Seveso Inspections Series - Volume 1
A joint publication of the European Commission's Joint Research Centre and the Belgian Federal Public Service of Employment, Labour and Social Dialogue, Chemical Risks Inspection Division

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NECESSARY MEASURES FOR PREVENTING MAJOR ACCIDENTS AT PETROLEUM STORAGE DEPOTS

KEY POINTS AND CONCLUSIONS

Federal Public Service of Employment, Labour and Social Dialogue

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MAJOR ACCIDENT HAZARDS BUREAU

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Contact information:

European Commission Major Accident Hazards Bureau, Community Document Centre on Industrial Risk (CDCIR) TP 361, Via E. Fermi, 2749 - 21027 Ispra (VA), Italy E-mail: cdcir@jrc.it Tel.: +39 0332 78 6218	Federal Public Service Employment, Labour and Social Dialogue Chemical Risks Inspection Division Ernest Blerotstraat 1, 1070 Brussels, Belgium E-mail: crc@employment.belgium.be Tel.: +32-2-233 45 12

Websites:
http://sevesoinspections.jrc.it
http://mahb.jrc.it
http://www.jrc.cec.eu.int
http://www.employment.belgium.be/seveso

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Mutual Joint Visit on Seveso Inspections
7 – 9 December 2005, Brussels, Belgium

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Disclaimer: The main purpose of the document is to provide a collection of knowledge and representing the state of practice in the EU in the expectation that it will aid Seveso inspectors and inspections programmes in reviewing and improving their performance as appropriate. It is understood that several approaches to controlling this type of major hazard may be equally effective and the document is not offered as a definitive assessment of all possible options in this regard. Moreover, the editors note that where information is provided on a practice applied in a particular country it has been provided with the view that this might be useful descriptive information. However, the document does not intend to represent a complete description of any one country's inspection practices since they often differ internally between regions and sometimes between competent authorities who share Seveso inspection responsibilities.

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The Chemical Risks Inspection Division gives special thanks to the other Belgian Seveso inspection services for their good cooperation in the organization of this workshop. Their participation in this Mutual Joint Visit on Seveso Inspections in Petroleum Storage Depots contributed significantly to the success of this workshop.

The Belgian Seveso inspection services are:

- **For the Flemish Region:** Service for the supervision of Major risk companies, Division Environmental Inspection, Department Environment, Nature and Energy;
- **For the Walloon Region:** Division for the supervision of the Environment, General Directorate of Natural Resources and Environment, Ministry of the Walloon Region;
- **For the Brussels Capital Region:** Environment Brussels;
- **For the Federal level:**
  - General Directorate Quality and Safety, Federal Public Service Economy, SMEs, Independent Professions and Energy;
  - Chemical Risks Inspection Division, Federal Public Service Employment, Labour and Social Dialogue.

Content

1. Preface

The inspection function has always been considered one of the most powerful and dynamic tools available to Member State authorities for enforcement of the Seveso II Directive. For this reason, the European Commission along with competent authorities responsible for Seveso II implementation have long held this area as a priority for EU level technical cooperation. There is a strongly shared commitment to continuing to work together to increase the effectiveness of inspection practices and to ensure a consistent approach with respect to interpreting Seveso requirements through inspections across the Member States.

The Seveso Inspections Series is intended to be a set of publications reflecting conclusions and key points from technical exchanges, research and analyses on topics relevant to the effective implementation of the inspection requirements of the Seveso II Directive. These publications are intended to facilitate the sharing of information about Member States' experiences and practices for the purpose of fostering greater effectiveness, consistency and transparency in the implementation of Article 18 of the Directive. The series is managed by the European Commission's Technical Working Group on Seveso II Inspections (TWG 2), consisting of inspectors appointed by members of the Committee of the Competent Authorities for Implementation of the Seveso II Directive (CCA) to represent Seveso inspection programmes throughout the European Union. The Technical Working Group is coordinated by the Major Accident Hazards Bureau of the European Commission's Joint Research Centre with the support of DG Environment.

This publication, "Necessary Measures for Preventing Major Accidents at Petroleum Storage Depots", is the first of the Seveso Inspections Series. The publication series is one of a number of initiatives currently in place or in development to support implementation of the Directive and sponsored at EU level. In particular, a prime source of content for publications in this series is the Mutual Joint Visit (MJV) Programme for Seveso II Inspections. Launched in 1999, the European Commission's MJV Programme was intended to serve as a vehicle for promoting technical exchange among Member State Seveso II inspectors. The aim of the programme was to encourage the sharing and adoption of best practices for inspections through a system of regular information exchange. The visits would be hosted by different Member States (hence visits would be "mutual") and targeted for working inspectors of other Member States (and thereby "joint" visits) charged with assessing compliance with the Seveso II Directive in industrial installations. The MJV Programme is managed by the Major Accident Hazards Bureau in consultation with the TWG on Seveso II Inspections.

Since 2005 the MJV programme has encouraged visits focusing on topics of specific interest for Seveso inspections as identified by the Technical Working Group. To the greatest extent possible, the conclusions and observations of inspectors participating in these workshops will be published as part of the Seveso Inspections Series.

The mission of the TWG is to identify and recommend actions to promote exchange of information and collaborative research among the Member States for improving the quality and consistency of implementation of Seveso II obligations within the Seveso inspection authorities. The results of these efforts may also be published separately on the Seveso Inspections website, or combined with MJV summaries in the Seveso Inspections Series.

For more information on Seveso inspections, please visit:
http://sevesoinspections.jrc.it. This site and the MAHB website (http://mahb.jrc.it) contain useful references to Seveso legislation, its implementation and related risk management and assessment projects.

2. The Mutual Joint Visit on petroleum storage depots

This Mutual Joint Visit (MJV) on Seveso Inspections in petroleum storage depots, held on 7 to 9 December 2005 in Brussels was the fourteenth visit in the MJV series. It was also the first MJV organised around a topic of specific interest. Previous MJVs had been centred on the implementation of Seveso inspections in the host country and related topics. The topic of petroleum storage depots was chosen as one of several important topics for technical exchange at EU level by common agreement of the EU Technical Working Group on Seveso Inspections, which is composed of representatives of Seveso inspection services in the Member States, Candidate and EFTA Countries.

The MJV was hosted by the Belgian competent inspection services in Brussels and co-sponsored by the European Commission. This chapter explains why the topic was selected and how the MJV was organised and structured to address it.

Storage and bulk handling of petroleum products

Sites for the storage and handling of petroleum products such as gasoline, diesel and gas oil, so called "petroleum depots" are widely spread over Europe. With the 2003 amendment of the Seveso II Directive (2003/105/CE), the number of such depots coming under the scope of the Directive increased significantly due to the lowering of the thresholds for the substances in question.

Compared to other Seveso installations of the petrochemical industry, the activities of these depots are "rather simple". A typical petroleum depot consists of unloading facilities for product supply (mostly by ship), storage in several atmospheric storage tanks and loading facilities for product delivery (mostly trucks). A country specific overview of how the depots were described during the MJV on petroleum storage depots is given in annex 1.

Because of the low technical complexity and the limited technical options, this kind of activity is easy to characterise by a "standard" or "typical" installation. Typical installations lend themselves very well for an exchange of experience amongst European Seveso inspectors and the development of common agreements on necessary measures for the control of major accident hazards.

Other particularities of this kind of facility are:

- They represent a significant hazard for man (gasoline) and the environment (gas oil);
- They are mostly operated by a very small staff, but still must comply with the Major Accident Prevention Policy (MAPP) or Safety Management Systems (SMS)[1] obligations of the Seveso II Directive;
- The larger depots often belong to multi-national companies, and hence can easily compare with requirements imposed on their Seveso-sites in different Member States;
- The smaller depots are often privately owned and often lack a formal management infrastructure;
- Loading of tank trucks is often done by the truck drivers themselves.

The Technical Working Group 2 on Seveso Inspections (TWG2) defined the control of major accident hazards in petroleum depots as one of its topics of interest, with the MJV programme as the vehicle for the exchange of information, practices and experiences.

Objective of the MJV

The MJV aimed to reach common agreement on the minimum necessary measures for a number of major accident hazards typical for a petroleum depot, on technical as well as on organisational and managerial level.

Approach of the MJV

The MJV started with an exchange of lessons learned from accidents in petroleum depots. The presentations of these accidents can be found in annex 2.

The remaining two days were fully devoted to discussion in small groups of (at most) eight inspectors. To facilitate the exchange of experience and the sharing of information between participants, discussion papers[2] where prepared and distributed to the participants prior to the meeting. One topic was the issue of inspection and enforcement of the requirements on the safety management system. This included a discussion on the differences between lower and upper tier depots as understood from an inspector's point of view. The reference site for the discussion of this topic was a small-sized gas oil depot, described as a typical Belgian gas oil depot in annex 1.

1 The Directive imposes a MAPP for lower tier sites and an SMS for upper tier sites.
2 The discussion papers are available at the JRC Seveso inspections website. See reference on the inside of the front cover.

Another two topics were the technical measures applied to guarantee a high level of protection against a number of major accident hazards presented by the storage and (un)loading of gas oil and gasoline.

A final topic was the inspection strategy for this kind of facility. The aim of this discussion was to exchange views and collect current practices.

The participants were free to choose the topic that interested them the most. The discussion groups were not bound to a time schedule for each topic, nor were they obliged to cover all topics.

The conclusions presented in this publication are the summary of the reports of all these discussion groups. The most important conclusions have been discussed and were agreed upon in a final plenary session.

The conclusions are divided into "Conclusions on the safety management system of a petroleum depot" and "Conclusions on technical measures to control major accident hazards in a petroleum depot". It is important to note that five of the six discussion groups spent most of their time discussing the safety management system. This fact explains why the conclusions on that issue are more extensive and elaborated.

During the course of discussion several questions arose, or observations were made, that could be important and of interest to many Seveso inspection programmes in the Member States. These issues are noted here as points of reference for the competent authorities as they seek ways to understand and to improve the effectiveness of their programmes, or alternatively, as possible areas of further exploration at European level.

A number of unresolved issues were identified and brought to the attention of the Technical Working Group on Seveso Inspections accompanied by a suggestion for further action. At its plenary meeting of April 2006, the working group decided to integrate these issues in its work plan.

A list of the participants in the MJV with their contact information can be found in annex 4.

3. Conclusions on the safety management system of a petroleum depot

3.1 The safety management system in general

Common Principles and Practices

Everyone agreed that an SMS (Safety Management System) is necessary in a petroleum depot. However, in verifying the SMS, a greater emphasis should be given to the quality of technical and organisational measures rather than the existence of a high level and sophisticated management system.

Several countries have specific requirements for SMS functions. Table 1 gives an overview of those mentioned during the MJV.

Table 1: Country-specific requirements for SMS functions

Country	SMS Functions
Belgium	All sites must have a safety advisor and an environmental co-ordinator.
Czech	Most sites are required to designate a safety officer. He/she makes a yearly report of safety activities.
Estonia	A safety advisor and an environmental expert are required by law.
Finland	It is expected that each establishment (both upper- and lower-tier) will have on staff an educated safety professional (with diploma or certified by exam) who is designated as the safety officer. The qualifications of the safety officer are an important assurance that he/she is competent to carry out his/her role.
Germany	There must be a designated officer responsible for Seveso II implementation on Seveso II establishments.
Italy	A safety officer for the site has to be identified and his/her role in the organisation specifically defined.
Poland	The occupational safety officer (depending on the number of employees), the transportation safety officer, and the fire prevention officer are considered necessary functions and should be clearly identified for each establishment.
Portugal	An inspector will expect that a safety officer will have been designated for the site. In the absence of this function he will examine whether a clear safety hierarchy exists, that is, where particular staff are specifically allocated essential safety functions.
Slovenia	There is an environmental expert required by law for the implementation of the Seveso and Integrated Pollution Prevention and Control (IPPC) Directives.

Sweden	A safety officer, per se, is not required but it must be clearly shown that the functions related to environment, health and safety responsibilities are effectively covered. The chief executive of the site will have been required to sign a yearly report detailing environment, health and safety activities. This information is also used during the inspection.
The Netherlands	No particular management structure is required by law.

General observations concerning enforcement of the SMS requirement

Discussions often reflected diverse opinions on the difficulty of enforcing the SMS requirement on small companies. Some participants felt that enforcement options were limited if they discovered that a company lacked an SMS. They were not sure what they could really do. In their opinion, there were few effective measures for influencing a small company with limited resources to adopt a functional SMS. However, other participants did not consider the SMS a difficult requirement to enforce.

Overall the main difficulty in discussing this topic was the lack of a general consensus on what the contents of an effective SMS should be.

Some participants thought it would be interesting to have examples of how each country verifies the good application of an SMS on site (e.g., a checklist of questions). In this regard, the Belgian system[3] was discussed in some detail and attracted some interest.

Elements of an SMS

The discussions produced the following list of elements that were suggested by one or more participants as important components of an SMS of a petroleum depot. This list should not be considered an agreed list or a list of "minimum requirements", but an indicative list of the types of elements that could belong in an effective SMS for this type of facility.

- Loading instructions for the (external) truck drivers;
- Instructions for ship unloading, including a checklist to be reviewed and completed before starting the unloading of the ship;
- Emergency instructions (who to call, what to do).
- Evidence of specific protocols for communications between the site manager and transport (e.g., ship or truck) operators;
- Written job descriptions specifically describing the functions of site personnel including safety-related responsibilities;

3 In Belgium the SMS of all Seveso sites (upper and lower tier) are audited using the "Metatechnical evaluation system" questionnaire. This questionnaire is freely available in English, French and Dutch on the website http://www.employment.belgium.be/seveso

- Evidence that a risk assessment[4] has been performed for all installations;
- Evidence of a specific procedure for management of change;
- A file denoting the maintenance and inspection history of the site, for example, with reports of previous tank inspections, technical controls (e.g., of the electrical installation), etc.;
- The existence of an active maintenance plan.

3.2 Major accident prevention policy

Common Principles and Practices

There was also some discussion about the value of the Major Accident Prevention Policy (MAPP) requirement itself and whether it was a meaningful requirement. Several participants considered the requirement important and appropriate for lower-tier establishments. Other participants were less convinced that the MAPP requirement was meaningful in safety terms. In particular, these participants did not feel that the difference between a MAPP and an SMS was very clear, mainly because (in their opinion) the Directive itself does not define the MAPP very well.

Participants differed considerable in their opinions concerning the contents, the size and even the necessity of a MAPP (despite the obligation in the Directive). Moreover, there was not full agreement on what should be the content of a MAPP. Various participants mentioned elements that might be part of a MAPP. The following list of these elements is provided for information (It does not represent either a comprehensive or agreed list.):

- The prevention policy (signed by the director of the company);
- The description of the organisation;
- The description of the activities of the site;
- A summary of the identified risks. The inclusion of this summary implies that a risk assessment has been made, but the analysis itself is too elaborate to include in the MAPP;
- The general training plan or strategy for all personnel (internal and external).

In the discussions representatives of some countries reported that they have implemented a stricter interpretation of the MAPP obligation:

- In Poland a small safety report is asked from lower tier establishments;

4 In this publication "risk assessment" stands for the identification and evaluation of hazards as meant in Annex III of the Seveso Directive.

- In the UK the MAPP is expected to make reference to other documents (e.g. risk assessments, training records and safe operating procedures), in line with the principles of Annex III, as evidence that the MAPP has been properly implemented. The extent of such additional documentation should be proportionate to the size and nature of the establishment.
- In Belgium the MAPP obligation is seen as a requirement to have an SMS for lower tier establishments. In practice all Seveso establishments are expected to have an SMS and are inspected with the same questionnaire (see footnote 3).

Participants generally agreed that there are parts of an SMS that should appropriately be applicable to all Seveso establishments.

Recommendations

It was suggested that the topic of enforcing the MAPP requirement including the advantages and disadvantages of requiring a MAPP vs. an SMS in lower tier establishments, could be useful to explore at European level.

