Safety Guidelines and Good Industry Practices for Oil Terminals

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Authors:

Frank Candreva (DNV Oil and Gas, Belgium)
Eddy De Rademaeker (European Federation of Chemical Engineers, Belgium)
Richard Gowland (European Process and Safety Centre, United Kingdom)
Alexey Isakov (GCE, Russian Federation)
Gerhard Winkelmann-Oei (German Federal Environment Agency, Germany)

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List of abbreviations

ADNR	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
API	American Piping Institute
ASA	American Standards Association
ASME	American Society of Mechanical Engineers
ATEX	European Union Directive Control of Explosive Atmospheres
BAT	Best Available Technology
CA(s)	Competent Authority(ies)
DIN	Deutsches Institut für Normung
ECE	United Nations Economic Commission for Europe
GIP	Good Industry Practices.
IEC	International Electrotechnical Commission
OT(s)	Oil Terminal(s)
OTMS	Oil Terminal Management System
QA	Quality Assurance
QC	Quality Control

Introduction

Under the Assistance Programme to the United Nations Economic Commission for Europe (ECE) Convention on the Transboundary Effects of Industrial Accidents (Industrial Accidents Convention), a project involving the Republic of Moldova, Romania and Ukraine was set up in 2010, aimed at preventing and mitigating the consequences of industrial accidents through improving hazard and crisis management in the Danube Delta.

When analysing the risk potential of hazardous installations from the involved countries in the Danube Delta, it became evident that three oil terminals (OTs) – Giurgiulesti (Republic of Moldova), Galati (Romania) und Reni/Izmail (Ukraine) – have an increased hazard potential for the ecosystem and natural heritage of the Danube Delta. In order to improve risk management within and between the three countries in the Danube Delta, particularly through strengthening hazard and crisis management, the project management group decided to elaborate safety guidelines and good industry practices (GIP) for OTs as a part of the project.

As safety problems and risks at oil terminals exist not only in the above-mentioned countries but may also be present at OTs in the entire ECE region, it was deemed useful to establish an international expert group which would elaborate safety guidelines for OTs that could serve as a basis for the harmonization of safety standards across the ECE region. To this end, the secretariat to the Industrial Accidents Convention established in March 2012 an international expert group to elaborate safety guidelines for OTs in order to assist authorities and operators in the ECE region to ensure an adequate safety level at OT facilities.

The expert group at its first meeting analysed the reasoning and need for the development of the current guidelines. Being aware that failures and incidents at OT facilities may have far-reaching consequences for the environment and human health, they stressed that since the 1970s, 40 per cent of small- and medium-sized oil spills and 29 per cent of the large oil spills occurred during loading or discharging (which are typical operations at ports and OTs[1]) and that those spills have caused harm to human health and severe environmental damage to fisheries, social and economic activities and the aquatic environment.

Also in many cases, an incident at OT facilities leads to much higher costs for a company (in terms of repairs, loss of share value, cost of closure, remediation and claims) than the company would have invested to ensure a proper level of safety and to have prevented the incident from happening. Proper design, construction, operation and closure of an OT should therefore be of high priority for both the operator and the authorities.

Although a number of guiding materials in this area are already available internationally, they are often too complex for effective use by many operators and authorities or too focused on particular technical elements. The ECE safety guidelines and GIP for OTs aim to address these and other challenges by providing a practical overview of the safety precautions needed for those running such a facility. Against this background, the international expert group, drawing upon its substantial expertise in OT safety, prepared the present safety guidelines. It took into account input provided by authorities, operators of OT facilities, financing

1 Source: The International Tanker Owners Pollution Federation (2010), http://www.itopf.com/information-services/data-and-statistics/statistics/index.html#no.

institutions and non–governmental organizations. The draft safety guidelines were also discussed with representatives and experts from ECE member States during a workshop on the safety of OTs, held in September 2013 in Odessa, Ukraine. The final version of the safety guidelines also includes comments from international organizations and ECE member States. It will be adopted at the eighth Conference of the Parties to the Industrial Accidents Convention in autumn 2014.

Scope

These safety guidelines apply to OTs in which one or more hazardous substances are present or may be present in quantities at or in excess of the threshold quantities listed in annex I to the United Nations Economic Commission for Europe (ECE) Convention on the Transboundary Effects of Industrial Accidents (further referred to as The Convention).

These safety guidelines and good industry practices (GIP) are to be applied at all land-based OTs. Off-shore terminals are not under the scope of the Convention, but the safety culture should not differ.

OTs within the meaning of the present principles and recommendations are facilities for storing oil and their derivatives, including loading, unloading and transfer activities. The oil derivatives include but are not limited to gasoline, diesel fuel, jet fuels, heating and fuel oils, naphta, flammable liquids etc..

The safety guidelines &GIP described hereafter are derived from industry experience, further to major accidents happened and best available technology developed in the aftermath of the incidents to avoid recurrence.

These guidelines recognize that different safety standards exist worldwide and that different levels of safety exist with regard to cargo, the modes of transport and transport interfaces.

This document focuses primarily on safety guidelines for OTs. Security concerns are not within the scope of these guidelines but they should be taken into account at all stages of the life-cycle of the OT.

