings (Geneva, 16-17 December 2010, and Vienna, 9-10 February 2011) and preparatory work for the training on on-site inspection in Croatia.
- A training session, including an on-site inspection for the purposes of evaluating safety reports, in Croatia (Zagreb, 29–31 March 2011).
- A follow-up phase.

3.1 Preliminary phase

Duration: 1 October 2010–28 March 2011

The preliminary phase aimed to plan effectively for the on-site inspection and to produce the supporting documentation addressing the priorities identified by the three countries in the best possible way. The preliminary phase included two preparatory meetings.

The first part of the project included the identification of the training facilitators who were tasked with improving the SSS checklist and facilitating the training session. In addition, the project coordinators from the countries had to propose an operator of

hazardous activities willing to participate actively in the project and to agree with an on-site inspection of the participants in its facility. The operator had to be from one of the project countries. It was to provide and share its safety report in order to provide participants with the background information on the installation. Croatia volunteered this task and provided the original and English versions of the safety report for the ETAN facility in Ivanic Grad during November 2010 (for more information see information box under chapter 3.2). During the preliminary phase of the project, the complete version of the report in the local language was distributed to the authorities of the participating countries and the English version to the facilitators.

The preparatory meetings were useful in coordinating and monitoring the work and the progress of the on-site inspection preparation. The first meeting (preparatory meeting) was organized on 16 and 17 December 2010 in Geneva. The meeting was attended by project coordinators of the three beneficiary countries, the training facilitators and the secretariat. The main goal of the meeting was to discuss the preparatory work for the organization of the project's main event (i.e., the on-site inspection) and to prepare a preliminary sketch of the agenda.

The preparatory meeting led to outcomes in the following areas:

(a) Duration and content of the training on on-site inspection

The group agreed that the event should be organized as three full days of training sessions including, as the main activity, the on-site inspection. Furthermore, it was agreed that the training should focus on those inspections that were carried out with the aim of verifying the content of the safety report, rather than on regular inspections that were carried out periodically at the sites.

(b) Preparatory work by the project beneficiary countries

The group agreed that the countries should prepare a presentation on their practices and procedures to organize inspections, indicating the competent authorities, their roles and modalities, among others. Moreover, the number and profile of the participants from the project countries were discussed. It was finally decided to invite up to 10 people from each country, and country project coordinators were invited to identify potential participants and to send the preliminary lists of participants per country to the secretariat.

(c) Preparatory work by the training facilitators

The group discussed the main task of the training facilitators, improving the SSS checklist for the evaluation of the safety report necessary for the on-site inspection. It was decided that the new checklist was to be user-friendly and that

the guidelines on the use of the checklist were to be developed separately. The training facilitators were also invited to propose an agenda for the training, including modalities and a schedule for the implementation of the project.

After the preparatory meeting, the training facilitators started to revise the SSS checklist which in its current version had a high practical value but also required the user to have detailed knowledge. These preconditions were not necessarily fulfilled in countries just starting to implement the UNECE Industrial Accidents Convention and/or the European Union Seveso legislation. It was further evident that the semi-quantitative score system of the SSS checklist was too complex for the countries in the evaluation of the quality of safety reports.

Against this background, the training facilitators developed a simpler evaluation system, assisting inspectors and operators to check the completeness, correctness and credibility of safety reports. The new checklist, developed based on these provisions, was named the triple-C checklist[3] and turned out to be very user-friendly for the relevant actors in the beneficiary countries.

The second meeting (coordination meeting) was held on 9 and 10 February 2011 in Vienna. It was attended by the training facilitators and the secretariat. The main objectives of the meeting were to finalize the preparation of the training material and the agenda before the meeting, as well as to assess the Croatian safety report prepared for the training. The results of the evaluation of the safety report and the plans for the inspections were to be compared and discussed during the first day of the on-site inspection.

The coordination meeting led to the following outcomes:

- The dates for the training were fixed for 29–31 March 2011.
- The triple-C checklist was introduced and, after discussion, again partly revised, in particular in view of the simplification of the new scoring system. The updated version of the triple-C checklist was finalized shortly after the meeting and was circulated to the beneficiary countries and to experts who could not participate.
- The provisional agenda was discussed and partially redesigned. The secretariat was tasked with finalizing it and circulating it to the experts and the country project coordinators.
- It was agreed with the host country to prepare an information notice containing the provisional agenda of the inspection and a logistical note on the meeting venue.

[3] The triple-C scoring system stands for Complete, Correct and Credible, the three categories under which the checklist questions are listed.

3.2 Training session and on-site inspection

Duration: 29–31 March 2011

The training session on on-site inspection took place in Zagreb, Croatia, from 29 to 31 March 2011. It was attended by experts from all three beneficiary countries. There were a total of 36 participants, including members of the UNECE secretariat and the training facilitators, Gerd Schulze, Nikolay Savov and Jan G. Roed.

Croatia was represented by 10 experts from the Ministry of Environmental Protection, Physical Planning and Construction (the Division for Environmental Impact and Industrial Pollution, the Directorate for Physical Planning and the Directorate for Inspection Affairs), the National Protection and Rescue Directorate and the Croatian Environmental Agency.

The former Yugoslav Republic of Macedonia had nine experts representing the Ministry of Environment and Physical Planning (the Division of Chemicals and Industrial Accidents and the State Environmental Inspectorate), the Directorate for Protection and Rescue (the Division for General Inspectorate) and the Ministry of Labour and Social Policy (the State Labour Inspectorate).

Serbia was represented by nine experts from the Ministry of Environment, Mining and Spatial Planning (the Group for Risk Management), the Ministry of Interior (the Sector for Emergency Management, the Directorate for Prevention and Protection) and the Ministry of Labour on Social Policy (the Group for Study and Analysis of Tasks within the Directorate for Occupational Health and Safety).

On the second day of the training, the on-site inspection of the ETAN facility in Ivanic Grad, some 40 kilometres from Zagreb, was held. The ETAN facility in Ivanic Grad includes three processing facilities: the ethane facility; the facility for the finishing of butane and pentane isomers; and the facility for the stabilization of natural benzene. The plant was built in 1980 in order to meet a growing demand for production of natural gas. It is at the hub of the technological and distribution systems for gas in Croatia, and manages the production, storage and sales of gas, including the preparation of gas for transport to end-users. Activities in the plant include processing of natural gas to levels suitable for distribution, separating ethane and liquid oil gases (namely propane and butane) and producing natural benzene from feedstock that represents a mixture of gases and C2+ components (higher hydrocarbons with two or more carbon atoms).

Background information about the ETAN facility in Ivanic Grad

The owner of the ETAN facility is the oil company INA-Industrija nafte d.d. (INA) which has its headquarters in Zagreb. The company employed 9,931 people in 2009. It was established in 1964 and is now a medium-sized oil company with a significant role in the region. It covers exploration and production of oil and gas (both at the national and international levels), processing of oil, production of oil derivatives (in two refineries in Rijeka and Sisak and lubricants production in Rijeka and Zagreb) and retail sales of oil derivatives and other products.

The three-day training combined sessions in plenary (training, discussions) and in groups (discussions, conclusions). The simulated inspection was also conducted with the participants divided into groups.

Theoretical preparation

On Day 1 the focus of the morning plenary session was on the inspection linked to the safety report and on the use of the proposed triple-C checklist system, including an in-depth explanation of the yes/limited/no triple-C scoring system. In the assessment of the safety report if the assessor ticks at least one "no", the report should be automatically rejected by the competent authority and returned for modifications or additional information. This session continued with presentations by countries on their national procedures for ensuring safety at hazardous industrial facilities in terms of safety reporting and inspection regimes.

The afternoon plenary session was dedicated to the evaluation of the safety report provided by the Croatian operator of the ETAN gas facility in Ivanic Grad. The safety report was analyzed by all three project countries using the latest version of the checklist system. This was done with the aim of familiarizing the participants with the new version of the triple-C checklist and using it to assess a real safety report. The countries had the opportunity to provide general feedback on the triple-C checklist as a tool for the evaluation of safety report, to highlight the elements of the checklist that were not clear enough, to suggest changes, to reflect on obstacles/difficulties encountered throughout the evaluation process, to address items to be verified during the simulated on-site inspection and to provide more general comments on what the necessary elements for the preparation of an inspection linked to the evaluation of a safety report should be.

After the plenary sessions, participants continued their work in national groups to discuss the evaluation of the safety report using the triple-C checklist, and to discuss the main points of the triple-C checklist to be clarified and improved. After a break the participants continued a second round of group sessions, but the groups were then broken out according to aspects of the safety report to be checked during the inspection and not by nationality. In particular, the groups discussed the information provided in the safety report for the ETAN facility, and the questions to be addressed in order to verify the contents of the report. The first day ended with a wrap-up

plenary session, with the rapporteurs of the groups presenting the conclusions drawn and outcome of their discussions.

On-site inspection

Day 2 started with a visit to the headquarters of the oil company INA, where the participants were informed about the company's activities, including the ETAN facility for gas products. INA representatives also presented general information on the safety system at INA and the safety report for the ETAN installation. The participants were also provided with more details on the visit and rules and regulations to be respected during the inspection. After a short trip to Ivanic Grad, participants were split into working groups per topic to be verified during the inspection (as agreed on Day 1) in order to perform a simulated on-site inspection. The groups tried to verify the information from the safety report related to the installations (in particular reservoirs/storage), risk assessment and the environment and site. For each group, a facility manager was assigned in order to provide additional information and explanations during the inspection.

Evaluation

Day 3 started with work in groups (the same groups as the day before) discussing the conduct of the inspection, the findings and recommendations. The outcome of the discussions in groups was briefly presented during the plenary session. The final session included a wrap-up and discussion on the role of inspectors (in using the triple-C checklist), the organization of inspections within an integrated approach and possible follow-up activities.

The improvements to parts of the triple-C checklist proposed by the countries referred to both specific content of chapters and the reorganization of some chapters. For the specific contents, feedback was provided to the training facilitators and all questions in the triple–C checklist were revised and updated accordingly. The reorganization of chapters mainly concerned chapter 6 of the checklist: Major Accident Prevention Policy (MAPP) and Safety Management System (SMS). It was proposed that the chapter be reorganized in a logical sequence (as had been done in the other chapters), and that the number of questions be reduced (considering the disproportionate amount as compared with other parts of the triple-C checklist).

Although, the triple-C checklist used during the training proved to be a valuable tool for the evaluation of safety reports, countries expressed the need to review the guidelines supporting the checklist in order to improve understanding of some of the questions in the triple-C checklist.

The countries in general agreed on the usefulness of an integrated approach for inspections. However, they expressed concerns related to the coordination and organization of such inspections, considering the involvement and jurisdictions of different governmental authorities. Another concern was linked to the legal obligation to organize such inspections. Therefore, an integrated approach for inspection should be legally binding at the national level. In any case, countries were open to learning more about how to plan the inspection, who should be involved, how to organize it, which elements should be covered by the different inspections and how to present the results compiled in one report.

Further strengthening the knowledge of national authorities would be possible by organizing more training sessions especially focused on inspections and inspectors.

Croatian experience

Representatives from Croatia informed training participants that coordinated inspections had been introduced in June 2009 based on a cooperation agreement between the inspection services in the environment field. The inspectors involved represented institutions/organizations working in areas such as fire protection; work safety; water protection; national protection and rescue; vessel pressure; and sanitary inspection. However, further improvements were still needed to address a lack of administrative capacity and experience in the evaluation of safety reports, and to ensure coordination of and cooperation between the different authorities.

Results

The main conclusions of the training included the usefulness of the triple-C checklist for the beneficiary countries, as well as the knowledge acquired by the competent authorities in conducting the simulated inspection at the hazardous facility, based on the results of the evaluation of the safety report. It was concluded that the triple-C checklist system would be of great value and could be used for the evaluation of safety reports, for better understanding their content and for reviewing and improving existing procedures on safety reporting. Furthermore, the triple-C checklist system could be used to prepare guidelines and for training inspection authorities in checking – and for training operators in preparing – safety reports.

In terms of knowledge acquired during the training, the involved authorities better understood their role as evaluators of safety reports and they got to know the key elements that had to be considered during inspections on the verification of information presented in the safety report. Further, the benefits of an integrated approach for inspections became evident. Serbia indicated that it would work to further align the triple-C checklist system with the requirements set by its national legislation.

The following results of the training could be emphasized in particular:

- The improvement of elements of the checklist system for evaluation of safety reports;
- The review of the guidelines supporting the checklist for evaluation of safety reports;
- Laying the foundation for the future elaboration of guidelines supporting on-site inspections, taking into account an integrated approach;
- The conclusion that additional training sessions in other countries and for other types of installations (i.e. other than a petroleum refinery or gas facility) are possible with the new triple-C checklist.

Finally, the project countries stated that repeating the experience in another country and for another type of facility/industry would support and consolidate their work in implementing the triple-C checklist system. In addition, repeating the experience would also better guide them towards the further elaboration of guidelines (for inspectors and operators) supporting on-site inspections, taking into account an integrated approach. Representatives from Serbia and the former Yugoslav Republic of Macedonia volunteered to identify interested operators and to organize similar activities in their countries.

3.3 Follow-up phase

In the immediate follow-up to the three-day training, the SSS checklist system developed during the previous project was improved based on the conclusions drawn during the work in groups. The new triple-C checklist for the evaluation of safety reports proved to be useful to better assess the content of reports, but also to review and improve existing procedures for safety reporting. Furthermore, the triple-C checklist could also be used in preparing guidelines and for training inspection authorities and for operators of hazardous activities in respectively evaluating and preparing safety reports.

The final triple-C checklist was to be translated into Russian to facilitate its use by Eastern European, Caucasian and Central Asian countries. The Russian version, once tested, could be further improved to better meet the requirements/needs of its users.

In the medium and longer term, the project-beneficiary countries should take steps to further review their legislation and the procedures to bring them further in conformity with internationally accepted standards. After completing the training and the simulated on-site inspection, all three countries expressed their interest in repeating the experience in another framework, and in another country. The request for a follow-up was to be explored. Such a follow-up project should include further hands-on training of competent authorities on the evaluation of safety reports.

4. Evaluation of the project

4.1 Challenges faced

The project was implemented without encountering any major obstacles, i.e., no situation occurred to prevent the project from attaining its objectives; in particular, none of the possible risks assessed before starting the project had occurred. However, some difficulties had been encountered in identifying one of the leading experts. That caused delays in starting the project. Additional difficulties and short delays occurred when another leading expert needed to leave the project. The secretariat managed, however, to find a substitute in a relatively short time.

At the early stage of the project, the Croatian coordinator invited the ETAN facility in Ivanic Grad to join the project. The company submitted and shared its safety report with all project participants, including those from the beneficiary countries. Additionally, the operator provided all the necessary background information on the facility and granted access to the facility, providing safety instructions and guides to be followed during the simulation. The Ministry of Environmental Protection, Physical Planning and Construction of Croatia provided an English version of the safety report.

The project coordinators for each country had identified experts with the backgrounds and roles that made for the right composition of the delegations in the training session; each country team was composed almost equally of staff working on the evaluation of safety reports or of inspectors. The mixed composition of the delegations was not only positive for the training and for the simulated inspection, but was also expected to have a positive effect on future work in the countries, as it had taught the experts with different but linked responsibilities how to work together and to cooperate. It also showed the importance of sharing information and of moving towards an integrated system of inspections.

Moreover, the inspectors participating from each country represented different ministries (for instance inspectorates within the ministries of environment and within the ministries of interior). This gave participants from the same country the opportunity to become more aware of the need to cooperate between ministries in order to ensure an effective system and to acquire the maximum amount of information. It also meant that experts and officials in industrial safety in each country gained insight into how their functions were organized in the other beneficiary countries.

In the preparation of and during the simulated inspection experts whose tasks included evaluating safety reports (or preparing the regulations for evaluating or

preparing safety documentation) could work together with experts whose role was to go into the field and perform the verifications needed. For inspectors working in the field it was useful to participate in the evaluation work “on paper”, as it gave them a better understanding of their complementary role in making an effective evaluation and of the difficulties that their colleagues had to face. For the experts more involved in policymaking and in the preparation of legislation, it was important that they could be involved in the simulated inspection so that they could better become aware of the needs and limits of inspections for the evaluation of safety reports. This experience should better enable them to tailor the requirements of safety documentation and its evaluation to the structure of the country and to the work of the inspectors.

4.2 Facilitators, training material and the triple-C checklist

The quality of training facilitation was outstanding, with very knowledgeable training facilitators who had years of experience in industrial safety. Nikolay Savov was highly involved in the preparation of the international standards on industrial safety and their national implementation; Jan Roed worked on establishing effective national safety policies; and Gerd Schulze was a senior adviser at a private consultancy company providing services to operators of major industrial activities in preparing safety documentation, as well as advising authorities in the area of safety policy.

The material prepared by the training facilitators was highly appreciated and easily understood by the experts from the authorities of Croatia, Serbia and the former Yugoslav Republic of Macedonia who attended the training.

The triple-C checklist developed during the project and that was used and commented by the participants is a revised version of the original SSS checklist prepared in the previous project (a subregional training session for the evaluation of safety reports in Croatia, Serbia and the former Yugoslav Republic of Macedonia) by Hans-Joachim Uth, Milos Palacek, Nikolay Savov and Neil Manning.

Feedback from the first training with the original checklist indicated that it should have a less detailed set of questions, a simplified evaluation system and be in a handier format. The new triple-C checklist (attached to this report), was designed by the facilitators and participants taking these considerations into account. In the current version, the triple-C checklist is split from the guidelines that contain the background information, the definitions, the explanation and the literature that were, in the previous version, part of the checklist. The facilitators and participants in the current project also added new examples, proposed new sequences for the questions and a slightly different order of the items.

A bigger change between the two versions of the triple-C checklist concerned the scoring system. Several users felt that for countries with little or no experience in the evaluation of safety reports the previous scoring system was too difficult and relied too much on the subjective point of view of the evaluator. It was therefore decided to modify the checklist, with the understanding that the original scoring system could still be used if the user wanted to.

In finalizing the current version of the triple-C checklist, the facilitators felt strongly that the information presented in the previous version – the SSS checklist – should be kept in the current checklist; the information and the bibliographical material were considered useful and important for the use of the triple-C checklist and for the evaluation of safety reports.

4.3 Recommendations

The participating countries highly valued the discussions with the training session's facilitators, the practical suggestions given throughout training sessions and the on-site inspection for the evaluation of safety reports. The participating countries recommended organizing other on-site inspections for different kinds of facilities. It was also recommended that this could be done in other countries (for example Serbia and the former Yugoslav Republic of Macedonia).

To ensure the long-term benefits of the project, it was recommended that the triple-C checklist system and the supporting guidelines be available for the every-day use of the relevant authorities upon their finalization and translation into Russian and German. Each language version should be then tested in training sessions, so that possible improvements could be introduced to ensure the language used was correctly understood by the end-users, i.e. the authorities. In particular, the Russian version could be tested in a training session under the Assistance Programme, should any of the Russian speaking countries request it.

It was recommended that any future training session should be organized as training for trainers, as had been the case for the present training. Participants should also be in the position to share the good practices and knowledge acquired during the project, as well as in implementing the project's outcomes, with other countries.