3.3 Instructions for safe operation and maintenance

Common Principles and Practices

Written procedures

Participants generally agreed that written procedures are needed. Moreover, there should be no difference between upper- and lower-tier depots on this matter. The existence of written procedures is considered as a minimum and enforceable requirement.

Content of written procedures

The participants agreed that the following elements should be included in the written procedures:

- Loading/unloading procedures: These procedures must be posted at the truck loading area and included in the standard training programme;
- Emergency procedures: These procedures must be posted at the truck loading area and included in the standard training programme;
- Maintenance and other foreseeable hazardous activities: These procedures do not necessarily have to be posted. It was also noted that maintenance procedures are not always written in appropriate detail. This problem often occurs due to lack of experience in writing this type of procedures;
- A work permit system.

Moreover, for loading and unloading operations and for the work permit system the participants agreed on certain details that should be considered or included in these elements as described in the following paragraphs.

For loading and unloading operations the following considerations were agreed to be particularly important:

- Given that these procedures will be posted for the use of transport operators, the instructions should not be too long and should clearly describe the necessary actions, in a clearly defined order, and in appropriate detail;
- Procedures for ships vs. trucks should be different because the operations and equipment are different for each and the risks are not the same. Consequences of loading/unloading accidents involving ships are normally greater and operations and equipment (distances, systems, ...) are more complex than those of trucks;
- The possibility of writing and posting information in multiple languages should be taken into consideration;
- In most countries there is little attention to the interface between the ship and storage tank and the interface between the truck and the loading dock. Often each element (e.g., truck vs. loading dock) is under the jurisdiction of a different inspection authority and there is no formal mechanism for inspecting how the two elements work together;
- Procedures should be frequently updated and reviewed. If no changes are required, this fact should be noted and dated in the procedures document.

For a work permit system, the following items should normally be included:

- Statement authorising the work signed by the owner or other designated company official;
- Task description;
- Task risk analysis if needed (depending on the task);
- Personal protective equipment and other safety precautions necessary to perform the task safely;
- Equipment specifications (e.g., EX);
- Other necessary conditions that must be in place prior to starting work;
- Checklist: what actions are authorised (or explicitly not authorised) by the permit;
- Specific criteria should be defined for deciding which activities are considered "non-routine" and in particular which activities require a work permit. Most maintenance activities should be covered as non-routine. For ship unloading some participants suggested the use of the permit system as an extra control measure, on the basis of the high potential for loss of control during this operation.

The level of detail of all written procedures should be proportionate to the hazard and to the complexity of the depot (regardless of whether an establishment is classified as upper- or lower- tier).

In some countries, e.g., Poland, the inspector also reviews the content of the procedures and checks whether instructions are up-to-date. In other countries these responsibilities are considered as solely belonging to the operator.

3.4 Operation of a depot without supervision

Common Principles and Practices

In general, all participants expressed discomfort with the idea of completely uncontrolled access to depots for (un)loading activities. No countries allowed completely uncontrolled access, although there was not full agreement on how an "unattended" site should be defined. Most countries did not allow unsupervised access at all. Belgium, Hungary, Norway, Romania and the UK allow unsupervised access but only with driver training and an electronic badge or card access control system.

There was much discussion about the conditions under which a truck driver or ship operator could be permitted to perform loading/unloading activities on their own. All participants agreed that a training certification programme and an access control system should be required. The following additional safeguards were suggested during the discussions:

- Risk assessment by the operator of this specific condition;
- Dead man switch;
- Overfill protection;
- Use of sophisticated communication equipment to monitor access and loading/unloading operations remotely.

Additional observations

Some participants observed that contractors should not perform work unattended, even if a closed-circuit camera is in place to monitor the activity.

Recommendations

It was suggested that the conditions considered necessary in order to allow un(loading) activities without physical supervision of the operator would be a topic of specific interest for a future technical exchange.

3.5 Safety training of personnel and contractor safety

Common Principles and Practices

The participants agreed that safety training is required to assure that tasks at all levels are performed safely and that adequate competence exists to oversee and carry out important safety functions.

A training programme and a record of training are necessary to demonstrate that the safety training is ongoing and appropriate. A system for verifying the effectiveness of training (e.g., supervision or tests) should also be in place.

The participants generally agreed that specific training programmes are necessary for all individuals allowed entry to the depot. For each category of personnel on site, the training should be repeated periodically. Table 2 gives a summary of considerations for the training programmes according to personnel categories usually found in a depot.

Table 2 : Training needs for depots

Site personnel	A personally administered basic introduction must be given to all site personnel. The basic training should at minimum identify and describe all the hazards present on the site, explain general safety precautions associated with each site activity, and provide essential information on how to behave in an emergency. It is expected that more specific training will be required depending on the specific tasks assigned. A personal file with the individual training records for all employees is expected.
External truck drivers	Drivers are expected to be competent to perform their duties at the depot. Whether they stop frequently or infrequently at the depot is not relevant. All truck drivers using the site must be trained for the duties they are expected to perform.
Ship personnel	There is some agreement that also ship personnel should receive a safety introduction. However, in practice this objective may be difficult to achieve. Some participants suggested using a permit system to ensure that the proper procedures are followed.
Contractors	A system should be in place to ensure that all (sub)contractors are informed about the site safety standards. Training of contractor personnel, number of incidents involving contract personnel and internal audits of their activities should be logged. Certain types of difficult work may only be performed by specialist contractors and both the contractor and the operator should be aware of the limits of competence and capability.
Visitors	A quick basic instruction course should be provided to visitors with emphasis on the most important points, focused appropriately to their needs, which in most cases are quite simple (basic safety precautions, emergency procedures, etc.). The hazards at the depot should be identified and briefly described.

Verification

Participants suggested the following techniques for verifying the performance of the training programme:

- Spot check (especially on contractors and new personnel) based on a policy and instructions;
- In larger depots/more complex situations, it may be possible to make more formal and frequent checks and audits;
- The permit system is a part of a performance check (i.e., an audit that verifies that permits are being followed properly);
- Also inspectors should verify the competence of depot personnel through interviews (e.g., in Sweden this verification is standard practice).

Language problems

Several participants mentioned the problem of different languages in relation to the training of truck drivers, ship personnel and contractors. Problems and practices seem to differ from country to country. The following issues were highlighted in particular:

- Communication with transportation personnel has become more complicated by the increasing number of trucks and ships coming from Eastern Europe. Communication is difficult or not possible because there is no common language between the depot operator and the truck/ship personnel;
- Similarly, communication difficulties with contractors due to lack of a common language arise more frequently especially during major shutdowns;
- Some countries (e.g., the Netherlands) require that operators identify and address language problems that could interfere with effective safety performance.

Additional observations

Participants also raised the following issues of interest that were not, however, debated extensively, but are noted here for the benefit of inspection authorities:

- Should the training records of all truck drivers be available on site or not?
- In some countries the truck driver is not asked about his/her ADR[5] license. Most probably in these cases the operator is not checking that the ADR licences of truck drivers stopping at the site have not expired.

5 European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR is the abbreviation of " Accord européen relatif au transports international des marchandises Dangereuses par Route")

3.6 Management of change

Common Principles and Practices

The participants agreed that the elements in the following list should be part of the Management of Change (MOC) process of all petroleum depots. This list is composed of the elements of MOC discussed during the MJV. However, it is noted that participants were not particularly resolved concerning accepted practice for implementing these particular MOC components. For example, the degree to which these practices should be formalised (e.g., depending on depot size and ownership) remains an open discussion point. Moreover, this list is not intended to be a complete list of all elements that should be in an MOC procedure.

Agreed elements of the MOC were as follows:

- "Change" and change actions that should be subject to MOC procedures are specifically defined. An itemised list of changes might also be included;
- Requirement to perform a risk assessment on any change;
- Records of these risk assessments should be available on site;
- Clearly defined responsibilities, procedures, and criteria for:
  - Assessing the impact of change;
  - Implementing recommendations resulting from the assessment;
  - Recording the outcome of the assessment and follow-up actions.
- A record of all changes must be available on the site.

In order to make an MOC possible it is necessary to have complete, up-to-date technical documentation (P&ID[6], equipment data sheets, …) of all installations, even for small and simple installations.

However the correctness of technical documentation is not inspected in a number of Member States.

In some countries, operators are required to conduct a proper MOC analysis when requesting a permit change from the authorities.

Country-specific practices, tools or techniques

Some countries use specific checklists to check the MOC. Organisational issues, technical issues and risk assessment practices are some of the categories covered by these checklists.

6 Piping and Instrumentation Diagram

Additional observations

Over the course of discussion, the following important points were raised by some participants:

- It is often the small companies that tend to underestimate the importance of MOC;
- MOC practices should take into account activities allocated to contractors. Contractors for relevant tasks should be trained on MOC procedures;
- A pre-requisite for effective MOC is that changes are notified in a timely fashion. For this reason, operators should generally demonstrate that technical information is kept up to date.

Recommendations

It was suggested that minimum MOC requirements for SMEs[7] would be a topic of specific interest for a future technical exchange.

3.7 Identification and documentation of major hazards

Common Principles and Practices

Discussions on risk assessment for petroleum storage depots revealed that Seveso inspectors apply and examine risk assessment concepts in their work in quite diverse ways throughout the EU. In many cases, it appeared that inspection authorities were still exploring how to best apply and examine risk assessment approaches in their inspections.

Nonetheless, a few points concerning the use of risk assessment to manage risks at petroleum storage depots were agreed:

- A risk assessment should be performed on all installations, even in lower-tier depots;
- The responsibility to organise risk assessments should be clearly defined;
- The detail required for an effective analysis depends on the complexity of the site and specific factors, such as the size of the company, volume and types of substances stored, etc.;
- For a small depot there are often only a limited number of scenarios that are applicable and they are usually rather easy to identify.

7 Small and Medium Enterprises

A few common principles concerning risk assessment techniques were also identified:
- The choice of technique is up to the operator;
- Belonging to a multinational/group can influence the choice of technique;
- If the depot does not have the necessary expertise, external support is recommended.

Country-specific practices, tools or techniques

- In some countries quantitative risk assessment (QRA) with numerical acceptance criteria is mandatory in the licensing procedure;
- In Finland the same risk assessment requirements apply for Seveso and non-Seveso gas oil depots (100 to 2500 tonnes);
- Also the Netherlands, Germany and Italy have specific requirements for "near Seveso" establishments;
- In some countries the safety report is used as a way to inspect the risk assessment;
- Countries seem to take account of a site's risk assessment procedures in a variety of different ways. Several countries appear to use one or more of the following strategies:
  - The risk assessment situation is reviewed in connection with the licensing procedure;
  - External experts are hired to provide an independent evaluation of the risk assessment;
  - The risk assessment review is incorporated in the inspection process;
  - A summary of the risk assessment must be available for the authorities to review if requested (e.g., as part of the MAPP).

Additional observations

- A wide range of definitions of the term "risk assessment" are currently used by participants in the context of Seveso inspections;
- Allowing the operator the freedom to choose the risk assessment technique implies that the inspection service must have knowledge of all the current techniques in use and also must keep abreast of potentially new approaches. There was also little concrete discussion about recommended methods for inspection of the risk assessment process of a company, for example, in SMS procedures;
- Some participants indicated they have problems evaluating the quality of risk assessments because they lack the expertise and guidance to do so;
- Even if an evaluation is done, several participants indicated they lack acceptance criteria for the residual risk;
- Most participants seemed to be unresolved concerning the question of frequency and timing of revisions to the risk assessment. Only a very limited inventory of practices was produced during discussions;

- Participants had little concrete discussion about how enforcement should take account of deficiencies in the operator's risk assessment. Few solutions were offered for the situation in which an operator fails to demonstrate that a risk assessment has been performed.

Recommendations

It was suggested that the topic of risk assessment in general and in the context of Seveso inspections could be useful to explore at European level. Some interesting questions that could be discussed, include:

- What is meant by the term "risk assessment" from an inspector's point of view?
- What criteria and principles should be used to determine the frequency and depth of risk assessment revisions at a particular site?
- What are effective ways to verify and enforce risk assessment requirements?
- What kind of training, tools or strategies might be helpful to inspectors in evaluating the adequacy of site risk assessment procedures?

3.8 Maintenance and inspection programme

Common Principles and Practices

The discussion on inspection of the maintenance and inspection programme of petroleum storage depots was generally quite robust. Participants agreed on the following common principles:

- An inspection and maintenance programme must be available on site;
- The programme should at least include the following information (Note: This list is not intended to be a complete list of minimum requirements.):
  - an up-to-date inventory of items to be checked;
  - the established frequency of inspection and maintenance for each item;
  - an instruction of how to perform the inspection and who will perform it (site personnel or a third party);
  - a system for regularly recording inspection and maintenance activities;
  - identification of staff responsible for carrying out inspection and maintenance tasks.
- The programme should include (but not be limited to) the following items:
  - Fire fighting equipment;
  - Explosion protection equipment;
  - Tanks;
  - Valves.

- The selection of inspected items and those in need of maintenance, must be risk-based if not already legally required;
- Records or reports of inspections and maintenance tasks performed must be available on site. However, there were several different views expressed concerning the type and level of what should be in these reports. For example, some inspectors considered completed checklists important; other inspectors were satisfied with reports detailing nonconformities;
- The operator should demonstrate that follow-up actions recommended as a result of inspection and maintenance have been duly implemented;
- Although participants had different opinions concerning what constituted a "safety critical" element, they agreed that safety critical elements should be identified through the risk assessment process.

Country-specific practices, tools or techniques

The legally required inspection items and/or inspection frequency can vary considerably from country to country[8]:

- The basis for the legal inspection requirements in their country was not known by some participants;
- At least one country has no legal inspection frequencies;
- In some countries, only certain elements of an installation are subject to a legally imposed frequency. For example, not all countries have a detailed inspection requirement for flexible hoses, fixed pipelines or electrical equipment;
- Some countries allow a lower inspection frequency than the legally established rate for operators that implement a Risk Based Inspection (RBI) system;
- Countries differ concerning the types of organisations that are legally authorised to carry out particular inspection and maintenance tasks. Depending on the type of equipment, a country may allocate legal authority to one or more entities, such as a competent authority, a private accredited organisation, other third party experts, or the site operator himself;
- Some countries assume different expectations concerning maintenance and inspection standards for bigger vs. smaller depots;
- Some countries have established standard approaches to examining the adequacy of the maintenance and inspection programme. For example, the Netherlands and Belgium start with the evaluation of the reliability of equipment and safety loops.

8 In principle all work equipment that can undergo degradation should be inspected and/or maintained according to the Council Directive of 30 November 1989 concerning the minimum safety and health requirements for the use of work equipment by workers at work (second individual Directive within the meaning of Article 16 (1) of Directive 89/391/EEC) (89/655/EEC).

Additional observations

Various participants also cited different practices that they considered effective for inspecting maintenance and inspection programmes, notably the following:

- Seveso inspectors should request to review some specific inspection reports (randomly chosen). The inspector should review remarks and conclusions in the reports (to check quality, precision, etc.). Moreover, the inspector should also verify that the recommended follow-up actions have been taken and that all non-conformities have been resolved;
- For installations or components that must undergo daily inspections, the presence of a checklist, itemising each element to be checked, is good evidence that the daily inspection is routinely followed. This evidence of a systematic approach is generally a better indication of good practice than the simple presence of an itemised list of observed non-conformities (only);
- The staff should understand why certain tasks must be performed and in particular whether safety is a factor. If the objective is safety, the staff should also be made aware of the consequences of a failure. In smaller depots, this crucial point is often overlooked and it is often up to the inspector to bring attention to this issue. In particular, inspectors should probe the awareness of staff who perform safety-related tasks on these sites in order to identify this problem.

3.9 Emergency planning

Common Principles and Practices

Participating inspectors found numerous points in common concerning obligations and expectations surrounding Seveso emergency planning requirements.

In practice a formal internal emergency plan is required for every establishment in every country. This standard is generally imposed by specific legislation (mostly fire protection legislation) and covers a wide range of establishments in which Seveso establishments are included.