Definitions

Definition	Explanation
Oil Terminal (OT) operator	Any natural or legal person, including public authorities, in charge of an OT.
Public	One or more natural or legal persons.
Effects	Any direct or indirect, immediate or delayed adverse consequences caused by an industrial accident on, inter alia: (i) Human beings, flora and fauna; (ii) Soil, water, air and landscape; (iii) The interaction between the factors in (i) and (ii); (iv) Material assets and cultural heritage, including historical monuments.
Transboundary effects	Serious effects within the jurisdiction of a Party as a result of an industrial accident occurring within the jurisdiction of another Party;
Good industry practices	In relation to any activity and any circumstances, the exercise of that degree of skill, diligence, prudence and foresight which would reasonably and ordinarily be expected from a skilled and experienced operator engaged in the same type of activity under the same or similar circumstances.
Incident	An undesired event which could ("near-miss") or does result in unintended harm or damage ("accident")
Near-miss	Any unplanned event which, but for the mitigation effects of safety systems or procedures, could have caused harm to health, the environment or property, or could have involved a loss of containment possibly giving rise to adverse effects involving hazardous substances.
Safety report/ Safety Declaration/ Major Accident Report	The written presentation of technical, management and operational information concerning the hazards of a hazardous installation and their control in support of a justification for the safety of the installation.
Stakeholder(s)	Any individual, group or organisation that is involved, interested in, or potentially affected by the OT activities.

PART 1: PRINCIPLES AND GENERAL RECOMMENDATIONS

1. Principles

1. Proper design, construction, operation and closure of an OT should be a high priority both for the operator and for the Competent Authorities:

   (a) The OT operator and/or owner has primary responsibility throughout the whole lifecycle of its systems both for ensuring safety and taking measures to prevent accidents and limit their consequences for human health and the environment. Furthermore, in case of accidents, all possible measures should be taken to limit the consequences.

   (b) Competent Authorities should introduce and enforce adequate measures to ensure that the operators are committed to safety (e.g. with respect to the adoption of Best Available Techniques, BAT). The Competent Authorities play an important role in the approval of post-closure plans, as specified further in chapter 5.2.3).

   (c) New industrial facilities (in case Oil Terminals) should incorporate the principles of "design for decommissioning" (see further sub 1.5.1).

2. Governments should provide leadership and create minimum administrative frameworks to facilitate the development and safe design/planning, construction, operation/management and closure/decommissioning of OTs.

3. The operators of OTs have the primary responsibility for ensuring operational and process safety of OTs and the personal health of the operating staff. The operators are therefore committed to adopt sound principles and arrangements and to develop a system to ensure that major hazards are effectively managed; reference is made to the principles defined by the Process Safety Leadership Group (PSLG, 2009).

4. The OT Operator should ensure that an appropriate level of competence is available throughout the life cycle phases of an OT (design / planning – construction / commissioning – operation / lifetime extension– closure/decommissioning) and only competent personnel should be allowed to perform high-risk tasks.

5. Appropriate measures should be taken in case of accidents. Emergency plans should be established by OT operators (internal emergency plans) and by authorities (external emergency plans) and should be tested and regularly updated. These plans should include descriptions of the measures necessary to control accidents and limit their consequences for human health and the environment.

6. For OTs which pose a potential risk to neighbouring countries, the concerned ECE Member states should inform each other of their emergency plans and endeavour to make such plans compatible and where appropriate should draw up joint off-site emergency plans.

7. Land-use planning considerations should be taken into account in view of OT siting and intended post-operational land use.It is important to ensure that the public is given early and effective opportunity to participate in the decision- making relating to OT

operations that can potentially have significant adverse effects.In especially the provisions of the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus, 1998) have to be taken into account.

8. For OTs which pose a potential risk to neighbouring countries, communities and land-users due to their size or presence of hazardous substances, information to and involvement of these countries, communities and individuals should be ensured for the purpose of drawing up an off-site emergency plan.
9. For proposed new major storage facilities for petroleum, petrochemical and chemical products, and for large-diameter oil and gas pipelines and modifications of existing ones that are likely to cause a significant adverse transboundary impact during normal operation and occurrence of major accidents, the provisions of the ECE Convention on Environmental Impact Assessment (EIA) in a Transboundary Context (Espoo, 1991) should be followed, considering also the available national EIA legislation

1.1. General recommendations

10. The following are the recommendations and the key elements of the ECE guidelines and good practices for OTs. They are designed to prevent incidents at OT facilities from happening and to limit the accidental consequences for human health and the environment. They are based extensively on accepted and published best practice procedures to ensure conformity with international standards.
11. These guidelines should be read also in the context of existing international guidelines, recommendations and standards concerning OTs.
12. These guidelines constitute a minimum set of Good Industry Practices (GIP) to ensure a basic level of safety for OTs by applying different policies, measures and methodologies.
13. National standards should be applied where they are stricter than the recommendations in this document.
14. Below are recommendations to the UNECE member States, Competent Authorities (CAs) and OT operators.
15. The Annex to Part 1 – Matrix of Life Cycle- and the technical and organizational aspects, listed in part 2, are an integral part of these guidelines and good industry practices.

1.1.1.ECE member States

16. ECE member States should ensure that OT operators are required to demonstrate the OT safety as part of the application for an OT permit. This should be complemented by a financial security or any other equivalent, on the basis of arrangements to be decided by the Member States, in order to ensure that all obligations arising under any

permit issued, including closure and post-closure requirements, as well as any other obligations, can be met. This financial security should be valid and effective before commencement of the operation.

17. ECE member States should adopt policies for the Safety of OTs, including safe transport, transhipment and storage of hazardous substances, aimed at limiting accidental consequences for human health and the environment. They should raise awareness and share experience and good practices through educational programmes and other means.
18. National legislation should be clear, enforceable and consistent with the requirements of the Convention in order to facilitate international cooperation in, for example, the development and implementation of external emergency plans.
19. ECE member States should aim to set up policies on insurance, civil liability and compensation for damage caused by the local and/or transboundary effects of industrial accidents. The ECE Protocol on Civil Liability could be used as a reference.
20. ECE member States should establish a system of controls and land-use planning procedures with involvement of the public. The safety of OTs should be ensured during all stages of the life cycle, in such a way that "ageing"[2] of the equipment is considered at all times.
21. National laws, regulations, policies and practices should take into account all the relevant stakeholders involved and should be consistent with international agreements and recommendations.
22. Member States should ensure that the competent authority is legally empowered and adequately resourced to be capable of taking effective, proportionate and transparent enforcement action, including where appropriate cessation of operations, in cases of unsatisfactory safety performance and environmental protection by operators and owners.
23. CAs should be designated at the national, regional or local level that, alone or together with other authorities, have the necessary competences to ensure adequate monitoring and control of OTs.The independence and objectivity of the competent authority should be ensured.
24. Member States should expect operators and owners, in following best practices, to establish effective cooperative relationships with the competent authority, supporting best regulatory practice by the competent authority and to proactively ensure the highest levels of safety, including, where necessary, suspending operations without the competent authority needing to intervene.