The triple-C checklist should be also used by the national authorities of the participating countries to prepare guidelines for inspectors and operators in evaluating and elaborating the safety reports. Furthermore, the SSS checklist proved to be useful for other countries because it allows for a detailed analysis of safety reports, in particular with regard to the semi-quantitative evaluation of safety reports.

4.4 Final remarks

The representatives of the beneficiary countries were actively involved in the training and all participants benefited from the sessions and from the on-site inspection, and in particular from the discussions with the training facilitators.

It should be noted that the working documents, in particular the safety report of the ETAN facility and the triple-C checklist system, were available in the local language. It is expected that the beneficiary countries will translate the proposed guidelines and the triple-C checklist in the coming period into their national languages.

The outstanding interpretation available during the training in Croatia should also be highlighted. Good-quality interpretation for this kind of project eases the transfer of information from the facilitators to the participants and vice versa.

The participating countries expressed their appreciation for the financial support provided through the Advisory Assistance Programme of the German Federal Environment Ministry for the Environment, Nature Conservation and Nuclear Safety Protection.

The participating countries also provided very positive feedback on the project and in particular with regard to the on-site inspection and the prepared material, including:

- The triple-C checklist, which would be additionally revised and finalized based on the results of the training session.
- The Croatian safety report and supporting documents.
- The very informative presentations related to the on-site inspection and evaluation of safety reports.

Finally, the triple-C checklist system provides references to a broad literature on industrial safety, including major accident prevention policies, safety management systems and risk assessment, which is available online. These references will allow experts from authorities to continue the learning process on their own.

Annex 1: Agenda of the on-site inspection

Zagreb, 29-31 March 2011 – Final agenda

Training session on on-site inspections for Croatia, Serbia and the former Yugoslav Republic of Macedonia

29 March 2011

9:00-9.30	**Opening and welcome statements**
9:00-9:10	Welcoming statement by (representative of Croatia)
9:10-9:20	Welcoming statement by Mr. Gerhard Winklemann-Oei, Federal Agency of Environment, Germany
9:20-9:30	Welcoming statement by Ms. Virginia Fusé, secretariat
9:30-13:00	**Session I: Safety reports, inspections and checklist**
9:30-9:45	Inspections vis-à-vis safety reports, use of the checklist. Mr. Gerd Schulze, expert
9:45-10:00	Procedures for ensuring safety at hazardous industrial facilities - safety reporting and inspection regime in Croatia (representative of Croatia)
10:00-10:15	Procedures for ensuring safety at hazardous industrial facilities - safety reporting and inspection regime in Serbia (representative of Serbia)
10:15-10:30	Procedures for ensuring safety at hazardous industrial facilities - safety reporting and inspection regime in the former Yugoslav Republic of Macedonia (representative of the former Yugoslav Republic of Macedonia)
10:30-11:00	Coffee break
11:00-11:20	Evaluation of the safety report by Croatia with emphasis on the elements to be verified during inspections. (Representative from Croatia)
11:20-11:40	Evaluation of the safety report by Serbia with emphasis on the elements to be verified during inspections. (Representative from Serbia)

11:40-12:00	Evaluation of the safety report by the former Yugoslav Republic of Macedonia with emphasis on the elements to be verified during inspections. (Representative from the former Yugoslav Republic of Macedonia)
12:00-13:30	Lunch
13:30-15:30	Work in Groups on the evaluation of safety reports using the checklist, identification of points to be clarified and improvement of the checklist
15:30-15:45	Coffee break
15:45-17:40	**Session II: Preparing the visit to the facility**
15:45-17:40	Work in groups to discuss the simulated inspection to the gas refinery
17:40-18:30	**Wrap-up from the work in group from session I and II and preparation to the simulated inspection**
17:40-18:30	Wrap-up by the rapporteurs from group I, II and III on the outcome of the work in groups from session I and session II. Moderator Mr. Jan Roed, expert
18:30-18:40	A gas refinery: its functioning. (Representative from the company).
19:30	Dinner

30 March 2011

9:00-9:30	Travel to the central office of the INA d.d. company in Zagreb, Av. V. Holjevca 10.
9:30-10:00	Information on the visit (Hrvoje Buljan + Representative of INA d.d. Zagreb)
10:00-10,45	General presentation about INA on “Etan” Ivanić Grad (Representative of INA d.d. Zagreb)
10:45-12:00	Presentation on Safety system in INA d.d. and Safety report on the Etan Ivanić Grad (Representative of INA d.d. Zagreb)

12:00-13:00	Travel to the installation ETAN Ivanic Grad
13:00-13:30	Sandwich lunch
13:30-15:00	Simulation of the on-site inspection
15.00-16:00	Discussion on the simulated on-site inspection
16:00-17:00	Travel back to Zagreb
19:30	Dinner

31 March 2011

9:30-12.30	**Session IV: Results the on-site inspection**
9:30-11:00	Work in groups to assess the simulation of an on-site inspection. Special attention on the assessment of questions in the checklist and the conduct of inspection and on recommendations for inspectors.
11:00-11:30	Coffee break
11:30-12:30	Report by the rapporteurs from group I, II and III
12:30-14:00	Lunch
14:00-16.00	**Session V: guidelines for inspection and checklist for the evaluation of safety reports**
14:00-15:30	Wrap up and discussion on the role of inspectors, the use of the checklist and guidelines for inspectors. Mr. Nikolay Savov, expert
15:30-15:45	The organization of inspections in within an integrated approach
15:45-16:30	The way forward for the countries
	Closing of the training

Annex 2: List of participants of the on-site inspection

Training session on on-site inspections for Croatia, Serbia and the former Yugoslav Republic of Macedonia

29-31 March 2011

Participants from Croatia	
Hrvoje Buljan	**Ministry of Environmental Protection, Physical planning and Construction**, Division for Environmental Impact and Industrial pollution, Head of Department, hrvoje.buljan@mzopu.hr
Daniela Petkoviček	**Ministry of Environmental Protection, Physical planning and Construction,** Division for Environmental Impact and Industrial pollution, daniela.petkovicek@mzopu.hr
Snježana Đurišić	**Ministry of Environmental Protection, Physical planning and Construction,** Directorate for Physical Planning snjezana.djurisic@mzopu.hr
Vesna Salamunović	**National Protection and Rescue Directorate,** National Protection and Rescue Directorate, vesna.salamunovic@duzs.hr
Nevenka Sugnetić	**National Protection and Rescue Directorate**, National Protection and Rescue Directorate, nevenka.sugnetic@duzs.hr
Dejana Pope-Ribar	**Croatian Environmental Agency** CEA, Head of Section in Plant and Pollution Unit, dejana-pope.ribar@azo.hr
Andrina Crnjak-Thavenet	**Croatian Environmental Agency** CEA, Senior Adviser in Plant and Pollution Unit, andrina.crnjak-thavenet@azo.hr
Dubravka Pajkin Tučkar	**Ministry of Environmental Protection, Physical planning and Construction** Directorate for Inspection affairs, Head of section dubravka.pajkin.tuckar@mzopu.hr
Ivan Pušić	**Ministry of Environmental Protection, Physical planning and Construction** Directorate for Inspection affairs, Brench unit of Zagreb, ivan.pusic@mzopu.hr
Brigita Mrvelj-Čečatka	**Ministry of Environmental Protection, Physical planning and Construction** Directorate for Inspection affairs brigitte.mrvelj-cecatka@mzopu.hr
Participants from Serbia	
Suzana Milutinovic	**Ministry of Environment and Spatial Planning** Group for Risk Management, Adviser, suzana.milutinovic@ekoplan.gov.rs
Vladimir Borota	**Ministry of Environment and Spatial Planning** Group for Risk Management, Adviser, vladimir.borota@ekoplan.gov.rs
Dragan Djuric	**Ministry of Environment and Spatial Planning** Environmental Inspector, dragan.djuric@ekoplan.gov.rs

Jelena Stankovic	**Ministry of Environment and Spatial Planning** Environmental Inspector, jelena.stankovic@ekoplan.gov.rs
Ljiljana Raus	**Ministry of Interior-Sector for Emergency Management** Directorate for prevention protection Chef of Division ljiljana.raus@mup.gov.rs
Goran Milutinovic	**Ministry of Interior-Sector for Emergency Management** Directorate for prevention protection Deputy of Head goran.milutinovic@mup.gov.rs
Miodrag Loncovic	**Ministry of Labour on Social Policy-Directorate for Occupational Health and Safety** Group for Study and Analysis task Adviser, miodrag.l@minrzs.gov.rs
Dusan Dobricic	**Ministry of Agriculture, Forestry and Water Management-Water Directorate** Group for International Cooperation in the field of water Senior Adviser, dusan.dobricic@minpolj.gov.rs
Mladjan Micevic	**Expert** SERBIA, mladjen@hotmail
Participants from the former Yugoslav Republic of Macedonia	
Emilija Kjupeva-Nedelkova	*Ministry* **for** *Environment* **and Physical Planning,** Head, Division for Chemicals and Industrial Accidents e.kupeva@pops.org.mk
Lilija Jankova	*Ministry* **for** *Environment* **and Physical Planning** Councilor, Division for Chemicals and Industrial Accidents l.jankova@moepp.gov.mk
Nevrije Rahmani	*Ministry* **for** *Environment* **and Physical Planning** Councilor, Division for Chemicals and Industrial Accidents n.rrahmani@moepp.gov.mk
Darko Blinkov	State Inspector, MoEPP/State Environmental Inspectorate (e-mail:d.blinkov@moepp.gov.mk)
Zoran Dimovski	*Ministry* **for** *Environment* **and Physical Planning** State Inspector, State Environmental Inspectorate zdimovski61@yahoo.com
Durak Arifi	*Ministry* **for** *Environment* **and Physical Planning** State Inspector, State Environmental Inspectorate durak77@yahoo.com
Krume Kocov	*Ministry* **for** *Environment* **and Physical Planning** State Inspector, State Environmental Inspectorate k.kocov@moepp.gov.mk
Bardilj Zumberi	*Ministry* **for** *Environment* **and Physical Planning** State Inspector, State Environmental Inspectorate d.blinkov@moepp.gov.mk
Trajko Todorchevski	**Directorate for Protection and Rescue** Assistant General Inspector, /Division for General Inspectorate trajko.todorcevski@dzs.gov.mk

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Annex 3: Letters of appreciation from the project countries

(1) Letter of appreciation of Croatia

REPUBLIC OF CROATIA
MINISTRY OF ENVIRONMENTAL
PROTECTION, PHYSICAL PLANNING
AND CONSTRUCTION
10000 Zagreb, Ulica Republike Austrije 20
Tel: +385 1 37 82-444 Fax: +385 1 37 72-822

Zagreb, 6 April 6. 2011

UNECE
Convention on the Transboundary
Effects of Industrial Accidents

Palais des Nations
CH-1211 GENEVE 10
SWITZERLAND

Dear Madam/Sir

It is with pleasure that I inform you onf the successful participation of Croatian experts of from the Ministry of Environmental, Physical Planning and Construction and others national authorities successful participation ion the Second phase – Training Session on-site inspection, which was held in Zagreb, Croatia, Zagreb from 29- to 31 March 2011.

On behalf of the Ministry of Environmental, Physical Planning and Construction of Croatia and myself, as well as on behalf of the participants from other ministries and experts in Croatia, I would like to thank the UNECE Secretariat of the Convention on the Transboundary Effects and The Federal Environment Agency of Environmental of Germany for organising and financially supporting this workshop. I would like to direct Sspecial thanks to all experts who with their expertise have contributed to to help maintain this training.

Participation in this training was very of great useful to representatives of Croatia, special learning in particular by enabling them to acquire new skills to check the Safety Report and new knowledge to use the checklist as a tool in the process for of evaluation of Safety Reports.

This training is was also an opportunity to meet representatives of the countries with which Croatia should cooperate on issues covered by the Convention on the Transboundary Effects of Industrial Accidents.

Looking forward to continuing cooperation on strengthening the implementation of the Convention on the Transboundary Effects of Industrial Accidents,.

Sincerely yours,

State Secretary:
dr. Nikola Ružinski

Co: Federal Environment Agency of Germany, Wörlitzer Platz 1 06844 Dessau-Roßlau

(2) Letter of appreciation of the former Yugoslav Republic of Macedonia

Republic of Macedonia
Ministry of Environment and Physical Planning
Administration for Environment

[redacted]

Archive No. 11-5011/1

Date: 19.05-2011

Republic of Macedonia
Ministry of Environment and Physical Planning
Administration for Environment

Bul."Goce Delcev" bb
1000 Skopje,
Republic of Macedonia
Telephone (02) 3251 400
Fax (02) 3220 165
E-mail: infoeko@moepp.gov.mk
Web: www. moepp.gov.mk

Convention on the Transboundary Effects of Industrial Accidents
Secretariat
Geneva, Switzerland
Atten.: **Mr. Lukasz Wyrowski**
Officer in Charge

Dear Mr. Wyrowski,

This is to express our gratitude to the Secretariat of the Convention on the Transboundary Effects of Industrial Accidents for excellent organization of the second phase of the training on evaluation of the safety report (on-site inspection) in the period 29 – 31 March 2011 in Zagreb, Croatia.

The Ministry of Environment and Physical Planning/Administration for Environment intensively works on establishment of a sound system for industrial accidents prevention and control in the country. In this sense the serial of trainings on evaluation of the safety reports was of great importance to strength capacities of the institutions involved in the industrial accidents management.

We are using this opportunity to thank the Secretariat that through realization of two exercises on safety reports assisted the country in the way towards establishment a strong scheme for sound industrial accidents management.

Following two successful workshop on safety reports under the Assistance Programme, we would like to express our needs for further common activities on capacity building in order to cover most of the stages of the industrial accidents management cycle.

Please, accept the assurances of my highest consideration.

Drafted by:
Emilija Kupeva

DIRECTOR
Filip Ivanov

(3) Letter of appreciation of Serbia

РЕПУБЛИКА СРБИЈА
МИНИСТАРСТВО ЖИВОТНЕ СРЕДИНЕ,
РУДАРСТВА И ПРОСТОРНОГ ПЛАНИРАЊА

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11070 Нови Београд

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MINING AND SPATIAL PLANNING

1, Omladinskih brigada Str.
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По мери природе

Бр/N°: 532-02-225/2010-02
Датум/Date: April 6, 2011

UNECE
Convention on the
Transboundary Effects of Industrial Accidents
Palais des Nations
CH-1211 Geneve 10
Switzerland

Dear Madam/Sir,

It is with pleasure that I inform you on the Serbian experts successful participation on the Training on on-site inspection which was held in Zagreb, Croatia on 29-31 March 2011.

On behalf of the Ministry of Environment, Mining and Spatial Planning of Republic of Serbia and myself, as well as on behalf of the participants from two other ministries I would like to thank the UNECE Secretariat of the Convention and the Federal Agency of Environment of Germany for organization and financial supporting of this activity.

Participation in this training was of great benefit to Serbia. It gave all of us the possibility to enhance safety reporting through applying the checklist methodology, which, according to the impressions of participants from Serbia, are excellent tool in the process of issuing the consent for the hazardous activities work. Also, this training enabled Serbia for the improvement of preparing and conducting an on-site inspection and allowed us to consider on the next steps to improve the industrial safety.

Finally, this training will help Serbia to fulfill the requirements on its way towards membership of European Union.

Looking forward to continuing cooperation on strengthening the implementation of the Convention on the Transboundary Effects of Industrial Accidents.

Sincerely yours,

ASSISTANT MINISTER,

Aleksandar Vesić

SECTORAL CHECKLIST

for preparation and inspection of a safety report

UNECE convention on the transboundary effects of industrial accidents & the EU Directive 96/82/EC (SEVESO II) by a consistent Checklist system

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Umwelt Bundes Amt
For our Environment

UNECE Convention on the Transboundary Effects of Industrial Accidents
Assistance Programme

Introduction
to system of checklists

To support the preparation, auditing and inspection of Safety Reports a hierarchical system of checklists was developed as presented in figure 1.

Figure 1
System of checklists for assessment of a Safety Report

Sectoral Checklists (SCL)

- SCL description of the environment and site
- SCL main activities and products for single installation
- SCL dangerous substances
- SCL identification of hazards, risk assessment and preventive measures
- SCL limitation of consequences and mitigation
- SCL Major Accident Prevention Policy (MAPP) and Safety Management System (SMS)

►

Detailed Checklists (DCL)[1]

- DCL substances
- DCL internal Emergency Planning
- DCL interface internal & external Emergency Planning
- DCL checklists for refineries
- DCL reaction process design considerations
- DCL components

Presented document represents different sectoral checklists (SCL) that give an overview on all safety performances, expressed by the simple yes/limited/no evaluation system. Detailed description of findings and comments are summarized at the end of every SCL.

The system of checklist is preferably used in a single electronic document, which allows an easy switch between the checklists, guidance text and literature.

1 The number of DCL can be extended accordingly to the need of the investigator.

To involve several experts at the same time, it is recommended to split up the document according to the different areas, e.g. description of substances, SMS, risk assessment, etc. This procedure is possible because:

- SCL's are short and comprehensive;

- SCL's address a limited area;

- SCL's can be performed by sectoral specialists (share workloads); and

- SCL's can be evaluated separately according to similar topics (not to compare apples and pears).

In the open literature there are several references to other checklist methods, which follow other principals as given in the "SEVESO-world". Those systems give within their limits also valuable information on the safety record of the objects investigated. As good examples are mentioned:

- The Belgium Metatechnical Evaluation System M.E.S.[1]; or

- Checklist of the German Federal Environmental Agency especially designed for installations handling substances, which are dangerous for the environment[2].

1 http://www.employment.belgium.be/WorkArea/showcontent.aspx?id=6642
2 http://home.arcor.de/platkowski/Raffinerie/Site/

Evaluation
system for the sectoral checklist

For inspection and surveillance purpose it is useful to evaluate accuracy of the information presented in the SCL throughout on-site inspection. The SCL includes six chapters that contain questions to be answered (see figure 1). All questions are organized in three categories, so-called “3-Cs”:

Complete, Correct and Credible.

The rational behind splitting the questions among the “3-Cs” is:

- Under “complete” questions will verify the presence of the required, essential information that a safety report should contain; and
- Under “correct” and “credible” will go questions that would be used to verify the ones in complete (to cross-check them).

Example

Q: Are the accidental scenarios described in the safety report?

**Note: Would this question go under “Complete”?*

Clarification: In order to understand whether these scenarios are calculated correctly or in a credible way, detailed knowledge of accident models is needed. Therefore a question is also asked under “Credible” – are the parameters given to calculate the scenarios by another party (following the approved accidents model)?”. If such information is available, the author of the Safety Report shows confidence in his/her own assumption/calculations.

Every question under “3-Cs” should be answered as yes, limited or no. For the evaluation purposes following principles should be applied:

- For every “no” checked, the Safety Report **would not be acceptable**, and should be immediately returned to operator for additional work;
- For every “limited” checked, the Safety Report **would still be acceptable**, but will need further clarification.

It should be noted that some of the “complete” and “correct” questions might need to be verified during the on-site inspection. Furthermore, it might occur that some questions are not applicable for certain type of installation. For example – a passive storage facility without any pipes will not have any piping and instrumentation drawings (as requested under the question 2.7). In such a case, the evaluator should immediately pass to the next question.