The risks associated with upper-tier establishments also should be considered in the external emergency plans prepared by the authorities. Most countries do not require that external emergency plans account also for hazards present at lower-tier establishments. However, lower-tier hazards are often addressed in the general intervention plans of local fire brigades.

The emergency plan is usually based on scenarios. These scenarios should consider all environmental, health and safety issues. Some scenarios require specific intervention material and equipment, e.g., foam, floating barrages.

The emergency plan should include (but not be limited to):

- a description of all reference scenarios, based on risk assessment;
- the intervention strategy for each scenario;
- links to relevant codes and good practices;
- site plans identifying key locations and areas where hazardous materials are present;
- an inventory of intervention equipment and manpower available;
- other information of importance to emergency services.

The emergency plan must take into account night and weekend conditions that might require additional or different measures. For instance, a minimal staffing requirement may be necessary.

Inspectors should seek assurance that the measures foreseen in the emergency plans are appropriate. It is generally not possible for the inspector to evaluate the adequacy of individual measures. Rather, the inspector should seek evidence that emergency plans have been approached thoughtfully, using appropriate expertise and experience, and tested on a regular basis. Proof of good communication with staff about emergency measures and regular emergency response exercises are examples of this kind of evidence.

Emergency plans can vary widely in scope depending on the staffing and intervention equipment of the depot. It is important to have a realistic emergency plan.

Emergency plans must be updated periodically although participants did not agree on any particular frequency. It was mentioned that updates could be combined with three-yearly exercises.

For additional assurance, inspectors should discuss emergency plans with fire brigades. The fire brigades often can confirm whether the site is appropriately prepared to implement the measures foreseen in the emergency plan. For example, they can provide information on the equipment, materials, knowledge, experience, and manpower available to the site for immediate use in case of an accident.

All site personnel and other personnel that are not direct dependents of the operator (e.g., truck drivers) should be trained on the emergency plan.

An emergency response exercise should be scheduled at least every three years. Exercises are important for observing, and correcting as necessary, the reaction of individuals when a dangerous situation really occurs, and testing other logistical elements of the plan. Terminal operators should be trained appropriately to respond to emergency situations, for example, by following specific courses similar to the fire brigades. Training should include a simulation of conditions during night and weekend hours.

All exercises should be followed by a debriefing, in which all actions and outcomes are reviewed. Lessons learned should be discussed and incorporated into follow-up actions.

Inspectors should pay particular attention to response times of external intervention services and whether expectations have been tested in training exercises.

Country-specific practices, tools or techniques

In some countries it is difficult to obtain written advice and reports following exercises from fire brigades. Within these countries formal de-briefings following an exercise do not often take place.

In some countries a depot must have an internal fire brigade because of specific legislation. In other countries workers must have specific fire fighter training.

In most of the countries there are also specific labour regulations requiring regular evacuation exercises (usually on a yearly basis).

Some countries have specific requirements for a maximum intervention time for the public fire brigade.

3.10 Incidents and accidents

Common Principles and Practices

Discussions about accident reporting and follow-up in petroleum storage depots were fairly generic.

There was an agreement that all depots, including lower-tier, should have an internal accident and incident reporting system. This system should also report near misses. All these cases should be investigated to learn the lessons from them.

Although most countries have specific laws that require accident reporting, in addition to the Seveso requirement, most participants felt that there is an under reporting of accidents and incidents to the authorities.

One reason may be that most Member States lack a clear definition of what is meant by accident, incident, and associated terms. Only the definition of major accidents that have to be reported to the European Commission is clear because the criteria are defined in Annex VI of the Seveso II Directive.

Country-specific practices, tools or techniques

Some Member States maintain accident databases (e.g., Germany, Poland, France), but they are not often used to obtain lessons learned to improve prevention and mitigation measures.

In Sweden most companies have a reward system that promotes the reporting of near misses by their employees.

3.11 Audit and review

This topic was not discussed very extensively at the MJV, in part, because there was considerable confusion about the meaning of the term "audit".

Recommendations

It was suggested that Member States should arrive at a common view on what is meant by the term "audit" in relation to the Seveso II Directive.

4. Conclusions on technical measures to control major accident hazards in a petroleum depot

Introduction

Next to the safety management system, the other main discussion topic of the MJV centred on the technical measures for controlling major accident hazards at a petroleum depot. The aim was to facilitate discussion among inspectors on what measures are judged as "necessary" to guarantee a high level of protection for man and the environment as the Seveso II Directive demands.

Due to the differences in types of hazards present at gas oil vs. gasoline depots, the topic was split into two: "technical measures for gas oil depots" and "technical measures for gasoline depots".

The risk analysis and documentation tool developed by the Belgian Inspection Authorities, PLANOP[9], was used to create a basic list of potential technical measures as a platform for discussion[10]. Participants in this discussion were requested to evaluate these measures in terms of their effectiveness in controlling major accident hazards, at gas oil storage installations and gasoline storage installations and their relative effectiveness to other possible measures.

Discussion

Only one of the six discussion groups started with the topic of technical measures and more specifically with technical measures for gas oil installations.

9 More information about the PLANOP programme and how to read the PLANOP documentation is given in Annex 3. PLANOP was used to draw up a number of Belgian inspection checklists, you can find them in Dutch and French on http://www.employment.belgium.be/seveso.

10 The discussion papers are available at the JRC Seveso inspections website. See reference on the inside of the cover.

Preventive and mitigating measures for the following loss of containment scenarios were discussed in detail by this group:

- leaking of the storage tank, due to:
  - filling above maximum design liquid level;
  - corrosive conditions.
- leaking or breaking of the temporary connection during ship unloading;
- leaking of a pipeline, due to:
  - liquid hammer;
  - exposure to corrosive conditions.

The other discussion groups primarily focused on SMS inspections, but also shared views about some technical measures for controlling loss of containment, specifically in relation to ship unloading of gas oil and gasoline. A few groups also touched on still other technical aspects during their discussions. However, it should be noted that technical discussions in these groups were much less elaborate than the SMS discussions.

The vast portion of discussions about technical measures focussed on gas oil installations. In fact, it seemed that all conclusions relative to gasoline installations were equally applicable to gas oil installations, and therefore, separate conclusions for the two types of petroleum depots were not necessary.

Conclusions

Even though only a limited number of major hazard accident scenarios related to petroleum storage and (un)loading were discussed during the MJV, it resulted in a general agreement on measures to be present and in some recommendations for good practice.

The conclusions have been integrated in the corresponding parts of the original preparatory discussion paper because the discussion paper, as prepared by the PLANOP risk analysis and documentation tool, described technical measures within the context of specific loss of containment scenarios. The MJV conclusions are highlighted within a shaded background.

The conclusions are summarised in this way because conclusions about the advantages and disadvantages of specific measures can only be interpreted in terms of the causes and consequences of specific scenarios and they are not valid outside this context.

You find these conclusions on the following pages.

A short explanation about how to read these technical documents is included in annex 3.

4.1 Storage tank

Event source 1: Filling above maximum design liquid level

Description:

Effect: High pressure

MJV conclusion: The three protection layers are all necessary:
M1 "Overfill protection",
M2 "Level measurement with high level alarm and operator action",
M3 "Check for sufficient free space in the tank before unloading a ship".
But some participants wondered whether it was possible or even desirable to enforce all of them.

Causes:

- High pressure
  - Filling above maximum design liquid level
    - M1 Overfill protection
    - M2 Level measurement with high level alarm and operator action
    - C1 Liquid flow to a tank with insufficient free space
      - M3 Check for sufficient free space in the tank before unloading a ship
      - C1.1 Filling of a tank from a ship

Release events:

- High pressure
  - M4 Overflow pipe
    - M5 Breather valve
      - Catastrophic failure of the storage tank
  - Leak at the storage tank

Measures:

M1 Overfill protection

The overfill protection is independent from the level measurement.

The overfill protection generates:
* OR an action which safely closes the liquid supply automatically when the storage tank level has reached 98%. There is also a signal on the loading zone.
* OR an acoustic (and visual) signal audible (visible) on the loading zone when the storage tank level has reached 95%

When the overfill protection doesn't generate automatic actions the appropriate response is described in the (un)loading instruction.

MJV conclusion: For gas oil, an independent overfill protection can be an alarm or a shut-off system.
Having an overfill protection is a minimum requirement because it is good practice.
But this system does not need to be automatic; a high level alarm triggering operator intervention is sufficient.
The participants agree that an automatic system is the best solution, and that such a system is strongly recommended. From a technical standpoint, there is virtually no argument against installing such a system. Overfill protection is standard good practice and there is simply no good reason NOT to implement such an automatic shut-off system.

Items of consideration:

A1 Inspection

The overfill protection is incorporated in the inspection programme.

M2 Level measurement with high level alarm and operator action

Items of consideration:

A1 Inspection

Periodical inspection of the level alarm.

A2 Instructions

Actions to take in case of high level alarm are indicated in the ship unloading instruction.

M3 Check for sufficient free space in the tank before unloading a ship

Items of consideration:

A1 Instructions

The check for free space is included in the ship unloading instruction.

M4 Overflow pipe

Items of consideration:

A1 Design

The diameter is bigger than that of the liquid inlet lines.

M5 Breather valve

Items of consideration:

A1 Design for protection against high liquid level

To protect against overpressure from high liquid level the breather valves need to be designed such that the liquid level can't rise above the valve itself. So the opening for the outflow needs to be equal to the largest inlet opening.
The outlet point of the breather valve should be as low as possible to prevent additional liquid head and the additional pressure on the tank resulting from it.

A2 Instructions

To prevent over pressuring the tank caused by overfilling the tank, the filling rate from the ship should be lower than the liquid flow capacity through the breather valve. This flow has to be agreed upon with the ship and monitored for compliance.

A3 Venting capacity to protect against over and under pressure

Designed according to recognized standard such as:
- BS 2654 app. F
- API Std 2000

A4 Availability

There are no valves to isolate the breather valve from the tank.

A5 Accumulation of rainwater above the breather valve

The breather valves are protected against accumulation of rainwater.
The accumulation of rainwater raises the opening pressure of the breather valve.

A6 Inspection

- Regular visual inspections to ensure they are free from pollution
- Complete inspections of the internals of the valve

Event source 2: Corrosive conditions

Description:

Effect: Corrosion

Causes:

Corrosion
└ Corrosive conditions
  └ C1 Exposure to internal or external corrosive conditions

Release events:

Corrosion
└ M1 Corrosion allowance
  └ Leak at the storage tank

Measures:

M1 Corrosion allowance

Items of consideration:

A1 Frequency and content of inspection

According to a construction code, e.g. API 653:
- external inspection maximum 5 years
- internal inspection based on the corrosion speed, maximum every 20 years (10 year if no data available)

An inspection of the liquidproofness is carried out every 5 year when the construction code is not known.

MJV conclusion: Periodic internal inspections are a minimum requirement. For such inspections, there are different regulations in different countries. Some countries will accept the operator's risk-based inspection frequencies. Nonetheless, there was general unease with the idea of accepting the frequencies set by the operator. For example, there is a problem with old tanks for which original design specifications are missing. In such cases a regular status check and a higher frequency of inspections are advisable. On the other hand, this recommendation is difficult to enforce. It was generally acknowledged that tank inspections are a specialized topic and it is difficult for all inspectors to have a detailed knowledge of all inspection methods.

Release events

Release events

- Storage tank
  - R1 Catastrophic failure of the storage tank
  - R2 Leak at the storage tank
    - M1 Regular inspection rounds
    - M2 Presence of hydrocarbon/liquid detectors in the bunds
    - M3 Alarm on abnormal level changes in storage tank
    - M4 Isolation system storage tank
    - R2.1 Release of large quantities
      - M5 Double wall tank
      - M6 Bund
      - M7 Controlled removal of water (and/or other liquids) from the bund
      - R2.1.1 Dispersion of leak fluid on the ground or in the groundwater
        - R2.1.1.1 Ignition
          - M8 Grounding of tanks
          - R2.1.1.1.1 Electrostatic ignition
          - M9 Electrical installation is explosion proof (ATEX)
          - R2.1.1.1.2 Ignition by fixed electrical equipment
          - M10 Explosion proof portable equipment
          - R2.1.1.1.3 Ignition by portable electrical equipment
          - M11 Smoking prohibition
          - R2.1.1.1.4 Ignition by open fire
            - M12 Fixed fire fighting system
            - R2.1.1.1.4.1 Fire

Measures for release events

<u>M1 Regular inspection rounds</u>

The rounds are registered. A form indicates which places and which items are controlled.

MJV conclusion: This is a minimum requirement for storage tanks. Periodic visual inspection of pipelines also constitutes a good practice. However, in large facilities with Risk Based Inspection (RBI) programs, gas oil lines are usually identified as "not critical".

<u>M2 Presence of hydrocarbon/liquid detectors in the bunds</u>

For double wall tanks: detection between the two walls.

MJV conclusion: This is a good practice but is not an alternative to regular inspection rounds.

Items of consideration:

A1 Inspection

The system is incorporated in the inspection programme.

<u>M3 Alarm on abnormal level changes in storage tank</u>

If there is an automated level measurement, valve and pump control system such an alarm can easily be implemented.
The alarm should be given in a permanently occupied place.

MJV conclusion: This is not a requirement but it can easily be implemented when automatic level measurement is available. Inspectors should promote this strongly.

M4 Isolation system storage tank

Automated valves on all liquid pipelines.

Activation:
- through the emergency stop buttons from the loading installation
- through the emergency stop buttons from the control room (or other permanent manned place)

The activation of the isolation system stops the loading pumps.

MJV conclusion: Automated valves are not common practice and there was no agreement that this measure should always be recommended. On the other hand, the location of the valves inside the bund can be problematic for manual closure. In particular, sending people into a bund when there is a large leak is a considerable risk. It is preferable to have a system that allows closing valves at the bund border or at the tank bottom from outside the bund. It was agreed that the ability to close the valves outside the bund should be considered a minimum requirement.

Items of consideration:

A1 Inspection

The interlock system is incorporated in the inspection programme.

A2 Location valves

The valves are located as close as possible to the tanks.

A3 Fire-resistance

- Proven by a test certificate
- The gasket between the tank and the valve is also fire-resistant.

A4 Indication valve

There is a clear indication of the position (open / closed).

A5 Fail safe position valve

The valves are fail close. The fail close action is also initiated by fire (e.g., burning away of instrument air line).

M5 Double wall tank

This is an alternative for a bund.

MJV conclusion: This solution is seldom chosen. It could be a reasonable solution if the tank were close to damage receptors (and there was insufficient room for bunds).

Items of consideration:

A1 Leakage detection system

The space between the two walls is equipped with a permanent leakage detection system.

A2 Foundation

Double wall tanks are placed on an impenetrable foundation.

A3 Inspection

The permanent leakage detection system is incorporated in the inspection programme.

M6 Bund

Items of consideration:

A1 Capacity

Half the total content of all tanks
OR
The content of the biggest tank + 25% of the content of the other tanks.

When there is mixed storage with gasoline, the more stringent rules for gasoline apply.
Double wall tanks aren't taken in consideration for the determination of the capacity of the bund.

MJV conclusion: Although the exact specifications are somewhat different in each country, every country has legally established minimum requirements for bunds.

A2 Liquid tightness

- The bund is constructed in a completely liquid tight material like concrete or an other incombustible material (thickness foundation, no cracks).
- Pipelines through the bund are only allowed when the tightness of the bund is maintained.
- Observation tubes are placed when the bund is located within a drinking water collection area or when the bund isn't liquid tight yet (soil dikes).

MJV conclusion: An obligation of result (penetration rate) is the best criterion, but this is difficult to demonstrate.
For new tank farms this is a minimum requirement.
For existing tank farms it is difficult to enforce.

A3 Resistance against hydrostatic pressure

The bund walls resist the hydrostatic pressure of a completely filled bund.