[2] The term "ageing" is defined by the Petroleum Safety Authority as follows: "ageing is not about how old your equipment is; it's about its condition and how it's changing over time" (PSA, 2008).

1.1.2.Competent Authorities

25. CAs should maintain within their organisations expertise relating to:
    (a) Accident prevention, emergency preparedness and response;
    (b) Inspection and audit;
    (c) Permitting requirements.
26. CAs should ensure that the objectives of preventing and limiting the effects of accidents are taken into account in their land-use policies, with particular regard to ensure safety distances between OTs and residential areas, buildings, areas of public use, recreational areas, major transport routes and areas of particular natural sensitivity or interest. For this purpose CAs should use discharge flow modelling and/or other relevant methodologies.
27. CAs should set up appropriate consultation procedures to facilitate implementation of the policies established. The procedures should be designed to ensure that technical information about human health & safety and protection of the environment is available, on a case-by-case or generic basis, when decisions are taken. CAs should also ensure that the public and other stakeholders are given the opportunity to give their opinion.
28. The CA is required to consider the technical and financial risks of applicants seeking a licence for operating an OT. There is the need to ensure that when examining the technical and financial capability of the license the licensing authority thoroughly examine also its capability for ensuring continued safe and effective operations under all foreseeable conditions. When assessing the financial capability of entities applying for authorisation, CAs should verify that such entities have provided appropriate evidence that adequate provisions have been or are to be made to cover liabilities deriving from major accidents.
29. CAs should implement the permitting process, by enforcing the future OT Operator to prepare environmental impact assessment, in a transboundary context when applicable.
30. CAs should oblige the OT operator to draw up a report on major hazards which should have to be thoroughly assessed and accepted by the competent authority. Acceptance by the competent authority of the report on major hazards should not imply any transfer of responsibility for control of major hazards from the operator or the owner to the competent authority.
31. CAs should set up a system of inspections or other control measures in order to ensure that OT Operators meet the legal requirements.
32. CAs are entitled to conduct legal inspections. They may establish provisions that set up a system for certified, independent experts to undertake the inspections of facilities.
33. When CAs use independent experts for inspections, they remain responsible for assessing the competence and accountability of experts and for the effectiveness of the inspection process.

34. The inspection regime of OTs as defined by the CAs should reflect the:
    (a) Hazard Potential of the OT;
    (b) Proximity to sensitive environments or communities;
    (c) Age of the installation;
    (d) “Ageing” of the equipment.
35. CAs should ensure that OT operators:
    (a) Draw up internal emergency plans and put them into effect without delay when an accident occurs; and
    (b) Supply the authorities designated for that purpose with the necessary information to enable them to draw up external emergency plans.
36. CAs should draw up and implement external emergency plans with measures to be taken in the vicinity of the OT where the effects of accidents might be noticeable.
37. CAs should ensure that internal emergency plans are drawn up in consultation with the personnel working inside the establishment, including long-term relevant subcontracted personnel, and that the public is consulted on external emergency plans when they are established or updated.
38. CAs may require the OT operator to provide any additional information necessary to enable them to fully assess potential accidents.
39. CAs should ensure that external and internal emergency plans are reviewed, tested and, where necessary, revised and updated at suitable intervals.
40. CAs should ensure that proper consideration is given to the prevention of third-party interference. They should provide the appropriate regulatory framework needed to control activities carried out by third parties, including clear awareness of responsibilities.
41. CAs should consult with other authorities, as well as other stakeholders (local communities, NGOs, other operators), in the surrounding of OTs in order to establish safety objectives and a control framework in the whole area. CAs are responsible for establishing permit conditions based on international accepted safety standards.
42. CAs should establish internal guidelines for key areas that need to be verified at OTs, and should train their own inspectors on an on-going basis.
43. CAs should encourage the existing educational institutions to develop education and training programmes that could ensure the necessary capacities for both industry and government staff.

1.1.3. OT Operators

The general recommendations for OT Operators are presented hereafter as they apply in the sequence of their lifecycle:

44. OTs should be designed, constructed, operated, and maintained to ensure a high level of protection for human health and the environment. Adequate consideration should therefore be given to various aspects which could affect the safety of an OT, such as inherent safe design and stress factors, quality of material, ageing phenomena, external impact protection, corrosion, and monitoring.

45. OTs should be designed, constructed and operated at least in accordance with recognized national and international codes, standards and guidelines and, where appropriate, internationally accepted industry specifications.

46. When considering hazard controls, or changes to existing controls, consideration shall be given to reducing the associated risks according to the following hierarchy of controls:

    (a) Elimination of the hazard;

    (b) Substitution of the hazard;

    (c) Engineering controls;

    (d) Administrative controls (e.g. procedures / work instructions) and / or signage / warnings;

    (e) Personal protective equipment.

47. The OT Operator should ensure at an early stage of the OT lifecycle (design stage) that all equipment is purchased to ensure a high level of protection of man and the environment. During construction, the OT Operator is responsible for purchasing all equipment and materials as specified in the design phase. The OT Operator is accountable for ensuring the as-built situation in accordance with design specifications. To this purpose, the OT Operator will implement controls on purchased goods and organizes the follow-up of inspections and contractor works.