This checklist system has been prepared within a project “Joint inspection for Croatia, the former Yugoslav Republic of Macedonia and Serbia” on the evaluation of safety reports under the UNECE Convention on the Transboundary Effects of Industrial Accidents which was **implemented with funds of the Advisory Assistance Programme for Environmental Protection in the Countries of Central and Eastern Europe, the Caucasus and Central Asia provided by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and managed by the Federal Environment Agency.**

No.	Reviewed item	Example	Evaluation		

1. SCL description of the environment and site

1.1 SCL description of the environment

COMPLETE			Yes	Limited	No
1.1.1	Is the general description of the region provided?	Maps/drawings which show site and surrounding like roads, water ways, rails, settlement, harbors, airports. It is recommended that these are topographic maps of an adequate scale considering the impact range of the major accidents identified. The scale of the maps should be indicated.	○	○	○
1.1.2	Is the description of the land-use situation provided?	Residential areas, recreational areas, traffic routes, factories, agriculture, forests, etc.	○	○	○
1.1.3	Are the special sensitive sites both manmade and natural identified?	Hospitals, schools, conservation areas, monuments, protected sites.	○	○	○
1.1.4	Are potential natural hazards described?	• Riverine flooding, flash floods from sealed surfaces, mudslides • Seismic events (volcano, earthquake, tsunami), subsidence • Tornado, storm • Avalanches, snow, ice	○	○	○
CORRECT					
1.1.5	Is the description of the land-use situation up to date?	New traffic routes, settlements, sports facilities, industry	○	○	○
1.1.6	Does the described potential natural hazard correspond with the given maps/information for the site?	• Near rivers - flooding • Seismic events - local information by authorities • Mudslides, subsidence - geological information • Storm - meteorological information	○	○	○
1.1.7	Does the Safety report contain adequate meteorological and geological, hydrological and hydrographic data?	As the natural environment of an establishment may present potential hazard sources, influence the development of an accident, and be affected by the consequences of an accident, data will be needed for the description of the relevant environmental factors. In general this includes meteorological data such as, for example average and maximum indices on precipitation (rain, snow, hail),	○	○	○

		thunderstorms, lightning, humidity, fog, frost, winds (direction, speed), stability classes, maximum and minimum recorded temperatures and geological, hydrological and hydrographic site data such as general geological context type and conditions of the ground/underground.	

CREDIBLE

1.1.8	Are the natural events in the past and their effects reviewed?	• Maximal flood in the past (e.g. 100 years) • Failure of supply depending on snow/ice • Earthquakes • Damage of buildings/installations by storms	○ ○ ○

1.2 SCL description of the site

COMPLETE

1.2.1	Is a detailed site plan provided?	Showing buildings, roads, installations, tanks	○ ○ ○
1.2.2	Are the main activities carried out on site described?	• Process flow diagram (or Process Block diagram) • Description of loading, unloading, storage, production, pipelines	○ ○ ○
1.2.3	Is the technical infrastructure described?	• Main storage facilities • Process installations • Location of relevant substances and their quantities • Relevant equipment (including vessels and pipes) • Utilities and services (supply with electricity, steam, coldness, nitrogen, water, natural gas, handling of waste water/gases, Incoming raw materials, outgoing products) • Means of access and egress • Control rooms, offices and other occupied buildings which could be vulnerable in a major accident	○ ○ ○
1.2.4	Is the list of safety critical systems and equipment enclosed?	• Tanks, vessels, pumps, piping • Flares, catchment areas • Safety valves, control/alarm instrumentations	○ ○ ○

CORRECT

1.2.5	Does the listed safety critical systems and equipment correspond with the qualifying criteria?	• Critical tanks/vessels are identified by mass • Critical pumps/piping are identified by flow • Flares, catchment areas are identified by relevance for outflow • Safety valves, instrumentation are identified by relevance for containment integrity	○ ○ ○

1.2.6	Are the activities of other companies on the site described?	Working, production, storage, handling of hazardous substances	○	○	○
CREDIBLE					
1.2.7	Are the distances from other industrial, commercial, agricultural or sensitive facilities given?	• Maps include named objects and scales • Tables of objects/distances are comparable with given maps	○	○	○
1.2.8	Are the threshold criteria for safety critical systems and equipment defined?	Criteria according to relevant regulation for flow, mass, safety function	○	○	○

SCL 1 acceptable?

EVALUATION of SCL 1 - Summary

2. SCL main activities and products for single installations

No.	Reviewed item	Example	Evaluation: Yes	Limited	No
COMPLETE					
2.1	Is the technical description of the installation provided?	Operating temperature/pressure/flow/level, rotational speed/ power, explosion protection of equipment, relevant qualitative and quantitative information on energy and mass transport in the processes i.e. material and energy balances, • In normal running • In start-up or shut-down periods • During abnormal operations	○	○	○
2.2	Are the operating procedures for the safety of important installation defined for normal and abnormal operations?	• Description of process based on named devices • Description of action by staff depending on alarms • Description of automatic action by the process safety system • Description of actions by the emergency shut down system	○	○	○
2.3	Is the process control concept described?	Range for normal operation, alarm values, process control concept (e.g. the defined Safety Integrity Level (SIL) of the safety critical systems and equipment	○	○	○
2.4	Are the protective systems described?	• Automatic depressuring system (Blow down), flare system/ flare stack, pressure relief valves (blow-off place – often the place where the substance dissipates into the atmosphere after (incorrect) opening of a pressure relief valve (e.g. the easiest available place)), emergency shut-off, over-fill protection/level control, fire protection (sprinkler, deluge, hydrants, foam, CO_2, powder), • Fire and Gas detection	○	○	○
CORRECT					
2.5	Are the design standards of the equipment included in technical description?	Specifications of the materials, design temperature/pressure	○	○	○
2.6	Does the technical plant design for the safety important installation comply with substances and operating conditions?	• Materials are resistant against substances • Normal operation range is within the technical design	○	○	○

2.7	Are diagrams available which display equipment and process flow?	• Detailed piping and instrumentation diagrams (P&ID's) for the safety important installation • Less detailed process flow diagrams (PFD) which allow to understand how the process works	◯	◯	◯
CREDIBLE					
2.8	Are documents about the classification of instrumentation available?	Showing process to compare result of risk analysis and quality of instrumentation	◯	◯	◯

SCL 2 acceptable?

EVALUATION of SCL 2 - Summary

Sectroal checklists (SCL) 3

3. SCL dangerous substances

No.	Reviewed item	Example	Evaluation: Yes	Limited	No
COMPLETE					
3.1	Is the inventory of hazardous substances, which are present under normal conditions provided?	CAS number1, chemical name, quantity, state	○	○	○
3.2	Is the maximum quantity or production of hazardous substances, which are present under accidental conditions provided?	CAS number1, chemical name, quantity, state, production rate	○	○	○
3.3	Is the indication of the hazards, both immediate and delayed from man/population and the environment provided/highlighted?	Flammability, explosiveness, toxicity, bioaccumulation, water risk	○	○	○
CORRECT					
3.4	Are the Material Safety Data Sheet (MSDS) for all hazardous substances and mixtures available?	Manufactured, used, stored	○	○	○
3.5	Does the Material Safety Data Sheet (MSDS) contain physical, chemical and toxicological characteristics?	• Chemical/IUPAC name, CAS number[1], EC number and/or Index number according the CLP Regulation • Physical and chemical characteristics (e.g. physical state, melting point, freezing point, boiling point, flash point, flammability, auto-ignition temperature, solubility, decomposition temperature) • Toxicological characteristics (e.g. acute toxicity, skin corrosion, mutagenicity, carcinogenicity, reproductive toxicity, specific organs toxicity, aspiration hazard) • Environmental toxicity characteristics (e.g. environmental toxicity, persistence and degradability, bioaccumulative potential, mobility in soil)	○	○	○

1 Only CAS number required by the Directive, for some of the substances there could be various CAS numbers.

CREDIBLE

3.6	Are the appropriate end-points for toxic substances for human beings and environment according their classification given?	• Acute Exposure Guideline Levels (AEGLs) • Emergency Response Planning Guidelines (ERPG) • Immediately Dangerous to Life and Health (IDLH) values/ concentrations • Threshold Limit Value (TLV) • Lethal Concentration 50 (LC50,) – is the concentration of a chemical which kills 50% of a sample population • Effective Concentration 50 (EC50) is the concentration of a chemical which doesn't kills but shows other defined effects on 50% of a sample population • Water risk index (could be calculated by "H" sentences of GHS)	◯	◯	◯
3.7	Are the relevant data to calculate physical effects and chemical reactions provided?	Vapour pressure, vapour density, relative density, heat of combustion, range of explosibility, potential exothermic reactions, calorimetric data, sensitivity on mixing with other chemicals/ingredients/catalysts, composition of combustion gas	◯	◯	◯

SCL 3 acceptable?

EVALUATION of SCL 3 - Summary

4. SCL identification of hazards, risk assessment and preventive measures

COMPLETE

No.	Reviewed item	Example	Evaluation: Yes	Limited	No
4.1	Is the adopted approach for the applied risk analysis described and does it correspond to the national requirements, if defined?	• Definition of the different categories of frequency • Reference to data bases and/or generic data • Models for calculation and representation of the consequences • Values (end points) for accidental loads (explosion loads, heat radiation, toxicity, etc.)	○	○	○
4.2	Does the risk analysis (RA) cover the entire facility?	• The entire site or on a specific part of the plant, or on hazards associated with a certain operations • Risks to human beings, assets and the environment • Considering external impacts (landslide, flooding, earthquake) • Which area/activity is the most hazardous and how is this considered	○	○	○
4.3	Are the accidental scenarios described, including the criteria and the process of their selection?	The selection of major accidental scenarios shall include: • Major accidents identified in the Risk Analysis • Accidental events that appear in the Risk Analysis without being identified as major accidents, as long as they represent separate challenges to the emergency preparedness • Events that have been experienced in comparable activities • Acute pollution • Temporary risk increase, e.g. lifting/transportation activities	○	○	○
4.4	Is the probability of the major accident scenarios assessed?	Deterministic or probabilistic, qualitative or quantitative values	○	○	○
4.5	Does the Safety Report contain a detailed description of the possible internal causes that might lead to an accident scenario?	• Failure by humans (e.g. mal operation) • Failure by equipment (e.g. seals, pumps, venting valves) • Failure by process control (e.g. sensors, wiring, control system) • Failure by supply (e.g. electrical energy, inerting systems)	○	○	○
4.6	Does the Safety Report contain a detailed description of the possible external causes that might lead to an accident scenario?	Critical wind speed, lightning, high tide	○	○	○

4.7	Are the anticipated consequences of a major accident described in the Safety Report?	• Concentration of toxic substances at next population • Heating of containments by heat radiation • Demolition of installations by pressure peaks			
4.8	Is it outlined which measures have been implemented for loss prevention of the identified major accidents?	Process control, firefighting, double-walled containments, gas detection			
4.9	Are the endpoints for toxic effects, heat radiation and pressure peaks described?	• Acute Exposure Guideline Level, Level 2 (AEGL – 2) • Emergency Response Planning Guidelines, Level 2 (ERPG – 2) • Maximum heat radiation for persons without special clothes over a long time – 1.6 kW/m2 (other examples – e.g. API 521/ISO 23251). • 0.1 bar as a pressure peak who can destroy stonework			
4.10	Is the physical and chemical behaviour under normal conditions of use described?	Reactivity, stability, conditions to avoid			
4.11	Have the potential undesired side reactions and products been identified?	Possibility of hazardous reactions, incompatible materials, compatibility matrix of the hazardous substances, hazardous decomposition products , thermal unstable substances, self-decomposition			

CORRECT

4.12	Do the assumptions inside of the described scenarios fit the reality?	Parameter of scenarios compare with equipment data like flow/pressure			
4.13	Is the calculation of the scenario dimensions done by approved models?	Models described within national/international regulations or literature			
4.14	Does the probability of the major accident scenarios comply with the preventive measures?	Context between heaviness of accident and classification of preventing installation			
4.15	Are the choice of limitations for toxic effects, heat radiations and pressure peaks given?	If both available - why ERPG-2 instead of AEGL-2 or otherwise • Sensitivity of installations or humans under influence of heat radiation • Sensitivity of installations or humans under influence of pressure peaks			

4.16	Are the assumptions for presence of possible victims understandable and reasonable (ref. to scenarios)?	Probability of presence at train/bus stations, on roads etc.	○	○	○
CREDIBLE					
4.17	Is the used applied risk analysis consistent?	Approached method is used for all identified critical installations	○	○	○
4.18	Are the accident parameters given to calculate the scenarios by another party?	Wind speed, released mass, diameter of burning pool, mass within a cloud of explosive material	○	○	○

SCL 4 acceptable?

EVALUATION of SCL 4 - Summary

5. SCL limitation of consequences and mitigation

COMPLETE

No.	Reviewed item	Example	Evaluation: Yes	Evaluation: Limited	Evaluation: No
5.1	Is the description of the equipment in the plant to limit the consequences of major accidents provided?	• Devices for limiting the size of accidental releases (scrubbing systems, water spray or water curtain, emergency flair systems, etc.) • Vapour screens, emergency catchpots or collection vessels, emergency shut-of valves • Automatic shut down systems • Emergency venting including explosion panels • Inerting systems • Equipment for removal of contaminated soil and other material • Booms and skimmers for spillages to water • Temporary storage arrangements e.g. portable storage tanks, for the contaminated material	○	○	○
5.2	Are the organization, responsibilities and pro-cedures for emergency response described?	• Activation of warnings and alarms for site personnel, external authorities, neighbouring installations, and where necessary for the public • Identification of rescue routes, escape routes, emergency refuges, sheltered buildings, muster points and control centres • Provision for shut-off of processes, utilities and plants with the potential to aggravate the consequences	○	○	○
5.3	Is the plan for training and information for personal and emergency response crews provided?	Evacuation exercises, first firefighting training	○	○	○
5.4	Is the external equipment to limit the consequences of major accidents described?	Equipment of external firefighters	○	○	○
5.5	Is the activation of external emergency response and co-ordination with internal response described?	• Mutual aid agreements with neighbouring operators and mobilization of external resources • Resources available on-site or by agreement (i.e. techni-cal, organizational, informational, first aid, specialized medical services, etc.) • Exercises or coordination with local external fire brigade	○	○	○

CORRECT

5.6	Does the equipment of emergency response crews compare with potential hazards?	• Alcohol-resistant firefighting foam if needed • Water shields against dispersion of gas clouds or heat radiation • Flow rate and availability of water for firefighting	○	○	○

CREDIBLE

5.7	Has the identification of installations, which need protection or rescue intervention been done?	• Cooling of installations against heat radiation • Plans for evacuation of buildings	○	○	○
5.8	Are the elements necessary for drawing up the internal emergency plan (contained in questions under "Complete") provided?	There should be a summary of the Items under "complete", which is part of the Safety report, or the operator has to have a proof that he has supplied the authorities with such an information	○	○	○

SCL 5 acceptable?

EVALUATION of SCL 5 - Summary

No.	Reviewed item	Example	Evaluation		

6. SCL Major Accident Prevention Policy (MAPP) and Safety Management System (SMS)

6.1 Major Accident Prevention Policy (MAPP)

No.	Reviewed item	Example	Yes	Limited	No
COMPLETE					
6.1.1	Does the MAPP exist as a written document?	The MAPP should be a written document. It should be complete and proportionate to the major accident hazards.	○	○	○
CORRECT					
6.1.2	Does the senior management show commitment to the MAPP, e.g. through signature	The MAPP should be signed by the senior management in order to guarantee that it will be implemented throughout the establishment.	○	○	○
CREDIBLE					
6.1.3	Has the MAPP been communicated to the workforce?	In order to guarantee the implementation of the MAPP and the commitment of the workforce onsite, the MAPP should be communicated to the employees, subcontractors and any third party, undertaking activities on the site. This should be documented in an adequate way. The credibility of this documentation should be validated through e.g. interviews with the people on the site, checking the availability of the MAPP in the workplaces, etc.	○	○	○
6.1.4	Is the MAPP communicated to contractors and third parties undertaking activities on site?		○	○	○

6.2 Elements of SMS

No.	Reviewed item	Example	Yes	Limited	No
COMPLETE					
6.2.1	Is the organisation of the facility documented, the process safety related units roles and responsibilities clearly identified?	There should be a complete documentation, which clearly links the process safety (major accident hazards) to the roles and responsibilities of the personnel on all levels. This should be visualized by the means of e.g. an organizational diagram	○	○	○
6.2.2	Have processes for identifying and monitoring the process safety requirements on personnel and their roles and responsibilities been developed?	There should be working procedures, which completely describe how are safety requirements identified and monitored and how the corresponding roles and responsibilities distributed.	○	○	○

6.2.3	Have processes for the identification of hazards and assessment of their risks been defined?	In order to have a fit and proper risk assessment procedure you have to have a complete set of processes for hazard identification and assessment of their risks. This should include definition of the scope of application, people responsible for initiating and carrying out the risk assessment, frequency of execution, follow-up activities, etc.	○	○	○
6.2.4	Have processed been defined for the communication of the results from hazard identification and risk assessment?	In order to be able to take into account the risk assessment in the management system, there must be procedures that ensure complete incorporation of the results of the risk assessment in the management of change, maintenance, operation, purchasing, etc. processes. The procedures should involve the management at all levels in the establishment.	○	○	○
6.2.5	Do processes exist for addressing changes in documents as a result of changes?	The management of change procedures should ensure that planned and implemented changes are fully taken into account in the complete range of management, technical and administrative documents, such as operating procedures, plans and drawings, telephone lists, safety report, SDSs, etc.	○	○	○
6.2.6	Do processes exist for developing internal emergency plans?	The internal emergency plans have to be developed within a procedure that completely takes into account the major accident scenarios, the responsibilities of the personnel, as defined by the MAPP and the SMS, the management of change procedures, the risk assessment results, etc.	○	○	○
6.2.7	Do processes / procedures exist for training / drills related to the internal emergency plan?	The procedures for emergency drills and testing of the internal emergency plan should be complete and with defined frequency, scope, responsibilities, involved persons, functions. They should be reviewed and the results should be used when updating the emergency plan and the MAPP/SMS.	○	○	○
6.2.8	Are there complete processes and procedures in place for monitoring compliance with defined requirements?	The processes and procedures for monitoring should completely define the reporting formats (regular reporting/ log books/journals, etc.), procedures (alarm monitoring by supervisors, work discipline monitoring, etc.), tools (Checklists of regular (shift / daily / weekly) and control measures (“walk round” visits by management).	○	○	○
6.2.9	Does an accident reporting mechanism exist?	The establishment should have a procedure for accident (and near miss) reporting, which should be complete and define the reporting formats and practices, incl. protection of reporting employees, investigation procedures, assessment of the reports, communication and follow-up.	○	○	○

6.2.10	Is a process defined for regular audits?	There should be a procedure for auditing which would completely define the kind of audits performed (internal and/or external), the frequency for their execution, the responsibilities and the persons involved.	◯	◯	◯
6.2.11	How does senior management review the MAPP and the SMS?	The system for review and update of the MAPP and the SMS should completely define the process of reviewing, the frequency of the review, other circumstances that would trigger a review, involvement of the personnel on all levels, the communication to other actors and follow-up.	◯	◯	◯