A4 Resistance against hydrodynamic pressure

The bund walls resist the hydrodynamic pressure caused by the wave from a collapse of the greatest tank.

MJV conclusion: Wave effects are generally underestimated: in the worst case 50% may flow over the bund wall in case of a catastrophic tank failure.
A special profile of the bund wall may deflect a wave (see references).
Often hydrants are too close to the bund which is a risk for fire fighters.

A5 Fire resistance

- Minimum 4 hours
- No flammable building materials, also not for seals.

MJV conclusion: This is not usually inspected. Its importance is unclear.
(Reporter's Note: The reports from the Buncefield Major Investigation Board, notably the Initial Report, dated 13 July 2006, and the Second Progress Report, dated 11 April 2006, give some insights into this issue.
The reports are currently located at:
http://www.buncefieldinvestigation.gov.uk/reports/index.htm.)

A6 Distance between bund walls and storage tank

- The distance between a tank and the interior bottom of the bund walls is at least half the height of the tank. This distance may be decreased to 30 cm when the tank is surrounded by a screen which prevents leak fluid to project over the bund walls.
- The minimum distance between the tanks is 1m.

M7 Controlled removal of water (and/or other liquids) from the bund

- The water drain from the bund is normally closed. This is verified during regular inspection rounds.
- Water is only removed under supervision of an operator.
- The water (and/or other liquids) are drained over a hydrocarbon separator.

MJV conclusion: The controlled removal of water from the bund is a minimum requirement.

M8 Grounding of tanks

The resistance is maximum 10 Ohm.

MJV conclusion: Lightning is a frequent ignition source in accidents, but remains underestimated.
It is not clear if normal grounding is sufficient to prevent ignition by lightning. More study is needed.

Items of consideration:

A1 Inspection

Periodic inspection programme (5 yearly)

M9 Electrical installation is explosion proof (ATEX)

This measure is applicable when the occurrence of switch loading can't be excluded. An alternative is to place the electrical equipment outside the explosion hazard area.

MJV conclusion: This is often not recognized as a problem in gas oil depots, but it is definitely a minimum requirement on loading racks for gas oil if switch loading is possible.

Items of consideration:

A1 Explosion safety document for the concerned installation

An up-to-date explosion safety document is available.

A2 Inspection

Periodical inspection of the electrical installation (5 yearly).

M10 Explosion proof portable equipment

Including walkie-talkies, flashlights, mobile phones.

The use of this material is included in the safety rules of the company.

The ban of mobile phones is indicated near:
- the entrance of the site
- the loading installations

MJV conclusion: The use of explosion proof equipment is good practice and such equipment is easily available. This is considered as a minimum requirement.

M11 Smoking prohibition

Prohibition is indicated at:
- all entrances to the site
- ship unloading quay

MJV conclusion: This is an absolute minimum requirement.

M12 Fixed fire fighting system

MJV conclusion: There are no clear requirements for testing of:
- Fixed foam drench systems on loading bays
- Fixed water cooling systems on storage tanks
- Fixed foaming systems on storage tanks

There are no strict regulations. A rule of thumb is to test every system at least every five years.
Remark: For testing a "testing foam" can be used. This foam cannot be used for fire fighting, only for testing.

Items of consideration:

A1 Number and location

- Determined in consultation with the fire brigade.
- Easily accessible

A2 Protection against external influences

Frost:
- sufficiently deep buried
- heated
- dry system

Corrosion:
- cathodic protection
- protective layer
- corrosion resistant

A3 Inspection and maintenance

The periodic inspection programme includes:
- fire water pumps (weekly check of operation and diesel reserve)
- sprinklers (monthly visual check)
- control of water and foam supply

Fixed fire fighting systems are immediately usable.

A4 Signalisation

Fire fighting water pipelines and hydrants are painted red.

4.2 Ship unloading

Release events

Release events

Ship unloading
- R1 Leak or breaking of the temporary connection
  - M1 Permanent presence
  - M2 Communication between quayside and the ship
  - M3 Emergency stop buttons enable quick stopping (ship loading)
  - M4 Motion detection
  - M5 Break-away coupling
  - R1.1 Release of large quantities

Measures for release events

M1 Permanent presence

- Each loading takes place under supervision of a representative.
- The deck guard is continuously on the deck of the ship during unloading.
- Supervision in a way that control over the loading operation is possible and that immediate intervention is possible.

MJV conclusion: This is a minimum requirement.
In some countries the presence of an operator is obligatory or standard practice; in other countries the shipper is sufficient if he is able to intervene quickly.
Camera supervision is not perceived as an alternative measure. The question was raised as to whether an operator can perform other jobs in parallel with ship unloading. This is considered acceptable if fast alerting and intervention are possible.

M2 Communication between quayside and the ship

The deck guard has a quick way of communication with a responsible of the depot (telephone, walkie-talkie).
Their language of communication is agreed upon before unloading.

MJV conclusion: This is essential.
Note that mobile phones are not a reliable form of communication. Only radio communication can be considered sufficient to fulfil this requirement.

M3 Emergency stop buttons enable quick stopping (ship loading)

Actions:
- closure of automatic valves
- stop of loading pumps
- raise an alarm to a representative of the company or to a permanently occupied place

MJV conclusion: This measure is only possible if automated valves are present. There was some agreement that having an alarm button on ships is important, but enforcement of such a measure may be difficult (usually outside a Seveso inspector's jurisdiction).

Items of consideration:

A1 Location

The emergency stop buttons are placed at all evacuation routes and on the ship (connected with fixed installation).

M4 Motion detection

The detection:
- activates the shutoff valves on the ship and the quayside
- stops the pumps

MJV conclusion: Very few applications could be identified by the participants. However, it was agreed that it is certainly a good practice for gas oil depots.

M5 Break-away coupling

The break-away coupling prevents spills in case of an excessive movement of the temporary connection.

MJV conclusion: Very few applications could be identified by the participants. However, it was agreed that this is certainly a good practice for gas oil depots.

Items of consideration:

A1 Included in a periodical inspection programme

4.3 Pipeline

MJV conclusion: Line pigging and blowing with compressed air were generally discussed in connection with this topic. It was unclear to participants whether using compressed air for these activities is consistent with good practice and should be allowed. In particular, participants did not feel adequately informed about current practice to properly judge them.
In addition, it was noted that thermal relief valves are necessary on long liquid-filled lines and these valves should be indicated on P&ID's.

Event source 1: Liquid hammer

Description:

Effect: High pressure

MJV conclusion: This is an important issue. It was the cause of the German accident presented in the introductory session (see annex 2).
The closing velocity of valves is to be controlled.
Note: For this reason many companies do not want automatic shut off valves. This reasoning is flawed, however. Valves can be easily engineered so as not to exceed a maximum closing velocity.

Causes:

- High pressure
  - Liquid hammer
    - M1 Closing speed of automatic valves is adapted to the pipeline network
    - C1 Fast closure of valves in long pipelines

Release events:

- High pressure
  - M2 Pipeline resists resulting overpressure
    - Breaking of or leak in pipeline

Measures:

<u>M1 Closing speed of automatic valves is adapted to the pipeline network</u>

Closing speeds of several seconds can be needed dependent on: liquid speed, length of line.

<u>M2 Pipeline resists resulting overpressure</u>

The resulting overpressure has to be known.

Event source 2: Exposure to corrosive conditions

Description:

Effect: Corrosion

Causes:

Corrosion
└ Exposure to corrosive conditions

Release events:

Corrosion
└ M1 Corrosion allowance
  └ Breaking of or leak in pipeline

Measures:

M1 Corrosion allowance

A periodic inspection programme ensures the piping is still sufficiently thick.
The supports of the pipelines are also inspected.

MJV conclusion: Preventive replacement once the pipeline has exceeded its expected lifetime is not acceptable as an alternative for inspection. Good practice requires regular inspection to demonstrate the good state of the lines.

Release events

Release events

Pipeline
├ M1 Regular inspection rounds
└ R1 Breaking of or leak in pipeline

Measures for release events

M1 Regular inspection rounds

The rounds are registered. A form indicates which places and which items are controlled.

MJV conclusion: This is a minimum requirement for storage tanks. Periodic visual inspection of pipelines also constitutes a good practice. However, in large facilities with Risk Based Inspection (RBI) programs, gas oil lines are usually identified as "not critical".

Recommendations

It was not possible to achieve the original objective of the MJV, to reach common agreement on minimum necessary measures, over the course of one workshop. The participants expressed the need for greater concertation amongst Seveso inspectors on "necessary" technical measures and that the work of the MJV towards this goal should continue.

- Minimum "necessary technical measures" for typical installations should be discussed and agreed among the Member States;
- Moreover, it is recommended that the relation between national legislation on various relevant technical equipment, e.g., flammable liquids storage and the Seveso Directive should be discussed at EU level. In the conclusions relative to technical measures the challenge of enforcing implementation of appropriate technical measures was highlighted.

  In particular, even though there was often agreement amongst most inspectors in regard to the necessity of a particular measure, many foresaw difficulties with enforcing these measures in reality. One barrier appears to be the failure of more general national legislation to recognise and include these measures in technical requirements for typical equipment used on these sites. However, it should be noted that this type of national legislation is typically not aimed to fulfil the high level of protection demanded by the Seveso Directive. Seveso competent authorities would benefit from sharing views and experiences around this topic, potentially identifying options for addressing the problem at national level.

References

During the technical discussions some references to useful publications where mentioned:

- ISO 10497:2004 Testing of valves - Fire type-testing requirements;
- HSG176: The Storage of Flammable Liquids in Tanks (1998);
- CIRIA Report 164: Design of containment systems for the prevention of water pollution from industrial incidents;
- Health and Safety Executive/AEA Technology, "The Design of Bunds" (SRD.HSE R500), March, 1990;
- IP Model of Safe practice Design Construction & Operation of Distribution installations (Aug 1998);
- http://www.umweltbundesamt.de/anlagen/Checklistenmethode/homeen.html;
- http://www.buncefieldinvestigation.gov.uk.

Annex 1 : Typical depot overview

General features

There is a wide variety of petroleum depots throughout the European Union:

- The capacity (size) of depots varies from country to country;
- Depots can be independent or attached to large sites (e.g., refineries), and belong to small or large companies;
- The location can be inland or coastal; all types of transport modes can be involved for import and export (ship, pipeline, road, rail);
- The transport interface is a particularly important part of safe operations and poses unique challenges in some areas, including:
  - Training of transport operators in safe loading and unloading and emergency procedures;
  - Control and enforcement of procedures involving transport operators;
  - Language;
  - Loading and unloading equipment (ownership, design, maintenance).

Typical Belgian gas oil depot

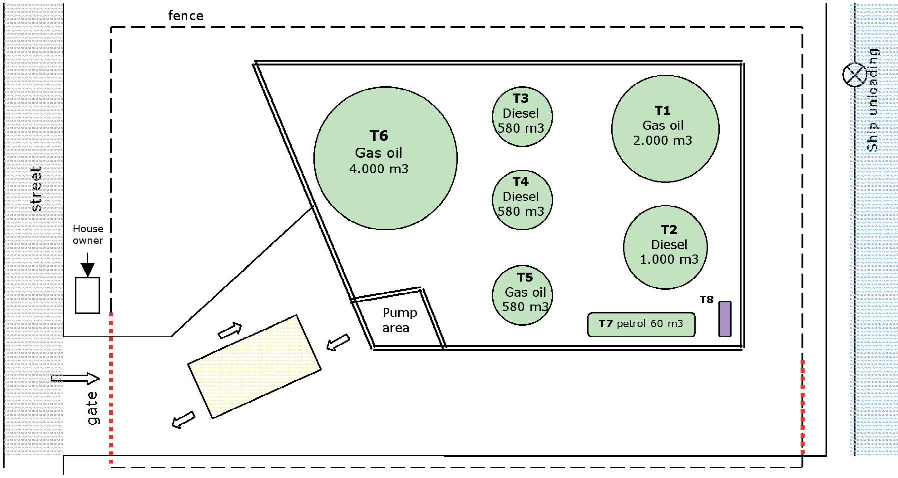
This is a description of a typical Belgian gas oil depot. It was used to give a concrete framework for the discussions during the MJV. Some references are made to this situation in the country-specific overview.

This typical depot stores gas oil and similar petroleum products in vertical and horizontal tanks. The maximum store capacity is about 7.500 tonnes, which means that the depot is submitted to the Seveso II directive as a lower tier establishment.

The product is supplied by ship. Product delivery is done by truck.

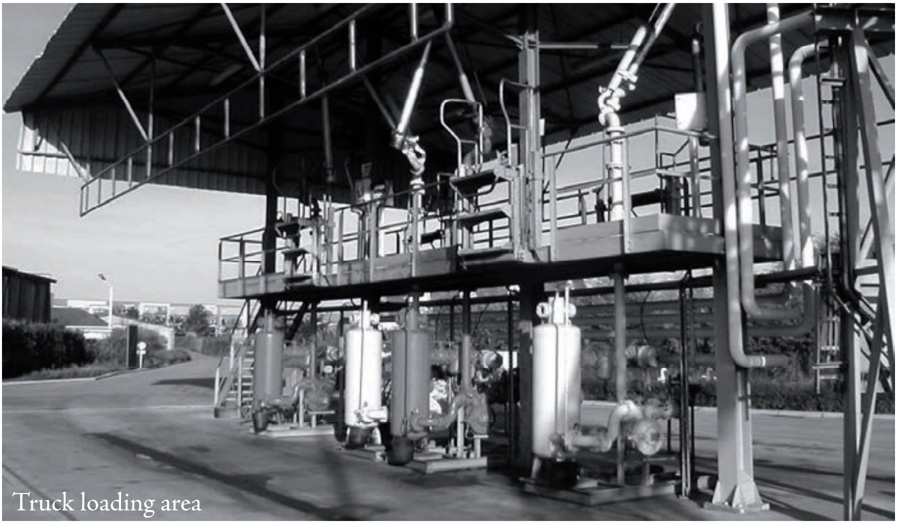
The depot is run by a depot manager and two operators. It does not belong to a bigger organisation.

The following depot lay-out and photo's give a good impression of such a depot.



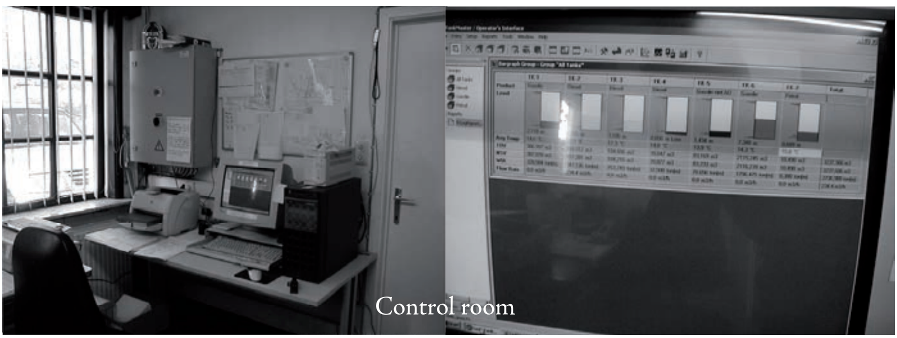
Depot lay-out

Storage tanks



Truck loading area

Ship unloading



Control room

Country-specific overview

The following table gives a summary of statements made by some participants about the situation in their country. It shouldn't be regarded as a complete overview.