48. The OT operator should establish and maintain an OTMS that is adequate to manage the OT risks and to comply with the applicable legal and regulatory requirements. The OTMS should also take into account any other voluntary commitments to which the OT Operator subscribes. To this purpose, it is required that the OT Operator establishes a Major-Accident Prevention Policy, MAPP, which would be the foundation of the OTMS.

49. Hazard identification and risk assessments should be undertaken during all stages of the lifecycle, as appropriate, in order to choose among different options and to assess unusual circumstances. The OT operator should adopt a methodology for the on-going hazards identification, risk assessment and determination of necessary control measures for routine and non-routine activities, and for management of change.

50. A report should be set up in order to make suitable arrangements for major accident prevention. Operators and owners of OTs should comprehensively and systematically identify all major accident scenarios relating to all hazardous activities that may be carried out, including impacts on the environment arising from a major accident. The hazard identification, risk assessments and arrangements for major accident prevention should be clearly described and compiled in the report on major hazards. The workers should be consulted at the relevant stages of the preparation of the report on major hazards.

51. The OT operator should inform the CA:

    (a) On planned arrangements to prevent major accidents (including the associated performance indicators and safety measures) by conducting risk assessments and adopting appropriate risk controls for identified scenarios (see also further, chapters 1, 2 and 3 of Part 2), and

    (b) On planned arrangements to limit the consequences when an incident occurs, as defined in the Emergency Planning and Response chapter (see further chapter 4 of Part 2).

52. To enable a safe operation, the OT Operator should establish and communicate clear management performance standards for all management levels and define roles, responsibilities and accountabilities for all employees. Lines of control and responsibility should be clearly defined and communicated to all parties.

53. The OT Operator should establish a list of key stakeholders (all parties involved in the safe operation of an OT) and identify their requirements.

54. The OT Operator should ensure that any person under its control performing high-risk tasks is competent on the basis of appropriate education, training or experience.

55. The OT Operator should establish competence requirements and identify training needs associated with the OT risks and risk controls as described in the OTMS. Consequently, OT Operators should train their personnel and reinforce and revise personnel's knowledge on safety as appropriate.

56. The OT Operator should determine those operations and activities that are associated with the identified hazards where the implementation of controls is necessary to manage the OT risks. For those operations and activities, the OT Operator will need to implement and maintain operational procedures and other controls.

57. OT should have an Operating Manual that is available to all personnel and to government inspectors. All documents relating to planning, design and construction should be maintained in an accessible way, with records kept permanently for reference at the future time.

58. OT operators should implement safety audits for their facilities and promote the use of management systems audits based on international standards.

59. OT operators are responsible for managing their contractors regarding the implementation of the major accident prevention, preparedness and response policy; this involves at least the following controls:

    (a) Defining selection criteria to ensure proper mapping with the competence requirements for specific activities;

    (b) Monitoring performance while working onsite the OT premises, including informing them on OT risks and their potential impact on the OT safety performance, communication and consultation where relevant when changes occur etc.).

    (c) Evaluating their overall performance.

60. The integrity and functionality of tanks and all mechanical equipment, instrumentation and safeguards of the OT should be maintained to good industry practice.

61. When applicable, OTs should be decommissioned in accordance with applicable national and international legislation, and where appropriate in line with agreed GIP.

PART 2 - TECHNICAL AND ORGANIZATIONAL SAFETY ASPECTS

Technical and organizational aspects of safety should be taken into account throughout the whole life cycle of OTs. Such an integrated view can be reflected by elements of the so-called safety chain, which comprises safety elements from the design and feasibility stage to the construction and operation till the decommissioning phase. Experiences from past industrial accidents are integrated in all elements through an efficient feedback mechanism.

The obligations for CAs are more general and are reflected already in the previous recommendations of part 1. The primary responsibility for safe operation of an OT is with the operator. The following safety guidelines concentrate on the operator's duties.

1. Design and Construction

Industrial facilities safety fundamentals and best operation practices are being formed during the design phase. The most significant is to consider the whole scope of safety aspects for the purpose of facilities engaged in hazardous substances manufacturing, storage, transportation and other processes. In most cases, oil terminals are classified as such facilities.

During the design phase, there is an opportunity to foresee all the site components location, considering essential safety regulations, similar facilities operational experience (positive and negative), propose the best and the most secure technologies and equipment.

The designing process should be carried out in recognition of identified hazards and risks assessment. Accepted design solutions should focus on maximal possible opportunity for risks reduction.

Designing should comply with national standards requirements, if available. In any case, oil terminals designing should be conducted within the best industrial sector methods.

Design failures, safety aspects incomplete accounting and environmental impact can cause substantial difficulties for oil terminal operator during a facility lifecycle phases and cause additional vast financial inputs.

Designing phase results should be documented and go through required monitoring procedures controlled by oil terminal operator and inspection authorities, in accordance with national standards requirements.

During designing phase, all environmental unfriendly impacts, safety factors and possible risks estimation should be considered in compliance with each lifecycle phase particularities, including decommissioning one.

Oil terminal operator and inspection authorities should maintain constant control for design solutions implementation during construction, equipment installation and commissioning phases, in accordance with national standards requirements.

Alterations introduced in design solutions during construction, equipment installation and commissioning phases require justification and should be confirmed by oil terminal operator and inspection authorities, in accordance with national standard requirements.

Subsequent parts of the chapter contain proposals on safety provisions to be considered for oil terminals design and construction phases.

1.1.Environmental Baseline and Impact Assessment

Environmental Baseline

For new OTs an Environmental Baseline should be established by the OT Operator and submitted to the CA, as part of the operating permit application. The Baseline Report should contain the information necessary to determine the state of soil and groundwater contamination so as to make a quantified comparison with the state upon definitive cessation of activities (decommissioning).