CORRECT

6.2.12	Are the qualifications and training requirements for all process safety related activities defined and documented?	In the Safety report there should be a description of all safety related activities (Annex II). For all such activities there should be a training programme that guarantees a certain level of qualification of the personnel involved. These persons should also receive regular refresher training and additional training when changes are implemented.	◯	◯	◯
6.2.13	Is a training programme for attaining and maintaining competence and skills related to process safety developed and executed?		◯	◯	◯
6.2.14	Have processes and procedures been adopted to systematically eliminate hazards and mitigate risks?	There should be written procedure(s) for these aspects of the SMS. They should identify the issues of concerne, personnel responsible on all levels, tools and documents.	◯	◯	◯
6.2.15	Have processes and procedures been established to define "normal operation" - (operating envelope)?	There should be written procedure(s) for these aspects of the SMS. They should identify the issues of concerne, personnel responsible on all levels, tools and documents.	◯	◯	◯
6.2.16	Are processes and procedures established to report deviations from "normal operation"?	There should be written procedure(s) for these aspects of the SMS. They should identify the issues of concerne, personnel responsible on all levels, tools and documents.	◯	◯	◯
6.2.17	Do processes and procedures exist for carrying out maintenance, repair and inspection activities?	There should be written procedure(s) for these aspects of the SMS. They should identify the issues of concerne, personnel responsible on all levels, tools and documents.	◯	◯	◯
6.2.18	Does a "Permit to Work" system exist?	There should be a written procedure describing how the "Permit to Work" system is implemented.	◯	◯	◯
6.2.19	Does a process exist for the "MoC"?	There should be a written procedure for the management of change aspects of the SMS.	◯	◯	◯

6.2.20	Are responsibilities for initiating, approving permitting and approving a change defined?	It should be within the procedure for the management of change and face the aspects detailed in the question.	○	○	○
6.2.21	Do processes exist for addressing training and communication as a result of changes?	It should be within the procedure for the management of change and face the aspects detailed in the question. It should be complementary and not contradictory to the training procedures.	○	○	○
6.2.22	Do processes / procedures exist for communicating the internal emergency plan to contractors / third parties on site?	There must be a procedure that outlines the communicating process of the internal emergency plan to workers/third parties/contractors. It should clarify the information disseminated, the training required, how is the training verified/ followed up.	○	○	○
6.2.23	Do processes / procedures exist for communicating the internal emergency plan to off-site emergency responders?	There must be a procedure that outlines who is responsible for communicating the internal emergency plan to offsite emergency responders, how often this should be done and when the information has to be updated. Additional issues that have to be clarified within are the communication channels used and cooperation in case of an accident.	○	○	○
6.2.24	Are processes / procedures in place to deal with deficiencies identified by monitoring activities (including closing out)?	There should be a follow-up procedure for deficiencies identified during monitoring activities. It has to clearly indicate persons responsible, competencies and follow-up procedures, up to discontinuing the operation of an installation or parts thereof.	○	○	○
6.2.25	Is there an internal communication / reporting system to allow employees to communicate about process safety deficiencies or improvements?	Employees should be able to communicate their opinions and findings on the safety of the installation they work in. this should be done in a systematic way, therefore a procedure must exist.	○	○	○
CREDIBLE					
6.2.26	What are the criteria for carrying out a risk assessment	The MAPP and the SMS should adequately and credibly demonstrate that a systematic and consistent approach is implemented, based on a sound scientific and technical principles, which identifies areas that represent a major accident hazard, such as e.g. HAZOP, HAZID, etc.	○	○	○
6.2.27	For which activities does a “Permit to Work” system exist?	The MAPP and the SMS should credibly demonstrate that for activities that could influence the risk of major accidents (e.g. hot works, electrical works, demolition works, etc.) a work permit is required that takes into account the hazards and risks entailed.	○	○	○

6.2.28	Is a “change” clearly defined within the management system and is a “safety relevant change” clearly defined in the SMS?	The procedures for management of change should have adequate definitions for “Change” and “Safety relevant change”. These definitions should credibly demonstrate that all safety related changes undergo a process of evaluation and adoption in order to control risks of major accidents.	◯	◯	◯
6.2.29	Does the MoC process link to the hazard Identification and risk assessment processes?	The MoC procedures should credibly demonstrate that for the changes foreseen proper hazard identification and risk assessment are performed.	◯	◯	◯
6.2.30	Do accident reports feed back into risk assessments?	There should be a credible proof that the SMS requires that accident and near misses reports are taken into account when performing or reviewing the risk assessment of the establishment.	◯	◯	◯
6.2.31	Are Performance Indicator Data collected on “activities” – Leading indicators, and “outcomes” – Lagging indicators?	The performance indicator data have to be adequate to the activities onsite, the major accidents hazards and the SMS. All the relevant processes and responsibilities should be credibly clarified in the MAPP and the SMS.	◯	◯	◯
6.2.32	How are the results from audits followed up?	The MAPP and the SMS should credibly demonstrate that relevant and adequate procedures for reporting, feedback and follow-up of the audits are introduced and that there is credible link to the other processes in the SMS, such as for instance MoC, Risk assessment, communication and training, etc.	◯	◯	◯
6.2.33	How are Performance Indicator Data; • Collected • and used?	Performance indicator data should be collected, processed and used in a consistent and systematic way that allows operators to identify deficiencies in the MAPP and SMS and to ultimately increase the safety level. The MAPP and the procedures in the SMS should demonstrate that this requirement is met with credible and relevant documents or procedures.	◯	◯	◯

SCL 6 acceptable?

EVALUATION of SCL 6 - Summary

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Umwelt Bundes Amt
For our Environment

UNECE Convention on the Transboundary Effects of Industrial Accidents
Assistance Programme

GUIDELINES
for preparation and inspection of a safety report

UNECE convention on the transboundary effects of industrial accidents & the EU Directive 96/82/EC (SEVESO II) by a consistent Checklist system

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Umwelt Bundes Amt
For our Environment

UNECE Convention on the Transboundary Effects of Industrial Accidents
Assistance Programme

Foreword

These instructions on preparing and inspection of a safety report provide a checklists system for safety reports. The document can be seen as containing three main parts:

First part, the introductory chapter, describes the purpose of safety reports and provides important definitions. This includes a useful definition of accident scenarios.

Second part, the guidelines chapter, provides background information on the content of the checklists (mostly questions in the complete category of the scoring system, although correct and credible could be found in the text), following the lists' numbering. The user can easily find detailed explanation of the chapters (1-6) in the checklist by referring to the corresponding numbers in the guidelines (for example, Q 1.1.1 Is the general description of the region provided?).

Third part, the literature, contains the list of useful references relevant for safety reports and inspections.

The document is designed as a supporting document to the SECTORAL CHECKLIST for preparation and inspection of a safety report in accordance with the UNECE Convention on the Transboundary Effects of Industrial Accidents and the EU Directive 96/82/EC (SEVESO II) by a consistent Checklist system presented in the separate document.

This checklist system has been prepared within a project on the evaluation of safety reports under the UNECE Convention on the Transboundary Effects of Industrial Accidents which was implemented with funds of the Advisory Assistance Programme for Environmental Protection in the Countries of Central and Eastern Europe, the Caucasus and Central Asia provided by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and managed by the Federal Environment Agency.

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Table of contents

1. Introduction, general principles and definitions

Learning from major chemical accidents in the past, the international community took action to issue several regulations dealing with prevention of, preparedness for and response to major industrial accidents. In particular:

- UNECE Convention on the Transboundary Effects of Industrial Accidents[1]
- OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response[2]
- EU Directive 96/82/EC (SEVESO II)[3], amended by Directive 2003/105/EC[4].

Those regulations aim at the prevention of major accidents which involve certain dangerous substances, and the limitation of their consequences for man and the environment, with a view to ensure high levels of protection throughout the whole international community in a consistent and effective manner.

The responsible handling of bigger amounts of hazardous chemicals requires a systematic approach on safety and accident control. This is efficiently laid down in a Major Accident Prevention Policy (MAPP), which basic principles are made operational by the measures of the Safety Management System (SMS). The SMS is a part of the overall management system; the whole system represents the safety culture. The core instrument to demonstrate that all measures are taken in a consistent way is the Safety Report (SR). The preparation, auditing and inspection of SRs are strongly facilitated using a consistent system of checklists, which is described below.

The following document is mainly based on the European “Guidance on the Preparation of a Safety Report to meet the Requirements of Directive 96/82/EC as amended by Directive 2003/105/EC (Seveso II)”[5] and the German Guidance SFK-GS-24, “Outline of a major-accident prevention policy and a safety management system pursuant to Article 9 (1) a and Annex III of the “Seveso II” Directive”.

1 http://www.unece.org/env/documents/2006/teia/Convention%20E.pdf
2 http://www.oecd.org/document/61/0,3746,en_2649_34369_2789821_1_1_1_1,00.html
3 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31996L0082:EN:NOT
4 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32003L0105:EN:NOT

5 http://mahb.jrc.it/fileadmin/MAHB/downloads/guidance/id-23/guidance-amended-by-2003-105-EC.pdf

1.1 Purpose of a safety report

→ WHY?
Safety reports are intended to demonstrate that:

- A major accident prevention policy (MAPP) and a safety management system (SMS) have been put into effect;
- All major-accident hazards are identified and necessary measures have been taken to prevent such accidents and to limit their consequences for man and the environment;
- Adequate safety & reliability have been incorporated into the design, construction, operation and maintenance of any installation;
- Internal emergency plans have been drawn up, supplying information to enable the external emergency plan to be drawn up; and
- Information for land-use planning decisions has been given.

→ HOW?
The safety report must include the following minimum data and information:

- Information on the MAPP and on the SMS;
- Presentation of the environment of the establishment;
- Description of the installation(s);
- Hazard identification, risk analysis and prevention methods; and
- Measures of protection and intervention to limit the consequences of an accident.

The safety report may be combined with other reports produced in response to other legislation to form a single safety report in order to avoid unnecessary duplication or repetition of work.

WHO is to prepare a safety report? The operator is the one to submit the safety report to the competent authority and he has the responsibility to decide on the competence of the people and organisations involved in the preparation of the safety report.

Relevant organisations entrusted with such tasks must be named in the safety report.

→ WHEN?
The safety report must be submitted:

- In case of existing establishment, a defined period of time from the date the relevant legislation enters into force;
- In case of an establishment, which subsequently falls within the scope of this Directive, within one year after the date on which this Directive applies to the establishment concerned;
- In case of a new establishment a reasonable period of time prior to the start of construction or operation; and
- Without delay after a periodic or necessary review.

The safety report must be reviewed and, if necessary, updated:

- In a regular period, which is laid down in the respective regulations; or
- At the initiative of the Operator or at the request of the Competent Authority, where justified by new facts, new technical knowledge about safety or about hazard assessment; or

- In case of a modification of a site, this means modification of the establishment, the installation, the storage facility, the (chemical) process, the nature of dangerous substance(s) or the quantity of dangerous substance(s). The decision whether these modifications would have an impact on safety and, therefore, would require a review of the safety report should be taken by using a systematic analysis such as for instance a screening method or a rapid ranking tool.

1.2 Definitions

The safety report should demonstrate that necessary measures to prevent, control and limit the consequences of a possible major-accident have been put in place and are fit for the purpose.

1.2.1 Demonstrate

For this specific purpose, "demonstrate" is intended in its meaning of: "justify" or "argue the case" but not "provide an absolute proof". In reality, the hazard identification, its associated risk analysis and the subsequent decisions in regard to control measures are processes that are always characterised by a certain degree of uncertainty. As such, it is normally not possible to prove absolutely in the safety report that "all necessary measures" have been taken.

In addition, it should always be assumed that the Competent Authorities will take the information and conclusions in the report largely as presented, using professional judgement more generally to assess the credibility and logic of the conclusions reached in the report. An extensive in depth scrutiny or exhaustive examination is not envisaged in most cases.

Finally, the effective implementation of this principle is strictly dependent on the correct identification of all potential major accident hazards and proper selection and application of the necessary control measures for each of them.

From these considerations the following guidance may be derived:

- The operator shall expect professional judgment from the assessor of a safety report and should base its demonstration on this assumption;
- The demonstration must be "convincing". This means that the rationale for deciding the completeness of hazard identification and the adequacy of the measures employed should be supported and accompanied by all assumptions made and conclusions drawn;
- The demonstration should provide evidence that the process was systematic which means that it followed a fixed and pre-established scope;
- The extent to which the demonstration is performed should be proportional to the associated risk.

1.2.2 All necessary measures

"Necessary measures" shall be taken in order to prevent, control and limit the consequences of a possible major-accident. In the context of the assessment of a safety report it means that, in applying the identified measures, all risks of concern have been properly reduced according to current national practices.

A point to note is that, although the "necessary measures" are properly taken, some 'residual risk' will always be present.

The decision as to whether the residual risk is acceptable depends very much on national approaches and practices.

Nevertheless there are some widely accepted supporting principles for this decision:

- The efficiency and effectiveness of the measures should be proportionate to the risk reduction target (i.e. higher risks require higher risk reduction and, in turn, more stringent measures);

- The current requirements of technical knowledge should be followed. Validated innovative technology might also be used. Relevant national safety requirements must be respected;

- There should be a clear link between the adopted measures and the accident scenarios for which they are designed;

- Inherent safety[6] should be considered first, when feasible (i.e. hazards should always be removed or reduced at source).

1.2.3 Prevent, Control and Limit

Prevent, control and limit can be defined as:

Prevent: to reduce the likelihood of occurrence of the reference scenario (example: automated system to prevent overfilling);

Control: to reduce the extent of the dangerous phenomenon (example: gas detection that reduces intervention time and may prevent major release);

Limit: to reduce the extent of the consequences of a major accident (e.g. through emergency response arrangements, bunding or firewalls).

1.2.4 Major Accidents

The regulations aim at the prevention of major accidents, which involve dangerous substances, and the limitation of their consequences to the man and the environment. As defined in Article 3 of the SEVESO II Directive, major accident means an

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

To qualify an accident as "major accident", three criteria must be fulfilled:

- The accident must be initiated by an uncontrolled development;

- One or more dangerous substances must be involved; and

- The accident must lead to serious danger to human health, the environment, or the property.

Whereas the criteria "uncontrolled development" and "dangerous substance" are viewed as relatively unambiguous, the interpretation of "serious danger" is more controversial and reflects often national policies. However a "serious danger" might be connected with:

- Potential life-threatening consequences to one human (on-site and off-site);

- Potential health-threatening consequences and social disturbance involving a number of humans;

6 See reference [6] in literature part.

- Potential harmful consequences to the environment at a certain (larger) extent; and
- Potential severe damage to property (on-site and off-site).

A major accident may be considered as a specific event (or a group of specific events) that is characterised by certain potential consequences.

In applying the criteria listed above a major accident may include those events involving dangerous substances that are often classified as "occupational accidents" (on-site) as well as those events that have effects outside the boundary of the establishment (off-site).

The description of measures should be limited to the explanation of their specific objectives and functions. Specific technical details should be provided within the safety report when this is necessary to demonstrate that the measures are sufficient, i.e. the measures have the required reliability and effectiveness, thus enabling the competent authority to come to appropriate conclusions.

1.3 Practical consideration for safety reports

The overall approach followed should be properly described and explained. The level of demonstration should be proportionate to the extent of potential consequences and the complexity of the installation/process/systems involved. Preparation is the sole responsibility of the operator. The Competent Authority has no responsibility for the content.

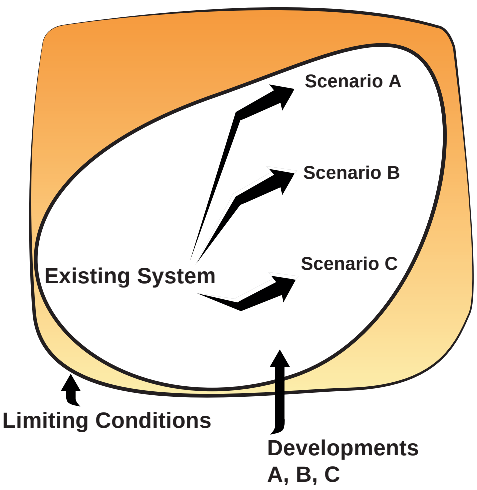
One of the main elements of the safety report is the definition of reference accident scenarios. These scenarios normally are the basis for demonstrating that the necessary measures are adequate. For this purpose, the scenario description should be structured and evidence provided to highlight the consistency between the scenario selected and the measures taken.

The safety report should be of a summarising character, in which the information provided is limited to its relevance in regard to major-accident hazards. However the information should be sufficient to demonstrate that the requirements with regard to major accident hazards have been met and allow the competent authority to come to justified conclusions.

1.4 Definition of "accident scenario"

In general, main elements presented in figure 1 represent a basis for the accident scenarios.

*** Figure 1** Development of accident scenarios



For example, an existing storage tank for ammonia developed an overpressure through the impact of thermal radiation. A possible following scenario is the release of this toxic substance over a safety relief valve. The safety relief valve is the limiting condition for the necessary calculation of the dispersion of this loss of containment to the neighbourhood. Without the safety relief valve the whole containment of the tank must be take into account.

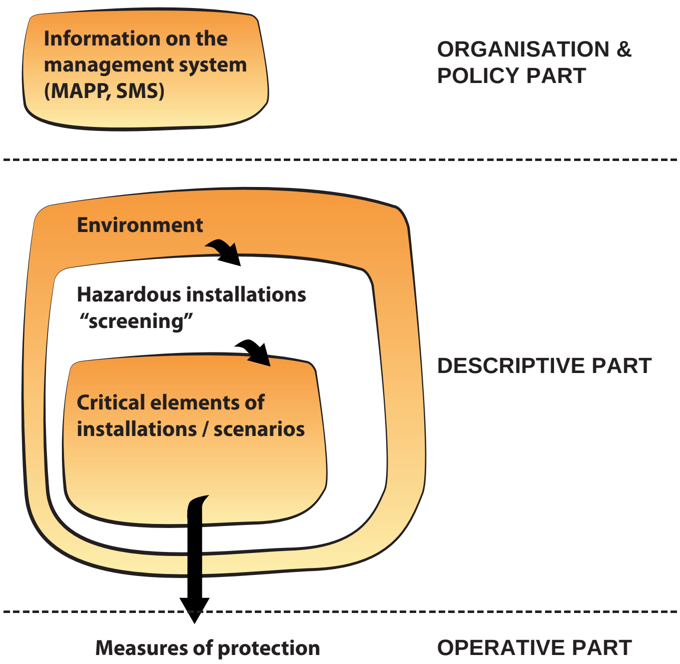
For the specific purposes of safety reports, a scenario is always an undesirable event or a sequence of such events characterised by the loss of containment (LOC) or the loss of physical integrity and the immediate or delayed consequences of this occurrence.

1.5 Essential elements of a safety report

The essential elements of a safety report are (illustrated in figure 2) logically grouped in three main parts:

- Organisation and policy part;
- Descriptive part;
- Operative part.