Austria	No depots are as small as the MJV example. No ship unloading occurs in Austria, but railway wagon unloading is an issue.
Belgium	Large and small depots can be found. All independent depots are accessible 24h/24h Typically ship in (product is delivered by ship), truck out (the product is taken away by truck).
Croatia	One big national company with 2 refineries (Rijeka and Sisak) Depots for Rijeka refinery (located on the coast) are situated on the island of Krk and connected with the refinery by an undersea pipeline. Depots are supplied by tankers. From the refinery, products are exported by trucks, railway and ships. Depots of the Sisak refinery are connected to pipelines from Eastern Europe, but also to coastal depots. Products are exported from the refinery by truck, railway and possibly by river ships. Unlike Belgium, Croatia tends to have bigger depots, operated by big companies. Truck drivers are sometimes independent, sometimes members of a big refinery group.
Cyprus	The majority of Seveso establishments are depots. Typically depots (diesel and gasoline) are small in Cyprus.
Czech	Similar mix of depots as in Belgium
Estonia	Petroleum comes by train from Russia and is exported by ship. 6 upper tier and 15 lower tier petroleum depots (They make up about 2/3 of all Seveso establishments).
Germany	Depots are usually in between medium and large.
Italy	Small and large depots can be found in Italy.
Norway	Product is supplied by boats. Many big companies operate in Norway. In general Norway's profile is similar to the Belgian situation.
Poland	Product is supplied by pipeline and exported over land. The petroleum business is about 25 – 30% of the Seveso establishments.
Portugal	Small depots (sometimes 2 tanks) are the norm in Portugal.
Romania	Romania has similar types of depots as in Belgium (diesel and gasoline).
Slovenia	Very large depots can be found on the coast (import of product by ship, export by truck and rail). Slovenia has 4 upper and 3 lower tier petroleum depots
Spain	In general Spain has much bigger depots than in Belgium. In some cases they also store other chemicals. Product is imported by ship and exported by truck. In the big companies, the same SMS is in place for multiple sites, including depots.
Sweden	The depots are bigger than in Belgium and located on the coast. Access to the depots is generally by barge.

The Netherlands	The Netherlands has mostly large depots.
UK	The size of depots in the UK tends to be larger than described in the example. Most of the depots are a mix of diesel and gasoline (coming from a refinery). Most depots try do be below the Seveso threshold quantities. Most depots take delivery by pipeline but some also by road or boat.

Annex 2 : Accident presentations

The following presentations of accidents in petroleum depots were given during the MJV. In this annex you find the slides that were used for these presentations.

Catastrophic failure of large storage tank (Belgium)

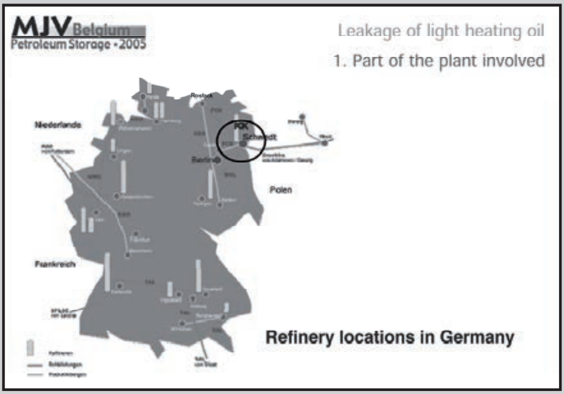
This presentation gave the first findings of the investigation of this accident that was still ongoing at the time of the MJV. Because the investigation is finished and a specific publication with the lessons from this accident has been made, this presentation is not included. You can find the publication "Safety Alert : Rupture of an (atmospheric) crude oil storage tank" on http://www.employment.belgium.be/seveso.

Leakage of light heating oil (Germany)

MJV Belgium
Petroleum Storage • 2005

Leakage of light heating oil
contents

1. Part of the plant involved
2. The accident, its development and consequences
3. Origin, causes and circumstances of the accident
4. Actions taken e.g. intervention, inspection, corrective actions, ...
5. Lessons learnt



MJV Belgium
Petroleum Storage • 2005

Leakage of light heating oil
1. Part of the plant involved

PCK Raffinerie GmbH is a company of the oil companies:

- **Ruhr Oel GmbH (37,5%)**
- **Shell Deutschland Oil GmbH (37,5%)**
- **AET-Raffineriebeteiligungsgesellschaft mbH (25%)**

bp RUHR OEL GMBH
Shell Deutschland Oil GmbH
Eni Agip TOTAL

MJV Belgium
Petroleum Storage • 2005

Leakage of light heating oil
1. Part of the plant involved

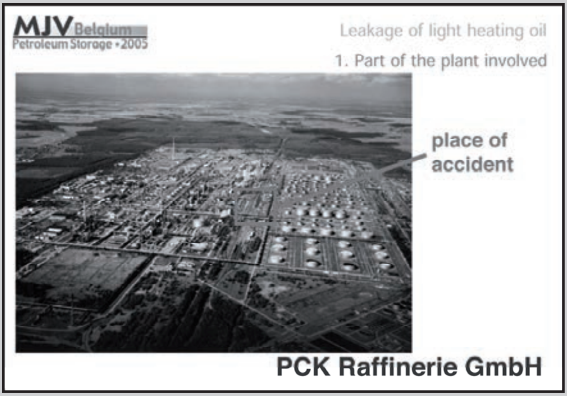
main products PCK annual produced from
11 Million tons of crude oil:

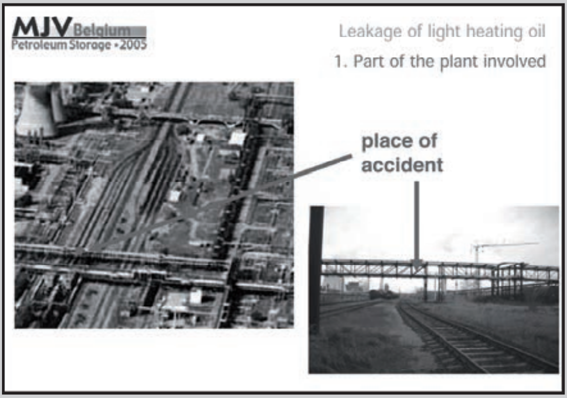
liquid pressure gas (LPG)	320 kt/a
petrol fuels	3.000 kt/a
diesel fuel	2.600 kt/a
light heating oil (HEL)	1.800 kt/a
aircraft turbine fuel (JET A1)	260 kt/a
heavy heating oil (HES)	700 kt/a
bitumen	240 kt/a

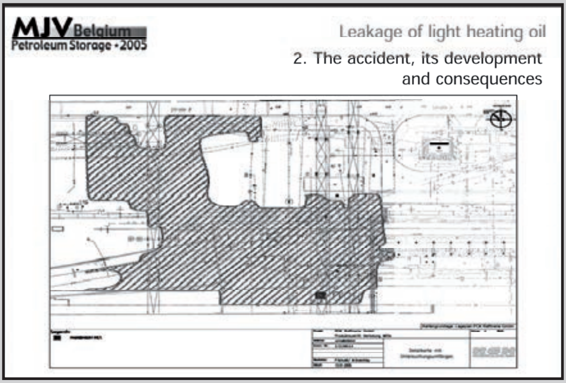
MJV Belgium
Petroleum Storage • 2005

Leakage of light heating oil
2. The accident, its development and consequences

- 25.12.2004 late shift
  - HEL was loaded in railroad tank cars
  - the leakage was detected by the night shift staff
  - central control room was informed, loading was stopped and the fire brigade of PCK was also alarmed
  - a part of the HEL was soaked up with pumps oft the fire brigade and temporarily stored in a special tank
- 27.12.2004 first accident report to the authorities


MJV Belgium
Petroleum Storage • 2005
Leakage of light heating oil
1. Part of the plant involved
place of accident
PCK Raffinerie GmbH


MJV Belgium
Petroleum Storage • 2005
Leakage of light heating oil
1. Part of the plant involved
place of accident


MJV Belgium
Petroleum Storage • 2005
Leakage of light heating oil
2. The accident, its development and consequences

MJV Belgium
Petroleum Storage • 2005

Leakage of light heating oil

2. The accident, its development and consequences

Quantity of flowed out light heating fuel oil (HEL)	512 t
→ in the area beside the rails	120 t
sucked up	77 t
removed together with 500 t of soil	10 t
estimated remaining quantity in this area	33 t
→ in the area of rails	392 t
saturation in soil	326 t
in ground water	66 t

MJV Belgium
Petroleum Storage • 2005

Leakage of light heating oil

3. Origin, causes and circumstances of the accident

defect axial expansion joint (axial compensator)

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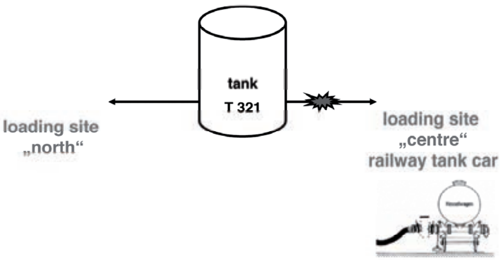
Leakage of light heating oil

3. Origin, causes and circumstances of the accident



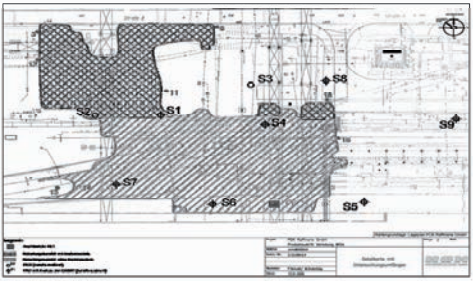
MJV Belgium Petroleum Storage • 2005

Leakage of light heating oil
4. Actions taken e.g. intervention, inspection, corrective actions, ...

- 27.12.2004 create a map of the contaminated area, 4800 m²
- 28.12.2004 start of soil excavation in the area beside the rails, 25 cm deep
- 03.01.2005 further 20 cm soil excavation in the same area
- 04.01.2005 start of the soil investigation by a specialized company
- 07.01.2005 updating of the accident report
- till 31.03.2005 soil excavation in the area of rails
- 22.04.2005 start of pumping out the contaminated ground water
- several inspections + decision of the details by the authorities

MJV Belgium Petroleum Storage • 2005

Leakage of light heating oil
4. Actions taken e.g. intervention, inspection, corrective actions, ...

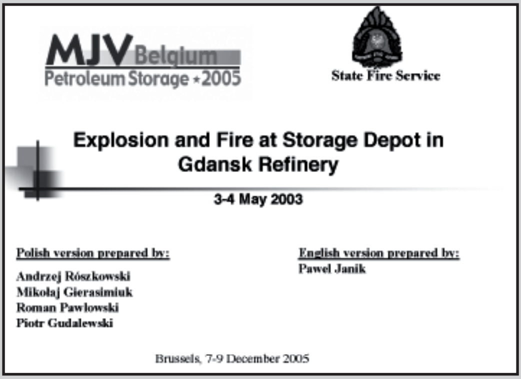


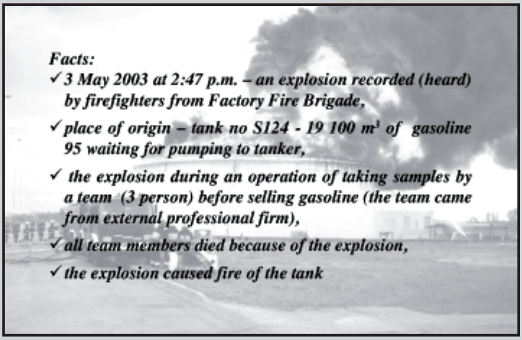
MJV Belgium Petroleum Storage • 2005

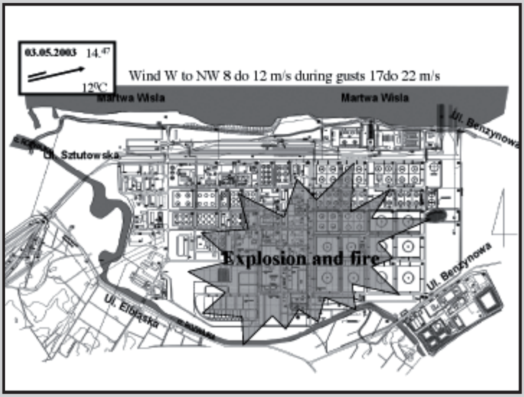
Leakage of light heating oil
5. Lessons learnt

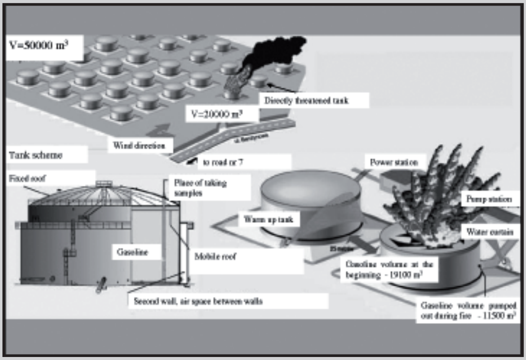
- replacement of the damaged expansion joint + 2 additional similar expansion joints in the concerned pipeline --> wave tube compensator
- Identification and listing of further existing stuffing box expansion joints
- operator report on the intended measures to prevent such accidents (by assistance of a specialized company)
- confirmative statement of a technical supervisory association (TÜV) regarding the operators proposals for prevention and improvement
- implementing effective measures for improvement - till 31.12.2005
- competent authorities (environment / health and safety): checking the operating instructions and checking the frequency of recurring tests

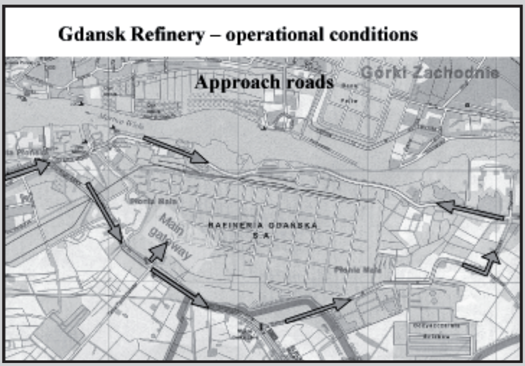
Explosion and Fire at Storage Depot in Gdansk Refinery (Poland)

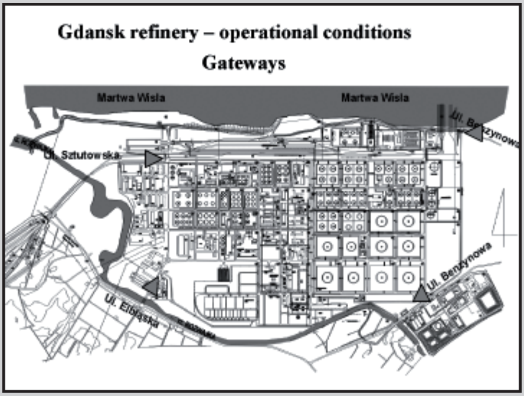


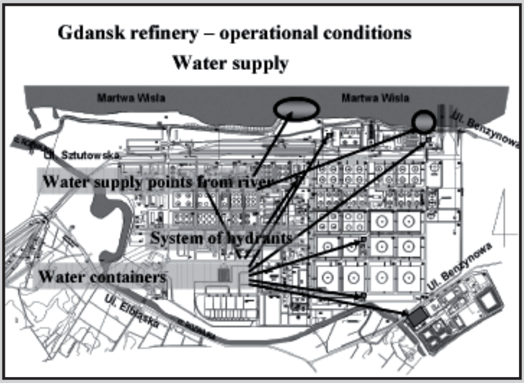


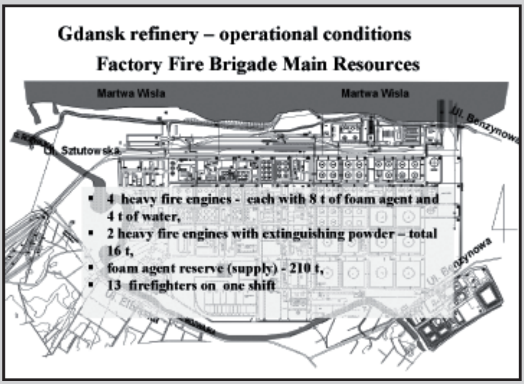

03.05.2003 14.47
12°C
Wind W to NW 8 do 12 m/s during gusts 17do 22 m/s
Martwa Wisla
Martwa Wisla
Ul. Benzynowa
Ul. Sztutowska
Explosion and fire
Ul. Benzynowa
Ul. Elbląska

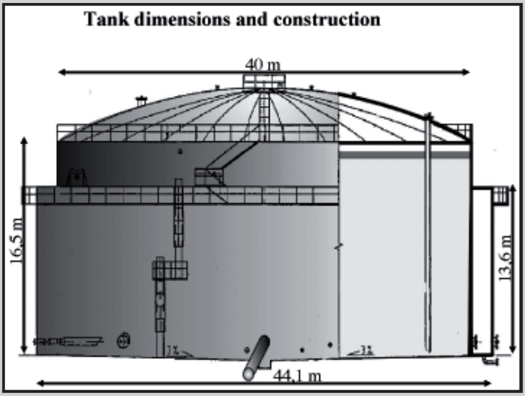

V=50000 m³
Directly threatened tank
V=20000 m³
Wind direction
Tank scheme
to road nr 7
Power station
Fixed roof
Place of taking samples
Pump station
Warm up tank
Water curtain
Gasoline
Mobile roof
Gasoline volume at the beginning - 19100 m³
Second wall, air space between walls
Gasoline volume pumped out during fire - 11500 m³

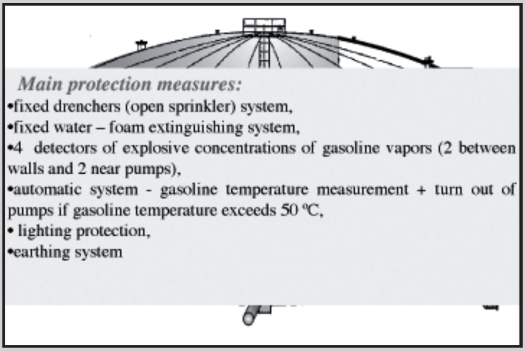

Gdansk Refinery – operational conditions
Approach roads
Górki Zachodnie
Main gateway
RAFINERIA GDAŃSKA S.A.