The Baseline Report should contain at least the following information:

(a) Information on the present use and, where available, on past uses of the site;
(b) Where available, existing information on soil and groundwater condition measurements that reflect the state at the time the report is drawn up
(c) Where relevant, existing information on nearby rivers or water courses that may be adversely impacted by the OT operations.

This recommendation applies to Oil Terminals involving the use, production, storage or transfer of relevant hazardous substances with regard to the possibility of soil and groundwater contamination, or having a potential adverse impact on other vulnerable parts such as water-courses of the receiving environment at the site of the industrial facility.

Environmental Impact Assessment (EIA)

If applicable, an EIA should be a precondition for construction and operation of an OT, or to major changes to the facilities at or operation of an existing OT. The EIA should address the potential adverse impact of the OT on the physical and social environment, in particular aquatic environment. The EIA should be available for the general public and interested or affected persons to comment and provide input to the assessment and to comment on or object to the construction and operation of the terminal.

The Espoo (EIA) Convention sets out the obligations of Parties to assess the environmental impact of certain proposed activities at an early stage of planning. It also lays down the general obligation of Member States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries. Among the proposed activities with a mandatory EIA are crude oil refineries and major storage facilities for petroleum, petrochemical and chemical products.

The OT Operator is responsible to prepare the EIA in a manner to conform to applicable legal and regulatory requirements. The information to be included in the environmental impact assessment documentation should, as a recommended minimum contain:

(a) A description of the proposed activity and its purpose;
(b) A description, where appropriate, of reasonable alternatives (e.g. locational or technological) to the proposed activity and also the no-action alternative;
(c) A description of the environment likely to be significantly affected by the proposed activity and its alternatives;
(d) A description of the potential environmental impact of the proposed activity and its alternatives and an estimation of its significance (for normal operations and when accidental releases are considered);
(e) A description of preventive and mitigation measures to keep adverse environmental impact to a minimum;
(f) An explicit indication of predictive methods and underlying assumptions as well as the relevant environmental data used;
(g) An identification of gaps in knowledge and uncertainties encountered in compiling the required information;
(h) Where appropriate, an outline for monitoring and management programmes and any plans for post-project analysis; and
(i) A non-technical summary including a visual presentation as appropriate (maps, graphs, etc.).

1.2. Facility Siting, Layout and Land Use Planning

Facility Siting and Land Use Planning can have significant effects on the hazards of the OTs. A thorough understanding of the risks posed by an OT will allow these to be minimized without adversely affecting commercial viability. New facilities offer an opportunity for adoption of appropriate safety distances (to vulnerable areas and the community), new technology, inherently safer designs and Good Industry Practices

When compared with new facilities, existing facilities may pose different problems demanding innovative approaches, more stringent operational controls enhanced asset inspection and emergency procedures. For existing facilities, new developments such as replacements and expansions need to reflect current Good Industry Practice in facility layout. Layout means the location of various components within the plant (such as flares, relief devices and blow-down systems, emergency access, fire pumps etc.).

1.2.1.Facility Siting and Layout

In the OT planning phase, site-selection decisions should take into account the risk of exposing human populations and vulnerable habitats to the hazards of toxic and flammable materials. The consequences of "credible worst case scenarios" need to be considered during the conceptual or basic engineering phase, before a large commitment has been made to a specific site location. The following parameters should be taken into account by the investor / future OT Operator:

(a) General layout of the facility: Is there an adequate buffer zone (safety distance) between the OT and vulnerable environment/populations / and public facilities;
(b) Domino effects: Are there nearby sources (equipment / installations) that could threaten the entire site by potential "domino effects";
(c) Secondary and tertiary Containment considerations;
(d) Emergency access and response support Access for Emergency Response teams (Fire Brigade, Police, Ambulance Services);
(e) Power supplies: The need for emergency equipment such as lighting, fire pumps, sprinkler system to operate when the main power source is impaired;
(f) 'Safe Refuges': Are there safe refuges considered in case of fire and toxic releases;
(g) Occupied Buildings (e.g. Control Rooms, meeting rooms and offices);
(h) The consideration of location of occupied buildings to minimise risk for the occupants in an emergency situation such as fire or explosion
    i. Location (e.g. remote from the source of hazard, consideration of prevailing wind direction);
    ii. Construction (e.g. resistance to effects of fire (thermal radiation) and or explosion (overpressure));
    iii. In the case of Control rooms – provided with uninterruptible power supplies to control systems in the event of power failure.
(i) Provision of Fire water and Fire Protection systems. These may be provided via specific systems within the OT or local city supply or from harbour. Capacity should be related to the fire water requirements (flow and total available volume) to fight the fire event. Vulnerability to disruption during an emergency needs to be considered e.g. damage from fire or explosion causing the fire protection to fail.
(j) Security systems and access controls:
    i. Provision of a secure perimeter fence (land side) and measures to prevent unauthorised access from water side;
    ii. Provision of access controls at land side gates and from ships in harbour;
    iii. Equipment for 24 hour surveillance of hazardous areas and perimeter fence.

1.2.2.Land Use Planning

For new OTs, the CAs have to take into account appropriate safety distances from transport routes, locations of public use and residential areas and areas of natural sensitivity or interest (vulnerable areas). These distances should limit the consequences of possible accidents for human health and the environment to an acceptable level.

For existing establishments, the CAs have to consider relevant technical and/or management measures for those establishments in or close to vulnerable areas.

1.3. Safe Design

National standards for equipment design and operation where they exist should be implemented and be the subject of inspection by the OT operator and the CA. Wherever possible, the design of equipment within an OT should be to industry good accepted practice and incorporate learning from relevant incidents (e.g. Buncefield Fire and Explosion – see Part 3).