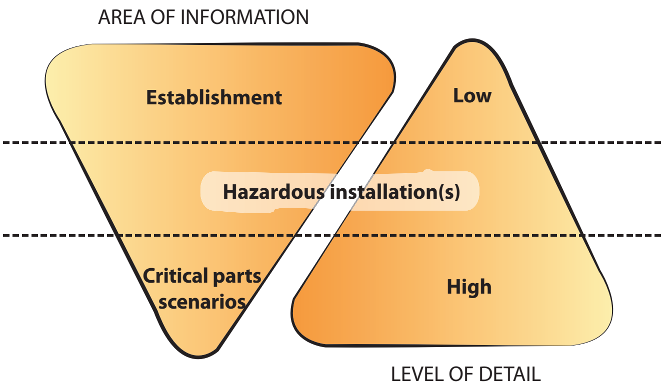
*** Figure 2** Elements of safety reports



An essential and extensive part of a safety reports is the central box, which refers to the description of the establishment, its surrounding, the hazardous installations and the critical scenarios which could lead to a major accident.

In this case, the description of the different sections is expected to be characterised by a different level of detail depending on the relevance of the involved topic to the purpose of the safety report. A suggested general approach is illustrated in figure 3.

* **Figure 3** Content of the descriptive part of a safety report vis-à-vis the level of detail



In the descriptive part of safety reports, establishments can be described in a low level of details, whereas the parts of report describing risks and possible emergency scenarios should provide high level of details.

2. SCL guidelines

2.1. SCL description of the environment and site

The description of the environment is important to estimate possible interaction between the plant and the environment. Please note that use of maps, indicated under Q 1.1.1, depends on the individual case if multiple information is given in the same document. In principle, it is a matter of required level of detail, but it is probably unwise to use large scale maps (e.g. such for land use patterns) to contain information on installation details.

2.1.1 Description of the environment

An introductory section should contain general information on the establishment, i.e.:

- Purpose of the establishment;
- Main activities and production;
- History and development of the activities, including the status of authorisations for operations already agreed and/or granted;
- Number of persons working at the establishments (i.e. internal and contractors' personnel, specifying working times, possibility of visitors, etc.);
- General statements characterising the establishment with respect to its main hazards as regards relevant substances and processes.

Q 2.1.1.1 Is the general description of the region provided?

The description of the location of the establishment should contain data on topography and accessibility to the site at a degree of detail commensurate with the extent of the hazards and the vulnerability of the surroundings. For example, if an establishment represents hazard for the aquatic environment only, as assessor would not expect great detail in the description of topography, but in the hydrology and hydrogeology. The description of the natural environment and the surroundings of the establishment should be detailed to an extent proportionate to the hazard. If for example the negative consequences for the worst case scenario have been estimated to spread at approximately 500 m, the scale of the maps should not be more than 1:5000. It should demonstrate that the natural environment and surrounding activities have been sufficiently analyzed by the operator to identify both the hazards that they pose to safe operation and the vulnerability of the area to the impact of major accidents.

The level of description details must correspond to the potential hazards. If hazard by flooding from nearby river is indicated, topographic details like contour lines or differences in altitude are needed. On the other hand, such information will be necessary in order to estimate a possible contamination of the river through a loss of containment at the plant. A difference in altitude of a few meters could be important if a liquid is stores, whereas few meters altitude could be insignificant if gas(es) are stored, for the calculation of the dispersion in the case of loss of containment.

The topographic maps submitted should be of an adequate scale and should include the establishment as well as all development in the surrounding area within the impact range of the accidents identified. The scale of the maps must be indicated; different scale maps may be necessary when long distance effects are foreseeable.

Q 2.1.1.2 Is the description of the land-use situation provided?

On the maps the following elements must be indicated: the land-use pattern (i.e., industry, agriculture, urban settlements, environmentally sensitive locations, etc.), the location of the most important buildings, infrastructure elements (i.e., hospitals, schools, other industrial sites, motorway and railway networks, stations and marshalling yards, airports, harbours, piplelines, etc.) and access routes to and from the establishment.

The land-use pattern of the area surrounding the establishment may be presented according to the specification of the official land-use plan of the greater area.

In more detail, relevant information in this respect should be supplied on:

- Inhabited (residential) areas (e.g., description of the areas including population densities);
- Establishments frequented by the general public, meeting points (regular or occasional) and recreation areas (e.g. swimming beaches, outdoor life areas etc.);
- Public utilities possibly affected (electricity, gas, telephone, water, sewers and treatment plants, groundwater supplies, etc.);
- Industrial activities external to the establishment (i.e., relative distance, nature of their activity, limitations they may impose in terms of access in emergency cases or infrastructure etc.); and
- Traffic routes and major transportation centers (i.e., roads, railways, waterways, ports, airports, marshalling yards, etc.).

Q 2.1.1.3 Are the special sensitive sites both man-made and natural identified?

In more details, relevant information in this respect should be supplied on:

- Sensitive public buildings (schools, hospitals, etc.);
- Conservation areas or similar, ecologically vulnerable or sensitive areas (e.g. used for reproduction of specific species); areas of special environmental interest, i.e., natural protected areas, protected fauna and flora species, sensitive ecosystems, areas of outstanding natural beauty, etc.

Q 2.1.1.4 Are potential natural hazards described?

As the natural environment of an establishment may present potential hazard sources and may influence the development and consequences of an accident, data will be needed for the description of these relevant environmental factors. In general, this type of data includes:

Meteorological data, such as:	**Geological, hydrological and hydrographical site data such as:**
• Average and maximum levels of precipitation (rain, snow, hail); • Thunderstorm severity; • Lightning probability; • Indices or values on humidity, fog, frost; • Winds (values for direction, speed); • Stability classes; and • Maximum and minimum recorded temperatures.	• General geological context; • Type and conditions of the ground/underground; • Seismic data; and • Flooding (including run-off water due to flash flooding) and landslide likelihood.

2.1.2 Description of the site

An introductory section should contain general information on the establishment, i.e.:

- Purpose of the establishment;
- Main activities and production;
- History and development of the activities, including the status of authorisations for operations already agreed and/or granted;
- Number of persons working at the establishments (i.e. internal and contractors' personnel, specifying working times, possibility of visitors, etc.);
- General statements characterising the establishment with respect to its main hazards as regards relevant substances and processes.

Other site specific natural factors such as:

- Surface and groundwater location values;
- Water quality and uses;
- Forests nearby (forest fire);
- Shore and marine environment data.

The lay-out of the establishment as a whole and of its relevant installations should be clearly presented on adequately scaled plans. Relevant diagrams and/or images of particular sections or equipment should be presented in an appropriate larger scale.

Following questions from the checklist are covered by the description provided below:

Q 2.1.2.1 Is a detailed site plan provided?

Q 2.1.2.2 Are the main activities carried out on site described?

Q 2.1.2.3 Is the technical infrastructure described?

Q 2.1.2.4 Is the list of safety critical systems and equipment enclosed?

The lay-out should adequately identify installations and other activities of the establishment including:

- Main storage facilities;
- Process installations;
- Location of relevant substances and their quantities;
- Relevant equipment (including vessels and pipes);
- Spacing of the installations and their main sections;
- Utilities, services and internal infrastructure equipment;
- Location of key abatement systems;
- Location of occupied buildings (with an indication of the n° of persons likely to be present); and
- Other units if relevant for the safety report conclusions.

2.2. SCL main activities and products for single installations

The installations of an establishment to be submitted to risk analysis have to be selected through a screening method. The selection could follow the threshold criteria for hazardous substances as given e.g. in German Guideline KAS-1[1], the ARAMIS project methodology [2] or other suitable indicators like the comparison of storage amount or flow rate with the threshold value of toxic substances. The Safety Management System (SMS) should provide the necessary objectives and approach basics.

Those installations, which have not been selected through this preliminary analysis, will not be considered as an essential element of the safety report. For this reason, this part of the analysis is particularly sensitive in terms of the following outcomes of the safety report study[3].

The result of this screening process should be indicated in a separate form in the safety report, e.g. a list of the installations and activities of concern or a specific indication in the respective maps.

1 KAS-1 Richtwerte für sicherheitsrelevante Anlagenteile (SRA) und sicherheitsrelevante Teile eines Betriebsbereiches (SRB), http://www.kas-bmu.de/

2 More information on the ARAMSI project methodology can be found at: http://mahb.jrc.it/fileadmin/ARAMIS/downloads/wp1/ARAMIS_scenario_appendix02.pdf

3 The ARAMIS project Method to associate critical events and relevant hazardous equipment can be found at: http://mahb.jrc.it/fileadmin/ARAMIS/downloads/wp1/ARAMIS_scenario_appendix03.pdf. The ARAMIS project could be recommended for all the hazard identification processes.

Q 2.2.1 Is the technical description of the installation provided?

The description of hazardous activities (processes/storage) and equipment parts shall indicate the purpose and the basic features of the related operations within the establishment, which are important to safety and may be sources of major risks. This should cover:

- Basic operations;
- Chemical reactions, physical and biological conversions and transformations;
- On-site interim storage;
- Other storage related activities i.e. loading-unloading, transport including pipe work, etc.;
- Discharge, retention, re-use and recycling or disposal of residues and wastes including discharge and treatment of waste gases; and
- Other process stages, especially treatment and processing operations.

Q 2.2.2 Are the operating procedures for the safety of important installation defined for normal and abnormal operations?

Q 2.2.3 Is the process control concept described?

Q 2.2.4 Are the protective systems described?

Sufficient information should be provided in the safety report to allow the competent authorities to assess the adequacy of the controls in place or foreseen in the hazardous installations identified through the screening process. Reference can be made to other, more detailed documents available to the authority on request and/or on-site (the “underlying documents” is mentioned in the section about the SMS below).

The safety report does not need to contain information on structural characteristics and other design data of the storage or process installation handling the dangerous substances like detailed engineering drawings of single devices, but summarizing descriptions, covering certain relevant topics, such as:

- Choice of materials important to safety;
- Foundations;
- Design of equipment under high pressure or temperature and their supports;
- Size;
- Stability (static calculations, conditions and load-bearing capacity of the ground); and
- Design against external events.

Q 2.2.5 Are the design standards of the equipment included in technical description?

Q 2.2.6 Does the technical plant design for the safety important installation comply with substances and operating conditions?

Where equipment is built to a specific standard, this standard should be named, together with its date and an indication of the validity for the intended purpose made where this is not evident.

The descriptive part of the safety report with respect to the safety relevant sections of the establishment (the identified hazardous installations) should mainly provide an outline description of the procedures for safe operation in all process stages, which includes:

- Measures for operations (e.g., normal running, shut-down and start-up, exceptional operations, emergency and safety procedures), and
- Specific precautions during storage, transport or handling because of specific characteristic of the substance (e.g., protection from vibration or from ambient humidity).

A preliminary analysis should identify the safety relevant sections of the establishment. These sections (installations) are usually characterized by the quantity and the intrinsic properties of dangerous substances and/or the processes involved and hence constitute the parts of the establishment requiring more detailed hazard analysis. The analysis can be accomplished using a variety of hazard screening methods.

Q 2.2.7 Are diagrams available which display equipment and process flow?

Q 2.2.8 Are documents about the classification of instrumentation available?

The safety report should in this respect contain a detailed description of the safety relevant sections and of the systems and components that are important for safety. The description should allow easy identification of:

- Those parts of the process or installation containing dangerous substances and their location;
- Those parts of the establishment involving hazardous processes;
- Elements serving safety relevant functions, i.e., prevention, control and mitigation measures;
- Elements capable of initiating a major accident; and
- Inter relationship between different installations/ parts of installations.

2.3. SCL dangerous substances

The safety report should give information on types and quantities of dangerous substances to which the Convention or the Directive applies at the establishment. The substances can fall into any of the following categories:

- Raw materials;
- Intermediate products;
- Finished products;
- By-products, wastes and auxiliary products; or
- Products formed as a result of loss of control of chemical processes.

Q 2.3.1 Is the inventory of hazardous substances, which are present under normal conditions provided?

Q 2.3.2 Is the maximum quantity or production of hazardous substances, which are present under accidental conditions provided?

For the relevant dangerous substances in concern, data to be provided should include:

- Type and origin of the substance (i.e. CAS Number, IUPAC Name, GHS classification, commercial name, empirical formula, chemical composition, degree of purity if relevant, the most important contamination, etc.).

For the dangerous substances in concern, data to be provided should include:

- Physical and chemical properties (i.e. characteristic temperatures and pressures, concentration and phases at normal and at the onset of abnormal conditions, equilibrium data and operation curves if relevant, thermodynamic and transport properties, data on phase changes, flash points, ignition temperatures, combustibility of solids, spontaneous- ignition temperatures, explosion limits, thermal stability data, data on reactions and their rates, decomposition etc.).

For the eligible dangerous substances, data to be provided should include:

- Toxicological, flammability and explosive characteristics (i.e. toxicity, persistence, irritant effects, long-term effects, synergistic effects, warning symptoms, effects to the environment, ecotoxic data, etc.);
- Substance characteristics under loss of control of process or storage conditions (e. g. information on possible transformation into new substances with other properties of toxicity, degradability etc.);
- Others (e.g. corrosion characteristics in particular relating to the containment. material).

The later two only when relevant for the safety report conclusions or specifically addressed there.

*** NOTE:**

Some information may be found in safety-data sheets (including maximum permissible working concentrations, reference to guidelines for health at working place, methods and means to detect their presence in the workplace and/or in the case of loss of containment, etc. Data on accidental release threshold levels may be taken from literature, national recommendations or dedicated studies.

The selection of the appropriate category of substances according to Annex 1 of the Convention or the SEVESO II Directive is sometimes not easy and should be addressed in the safety report.

The estimation of the quantity of substances present in the installation has to be shown in the safety report, including the application of the summation rule if required.

2.4. SCL identification of hazards, risk assessment and preventive measures

The main elements in any risk analysis process are as follows:

- Hazard identification;
- Accident scenario selection;
- Scenarios' likelihood assessment;
- Scenarios' consequence assessment;
- Risk ranking; and
- Reliability and availability of safety systems.

Q 2.4.1 Is the adopted approach for the applied risk analysis described and does it correspond to the national requirements, if defined?

Q 2.4.2 Does the risk analysis cover the entire facility?

Q 2.4.17 Is the used applied risk analysis consistent?

With regard to the hazard identification, a range of methods exists for systematic assessments[4], which are selected depending on the complexity of the individual case. Furthermore the level of detail required depends on the intended use of the accident scenario.

Essential parts of the hazard identification are indications on the identification methods used, the scope of the analysis and related constraints. The identification of hazards is followed by designation of reference accidence scenarios, which form the basis for determining whether the safety measures in place or foreseen are appropriate.

Q 2.4.3 Are the accidental scenarios described, including the criteria and the process of their selection?

Q 2.4.4 Is the probability of the major accident scenarios assessed?

Major accident scenarios may serve different purposes, for example:

- To demonstrate that, in practice, a particular scenario no longer presents a major-accident hazard due to the measures in place;
- To demonstrate that the extent of the effects of a particular scenario have been limited due to the protective measures in place;
- To demonstrate the efficiency and the effectiveness of mitigation measures put in place;
- To establish whether the activity should be considered as unacceptable; or
- To establish whether further mitigating measures, which are specifically relevant within the safety report's scope, are necessary.

Scenarios' likelihood assessment

For the scenarios' likelihood and consequence assessment, which are essential steps in the risk analysis process, quite different approaches can be followed. These assessments make use of methodologies that are generally subdivided into different categories, in particular:

- Qualitative – quantitative;
- Deterministic – probabilistic.

4 For example – hazard and operability studies (HAZOP), failure modes and effects analysis (FMEA) or "What-If" checklists.

Qualitative/Quantitative assessments

The likelihood of occurrence and the consequences of a major accident scenario could be assessed either:

- In qualitative terms using ranges, for example highly likely to extremely unlikely for likelihood, and very severe to negligible for consequences; or

- In (semi) quantitative terms by providing numerical figures (e.g. occurrence per year, number of fatalities per year).

In general, the choice of either a qualitative or quantitative approach is strongly influenced by the specific safety culture philosophy within each individual country. Moreover, it is based on the level of detailed information and data available and the level of rigour and confidence required for regulatory acceptance. The depth and type of risk assessment is likely to be proportionate to the nature of the major accident hazards presented by the site, the extent of the possible damage, the complexity of the process and activities and the difficulty in deciding and justifying the adequacy of the risk control measures adopted.

The nature of the simpler qualitative approach is that it can act as an indicator of risk but does not constitute its numerical characterisation. A detailed quantitative analysis requires correct and reliable data, which are often not available. In this circumstance, the adoption of a phased approach could be a reasonable strategy. Such an approach usually starts with a qualitative assessment at a system/installation level, which is then used as the initial screening process. Once this assessment has been performed, the results could be analysed to decide whether or not a more thorough quantitative analysis would be necessary.

For consequence assessment, normal practice suggests that, certain quantitative considerations are virtually indispensable (e.g., threshold limits, isorisk curves etc.), especially in the case of high risk/consequence scenarios. This often is necessary for activities related to emergency planning and land-use planning.

Deterministic/Probalistic assessments

In the deterministic approach the safety assessment assumes that a scenario has been selected and all necessary facts about the scenario are known. The uncertainty associated with the likelihood of the occurrence is implicitly considered in the scenario selection process.

The deterministic approach is associated with consequence-based decision criteria and it is often related to the use of qualitative terms.

The probabilistic approach is associated with a numerical account for the likelihood and consequences of possible accident sequences in an integrated fashion ("risk-based" methodology).

The methodologies currently in use do not always fall under one of these two general categories, but might belong to a combination of the two. For instance, for some methodologies, a deterministic approach can be used for the selection of significant scenarios ("worst case" approach) whilst a probabilistic approach could be used for the assessment of safety measures' efficiency and for the definition of a risk reduction strategy. Especially some considerations concerning rare initiating events (e.g. intentional attacks) or specific forms of consequence (e.g. environmental) may be subject to qualitative description only.

A proposed identification of qualitative description a possible (semi) quantitative classification is given by frequency classification from F.P. Lees "Loss prevention in the process industries"[5].

Please note that those classifications are a common convention by the scientific community only. The value classification should be settled by national regulation.

5 See reference [39] in literature part.

Qualitative/quantitative probability relation, see [39]

Event classification	Frequency (event/year)
Probable	> 10-1
Fairly probable	10-2 ÷ 10-1
Somewhat unlikely	10-3 ÷ 10-2
Quite unlikely	10-4 ÷ 10-3
Unlikely	10-5 ÷ 10-4
Very unlikely	10-6 ÷ 10-5
Extremely unlikely	< 10-6

Description of major-accident scenarios

The safety report shall demonstrate the adequateness of the measures taken by the systematic identification of possible major-accident scenarios and their initiating events (causes). The scenarios are normally based on the assumption of loss of the safe containment (LOC). However, not all scenarios are necessarily of the LOC – type, e. g. self- decomposition, and the subsequent start of fire or explosion may also be of relevance in such cases.

A structured approach to scenario selection is a crucial step in the overall analysis. The safety report should, therefore, outline the principles and procedures followed (see SMS) to determine the scenarios. In doing so, events which are documented in accident databases, near-miss recording, safety alerts and similar literature must be reviewed when drawing up the list of scenarios and appropriate lessons learnt incorporated (historical accident analysis).