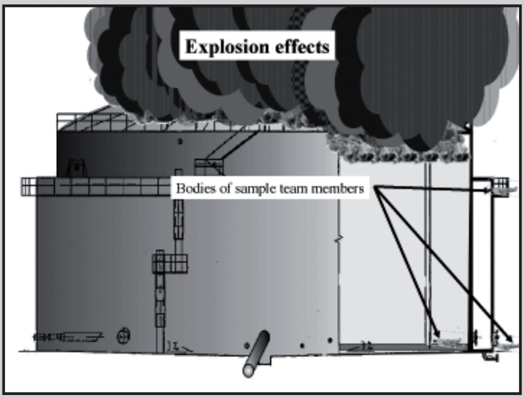

Gdansk refinery – operational conditions
Gateways
Martwa Wisla
Martwa Wisla
Ul. Benzynowa
Ul. Sztutowska
Ul. Benzynowa
Ul. Elbląska

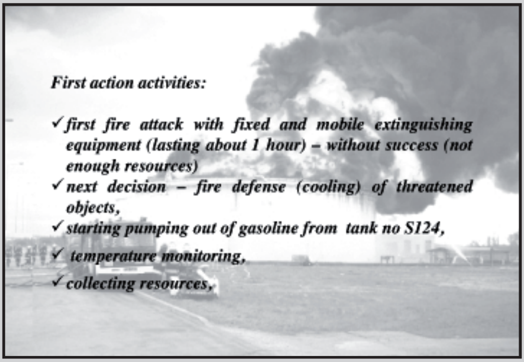

Gdansk refinery – operational conditions
Water supply
Martwa Wisla
Martwa Wisla
Ul. Benzynowa
Ul. Sztutowska
Water supply points from river
System of hydrants
Water containers
Ul. Benzynowa
Ul. Elbląska

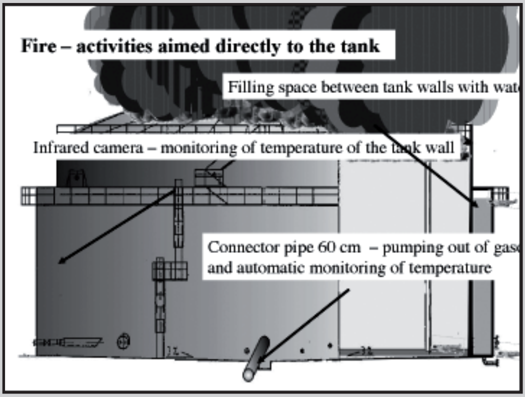

Gdansk refinery – operational conditions
Factory Fire Brigade Main Resources
Martwa Wisla
Martwa Wisla
Ul. Benzynowa
Ul. Sztutowska
▪ 4 heavy fire engines - each with 8 t of foam agent and 4 t of water,
▪ 2 heavy fire engines with extinguishing powder – total 16 t,
▪ foam agent reserve (supply) - 210 t,
▪ 13 firefighters on one shift

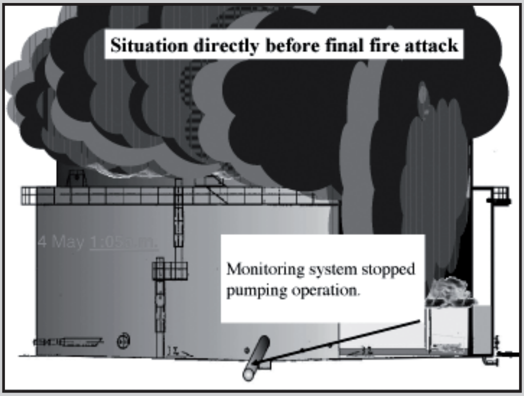

Tank dimensions and construction
40 m
16,5 m
13,6 m
44,1 m


Main protection measures:
•fixed drenchers (open sprinkler) system,
•fixed water – foam extinguishing system,
•4 detectors of explosive concentrations of gasoline vapors (2 between walls and 2 near pumps),
•automatic system - gasoline temperature measurement + turn out of pumps if gasoline temperature exceeds 50 °C,
• lighting protection,
•earthing system


Explosion effects
Bodies of sample team members


First action activities:
✓first fire attack with fixed and mobile extinguishing equipment (lasting about 1 hour) – without success (not enough resources)
✓next decision – fire defense (cooling) of threatened objects,
✓starting pumping out of gasoline from tank no S124,
✓ temperature monitoring,
✓collecting resources,

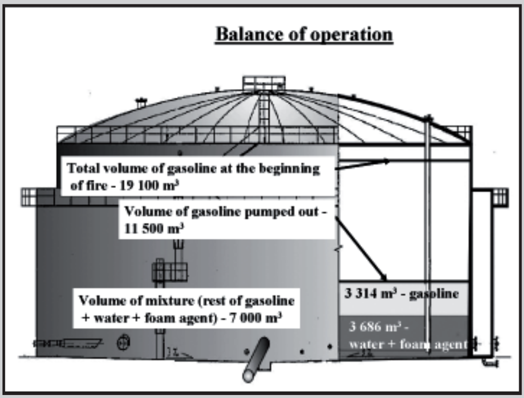

Fire – activities aimed directly to the tank
Filling space between tank walls with wat
Infrared camera – monitoring of temperature of the tank wall
Connector pipe 60 cm – pumping out of gas
and automatic monitoring of temperature


Situation directly before final fire attack
4 May 1:05
Monitoring system stopped pumping operation.


4 May 1:07 a.m.
beginning of final fire attack


4 May 2:02
Fire putted out


Operation organization


Balance of operation
Total volume of gasoline at the beginning of fire - 19 100 m³
Volume of gasoline pumped out - 11 500 m³
3 314 m³ - gasoline
Volume of mixture (rest of gasoline + water + foam agent) - 7 000 m³
3 686 m³ - water + foam agent

Fire resources participated in operation:

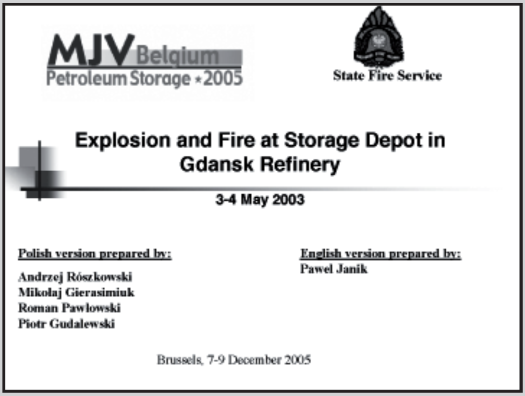
1.	State Fire Service	– 110 units and 284 firefighters
2.	Factory Fire Brigade	– 20 units and 43 firefighters
3.	Voluntary Fire Brigade	– 2 units and 8 firefighters
4.	Reserve	– 94 firefighters
Total		– 132 units and 429 firefighters

Using of extinguishing devices and agents :

1. Offensive firefighting jets – 9 with total capacity 42 m^3/min
2. Defensive firefighting jets – 14 with total capacity 27,2 m3/min
3. Foam agent – 120 t

Lessons learnt

- explosion and fire caused by persons from external but professional firm,
- tank correctly protected,
- earlier fire inspections pointed out cases of low level of knowledge concerning fire protection among Refinery personnel (lack of information concerning subcontractors),
- need for increasing fire pumping station capacity,
- need for assuring full crew for minimum 3 heavy fire engines in Factory Fire Brigade,
- need for fitting all heavy fire engines in Gdansk State Fire Service with mobile fire monitors


MJV Belgium
Petroleum Storage * 2005
State Fire Service
Explosion and Fire at Storage Depot in Gdansk Refinery
3-4 May 2003
Polish version prepared by:
Andrzej Rószkowski
Mikołaj Gierasimiuk
Roman Pawlowski
Piotr Gudalewski
English version prepared by:
Pawel Janik
Brussels, 7-9 December 2005

Tank Farm Incidents in the UK: The Story of Tank 115 Petroplus, Milford Haven

MJV Belgium
Petroleum Storage • 2005

Tank Farm Incidents in the UK

The Story of Tank 115
Petroplus Milford Haven

MJV Belgium
Petroleum Storage • 2005

The Story of Tank 115 Petroplus, Milford Haven
Background

- Tank 115 constructed by Whessoe in 1966/67 API 650 (Gulf Refinery) – For black fuel oil (capacity 40,000m3).
- Gulf Refinery closed 1996. No records of tank 115 failure.
- Modified by Petroplus in 1999 to take white oils. Floor plate repairs – outer 2m of floor replaced and patch welds on worst areas.
- Leak reported Sept 2001 and traced to poor workmanship on fillet welds on patch welds and a large crater.
- Whole floor replaced except the outer 2m replaced in 1999. Foundations remade with 200te stone topped with 50mm sand.
- Original assembly – sump, 1 inch try line, 6 inch drain line

MJV Belgium
Petroleum Storage • 2005

The Story of Tank 115 Petroplus, Milford Haven
Incident

- Sump and 1 inch try line replaced. 6 inch drain line kept and an additional 6 inch drain line fitted. 1 inch try line supported by bracketing with original 6 inch line
- Tested with dyed water and painted with epoxy coating – 5 year manufacturers warranty

Incident reported 2/8/05

- EA notified of a leak of Kerosene (about 650te).
- Reports of oil contamination, EA declared a MATTE after kerosene found in gardens, farmland, shoreline.
- Pollution of ground and groundwater. Marine wildlife affected.
- Hydrocarbon odour in houses.
- Media interest, TV, Newspapers, Public and Pressure Groups, claims of ill health.

MJV Belgium
Petroleum Storage • 2005

The Story of Tank 115 Petroplus, Milford Haven
Environmental effect

- 600m of stream and banks had no invertebrate life one week after release into stream started.
- 2 months later invertebrate life had started to return to uppermost part of stream affected (immediately adjacent to unaffected area).
- Consequence of spill judged a Major Accident to the Environment (MATTE)
- Not reportable to the EU as less than 5% of the qualifying quantity of flammable material (50,000Te) lost - loss estimated at about 650Te.

MJV Belgium
Petroleum Storage • 2005

The Story of Tank 115 Petroplus, Milford Haven
MATTE scenario

- Introduces a new MATTE scenario.
  - Usually MATTE scenario are seen as large events such as catastrophic failure of tank.
  - This shows that minor leaks if go undetected over a period of time can also lead to a MATTE.
- This scenario and ones that could lead to a similar build up in the environment need to be considered in the Safety Report.

MJV Belgium
Petroleum Storage • 2005

The Story of Tank 115 Petroplus, Milford Haven
Investigation

- CA agreement for EA to lead with assistance from HSE.
- Investigation by EA/HSE Mechanical Engineer.
- Investigation is on-going.

<u>Observations</u>

Two six inch drain lines and 1 inch try lines poorly positioned within the sump.

Pipework against the sump wall, pipe openings closer to the sump bottom than the 4 inch recommended.

Pipe supports changed to allow free movement upwards

MJV Belgium
Petroleum Storage • 2005

The Story of Tank 115 Petroplus, Milford Haven
Communication of incident

- HSE has issued a safety alert (November 2005) to UKPIA, CIA and Tank Storage Association (TSA)
- Similar communication distributed with Environment Agency to all Inspectors regulating refineries and oil storage depots.
- The positioning of piping into the tank sump of a cone down storage tank is discussed in BS2654 and API 650. Both standards require sufficient clearance between sump base, sump wall and piping.
- Clearances allow for sump parts to be adequately shot blasted and coated. Without adequate preparation and coating tank sumps can corrode rapidly (40 months)

MJV Belgium
Petroleum Storage • 2005

The Story of Tank 115 Petroplus, Milford Haven
Other tanks on Petroplus site

- Checks on other tanks on Petroplus site showed 2 others with similar arrangement of pipework.
- Potentially these could also have resulted in a slow leak to the environment if gone undetected could lead to a MATTE.
- One other tank had pipework to sump modified which could have weakened sump.
- Any others out there on other sites?

MJV Belgium
Petroleum Storage • 2005

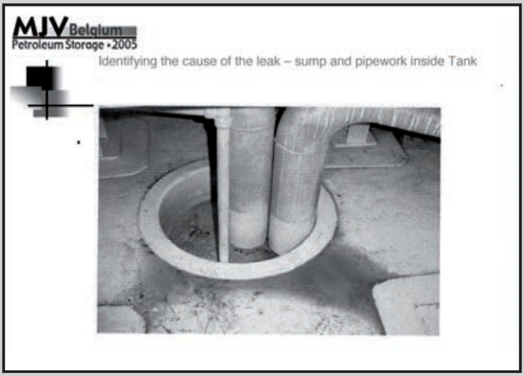
The Story of Tank 115 Petroplus, Milford Haven
Recommendations for Operators

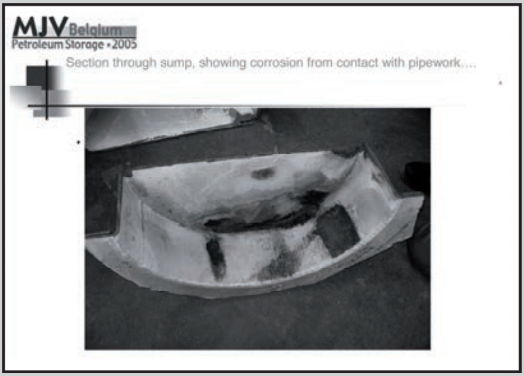
Recommendations for operators

Tank inspections to include a check that there is sufficient clearance between piping and the tank sump.

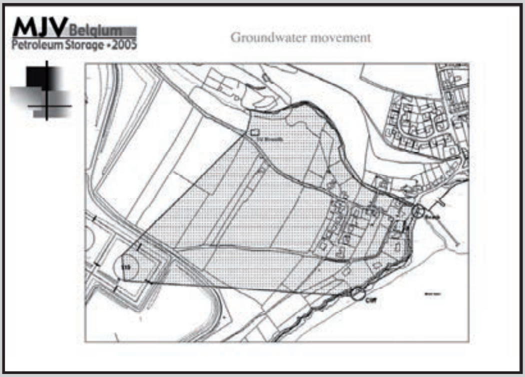
Surface coatings in the sump to be examined to ensure protection against corrosion.