The following key aspects for the design and operation of equipment related to hazard / detection / control and response have to be taken into account at three levels of protection:

1.3.1. Primary safety considerations:

(a) Tank design to meet appropriate local legal codes or industry standards (such as ASME, DIN);
(b) Piping, valve, pumps and fitting design according to requirements for piping design to meet appropriate local legal codes, or industry standards (such as DIN,ASA) ;
(c) Choosing construction material according to the mechanical, thermal, chemical and biological stress of service;
(d) Isolating Valves should be "firesafe" to a typical industry standard;
(e) Outdoor over ground plant units should be protected against the force of buoyancy during flood events and from mechanical damages due floating substances or objects;
(f) Underground containers and pipelines should be secured against the force of buoyancy;
(g) Level measurements devices should be installed, which include Low and High level alarms;
(h) Overfill prevention devices – Level detection linked through a "logic solver" (hardware or software) to interrupt flow in the event of a hazardous level occurring in a tank;
(i) Provision of equipment designed and managed (i.e. in accordance with ATEX 99/92/EC):
    i. Electrical Systems (motors, instrumentation);
    ii. Hot surfaces (pumps, gearboxes etc.);
    iii. Electrostatic charge;
    iv. Control of hot work.

1.3.2.Secondary safety considerations:

(a) Storage tanks are normally located inside a retaining wall on a solid foundation (i.e. full tank base coverage, not "ring" foundation, flat-bottom tanks should have a double-walled and the between wall space monitored to detect leaks in the primary containment);

(b) Transhipment sites should have retention facilities capable of accommodating the volumes of liquid that can escape until suitable measures or automatic safety systems take effect (secondary containment);

(c) Underground pipelines should be double-walled or any detachable installed connections and valves should be installed in monitored leak proof inspection chambers;

(d) Construction of containment should be impermeable: The integrity of sealed systems must be in accordance with the physical-chemical properties of the substances handled. The integrity of the containment should be demonstrated by generally accepted and recognized testing method;

(e) The containment should have total volume appropriate to 110% of the largest tank or 25% of all the Tank volumes (whichever is the greater) , plus an allowance for maximum daily rainfall

(f) Additional tertiary containment volume for fire water retention, which must be leak proof and resistant to the fire fighting water and foam. needs to be considered. The size of the fire water retention depends on following parameters:

  i. Hazard of the stored substances;
  ii. Readiness of the fire brigade and the predicted time to gain control of a fire event;
  iii. Predicted flow of fire water to control the fire event.
  iv. Fire protection infrastructure (fire detection systems, fire extinguishing system) ;
  v. Total area of storage section;
  vi. Height of goods stored in warehouses etc.

(g) Loading and Off-Loading inland waterway vessels-special care should be taken to observe the process (ADNR 151412) ;

(h) Overflow detection devices, which act when a release has started. These could be situated inside the secondary containment or in a piped overflow from a tank;

(i) Gas and Flammable Vapour Detection:

  i. These act to detect flammable vapour in (e.g.) secondary containment. They are usually located close to tanks and equipment such as pumps and overflow piping. They do not act to prevent a loss of containment, but mitigate the potential scale of the event in the sense that they alert process operators or in some cases initiate the fire protection system. There are several suitable technologies used for detection including Infra-Red, Catalytic Oxidation etc.

(j) CCTV surveillance;

  i. This is frequently provided for security purposes, but has value in observing the presence of flammable vapour.

1.3.3.Tertiary safety considerations:

(a) Meeting the hazardous area classification and management (e.g. electrical area classification and zoning (for example, as described in the requirements of the EU ATEX Directive 1999/92/EC)
(b) Operators should review and amend if needed, the management system for the maintenance of equipment to ensure their reliability in operation. This includes:
   i. Periodic proof testing of equipment to minimise the likelihood of equipment failure.
   ii. Management of change (hardware, software, mode of operation, service (material stored or transferred) personnel and frequency.
(c) All elements of an overfill prevention system should be proof tested in accordance with validated arrangements and procedures sufficiently frequently to ensure the required reliability (e.g. probability of failure on demand) Safety Integrity Level (SIL) of protective systems; in the case of Safety Instrumented Systems the Safety Integrity Levels is maintained in practice in accordance with the requirements of Part 1 of IEC 61511)

Periodic test by (external) experts of the safety-systems. This test should be documented and retained by the OT operator in equipment files. Overfill prevention systems (i.e. the high-high level shut off devices)should be physically and electrically separate and independent from the systems which are used to manage and adjust the levels in tanks. It provides a warning that the tank rated capacity has been (or is about to be) reached/exceeded and triggers a response:

Overfill protection systems including instrumentation, alarms and automated shutdown systems should be assessed using IEC 61511, to include the following:

(a) Design, installation, operation, maintenance and testing;
(b) Management systems;
(c) Redundancy level, diversity of measuring methods. (Avoiding common cause failures) ;
(d) Fail safe design principles, proof testing coverage and frequency;
(e) Consideration of common cause failures.
(f) Independence from the level control activity.

1.3.4.Information and system interfaces for front-line staff

Control room design and ergonomics, as well as effective alarm systems, are vital to allow front line staff, particularly control room operators, to reliably detect, diagnose, and respond to potential incidents.

1.4. Quality Assurance during procurement, fabrication, installation and commissioning

A QA/QC programme ensures that equipment is purchased and built according to the design requirements, while meeting all applicable legal and technical standards and codes.

The OT Operator is recommended to have a QA/QC programme in place to prevent equipment failures that could result from:

(a) Use of faulty parts / materials due to improper controls at material/ parts delivery stage;
(b) Improper fabrication, installation or repair methods.

The Operator's OT Management System should provide guidance and mechanisms to assure that appropriately qualified and trained craftsmen (such as certified welders) are used for specified vessel and piping fabrication and for installing safety critical equipment and instrumentation.