A major-accident scenario for the purposes of the safety report usually describes the form of the loss of containment specified by its technical type e.g.:

- Vessel rupture
- Pipe rupture or
- Vessel leak etc.

And the triggered event, namely:

- Fire;
- Explosion; or
- Release of hazardous substance(s).

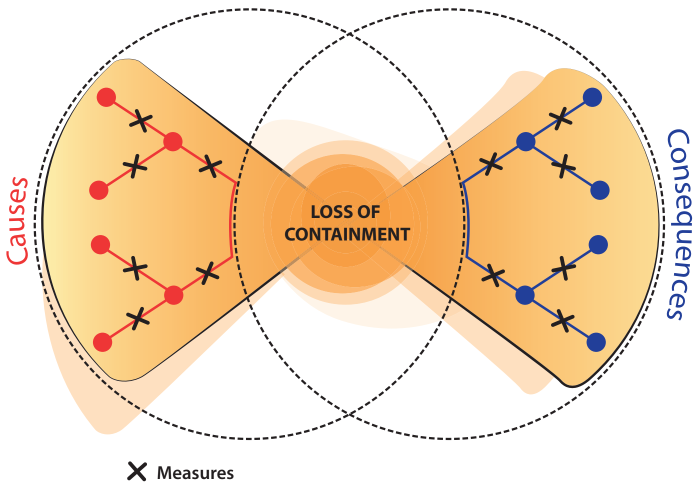
Q 4.5 / Q 4.6 Does the Safety Report contain a detailed description of the possible internal / external causes that might lead to an accident scenario?

Q 4.7 Are the anticipated consequences of a major accident described in the Safety Report?

Q 4.12 Do the assumptions inside of the described scenarios fit the reality?

The "bow –tie" diagram can be used to describe major-accident scenarios to include underlying causes:

*** Figure 4** Bow tie diagram



The centre of the diagram is the loss of containment event ('top event'). The bow-tie left depicts the overall possible causes, which could lead to the occurrence of the top event. The vertical bars refer to the measures that are put in place to prevent the release of dangerous substances by including also measures to control escalation factors. The bow-tie right side describes the development of possible outcomes resulting from the top event. The vertical bars in the bow-tie right side refer to the measures to prevent/mitigate that the top event could not cause harm too the men, the environment and the installations.

The following non-exhaustive list provides the most relevant event types that describe the consequences of the top event development (outcome):

- Pool fire;
- Flash fire;
- Tank fire;
- Jet fire;
- VCE (vapour cloud explosion);
- Toxic cloud;
- BLEVE (boiling liquid expanding vapour explosion); or
- Soil/air/water pollution.

A point to note is that these events may occur in:

- Process units;
- Storage units;
- Pipe work;
- Loading/unloading facilities; or
- On-site transport of hazardous substances.

The hazardous substances may be present under various physical conditions (temperature, pressure, aggregate form). The safety report must demonstrate that, of these possible scenario elements, the relevant scenarios were chosen. The selection may follow strategies such as:

- Event likelihood;
- Consequences; and
- How comprehensive or representative the scenario is.

Initiating causes

For some types of scenarios it is necessary to consider the causes of the potential accident, like:

Operational causes are determined according to the methodology chosen, at least the following should be considered:

- Physical and chemical process parameters limits;
- Hazards during specific operation modes (i.e., start up/shut down);
- Failure of containment;
- Malfunctions and technical failures of equipment and systems;
- Knock-on effects from other equipment;
- Faults of utilities supply;
- Human factors involving operation, testing and maintenance;
- Chemical incompatibility and contamination; and
- Ignition sources (electrostatic charge, etc.).

Internal causes

Internal causes may be related to fires, explosions or releases of dangerous substances at installations within the establishment which the safety report covers and affecting other installations leading to a disruption of normal operation. (e.g. the fracture of a water pipe in a cooling tower, thus leading to a disruption in the cooling capacity on site).

External causes

External causes to be considered are mainly:

- Impact of accidents (fire, explosions, toxic release) in neighbouring establishments (Domino effects) and other third party activities and transportation networks;
- Transportation of dangerous substances off site (i.e. roads, railways, pipelines, shipping, oil or gas ports, air, etc.);
- Functional interdependence with the installations of neighbouring activities;
- Pipelines or other common utilities, Transport networks and centres (public roads, railway lines or airports close to the installation and/, or establishment; and
- Natural hazard sources like precipitation (extreme) (rain, snow, hail), wind, thunderstorms, lightning, floods, landslide, seismic activity, etc. (Natural Hazard Triggering Technological Disasters - NATECH).

Plant security

The effect of possible intentional acts that could affect plant safety should also be taken in the proper consideration. In a first screening step the possibility of intentional act are assessed. If this gives a positive result a full security analysis may be carried out. For screening and security analysis see e.g. German Guideline on Combating Interference by Unauthorised Persons[6].

6 SFK-38 Combating Interference by Unauthorised Persons, http://www.kas-bmu.de/

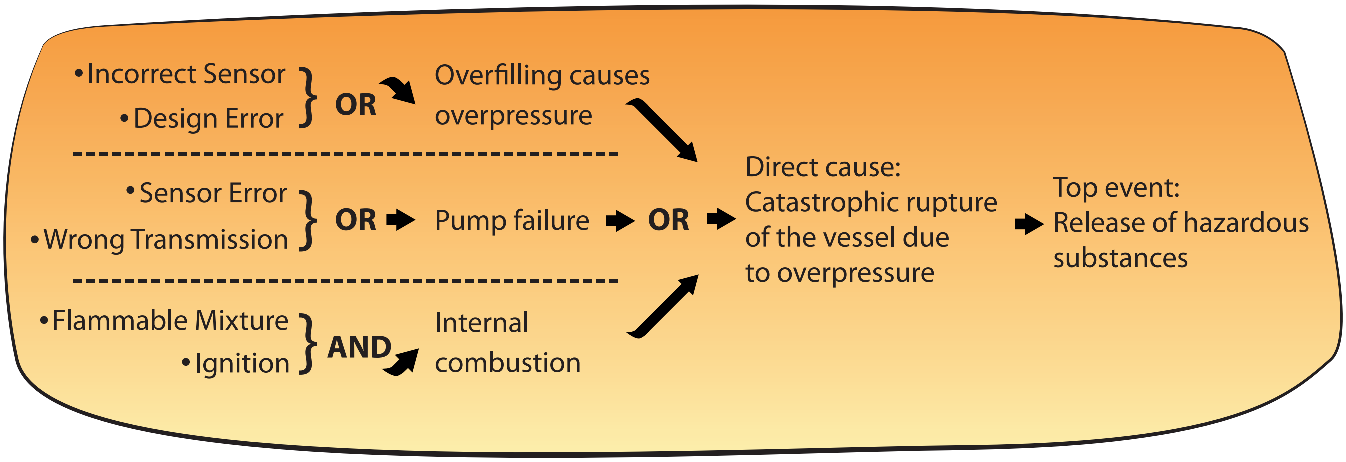
Other accident causes

Other accident causes may be related to design, construction and safety management; these causes may concern also plant life cycle management, commissioning, decommissioning, equipment or process modifications, work permit system, maintenance, etc.

The conditions under which accidents occur

The 'top event' and the related causes constitute what is often called the "fault tree" or left- hand side of the "bow –tie" (see figure 4). In the figure 5 below this is shown in a schematic form:

Figure 5 Example of fault tree



The example shows a hypothetical "unrestricted" event. To decide on the scenario likelihood usually the efficiency of technical measures and human intervention ('measures') is taken into account.

Q 4.8 Is it outlined which measures have been implemented for loss prevention of the identified major accidents?

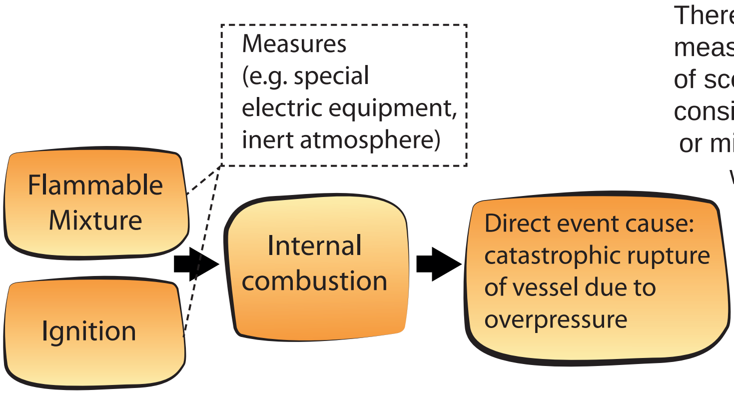
Q 4.14 Does the probability of the major accident scenarios comply with the preventive measures?

An overall typology of measures could distinguish between those being (functioning) permanent, independent of the state of the process (all passive measures are permanent), and those being activated by the state of the process. The latter measures can either disable actions (interlock systems, preventing certain actions from being performed, e.g. safe operating envelopes for processes) or initiate one or more actions (e.g. opening of a relief valve or emergency shut down).

Activated measures always require a sequence of detection – diagnosis – action. Using hardware, software and human action as building blocks alone or in combination can perform this sequence.

The following figure 6 shows the schematic role of measures in the fault tree.

Figure 6 Schematic role of measures in the fault tree



A more detailed classification can be specified as follows:

- Passive hardware measures (no actuation mechanism required to fulfill its safety function; e.g., a retention bund round a tank, enclosure designed for total containment or with elevated stack); passive hardware measures have a relatively high level of availability;
- Active hardware measures require external source of energy to fulfill the safety function but operating without human intervention, e.g. automatic shutdowns, emergency cooling systems;
- Passive behavioural measures behaviour consisting of staying away from defined areas, refraining from touching or modifying parts of the plant, and this behaviour alone constitutes the measure without any hardware being involved e.g. safety distances, exclusion areas, no smoking area;
- Active behavioural measures behaviour consists of acting in defined ways whilst interacting with the dangerous part of the plant, and this behaviour alone constitutes the measure without any hardware being involved, e.g. evacuation in case of toxic or fire alarm, safe working methods when handling chemicals.

There is no common approach concerning which type of measures should be taken into account for the selection of scenarios and passive measures are almost always considered to be effective. In principle, active hardware or mixed measures may be taken into account as well, when demonstration is made through the safety report of good effectiveness and reliability. The decision may also relate to a legal framework that mandates the presence of certain measures. Human intervention (=behavioural measures) as the only means of protection usually is not given credit in this respect.

Q 4.9 Are the endpoints for toxic effects, heat radiation and pressure peaks described?

Q 4.10 Is the physical and chemical behaviour under normal conditions of use described?

Q 4.11 Have the potential undesired side reactions and products been identified?

Q 4.13 Is the calculation of the scenario dimensions done by approved models?

Q 4.15 Are the choice of limitations for toxic effects, heat radiations and pressure peaks given?

Q 4.16 Are the assumptions for presence of possible victims understandable and reasonable (ref. to scenarios)?

Q 4.18 Are the accident parameters given to calculate the scenarios by another party?

Assessment of the extent and severity of the consequences of identified major accidents

The assessment of accident consequences to people and the environment is essential in several steps of the overall risk assessment process and the safety report should summarise and document the conclusions of this assessment step.

Within a safety report, the consequence assessment will be used for two different types of decision processes:

- Consequence assessment constitutes an indispensable part of the systematic risk assessment aimed at the identification and establishment of technical/organisational safeguards to prevent major-accident hazards and to mitigate accident consequences, or to evaluate the efficiency and adequacy of the protective measures taken;

- Consequence assessment also describes the outcomes of specific accident scenarios selected in order to provide information especially for external emergency planning and land use planning around establishments. The results of this assessment should be presented in the form of “maps, images and descriptions”.

For the first type of process, the assessment may be carried out in a qualitative way only and without any calculation (in the strict sense, not in the meaning of “estimation”) of effects. Such an approach is often adopted for assessing the adequacy of existing or proposed measures or safeguards; for this type of approach only in exceptional situations (e.g. if the measure is very expensive) would a more comprehensive consequence assessment be considered.

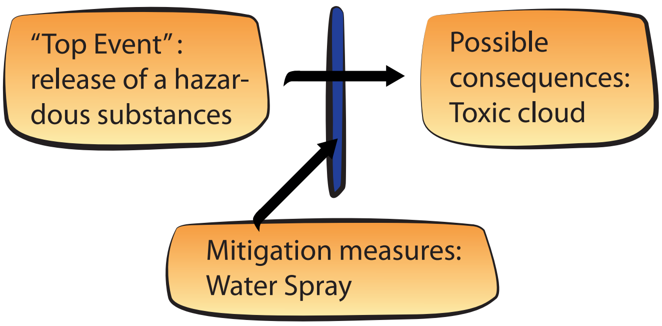
If the consequence assessment has the character of a more complete calculation it requires a procedure that is some form of detailed modeling. In general, modeling the consequences of major accidents is based on several inputs such as for instance:

- The physical and hazardous properties of the substances in question (flammability, toxicology, etc.);
- Emission potential (thermal radiation, overpressure);
- Release characteristics (amount, phases, conditions etc.); and
- Weather conditions.

The foundation of modeling of this type is again a specific set of reference scenarios. In this case it is the right side of the “bow-tie” that serves as the starting point. For this assessment measures to limit the consequences (= mitigation measures) are taken into account (and mitigation measures may also be identified as a result of the assessment).

The following figure 7 shows this part of the bow-tie, usually called the “event tree”.

Figure 7 Event tree



Results of this modeling exercise are expressed in terms of severity of (potential) impact. For safety reports, potential impact is commonly defined in terms of human health, although relative property or environmental damage may also be presented.

Two main approaches are used to measure severity of impact:

- The damage Probit curve;
- Fixed damage thresholds.

The Probit curve approach considers the impact on a vulnerable receptor (e.g. a human being) over time and relates this impact to a probability that certain damage (physiological or material) will occur, given a specific level and time of exposure. In contrast, the fixed threshold approach links specific impacts, such as the onset of death or serious injury, to specific level and time of exposure. The thresholds are usually established, using probabilistic methods, as levels at which or above which particular effects are expected to occur. Threshold levels for accidental airborne releases of toxic substances, static or dynamic thermal radiation, and overpressure have been calculated by various expert groups.

An overview is given in e.g. German report SFK-GS-28[7]. Their settlement is a matter of convention in every particular community.

For the purpose of safety report scenarios the end-points indicated in table 2 may be used.

7 SFK-GS-28 Toxicological data for scenario endpoints, http://www.kas-bmu.de/

Possible endpoints to be used in scenarios

Hazard	Endpoint value
Toxic load	ERPG - 2 or AEGL-2
Heat radiation	1.6 [8] or 3[9] kW/m2
Explosion pressure	0.1 or 0.05 bar

Description of technical parameters and equipment used for the safety of installations

In connection with the risk assessment the technical parameters, the equipment used for safety and their fitness for purpose need to be justified. This activity is usually performed together with the identification of scenarios and the initiating events.

The safety report should discuss general criteria assumed (i.e. best available technology, good engineering practice, qualitative or quantitative risk criteria), should give the reason why a method of presentation has been selected over and above other possible options, and in particular should describe:

- The criteria used to decide the degree of redundancy, diversity and separation required for the prevention, control and mitigation measures;
- The reliability of components and systems and the efficiency of organizational measures;
- The functional calculations needed to confirm the capability of the measures to cope with the design-basis accidents (design criteria and load assumptions according to the relevant good engineering practice; time and order in which the measures become effective in relation to the process/accident evolution and the man-machine interface etc.);
- Feedback from measures to the system as a whole; and
- Declaration of compliance with relevant national regulations and relevant codes of practice.

Prevention, control and mitigation measures of a hazardous installation may include:

- Process control system including back ups;
- Fire and explosion protection systems;
- Devices for limiting the size of accidental releases, e.g. scrubbing systems, water spray;
- Vapour screens, emergency catch pots or collection vessels, and emergency shut-of valves ;
- Alarm systems including gas detection;
- Automatic shut down systems;
- Inerting systems;
- Fail-safe instrumentation;
- Emergency venting including explosion panels;
- Fast shut-down and other emergency procedures; and
- Special precautions against unauthorized actions related to the plant security.

8 e.g. Germany
9 e.g. Austria and European Commission Joint Research Centre

Further details may be required of the safety relevant sections in accordance with the actual risk assessment. This description should thus include a substantial amount of data significant from the process engineering and technical safety standpoint; and cover the safety systems as well. This may include:

- Flow charts and Piping and Instrumentation (P&I) diagrams[10];
- Flow patterns and machinery/equipment needed in the processes; inventories and key dimensions of the containers and pipes shall be available if relevant;
- Process conditions, i.e., pressure, temperature, concentration (their safe operation ranges) and any relevant thermodynamic and transport properties at the successive steps of the process such as:
  - → Normal and maximum flows, consumption of reactants, production of intermediate/end-by-products (e.g. overall and substance mass balances);
  - → Average or typical quantities normally or accidentally possible to be present, stored or in process;
  - → Formation conditions of by-products and unplanned accident products;
  - → Conditioning of the final products;
- Instrumentation, control/alarm and other safety systems;•Relevant qualitative and quantitative information on energy and mass transport in the process, i.e. material and energy balance:
  - → In normal running;
  - → In start-up or shut-down periods;
  - → During abnormal operations;
- Characteristic process conditions and substance state parameters (i.e., temperature/pressure / concentration/boil-off fluctuation etc.).

10 Please consider the generic character of this term; there are various levels of information provided by P&I-diagrams of which not all may be suitable for safety report purposes.

2.5. SCL limitation of consequences and mitigation

The safety report should also clearly include information which identifies any key mitigation measures resulting from the analysis that are necessary to limit the consequences of major accidents, namely:

- Description of the equipment installed in the plant to limit the consequences of major accidents;
- Organisation of alert and intervention;
- Description of resources that can be mobilised, internally or externally;
- Summary of elements described above necessary for drawing up the internal emergency plan; and
- It is very important that there is a clear link between the consequences of scenarios identified and the measures of protection and intervention to limit the consequences of an accident.

Following general questions from the checklist are covered by the explanations provided below, supplemented by some following questions which look for special critical points:

Q 2.5.1 Is the description of the equipment in the plant to limit the consequences of major accidents provided?

Q 2.5.2 Are the organization, responsibilities and procedures for emergency response described?

Q 2.5.3 Is the plan for training and information for personal and emergency response crews provided?

Q 2.5.4 Is the external equipment to limit the consequences of major accidents described?

Q 2.5.5 Is the activation of external emergency response and co-ordination with internal response described?

Description of equipment

A description of equipment installed in the plant to limit the consequences of major accidents should be provided. This list should include an adequate description of the circumstances under which the equipment is intended for use.

Q 2.5.6 Does the equipment of emergency response crews compare with potential hazards?

Organisation of alert and intervention

The organisation for alert and intervention should be adequately described. This description should include:

- Organisation, responsibilities, and procedures for emergency response;
- Training and information for personnel and emergency response crews;
- Activation of warnings and alarms for site personnel, external authorities, neighbouring installations, and where necessary for the public;
- Identification of installations which need protection or rescue interventions;
- Identification of rescue and escape routes, emergency refuges, sheltered buildings, and control centres;
- Provision for shut-off of processes, utilities and plants with the potential to aggravate the consequences.