Where there is potential for pipework movement, operators to ensure that pipes are adequately supported to ensure that they do not contact any part of the sump wall.






MJV Belgium
Petroleum Storage • 2005
Causes:
Pipes in contact with parts of sump – poor installation;
Inadequate preparation / painting of sump surfaces;
Movement in pipes when under load due to poor pipe support arrangements


MJV Belgium
Petroleum Storage • 2005
Groundwater movement

Spills during ship unloading (Belgium)

MJV Belgium
Petroleum Storage • 2005

Spills during ship unloading

Bernard Yu
Brussels Institute for Management of the Environment

MJV Belgium
Petroleum Storage • 2005

TOPICS

- Introduction
- Accident n°1 : 22/08/2002 – pollution in the canal
- Accident n°2 : 13/12/2002 – pollution within the site
- Lessons
- Conclusions

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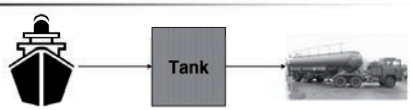
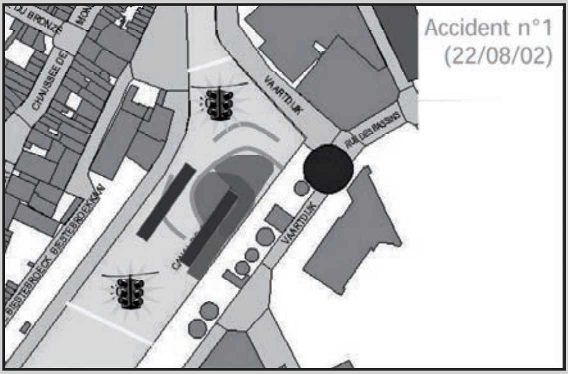
Petroleum Storage • 2005

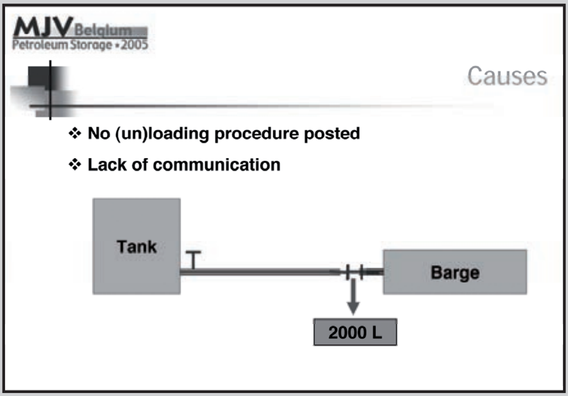
Introduction

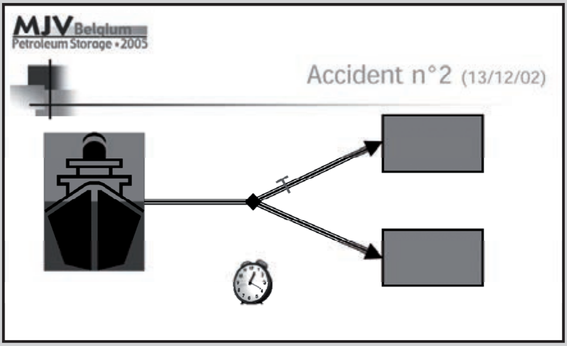


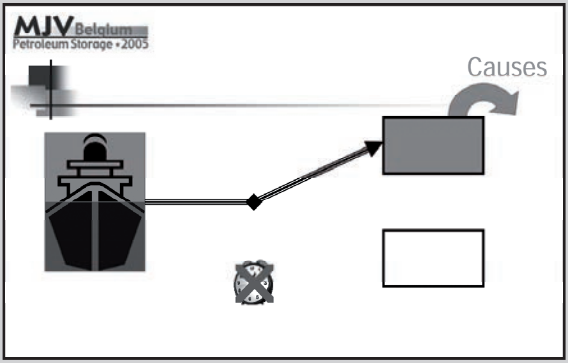
- SEVESO 1 Company → diesel and fuel oil
  - Site 1 : 6 000 m³ heating fuel
  - Site 2 : 8 225 m³ heating fuel et type C petroleum
- GROUND pollution
- Ongoing SEVESO inspection


Localization


Accident n°1
(22/08/02)
VAARTDIJK
RUE DES BASSINS
VAARTDIJK


MJV Belgium
Petroleum Storage • 2005
Causes
❖ No (un)loading procedure posted
❖ Lack of communication
Tank
Barge
2000 L


MJV Belgium
Petroleum Storage • 2005
Accident n°2 (13/12/02)


MJV Belgium
Petroleum Storage • 2005
Causes

MJV Belgium
Petroleum Storage • 2005

Consequences

- ❖ Spilled Quantities estimated at 3000 L + 2000 L
- ❖ Pumping and evacuation of waste by the company

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Petroleum Storage • 2005

Lessons

- ❖ Environmental permits modified (BAT)
- ❖ Hired a full-time prevention expert
- ❖ Concluded several periodical maintenance contracts
- ❖ Execution of action plan for compliance with legislations

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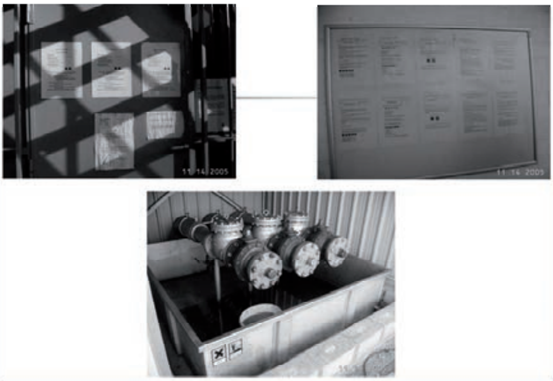
Petroleum Storage • 2005

Improvement

- ❖ Automatic level detection (radar)
- ❖ Unloading procedures updated
- ❖ Standardization of procedures for all sites (3 Regions)
- ❖ Automatic valves at Tanks
- ❖ New coupling system for boats
- ❖ Bi-lingual instructions posted
- ❖ Bund → Watertight (in progress)



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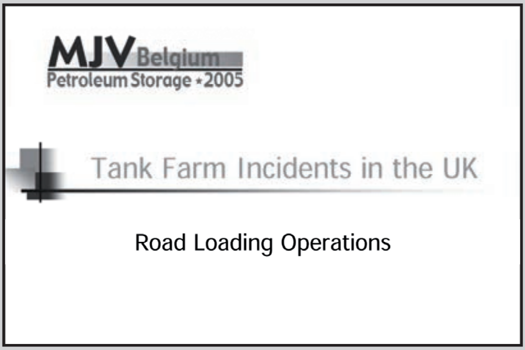
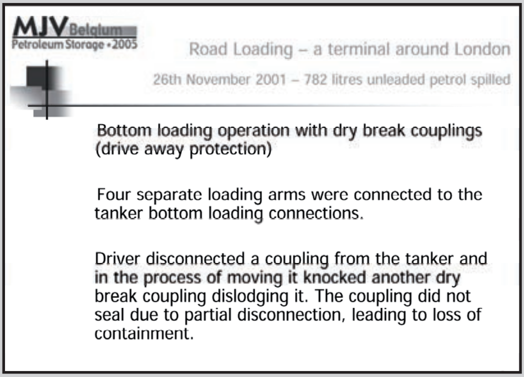
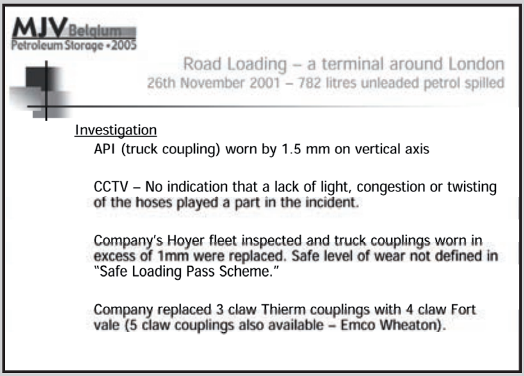
CONCLUSIONS

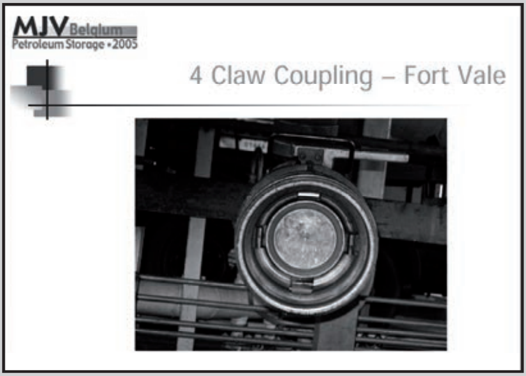
- ❖ NOT a « SEVESO » Major Accident
- ❖ Working with subcontractors
- ❖ Language problems
- ❖ Minimum distances from the walls of the bunt
- ❖ Standardization of work procedures
- ❖ Appropriate means of intervention available on site

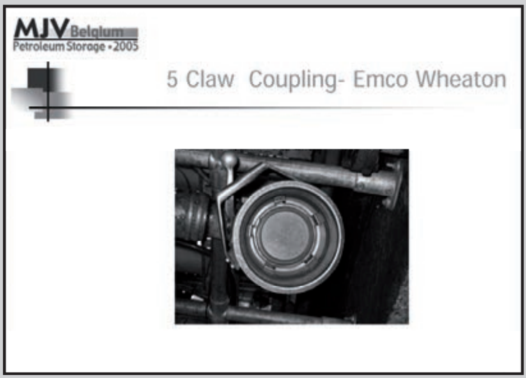
Tank Farm Incidents in the UK: Road Loading Operations

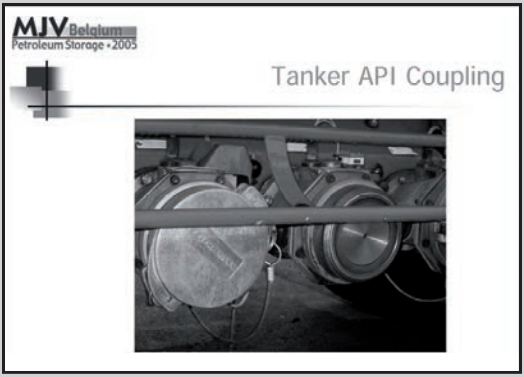


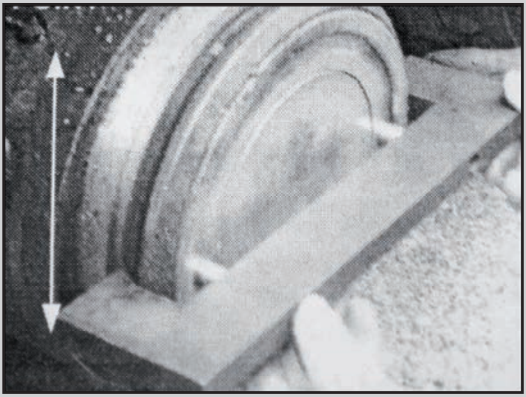





MJV Belgium
Petroleum Storage • 2005
4 Claw Coupling – Fort Vale


MJV Belgium
Petroleum Storage • 2005
5 Claw Coupling- Emco Wheaton





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Road Loading – a terminal around London
20th November 2003 – 2500 litres of petrol

Release during the making of the API bottom loading connection.

- The coupling had been maintained two days before the incident.
- The cap head screw (CHS) was not replaced, as thought not required anymore (the CHS prevents rotation of the valve handle on the coupling until the coupling has been fully mated to the road tanker inlet by internal clamps).
- The connector valve was opened before the clamp was fully connected, leading to release.
- ESD switch failed due to lack of lubrication.

MJV Belgium
Petroleum Storage • 2005

Road Loading – a terminal around London
20th November 2003 – 2500 litres of petrol

Recommendations

- Formal training on maintenance and overhaul of Fort Vale Safe Load Couplings.
- Ensure up-to-date drawings and overhaul recommendations from the manufacturer.
- Set and monitor acceptable coupling tolerances
- Check remaining couplings for the cap head screws (CHS).
- Check and test couplings after overhaul.
- Set maintenance schedules and track maintenance history.
- Routinely test and maintain ESD systems

MJV Belgium
Petroleum Storage • 2005

Road Loading – a terminal around London
20th November 2003 – 2500 litres of petrol

Period of continued releases (two)

Fort Vale specified and advised of stiffer "trigger springs."

Final solution – overhaul of couplings by Fort Vale

Ensure ongoing communication with the coupling manufacturer

Implementation of formal 6 monthly inspections and the use of "no go" plug gauges to check for wear on surfaces of the coupling triggers.

MJV Belgium
Petroleum Storage • 2005

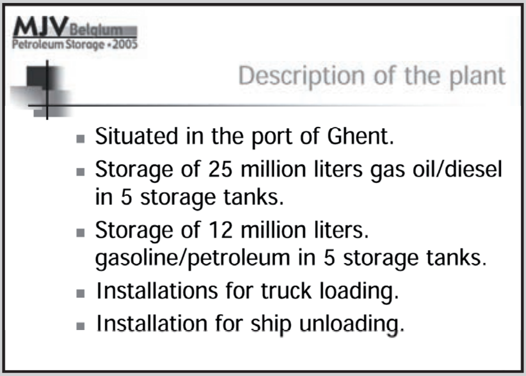
Conclusions

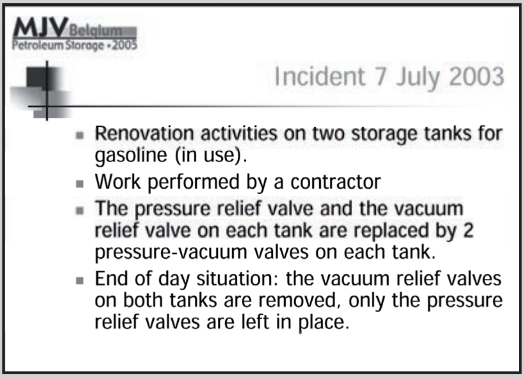
The high number of make and break connections at bottom road loading bays makes coupling failure likely.

Operators can be drenched in petrol and ignition then is a matter of probability.

Need an SMS system that ensures adequate coupling maintenance (tanker and loading bay), ESD function and operator competence.