A material tracking programme should be in place as control function to ensure that materials and equipment are purchased as specified in the OT Requirements Database. The material certificates supplied by tank fabricators should be stored in the OT Operator equipment file.

1.5. Hazards Management

The term Hazards Management refers to the process of Hazard Identification and Risk Assessment (HIRA), risk ranking and further controlling / reducing the risks to acceptable or tolerable levels. Hazards Management should be taken into account by the OT Operator and all other key stakeholders in all phases of the life cycle of the OT.

In these guidelines we have assumed that the majority of the OTs have the potential for causing a major accident and are potential hazardous activities regarding the quantities of hazardous substances as specified in Annex I of the Convention

1.5.1. Hazards Management in the Design & Planning phase

Design and planning phase as considered here includes all the project initiatives in what can be considered as first phase, such as:

(a) Technical & Economic Feasibility study phase;
(b) Basic Engineering;
(c) Detailed Engineering.

Safety Report

After having conducted a high-level Technical & Economic Feasibility study, the permit application process can start as soon as the investment decision is being made. The OT operator may produce a written presentation of technical, management and operational information concerning the hazards of a hazardous installation and their control in support of a justification for the safety of the installation (a Safety Report).

The Safety Report and the EIA are valuable documents in the operating permit application phase. Atypical Safety Report has 3 dimensions:

(a) To establish a MAPP (Major-Accident Prevention Policy);
(b) To implement a SMS (Safety Management System) aiming at prevention of major accidents happening;
(c) To institutionalize a damage control system by the preparation and implementation of effective internal emergency plans to limit the consequences on man and the environment.

The Safety Report should address the following essential parts (chapters):

(a) General information on the OT;
(b) Description of the OTMS;
(c) Description of the OT location, indicating the existence of possibly nearby vulnerable environmental sensitive areas or populations;
(d) Description of the installation and its operations, including the storage and related transport modes for the hazardous materials (e.g. ship transfers, pipeline transfers, road and rail transfers) ;
(e) Identification of the major-accident hazards, incorporating preventive action measures to prevent such scenarios from happening, and in addition risk control measures to limit the consequences on man and the environment in case such scenarios (e.g. loss of containment) would happen. This part constitutes the core of the Safety Report;
(f) The Internal Emergency Plan (IEP), describing the organisational aspects related to emergency preparedness and internal measures to respond to undesired events and mitigate to avoid further escalation (damage control). Testing of the effectiveness of the IEP is part of the emergency preparedness.

The Hazard Identification & Risk Assessment part constitutes the core of the Safety Report: the Operator describes the hazards and relevant scenarios with the potential to cause a major accident. Risk assessments may include Process Hazard Analysis (PHA), structured ‘What-If?’ methods and checklists, Hazard & Operability studies (HAZOP), Layer of Protection Analysis (LOPA), Quantified Risk Assessment (QRA) .This risk assessment leads to an understanding of potential major accidents allowing ranking of the most credible major accident scenarios and methods of controlling them to a tolerable level. Subsequently, the OT Operator examines the Safety Critical Elements for each classified major accident scenario (Safety Case). The Safety Critical

Elements can also be formulated as the “Critical Barriers” or “Layers of Protection” that prevent the MA scenario from happening.

To be effective, “technical performance standards” should be defined for these critical barriers. The following criteria are considered as good industry practice for these barriers:

(a) Functionality - what the barriers should achieve;
(b) Availability - how often it will be required to operate satisfactorily;
(c) Reliability - how often it will be required to operate on demand;
(d) Survivability - the conditions under which it will be required to operate (from the effects of Major Accident Hazards) ;
(e) Interaction / dependency – how the critical barrier interacts with or is dependent on other barriers.

OT Operators should ensure (e.g. by testing) that they have suitable techniques to demonstrate and assess their barriers for effectiveness.

Domino effects:

The OT Operator should evaluate to what extent a small accident at the OT may escalate to a major accident and take adequate measures for these scenarios. The CAs shall identify possible domino effects by actively requesting additional information from the OT Operators. The CAs should ensure communication to other Member States in case of potential transboundary effects. Large scale domino effects should be considered in External Emergency Plans by the CA’s.

Many of the items suggested for this safety report will be valuable in the creation of the OT Operating Manual. (see 2.4)

Design for decommissioning

The “design for decommissioning” proactive approach is recommended as GIP and specifies the application of general design requirements such as:

- Using materials that are easy to recycle or reuse.
- Using a modular design to make it easier to assemble, disassemble and transport parts of the industrial facilities
- Minimizing the use of hazardous materials.
- Minimizing the amount of contaminated material or hazardous waste that will be generated upon decommissioning.
- Using pollution prevention measures such as concrete areas, interceptors, containment, and liners to prevent or mitigate pollution from on-going operations.
- Avoiding the installation of underground storage tanks containing hazardous substances, if possible.
- Considering the installation of double contained piping systems for extremely hazardous and toxic chemical piping systems.

The protection of soil and groundwater is of particular concern. Remediation of contaminated soil and groundwater is expensive and very difficult.

The following four key activities reflect the “design for decommissioning” proactive approach, recommended as GIP, to be considered during the OT design phase:

(a) Identifying and implementing current and future legislation, regulatory and contractual requirements. This implies by example:

- Identification of specific site conditions and site closure plans aiming at reaching a “satisfactory state” and preventing on-going pollution)
- Applying relevant legislation on end-of-life equipment (e.g. waste electronic equipment).

(b) Establishing the contractual liabilities of the OT Operator, i.e. the company should only be responsible for pollution caused by their own operations (for properties that are bought or leased). This triggers the OT Operator:

- To consider any insurance requirements.
- To make possible provisions for future costs.
- To establish conditions and method statements for subcontractors.