Q 2.5.7 Has the identification of installations, which need protection or rescue intervention, been done?

Description of resources that can be mobilized

The safety report should contain an adequate description of all relevant resources, which will need to be mobilised in the event of a major accident. This report should include:

- Activation of external emergency response and co-ordination with internal response;
- Mutual aid agreements with neighbouring operators and mobilisation of external resources;
- Resources available on-site or by agreement (i.e., technical, organizational, informational, first aid, specialized medical services, etc.).

Q 2.5.8 Are the elements necessary for drawing up the internal emergency plan provided?

Summary of elements for the internal emergency plan

The report should include a summary of elements described above that are necessary for the preparation of the internal emergency plan to deal with major accidents, or for foreseeable conditions or events that could be significant in bringing about a major accident. It may be useful to include or refer to the internal emergency plan, which has been drawn up to comply with the regulations.

2.6. SCL Major Accident Prevention Policy (MAPP) and Safety Management System (SMS)

2.6.1 Major Accident Prevention Policy (MAPP)

The operator has to produce Major Accident Prevention Policy (MAPP) as a written document, which deals specifically with the overall objectives and general principles of the procedures for limiting the risk of hazardous incidents. The document should specifically include the following points:

- Formulation of a company policy, which states that the prevention of hazardous incidents and the limitation of the effects of hazardous incidents that, despite all efforts, do occur is a high priority in the company objectives;
- Presentation of the basic approach to implement this objective, for example in the form of guidelines, which are part of company policy.

Trust is one of the most important pre-conditions for an effective safety management system. Managers are therefore advised to draw up company policy and the accompanying guidelines in conjunction with staff. The employees' right of co-determination, which can be particularly valid in the case of working conditions regulations contained in the safety management system, must be respected. It is recommended that management signs the relevant documents. In addition to the company policies and any accompanying guidelines, MAPP must also state:

a. What risks of hazardous incidents are present in the establishment;
b. What provisions have been made for preventing these, or limiting their effects; and
c. In which way it is ensured that these measures are implemented properly.

The answers to a. and b. are supplied in other sections of the safety report, particularly in the installation-specific safety analysis. c. Refers to the presentation of the safety management system, which is dealt with in section that follows.

Q 2.6.1.1 Does the MAPP exist as a written document?

Corporate/company policies and guidelines

The operator should commit in an appropriate manner[11] that the prevention of hazardous incidents and the limitation of their consequences are part of the primary company objectives and have priority in the event of such an incident. The corporate policy is the basis for the measures outlined below. In larger companies, it may be appropriate to complement the corporate policy, which is usually formulated in rather general terms, with guidelines that show predominantly the company's strategy for achieving certain protection goals.

The corporate policy should not only make clear what the company is trying to achieve externally, but above all focus on this towards his own staff. Therefore it is recommended that staff, or staff representatives, are involved in the policy formulation process from the beginning, and that the policy's validity is confirmed by signatures of the company management.

Q 2.6.1.2 Does the senior management show commitment to the MAPP, e.g. through signature?

Q 2.6.1.3 Has the MAPP been communicated to the workforce?

Q 2.6.1.4 Is the MAPP communicated to contractors and third parties undertaking activities on site?

11 Either by including details in the written document, by referring to the relevant documentation, or by including the documentation with the written document.

Hazard potential in the establishment

The basis of all considerations is the identification of possible hazards. The regulations emphasize on major accidents (hazardous incidents). Basic details for the identification and evaluation of hazards are supplied in the notification procedure, which should be included as a copy. A reference on this document principally is possible as well.

In this section it should be clarified which hazards can originate in the establishment. To do this, the possible hazards should be specified and evaluated with regard to their relevance to safety.

The following factors in particular should be taken into consideration:

Geographical location

Here, particular attention should be given to any neighbouring residential areas, areas of particular sensitivity or interest and to factors specific to the location (earthquakes, floods, etc.).

Substances

A complete list of the dangerous substances and/or the relevant categories, specifying the quantity and physical form of each substance, is part of the notification procedure. In this notification, the operator should name and describe the substances and their properties which are particularly relevant for the target of preventing major accidents. In addition to information on the quantity involved and the methods of handling, of particular importance are physical properties, technical data regarding safety, reactions properties, information on their effects, and possible threshold limit or assessment values.

Type of process or activity

The main activities in the establishment already form part of the notification. In this document the operator has to describe which installations or parts of those installations and which activities are important under the point of view of major accidents. The following points are important when assessing the hazard potential and can be taken into account:

- The technical purpose of the establishments/installations including basic operations (physical or chemical transformations, interim storage of educts and products, handling of waste materials and waste gases);
- Characteristic process parameters of establishments/installations (pressure, temperature, physical conditions, reaction or kinetic parameters such as data on exothermic reaction enthalpies, autocatalysis, decomposition reactions, etc.) and their assignment to significant substance hold ups and mass flows. The Operators attention is drawn to the guidelines entitled "Recognizing and controlling exothermic reactions"[12];
- The size, layout, type, construction and design of the establishment, for example storage facilities or processing plants, which can be operated continuously or as batch processes. Another important aspect is whether the individual facilities are located in buildings, surrounded by enclosures or are open-air plants;
- Hazardous substances and their maximum quantities in each of the establishments/installations;
- Identification of the establishments/installations which are significant to safety, such as distillation columns, stirred reactors, furnaces, storage tanks, driers, pumps and pipes.

12 TAA-GS-05 produced by the Technical Committee for Plant Safety (Technischer Ausschuss für Anlagensicherheit) for evaluating the safety related aspects of exothermic reactions. Visit: http://www.kas-bmu.de/

Technical and organisational measures to prevent or limit the consequences of major accidents

In this section, the operator should explain the basic measures proposed to reduce and control the hazard potential described in the previous section, and to limit the consequences of a hazardous incident. These measures can be of technical and/or organisational nature.

Reference should also be made, if applicable, to other relevant documents, such as licences, permits. It is, however, strongly recommended that the operator makes clear in this section, which priorities are set in applying the safety policy[13] to meet the general obligations of the regulations, namely the prevention of hazardous incidents and the limitation of their consequences.

The following factors may be important when determining and presenting technical safety- related measures:

- Safety-related construction and design characteristics of installation components, such as the material used (e.g. steel, glass or graphite), as well as location and overall design of these components;
- Safety-related maintenance at the establishment/installation;
- State-of-the-art of safety technology, regulations, standards, guidelines, etc. which must be observed.

13 For example: "single failure principle", physical distance between the hazardous area and protected goods, inerting.

Measures to prevent, and limit the effects of events which could cause major accidents, may include:

- Process control systems to prevent excessive pressure or temperatures;
- Safe containment of hazardous substances;
- Safety valves;
- Measures to avoid explosive atmospheres (e.g. inertisation);
- Measures to avoid sources of ignition (for example, using electrical installations according to qualified, i.e. standardised, categories of explosion protection, grounding);
- Fire prevention measures;
- Defensive and constructional fire protection measures;
- Equipment of constructional explosion protection, such as rupture disks, explosion flaps and explosion suppression systems;
- Rapid closure devices;
- Spillage-collection facilities;
- Sprinkler systems;
- Gas detectors; and
- Water/steam curtains.

The structure of the organisational measures is based on the principles for a Safety Management System (SMS), detail see chapter that follows of this guideline.

In general, the technical and organisational measures of the operator have to provide the premises of meeting all legal requirements (laws, ordinances, accident prevention regulations, permits and legal conditions). This particularly includes measures, which guarantee that the operator's documentation is in line with the current situation.

In contrast to the description as required in the safety report does not require the operator to provide a detailed description of a safety management system. However, he should clearly describe the fundamental elements of his safety organisation. This is resulting in significant differences between the requirements for larger and smaller companies. The simpler an establishment's organisational structure, the less information needs to be included in the document.

2.6.2 Elements of Safety Management System (SMS)

A safety management system (SMS) is a set of activities that ensures that hazards are effectively identified, understood and minimised to a tolerable level.

In this sense, it may be regarded as the transposition of the general goals identified in the Major Accident Prevention Policy (MAPP) into specific objectives and procedures.

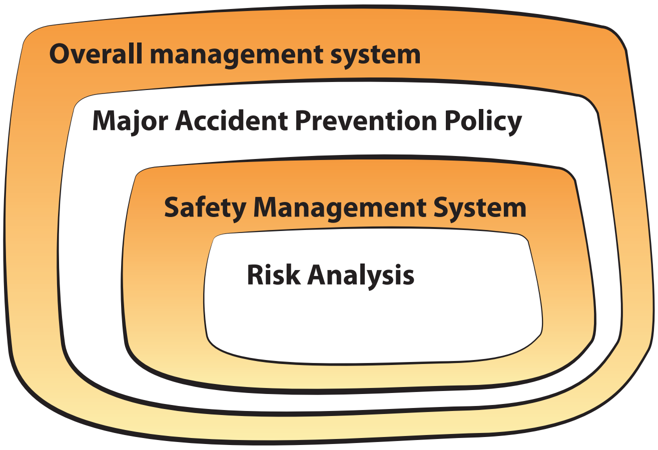
As safety reports address major accidents deriving from hazardous substances the safety management system is a subset of the overall management system.

In practice a SMS consists of a compilation of written principles, plans, formal organisation charts, responsibility descriptions, procedural recommendations, instructions, data sets etc. This does not mean that all of these documents do not have to be available in case of inspections but with respect to the safety report, most of them have the character of "underlying documents". Therefore for the purpose of a safety report, the description of the SMS is of a summarising character and should address the following subsets. It shall at least consist of:

- The major accident prevention policy (MAPP);
- An explanation of the relationship of the MAPP to the site-specific aims and safety-related objectives;
- Explanations in generic terms concerning how these objectives are met, especially with respect to consistency between the approaches followed and the measures taken.

The main relevance of the SMS is the setting of objectives for the concept of understanding the risk associated with the presence of dangerous substances and the selection of "lines of defence" – the risk analysis in a broad sense. This leads to the image below as shown below, where the MAPP is embedded in the overall management system of a company or site. The MAPP sets the general goals for the SMS, the latter serving as basis for the risk/hazard analysis (as far as it concerns major accident hazards).

Figure 8 Relationship of the different parts of safety documentation



Following group of questions from the checklist are covered by the description provided below:

Q 2.6.2.1 Is the organisation of the facility documented, the process safety related units roles and responsibilities clearly identified?

Q 2.6.2.2 Have processes for identifying and monitoring the process safety requirements on personnel and their roles and responsibilities been developed?

Q 2.6.2.3 Have processes for the identification of hazards and assessment of their risks been defined?

Q 2.6.2.4 Have processed been defined for the communication of the results from hazard identification and risk assessment?

Q 2.6.2.5 Do processes exist for addressing changes in documents as a result of changes?

Q 2.6.2.6 Do processes exist for developing internal emergency plans?

Q 2.6.2.7 Do processes / procedures exist for training / drills related to the internal emergency plan?

Q 2.6.2.8 Are there complete processes and procedures in place for monitoring compliance with defined requirements?

Q 2.6.2.9 Does an accident reporting mechanism exist?

Q 2.6.2.10 Is a process defined for regular audits?

Q 2.6.2.11 How does senior management review the MAPP and the SMS?

Fundamental principles

The SMS is part of the implementation of the MAPP.

With a view to a holistic management system it is useful to link the SMS to other existing or planned management systems in the company. If a holistic management system is already in place, the SMS should be integrated into it.

This allows the operator to take company specific factors into account, for example, the SMS can be integrated into existing managements systems which comply with e.g. ASCA-based systems, ISO 9000 ff, ISO 14001, EMAS, or can be built onto these, or can make use of other existing management structures. When implementing an installation specific SMS, certain factors can be necessary in order to ensure that implementation takes place throughout the whole establishment. For integration of all management systems see also [20].

The safety report must demonstrate in a way that can be verified that the SMS at least complies with the requirements and procedures given in the following lines. Obviously, the SMS also has to meet all the conditions necessary to fulfill all the legal requirements (laws, ordinances, accident prevention regulations, licences and legal conditions).

Organisation and staff

Establishing the principal responsibility of the operator

The operator, i.e. the management, is responsible for formulating the SMS and for ensuring it adheres to it . Responsibility can be delegated where appropriate, and if fully documented, particularly in the area of respecting and fulfilling legal requirements and company regulations. However, delegating responsibility does not release the management from a regular monitoring and up-dating of the SMS.
If the company management comprises several people, a decision must be reached on who carries this responsibility. This does not affect the management's overall responsibility.

Structural organization

The structural organisation of the SMS must be detailed, providing a clear assignation of tasks, functions and competences at the different levels of the company. Organisation charts and job descriptions are particularly suitable for this task.

At all levels of the company hierarchy, staff must know what exactly they are responsible for and what rules apply to the "interfaces" with the areas of responsibility of others. This means defining tasks, areas of responsibility (where necessary with local delimitation), and liability within the organisation, with particular attention given to safety and how to deal with the risk of hazardous incidents. When transferring such responsibilities, it is necessary to verify that the tasks can in fact be accomplished with the transferred authorisation.

Particular tasks, which must be covered by the SMS are:

- Respect of the legal requirements, including conditions arising from licences, authorisations and permits;
- Respect of internal safety, procedural and working instructions;
- Ensuring management instructions become establishment practice (e.g. safety principles);
- Selection of suitable staff for the job;
- Staff training and regular safety-awareness training, involving third party companies and their subcontractors in establishments;
- Monitoring behavior of both internal and contracting staff, to ensure that they are being safe;
- Immediate notification of any disruptions or identified hazards in their area of responsibility to the respective superior or any other person/body that may be responsible;
- Regular reports to the responsible superior regarding disruptions and hazardous incidents;
- Any lack of safety, which has been identified in the installation or in the organization, and the measures planned or already implemented to resolve this, and organization and maintenance of the SMS.

The relevant regulations should include line organisation and the organisation of safety officers, and should also go into detail about how they are to cooperate.

Establishment organization

Details must be given of the principle used in the SMS to deal with establishment processes in order to comply with the regulations (particularly establishment processes which cover more than one function or department). This covers establishment processes throughout the SMS, so detailed descriptions are not necessary in this section. However, the document must demonstrate that important establishment processes which are directly linked to the structural organisation are dealt with, in particular the question of delegating responsibility, which includes the constant availability of checking which function has been assigned to which management personnel.

Committees

Where committees are set up as part of the SMS, it is necessary to describe their composition and responsibilities, and also to address the issue of how they cooperate with one another and with other committees when necessary.

Qualifications and training

The document should explain how the needs of the various groups for training, specific qualifications (particularly in the case of staff who have a role in plant safety, such as the safety officers), and further training are met within the framework of SMS; what routine procedures have been introduced; the focus of these routines; what is done to ensure that staff attend training, and what record is made of their attendance. Where third parties and subcontractors are used, it is necessary to explain how the contracting staffs are included in the system of training.

Involvement of staff and where appropriate of third parties and subcontractors

Staff and their representatives should be involved in planning and implementing the SMS. The documentation must show in what way staff knowledge has been used in each part of the SMS, and how staff are involved in defining and introducing technical and administrative safety measures (in order to increase the effectiveness and acceptance of these measures). In addition, details are to be given of how to include staff suggestions and advice on safety- related matters.

Where co-determination is affected, employee representatives are to be involved. To increase the efficiency of the measures adopted, they should also be regularly included over and above the legally-required minimum.

The document must explain how the SMS provides for information on risks arising from certain sections of the establishment and safety measures to be passed on to temporarily employed staff, to outside companies and subcontractors if these are used. Procedures must be established which deal with coordination between external and internal staff (for example, release procedures and keeping records), and also with the areas of responsibility and work supervision. It must also explain how subcontractors can put forward suggestions and advise the operator on safety related matters.

Identifying and assessing the risk of hazardous incidents

The SMS must ensure that the potential for hazardous incidents is identified and that the probability and severity of these incidents is assessed. Suitable systematic methods should be used to achieve this. All sections of the establishment, and where appropriate external sources of potential hazards, are to be taken into account. Appropriate measures should be taken on the basis of the risk assessment. The safety examination for identifying and assessing risks should take place for all relevant planning and establishment stages of sections of the establishment, particularly installations. In doing this, both the establishment as defined by the normal operation and disruptions are to be considered. The SMS provides the more detailed definitions on which the identification and assessment of risks of major accidents are based.

If existing installations already have a system for safety evaluation and analysis, these can be used as a substantial part of the systematic identification and assessment of risks.

The company in question should establish in the SMS the general approach to complying with these obligations. The following points could be particularly significant when doing so:

- At what juncture or what times are procedures to identify and assess the risk of major accidents to be carried out?
- What methods will be used in each case and what will be examined?
- How are the results dealt with basically?

Examples of systematic methods for identifying potential risks are:

- PAAG or HAZOP procedures;
- “What if “ procedures;
- Checklists.

Systematic procedures for evaluating incident probability include, among others:

- Matrices (e.g., Zurich, Bützer);
- Indexing (e.g., Dow, MOND);
- Z-factor methods;
- Cause-consequence analysis;
- Analysis of course of events;
- Fault-tree analysis;
- Risk graphs as per German Industry Standards (DIN)19250;
- Metric method;
- In which way is up-dating of the methods ensured?
- Who carries out the examination?

It is advisable to always have a team carrying out the examination. There should be fixed requirements regarding the knowledge and skills of people employed to do this:

- How can staff be involved?
- How can findings and information from relevant breakdowns and hazardous incidents within the plant and at other plants be used in the examination?
- Where does information from audits and other monitoring come in?
- How are the results to be written updated?
- How are the results dealt with basically?

Particular attention should be given to:

- Action to be taken as a result of the findings;
- Responsibility for implementation;
- Follow-up;
- Informing staff, and where appropriate other operators and the authorities about the results;
- Measures to be taken in the area of training; and overall use/application of the findings.

Establishmental control (monitoring the operator)

General remarks

The SMS must ensure that for all safety-related procedures:

- There are written work and operating instructions;
- Staff are informed in writing or orally in an appropriate way;
- The work and operating instructions are exercised in practice where necessary; and
- Are monitored, to see whether they are reasonable and viable, and whether they are obeyed.

The inclusion of temporarily employed staff, outside companies and subcontractors should be taken into consideration when drawing up work and operating instructions. When drawing up this section of the SMS, it is important to remember that work and operating instructions are required under a number of other national regulations.

Work and operating instructions

Work and operating instructions can be related to the workplace, the activity, or the substances handled. According to context and validity, they should resolve the following issues in particular:

- Competence and responsibility;
- Start of the installation or facility;,
- Normal operation of installations, facilities and work materials;
- Handling of hazardous substances and preparations;
- Recognising disruptions, procedure for establishing the cause and both methods and responsibility for resolving the disruptions (return to normal operation);
- Fixed-term or special operating circumstances;
- Operation during maintenance and cleaning;
- Close down of the installations and facilities under normal conditions;
- Procedures for installation stoppages; and
- Orocedure in the event of operational disruptions and in emergencies, including emergency stoppages, first aid procedures and appropriate disposal of wastes.

Where there are extensive procedures and protection measures, it has always been worthwhile to expand work and operating instructions with checklists or step-by-step lists (where this is not provided for by a process control system).