Incidents in depot VDS in Ghent, Belgium





MJV Belgium
Petroleum Storage • 2005

Incident 7 July 2003

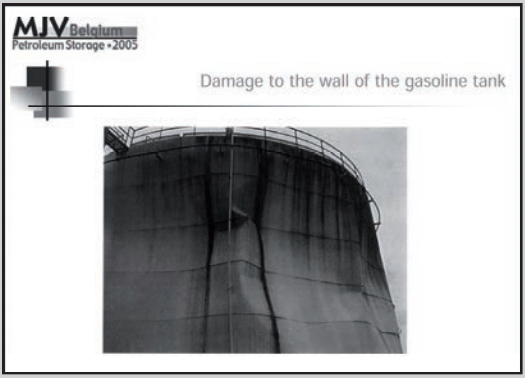
MJV Belgium
Petroleum Storage • 2005

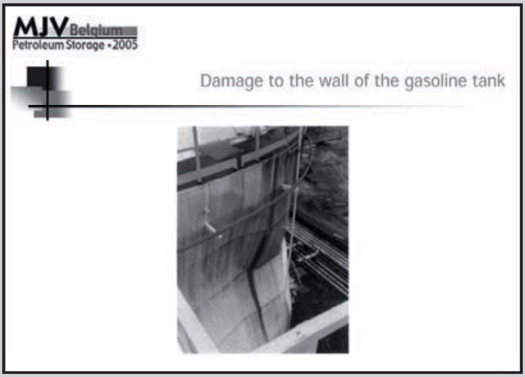
Incident 7 July 2003

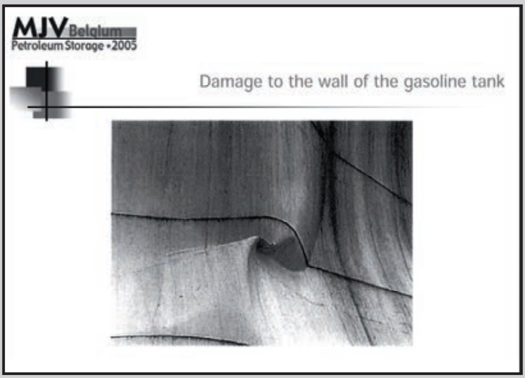
- At night: truck loading activities from these tanks
- Result: 2 gasoline storage tanks are damaged (implosion)
- No Loss of Containment

MJV Belgium
Petroleum Storage • 2005

Damage to the roof of the gasoline tank


MJV Belgium
Petroleum Storage • 2005
Damage to the wall of the gasoline tank


MJV Belgium
Petroleum Storage • 2005
Damage to the wall of the gasoline tank


MJV Belgium
Petroleum Storage • 2005
Damage to the wall of the gasoline tank

MJV Belgium
Petroleum Storage • 2005

Incident 7 July 2003

- Causes:
  - communication with contractor failed
  - follow up of work permit insufficient
- Actions taken:

  communication with contractors is improved (procedures adapted)

MJV Belgium
Petroleum Storage • 2005

Incident 19 March 2005

- 9h30: release of gasoline during emptying of pipe via flange (no low drains available)
- 11:00: release of gasoline by opening wrong valve (on line without blind flange)
- released gasoline washed away with water to water treatment installation
- situation evaluated as safe (measurements)

MJV Belgium
Petroleum Storage • 2005

Incident 19 march 2005

- 11:15: contractor starts hot work (grinding) close to the zone where gasoline was released. A work permit was available.
- 11:20: fire
- Activation of deluge system
- Fire brigade starts intervention with water, later with foam
- 12:05 fire under control
- damage to piping

MJV Belgium
Petroleum Storage • 2005

Incident 19 march 2005

- Causes:
- work permit system and follow-up insufficient
- emergency plan contains no "land spill" scenario
- communication with local fire brigade insufficient

MJV Belgium
Petroleum Storage • 2005

Incident 19 march 2005

- Actions to take:
- improving work permit system annex follow up
- improving emergency plan

Annex 3 :
Short explanation on the Planop documentation

PLANOP

PLANOP is a software-assisted method for performing "loss of containment" analyses for process installations handling hazardous substances.

Key features:

- Loss of Containment Analysis: Progressive identification of the causes and consequences of undesired releases of substances or energy, supported by a series of suggestion lists;
- Hazard analysis, i.e., investigating substances and reactions and their hazardous properties;
- Layers Of Protection Analysis (LOPA) for evaluating measures preventing major accidents (including SIL classification of instrumental safety systems);
- Creation of Process Safety Documentation, to be used as the basis for a (Major Accident) Safety Management System.

PLANOP is being developed by the Chemical Risks Inspection Division of the Belgian Federal Public Service of Employment, Labour and Social Dialogue.
The PLANOP program is freely available at http://www.planop.be.

Structure of the documentation

Each installation is subdivided into subsystems. For each subsystem different scenarios for loss of containment are identified and analysed. This analysis is split into an analysis of the causes of a loss of containment and an analysis of the consequences of the loss of containment.

The causes are identified and structured by means of so called "event sources". These are phenomena that can cause a loss of containment. For each subsystem a list of event sources is produced.

For each event source the underlying causes are elaborated in a tree like structure. These can be found in the event source data sheets.

The consequences are analysed by means of a tree structure of so called "release events". Release events are events that happen after a release. This tree structure of release events can be found in the release event data sheet (one for each subsystem).

Both tree structures describe a chain of events and include the preventative and mitigating measures that can stop or mitigate this chain.

The measures are identified with the scissors symbol.

After the tree structure which indicates how the measure intervenes in the chain of events, a list is given with additional information and requirements (items of consideration) for the measures. Note that all measures are numbered for easy reference to the tree above.

Reading an Event source data sheet

For each subsystem there is a list of event sources. For each event source there is a data sheet elaborating the underlying causes of the event source.

Each event source leads to a certain effect, e.g. high pressure, internal corrosion, etc.

The event source data sheet contains two tree structures.

- A first tree structure leading from various initial events and conditions to the effect;
- A second tree structure linking the effect to one or more releases (e.g., fatal rupture of vessel, release through breathing valve, etc.).

Part one: tree from initial event to effect

The top event of the tree is the effect.
The chain of events is shown in this tree from the right to the left. So the underlying (preceding) causes are detailed to the right. Here again the different levels are indicated by an indent to the right.
The mitigating measures ( ) are shown above the cause they are acting on. So they cut the chain of events preventing it to move up the tree.

The events in the cause tree can be of two types:

- conditions, this is a permanent property or temporary state of the process or installation under consideration;
- an event, that is always treated as instantaneous, so no two events can happen on the same moment.

The events and conditions are linked in the tree structure by AND and OR operators indicating when the chain of events can continue.

Part two: tree from effect to release

This part of the tree indicates which release events ( ) can result from the effect described in the event source.

The measures ( ) in this list will only prevent the release event shown immediately underneath them (generally the worst case). If they work, they prevent this release and cause the release that is shown further down in the list. So these measures determine which of the two releases can be expected.

Reading a Release event data sheet

The release events are the consequences of a loss of containment.
The release events are shown in an event tree format.
The top item is the subsystem under consideration (symbol).
The following events are the different types of loss of containment that are possible in the subsystem. They are indicated with the release symbol .

For those releases where it is deemed useful, resulting events are further detailed. The chain of events in this tree goes from the left to the right. Note that this is the reverse of the event source tree! Different levels in the tree are indicated by an indent to the right. In this tree, measures ( ) are always shown before the event they try to prevent or mitigate. Note that the tree was only worked out for some loss of containments. This is done for simplicity of the presentation. In practice large parts of the tree will be valid for all loss of containments, but are not duplicated because they do not contain new information.

Different types of release events are represented in the tree with different symbols:
for spreading of a release;
for the impact of a release;
for harm to people;
for other damage caused.

Chain of events

The complete chain of events from underlying cause to victim can be followed through the different trees in the following way:

- initiating events have an indent to the far right of the cause tree in the event source data sheet;
- the chain continues to the left and upwards in the cause tree leading to the effect on top of the cause tree;
- the effect on top of the small tree in the release event section of the event source data sheet leads to one of the release events down that tree;
- that release event is the top of the release event tree;
- in the release event tree the consequences of the release are further detailed to the right and down that tree.

Annex 4 : List of participants

Title	First Name	Last Name	Organisation	Country/ Affiliation	E-mail
Mr.	Ernst	Simon	Government of Steiermark	Austria	ernst.simon@stmk.gv.at
Ms.	Miljenka	Klicek	Ministry of Environmental Protection, Physical Planning and Construction	Croatia	miljenka.klicek@mzopu.hr
Ms.	Vlasta	Pašalic	Ministry of Environmental Protection, Physical Planning and Construction	Croatia	
Mr.	Themistoclis	Kyriacou	Department of Labour	Cyprus	tkyriacou@dli.mlsi.gov.cy
Ms.	Leona	Roznetinska	Regional Inspectorate Prague	Czech Republic	roznetinska@ph.cizp.cz
Mr.	Paul	De Bruyn	TOTAL	European Process Safety Centre	paul.de-bruyn@total.com
Ms.	Sirje	Arus	Technical Inspectorate, Chemical Safety	Estonia	sirje.arus@techinsp.ee
Mr.	Priit	Laaniste	Estonian Rescue Board	Estonia	priit.laaniste@rescue.ee
Ms	Camilla	Rapp	Safety Technology Authority (TUKES)	Finland	camilla.rapp@tukes.fi
Mr.	Medhy	Melin	DRIRE - Ile de France	France	medhy.melin@industrie.gouv.fr
Mr.	Josef	Schwitte	Behörde für Stadtentwicklung und Umwelt, BSU (State ministry of urban development and environment)	Germany	josef.schwitte@bsu.hamburg.de
Ms.	Kerstin	Tschiedel	Environment Agency of Brandenburg	Germany	kerstin.tschiedel@afi-sdt.brandenburg.de
Mr.	Steinar	Hardarson	Administration of Occupational Safety and Health	Iceland	steinarh@ver.is
Ms.	Noreen	Tipping Quinn	Health and Safety Authority	Ireland	noreen_quinn@HSA.ie
Mr.	Paolo	Bragatto	Institute for Prevention and Safety at Work (ISPESL)	Italy	paolobragatto@tiscali.it
Mr.	Gianfranco	Capponi	National Environmental Agency (APAT)	Italy	cappg@anpa.it

Title	First Name	Last Name	Organisation	Country/ Affiliation	E-mail
Mr.	Dainis	Kanders	Latvia State Environmental Service	Latvia	dainis.kanders@vvd.gov.lv
Mr.	Joy	Oh	Ministry of Social Affairs and Employment	Netherlands	JOh@minszw.nl
Mr.	Ron	Ooms	Labour Inspectorate	Netherlands	MOoms@MINSZW.NL
Mr.	Lars	Drolhammer	Norwegian Pollution Control Authority	Norway	lars.drolshammer@sft.no
Mr.	Jon	Salvesen	Directorate for Civil Protection and Emergency Planning	Norway	Jon.Salvesen@dsb.no
Mr.	Pawel	Janik	Chief Headquarters of the State Fire Brigade	Poland	pjanik@kgpsp.gov.pl
Mr.	Álvaro	Barroqueiro	Inspectorate General of the Environment	Portugal	abarroqueiro@ig-amb.pt
Mr.	Rui	Cabrita	Inspectorate General of the Environment	Portugal	rcabrita@ig-amb.pt
Ms.	Mihaela	Popaliciu	National Environmental Guard	Romania	popaliciu3@yahoo.com
Mr.	Daniel	Geisbacher	Slovak Environmental Inspectorate	Slovakia	geisbacher@sizp.sk
Ms.	Daša	Janežic	Ministry of Environment and Spatial Planning	Slovenia	Dasa.Janezic@gov.si
Ms.	Sofía	Tost Pardell	General Directorate of the Catalan Region	Spain	stost@gencat.net
Ms.	Britta	Andersson	The County Administrative Board of Oestergoetland	Sweden	britta.andersson@e.lst.se
Ms.	Ann-Marie	Stomrud	Swedish Work Environment Authority	Sweden	ann-marie.stomrud@av.se
Mr.	Robin	Cowley	Health and Safey Executive	United Kingdom	robin.cowley@hse.gsi.gov.uk
Mr.	Brian	Mills	Health and Safety Executive	United Kingdom	Brian.Mills@hse.gsi.gov.uk
Ms.	Maureen	Wood	Major Accident Hazards Bureau	European Commission	maureen.wood@jrc.it

European Commission
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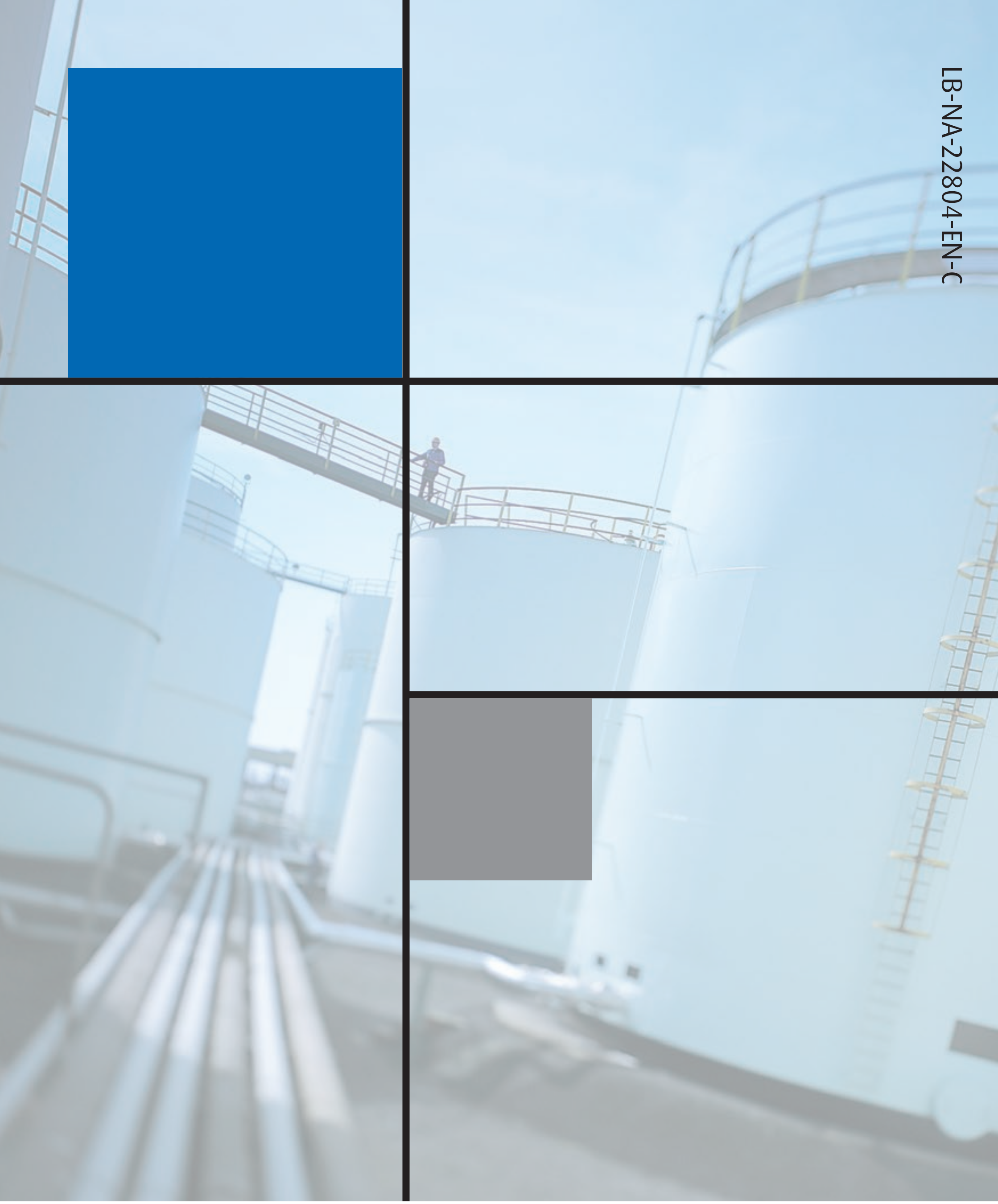
Abstract
Sites for the storage and handling of petroleum products such as gasoline, diesel and gas oil, so called "petroleum depots" are widely spread over Europe. With the 2003 amendment of the Seveso II Directive (2003/105/CE), the number of such depots coming under the scope of the Directive increased significantly due to the lowering of the thresholds for the substances in question. Petroleum storage depots have been defined by EU Seveso inspectors as one of its topics of high interest. Therefore, a "Mutual Joint Visit" (MJV) workshop was formed around this topic to solicit expert opinions on good practice and key elements for enforcing the Directive in these types of establishments. This document, Necessary Measures for Preventing Major Accidents at Petroleum Storage Depots: Key Points and Conclusions, summarises the key points and conclusions on this topic generated by discussions between Seveso inspectors from 20 different countries, including 16 EU Member States, 2 candidate countries and 2 EFTA countries who participated in this event.

This document is the first publication in the Seveso Inspections Series. The Seveso Inspections Series is intended to be a set of publications reflecting conclusions and key points from technical exchanges, research and analyses on topics relevant to the effective implementation of the inspection requirements of the Seveso II Directive. These publications are aimed to facilitate sharing of information about Member States experiences and practices for the purpose of fostering greater effectiveness, consistency and transparency in the implementation of Article 18 of the Directive. The series is managed by the European Commission's Technical Working Group on Seveso II Inspections (TWG 2), consisting of inspectors appointed by members of the Committee of the Competent Authorities for Implementation of the Seveso II Directive (CCA) to represent Seveso inspection programmes throughout the European Union.



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