The SMS has to ensure that work and operating instructions:

- Address all the relevant findings from the "Identification and assessment of the risk of hazardous incidents;
- Are amended or renewed each time processes, establishments or working arrangements are modified, or when pertinent legal requirements are altered;
- Even without this kind of external necessity, are regularly reviewed and updated, making use of operating experience;
- All the necessary information for the safe operation of the installation and facilities are available to staff in comprehensible form and language and
- Are available at all times to all staff directly or indirectly affected, and contain regulations for shift handovers in accordance with the legal requirements.

Training

The SMS should ensure that not only there is regular training on the content of the operating and working instructions, but special instructions are provided:

- Before new or modified installations, facilities or work materials begin to operate;
- Before new or transferred staff take up related functions;
- Before processes, establishments or working arrangements are modified;
- Before different substances or operating media are used;
- Before major disconnections, closures or other activities which are particularly hazardous;
- After incidents involving accidents, damage or emissions;
- When legal requirements have an effect on establishment processes; and
- In the event of any other changes which have to be made to the operating and work instructions, for whatever reason. In addition to specific instruction, further training activities can be useful, and even necessary.

Safety implementation of modifications

This section of the SMS includes both modifications in the strict sense of the term (planned, or necessary at short notice because of special circumstances), and the planning of new installations within the establishment. To cover the full establishment life of an installation, a procedure or a storage plant, this should consider construction and commissioning (as the meeting point between planning and establishment), maintenance and also closure and dismantling.

The SMS should address the following points in particular:

- The competences/responsibilities and procedure for the safe implementation of modifications in the broader sense of the term, as defined above, are to be established in writing;
- Defining which modifications have an impact on safety. For this purpose an evaluation procedure has to be defined. In doing this, it is advisable to consider all of the modifications in the context of the SMS at first, but to make the effort needed to prepare, approve and implement the modifications dependant on the relevance to safety. For example, a list of modifications could be drawn up, based on operating experience, which the manager, foreman or even the shift leader could authorise themselves;
- Ensuring that modifications during the operating period remain within the limits of the relevant permits, or that appropriate notice of modification or authorisation is given in time;
- Tracking the legal requirements and legislation as well as the state of the art with regard to potential consequences for the planning, establishment or decommissioning of installations, processes or storage facilities. Establishing areas of competence and communication channels;

- Establishing how the findings from the identification and assessment of the risk of hazardous incidents, of near misses and of unsafe circumstances can be taken into account when making new plans, modifications and decommissioning;
- Considering the possible consequences of modifications for general systems, such as pipeline systems for raw materials, energy supplies, disposal facilities and other infrastructural establishments and emergency organisations;

- Ensuring that when the establishment is constructed and taken in operation, the implementation conforms to the plans;

- Establishing safety measures and controls for implementing the modifications and for test runs;
- Providing information and training for staff, and where necessary, for external staff concerned or staff from adjoining installations;

- Documenting the modifications, including revising the operating documentation and any documentation available to the authorities;

- Monitoring possible consequences of the modifications and implementing corrective measures in the event of unforeseen harmful consequences for working conditions and environmental protection;

- Monitoring decommissioned installations until they are disassembled, including retaining expert knowledge regarding the installation and the substances present;

- Proper disposing of the remaining contents of the installation, of any objects created during the disassembly, and of the disassembled installation components.

Emergency plans

General remarks

Internal emergency plans are to be produced in line with the requirements set out in annex IV of the Seveso II guidelines. The information required for external emergency plans is to be provided to the competent authorities.

Staff is to be involved in drawing up the internal emergency plans. The public must be involved when devising external emergency plans.

Implementing the emergency plans

This section of the SMS contains a description of the procedure for identifying foreseeable emergencies, and for drawing up, testing and reviewing the internal emergency plans (alert and disaster control plans), and for the identification and passing on of information required from the operator for drawing up external emergency plans.

The SMS should determine the following, in particular:

- The procedure for identifying foreseeable emergencies, based on a systematic analysis (scenarios). This must ensure that all installations and storage facilities are systematically examined for potential technical, organisational or human failures, which could cause an emergency situation;

- The group of people who will carry out this analysis. Teamwork is recommended. In the event of insufficient internal expertise, outside resources have to be brought in;

- The different competences for carrying out the analysis, and for devising, testing and reviewing the resultant emergency plans;

- The procedure for devising internal emergency plans.

The following issues must be resolved:

- Areas of responsibility, including the procedure for handing over these responsibilities from one person to another;
- Participants (a team is recommended for this as well; staff must be included);
- Documentation;
- Updating documentation;
- Informing and training staff and other workers, and the internal hazard prevention organisations;
- Providing information to the external hazard prevention organisations and, where appropriate, those inhabitants who are affected;
- Identifying the safety equipment, resources, communication links needed by staff and by the crisis committee, if there is one.

Testing the emergency plans particular attention should be given to establishing the following:

- Responsibilities for setting up a plan for drills, and for carrying out and evaluating drills;
- Establishing those groups to be involved in the drills, with particular consideration of the staff, external assistance organisations and agencies, hazard prevention organisations and where appropriate, the inhabitants;
- Reviewing the emergency plans.

In doing this, the following issues must be resolved:

- Responsibilities;
- Intervals at which routine review takes place;
- The criteria for an immediate review (for example, based on the experience of drills and real accidents, a change in requirements or resources for external hazard prevention organisations, assistance organisations and agencies, changes in the law);
- Identifying, working on and conveying the information required for drawing up external emergency plans (Planning data).

To do this, the following issues must be resolved:

- A decision regarding co-establishment with the authorities and external hazard prevention organisations by identifying the information needed;
- Responsibilities for identifying, compiling and communicating this information to the authorities,
- Responsibilities for keeping information up-to-date;
- Responsibilities for maintaining constant contact with the authorities regarding this matter.

Quality assurance (monitoring the effectiveness of the SMS)

General remarks

Part of the SMS's role is to constantly monitor the efficiency of the policy, the SMS and the safety measures. The results of this monitoring are to be compared with the safety targets that had been set. In particular, this includes:

- An active monitoring of whether the plans and targets, which had been set were achieved;
- Whether safety measures are implemented so as to be preventative, rather than only being taken after hazardous incidents or accidents;
- Precautions to be taken to record disruptions to normal operation that could endanger the public and the neighbouring area, or where the findings could help to improve establishment safety;
- For notifying the operator as appropriate, and for investigating these accidents (reactive monitoring).

Active monitoring

Active monitoring covers all elements of the SMS. This includes in particular examining the construction and establishment of safety-critical sections of the installation; constant monitoring of installation safety and regular maintenance under safety-technological aspects; taking the required safety precautions to avoid operating errors; preventing wrong action by providing appropriate operating and safety instructions, and by means of training; and also monitoring behaviour to ensure that it is safety compliant.

The examination, monitoring, maintenance and possible reparations are to be documented.
In existing systems for recording suggested improvements, comments on how to increase safety should be particularly encouraged. If appropriate, this kind of system should be introduced.

Reactive monitoring, learning from accidents

An effective system for reporting all accidents and other safety-related incidents, including "near misses" is to be provided, and should be initiated in accordance with standardised requirements. An investigation procedure is also necessary, which must be capable of identifying not only the direct causes, but also all the fundamental failures, which led to the incident (root causes).

The SMS should contain precautions that give particular attention to disruptions in safety equipment (including establishment disruptions and organisational errors).

These must be investigated and analysed in an appropriate manner, and lead to measures to ensure that the experience gained from the disruption will be used in the future (including making the information available to the staff responsible).

The findings from accidents, near misses, unsafe circumstances and unsafe behaviour should be systematically recorded, evaluated and made available for the purpose of sharing experiences. If appropriate, organisational procedures must be refined under the light of the new experience. Those modifications are to be reviewed. These experiences should not be used within the company only, but should be made available to others. Vice versa experiences from other companies or open sources e.g. accident data basis[14] should be collected regularly and evaluated for the own need. The operator has to establish who is responsible for initiating the investigations and for taking remedial action in the event of a failure to observe SMS principles. In particular, a revision of the instructions or of the system should be considered, if this can prevent a repetition of the incident. It is necessary to ensure that relevant information gained through the monitoring activities is included as an important element of the audit and evaluation procedure (see below).

Monitoring and analysis (audit and review)

General remarks

In addition to the monitoring detailed in previous section, the operator should undertake regular reviews (audits) of his policy and his safety management system. The results of the review are to be evaluated. The policy and the safety management system are to be optimised on the basis of this evaluation.

14 See references [28] and [29] in literature part.

Audits

The audit aims to ensure that organisation, processes and procedures – regarding their definitions and their actual implementation – are in line with the major-accident prevention policy and the SMS, and also with both external and internal requirements. The audit's results should be used to determine what improvements should be made to the individual sections of the SMS and to their implementation.

In principle, it must be possible for independent third parties to carry out the SMS audit.

Audit plan

The operator should draw up and use an audit plan. This plan should be reviewed at appropriate intervals, and should contain the following:

- Details of the areas and activities to be audited;
- The frequency of the audit for each of the areas in question;
- Who is responsible for each audit;
- Details of resources and staff that are required for each audit, providing for the necessary expertise, independence and technical support (see below);
- The audit protocols to be used (what questionnaires, checklists, open and/or structured interviews, measurements and observations can be included);
- The procedure for reporting the findings of the audit;
- The follow-up procedure (using the audit to improve the SMS);
- Who is responsible for maintaining the audit system?

Requirements to be met by the auditors and their activities

The auditors and their activities are required to comply with the adopted national or international standards, (e.g. German Industry Standard (DIN) EN ISO 8402 and DIN ISO 10011 sections 1-3 are to be applied as appropriate) for instance:

- Unbiased execution of duties;
- Examination of whether safety-related legal requirements are being observed;
- Collection and analysis of sufficient relevant evidence to be able to come to a conclusion regarding the system being audited;

- Attention is to be paid to indications suggesting a factor, which may influence the audit findings and which may make further reviews necessary;

- Interviews are to be held with staff from various levels in the company hierarchy and with various functions, to review the implementation of the SMS and the appropriateness of the major-accident prevention policy, paying particular attention to the staff from areas of particular significance when evaluating the SMS, such as worker representatives and company representatives.

The following conditions must be met when carrying out the audit:

- Adequate documentation and other information must be available for evaluating the effectiveness of the SMS;

- Adequate examination of the system;

- Adequate staff training;

- Adequate participation by the staff/works council.

Review

The review is to be understood as an essential investigation by the company management, in which the major-accident prevention policy and all aspects of the SMS are to be reviewed at appropriate intervals in order to ensure that they are in agreement. The findings of the monitoring) and of the audit are to be specifically included. This review should provide information to determine whether the policy or the objectives themselves need to be modified. It should also resolve the issue of allocating resources for implementing the SMS and should take into account changes in terms of company organisation, technology, standards and legislation.

In particular the SMS should establish:

- Areas of responsibility within the management;

- Deadlines;

- Documentation, including the distribution of the report; and

- Action to be taken.

It is advised to carry out the review, the evaluation and the decision whether to continue with the policy and SMS at management level, and to document it.

3. Literature

No.	Title	Content	Language	Source
[1]	Guidance on the Preparation of a Safety Report to meet the Requirements of Directive 96/82/EC as amended by Directive 2003/105/EC (Seveso II)	Safety reports	English	http://mahbsrv.jrc.it/downloads-pdf/guidance-amended-by-2003-105-EC.pdf
[2]	Guidance on inspections as required by article 18 of the council directive 96/82/EC (Seveso II)	Inspections of SEVESO establishments	English	http://mahbsrv.jrc.it/downloads-pdf/in-specf.pdf
[3]	General guidelines for content of information to the public directive 82/501/EEC - ANNEX VII	Information of the public	English	http://mahbsrv.jrc.it/downloads-pdf/EN-info.pdf
[4]	Guidelines on a Major Accident Prevention Policy and Safety Management System, as Required by Council Directive 96/82/EC (Seveso II)	MAPP, SMS	English	http://mahbsrv.jrc.it/GuidanceDocs-SafetyManagementSystems.html
[5]	OECD Guiding Principles for Chemical Accident Prevention, Preparedness and Response, 2003		English	http://www.oecd.org/document/61/0,3343,en_2649_34369_2789821_1_1_1_1,00.html
[6]	A Checklist for Inherently Safer Chemical Reaction Process Design and Operation	Inherent safety	English	http://www.aiche.org/uploadedFiles/CCPS/Publications/S afetyAlerts/CCPSAlertChecklist.pdf
[7]	CCPS Guidelines on Process Safety Management: • Auditing Process Safety Management Systems • Implementing Process Safety Management Systems • Process Safety Documentation • Contractor and Client Relations to Assure Process Safety • Integrating Process Safety Management, Environment, Safety, Health and Quality • Process Safety in Batch Reaction Systems • Process Safety in Outsourced Manufacturing Operations Investigating Chemical Process Incidents	Diverse	English	http://www.aiche.org/ccps/webknowledge/PSM.aspx

[8]	Quantification of real risk, A element of a UNDP/GEF Danube regional project "Activities for Accident Prevention - Pilot Project -Refineries" (RER/03/G31/A/1G/31), September 2006 Checklists for Refineries: • Part 1: Safety management system • Part 2: Requirements on the structure and equipment of production plants	Refineries checklists	English	http://www.icpdr.org/icpdr-files/14141
[9]	Enforcement of Seveso II: An analysis of compliance drivers and barriers in five industrial sectors	Different sectors	English	http://139.191.1.51/typo3/index.php?id=78
[10]	Necessary Measures for Preventing Major Accidents at Petroleum Storage Depots	Petroleum storage	English	http://139.191.1.51/typo3/index.php?id=78
[11]	Improving majour hazard control at petroleum oil refineries	Refineries	English	http://139.191.1.51/typo3/index.php?id=78
[12]	ILO Guidelines on OSH&E	Various topics	English	http://www.ilo.org/safework/normative/codes/lang-- en/index.htm
[13]	ILO Workplace Fire Protection Checklist	Fire Protection	English	http://www.ilo.org/public/english/protection/safework/haz ardwk/fire/fir02.htm
[14]	R&D-Project "Technology transfer for plant-related water protection in Romania, Moldavia and the Ukraine"	16 Checklists for functional units in process plants	German	http://www.umweltbundesamt.de/anlagen/Checklistenmet hode/html/functional_units1.html
[15]			English	http://home.arcor.de/platkowski/Raffinerie/Site/
[16]	Checklist Nr. 12, Basic structure of safety reports concerning Hazards to water	SR	English	http://www.umweltbundesamt.de/anlagen/Checklistenmet hode/Check12_SafetyReport3.pdf
[17]	Checkliste zur Prüfung des Konzeptes zur Verhinderung von Störfällen	MAPP	German	Internal
[18]	SFK-GS-23, Guideline issued by the SFK Management Systems Working Group to explain the major-accident prevention policy in accordance with Article 7 in conjunction with Annex III of the "Seveso II" Directive	SMS & MAPP		

[19]	SFK-GS-24, Guideline issued by the SFK Management Systems Working Group to outline a major- accident prevention policy and a safety management system pursuant to Article 9 (1) a and Annex III of the "Seveso II" Directive	MAPP	English	http://www.kas-bmu.de/publikationen/pub_gb.htm
[20]	SFK-GS-31, Aid for integration of a safety management system pursuant to Annex III of the Hazardous Incident Ordinance 2000 within existing management systems issued by the SFK Management Systems Working Group	SMS	English	
[21]	KAS-7, Bericht des Arbeitskreises Texas City Empfehlungen des KAS für eine Weiterntwicklung der Sicherheitskultur Lehren nach Texas City 2005	Safety culture	German	http://www.kas-bmu.de/publikationen/kas_pub.htm
[22]	Met technical Evaluation System (M.E.S.) Manual, April 2002 FEDERAL MINISTRY OF EMPLOYMENT AND LABOUR ADMINISTRATION OF LABOUR SAFETY TECHNICAL INSPECTORATE CHEMICAL RISKS, Belgium	SMS, MAPP	English	http://www.employment.belgium.be/WorkArea/showcont ent.aspx?id=6642
[23]	SFK-GS-38 Leitfaden Maßnahmen gegen Eingriffe Unbefugter der ad hoc-Arbeitsgruppe Eingriffe Unbefugter	Security Analysis	German	
[24]	KAS-1"Richtwerte für sicherheitsrelevante Anlagenteile (SRA) und sicherheitsrelevante Teile eines Betriebsbereiches (SRB)"	Screening method	German	
[25]	Preparation of an Internal Emergency Plan- Instructions on Methods in accordance with Directive 96/82/EU (Seveso II Directive)	Internal emergency plan according to Seveso II	English	TÜV Ostdeutschland Sicherheit und Umweltschutz GmbH Safety Analysis and Disaster Protection Division Müggelseedamm 109-111 D 12587 Berlin
[26]	Land use planning guidelines in the context or article 12 of the Seveso ll Directive 96/82/EC	LUP	English	http://mahbsrv.jrc.it/downloads-pdf/LUP%20Guidance-2006.pdf
[27]	HAZOP: Hazard and Operability Studies	Description of method	English	http://slp.icheme.org/hazops.html http://en.wikipedia.org/wiki/Hazard_and_operability_study

[28]	Major Accident Reporting System (MARS)	Accident data	English	http://mahbsrv.jrc.it/mars/default.html
[29]	ZEMA - Zentrale Melde- und Auswertestelle für Störfälle und Störungen in verfahrenstechnischen Anlagen	Accident data	German	http://www.umweltbundesamt.de/zema/
[30]	US Chemical Safety Board – CSB	Accident data	English	http://www.csb.gov/
[31]	IAEA Manual for the classification and prioritization of risks due to major accidents in process and related industries	Risk Assessment method	English	http://www- pub.iaea.org/MTCD/publications/PDF/te_727r1_web.pdf
[32]	Fault tree analysis	Description of method	English	http://en.wikipedia.org/wiki/Fault_tree_analysis
[33]	OREDA – Offshore Reliability Data	Data	English	http://www.oreda.com/
[34]	EPA CAMEO, Collection of free software components for Accident scenario modelling	Free Software	English	http://www.epa.gov/emergencies/content/cameo/cameo.htm
[35]	DEGADIS Dispersion model	Software	English	http://www.epa.gov/scram001/dispersion_alt.htm#degadis
[36]	WHO Rapid environment and health risk assessment (REHRA)	Simple Risk Assessment method	English	http://www.euro.who.int/watsan/CountryActivities/20030 729_10
[37]	Event Tree Analysis	Description of method	English	http://www.fault-tree.net/papers/clemens-event-tree.pdf
[38]	“Water, Drinking Water, and Water Protection Substances hazardous to waters” Section of the Federal Environment Agency (Umweltbundesamt)	Classification system	English	http://www.umweltbundesamt.de/wgs-e/index.htm
[39]	Lees’ Loss Prevention in the Process Industries, Volumes 1-3 (2nd Edition), Edited by: Mannan, Sam	Monography	English	http://www.knovel.com/web/portal/browse/display?_EXT _KNOVEL_DISPLA Y_bookid=1470
[40]	“Green Book - Methods for determination possible damages to people” - TNO, 1992	Description of method	English	http://www.tno.nl/content.cfm?context=markten&content =product&laag1=186&laag2=151&item_id=445&Taal=2

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