(c) Establishing the environmental baseline for soil, waters and groundwater, aiming at:

- Identifying any existing pollution, sources and possible pathways offsite;
- Providing a comparison point for future assessment so that it is easier to show the responsibility for existing pollution at the end of the life of the plant
- Considering the influence of neighbours and surrounding land use;
- Considering the possible impacts of natural phenomena, such as flooding, on the possible spread of pollution offsite;
- Considering the impacts of rainwater runoff.

(d) Specifying design requirements (see details sub section 1.5.1)

NB: The above information may be used as part of the permit preparation and should be generated at the design stage for new industrial facilities.

1.5.2.Hazards Management in the other phases of the OT lifecycle

The OT operator should have a procedure in place indicating which type of HIRA will be used in all further lifecycle phases once the terminal is built.

Typically, risk assessments as described in the above section on safety report also apply during the Operations Phase.

Task-based risk assessments are often used for all routine tasks while Job Safety Analyses and Pre Start-up Safety Reviews are being used for more complex and non-routine tasks such as safe start-ups after shutdown and specific maintenance activities.

Expert safety reviews, Process Hazards Analysis, legal compliance checks and due diligence reviews are being used for life extension considerations, closure and decommissioning activities.

2. Operations and Management

Oil terminals refer to industrial facilities with high potential to large-scale accidents occurrence, due to operations performed, installed equipment, processed hazard substances and other distinctive features. Technology and equipment accepted during the design phase and implemented during construction phase cannot generate emergency situation alone. Various emergency scenarios realization capability, including large-scale accidents, appears only in the process of industrial activity, i.e. during operational phase.

Workforce (experts of various specializations and qualification, etc.) is one of the key elements of industrial activity. Operated facility safety status depends much on the personnel actions. Successful personnel performance, causing no emergency situations, depends on system approach to oil terminal industrial process safety management.

Subsequent parts of the chapter provide elements of oil terminals safety management.

2.1. Process Safety

For managing operating systems and processes that handle hazardous substances a disciplined framework called process safety is being used in both upstream and downstream oil and gas industries, as is in the chemical industry.

Personal or occupational safety hazards may provide damage to health by short or long-term exposure to hazardous materials or by accidental damage to individual workers as a result of slips, falls or other contacts with machinery or moving objects.

Process safety hazards, on the other hand, can give rise to more severe consequences or major accidents involving the release of potentially hazardous materials, the release of energy (fires and explosions) or both; they can have catastrophic consequences and may result in multiple fatalities, economic loss, substantial loss to property or may lead to severe environmental damage.

Therefore, the OT Operator should focus primarily on process safety and process safety management, which means to orient his resources more towards issues such as safe design, adoption of engineering best practices, process hazards assessments, management of change, inspection, testing and maintenance of safety critical equipment, effective alarms, effective process controls and training his workforce accordingly, to enable them to better understand and manage process safety hazards.

Process safety management involves a particular type of hazards management, identifying and controlling the hazards arising from process activities, such as the prevention of leaks, spills, equipment malfunctions, over-pressures, excessive temperatures, corrosion, metal fatigue, and other similar conditions.

OT operators should ensure implementing an integrated and comprehensive management system that systematically and continuously identifies process safety hazards, reduces and manages process safety risks, including risk of human failure, to finally achieve acceptable levels of risks.

The following sections from this Chapter are considered as good industry practices for implementing an OT Management System oriented towards process safety.

2.2. Leadership and Safety Culture

Poor safety culture has been found to be a significant causal factor in major accidents. The leadership of senior managers, and the commitment of the chief executive, is therefore vital to the development of a positive safety culture.

The following six elements are considered as essential features for establishing and maintaining a sound process safety culture:

(a) Establish process safety as core value:
The OT Operator and the workforce are highly committed to process safety and accept full responsibility for their performance. A strong operational discipline is adopted; as such, there is a strong individual and group intolerance for violations of performance norms.

(b) Enforce high standards of performance:
Management performance standards and workforce expectations are fully understood, while adopting a zero tolerance policy for wilful violations of process safety standards, procedures and rules.

(c) Provide strong leadership:
OT Leaders act as role model and walk the talk by visible and consistent support for selected process safety programs and established targets. Adequate resources are provided to support a high performance level, without creating initiative overloads for leaders and the workforce.

(d) Document the cultural values:
The key principles and practices that characterize the foundation of the company values and beliefs are documented in clear statements and periodically challenged.

(e) Empower employees at all levels:
A positive and trusting work environment is aimed for, while avoiding a blame culture and allowing maximum learning from incidents. The OT Operator should encourage effective communication lines and a mutual understanding between management and workforce.

(f) Incorporate process safety in senior management decision-making:
Process safety programs tend to have a long-term focus and may require higher investments in resources, in comparison with personal safety initiatives. This long-term timespan often needed to achieve results in process safety performance should be

well considered when allocating accountabilities and expectations to the OT Operator, line managers and supervisors.

2.3. Organisation and Personnel

2.3.1. Roles and Responsibilities

Safe operation and maintenance of the OT requires that there is a system of control at the economic entity in order to meet safety requirements, and in particular it requires reliable human performance at all levels, from managers and engineers to operators and craftsmen.

Clear understanding and definition of roles and responsibilities, and assurance of competence in those roles, are essential to achieve a high reliability of task execution for the control of major accident hazards.

OT operators should ensure that they have:

(a) Clearly identified the roles and responsibilities of all those involved in managing, performing, or verifying work in the management of major hazards, including contractors and ship operators/crews;
(b) In particular, defined the roles and responsibilities of control room operators (including in automated systems) in ensuring safe fuel transfer operations;
(c) Defined the roles and responsibilities of managers and supervisors in monitoring safety-critical aspects of fuel transfer operations.

OT operators should ensure that they have implemented a competence management system, linked to major accident risk assessment, to ensure that anyone whose work impacts on the control of major accident hazards is competent to do so.

2.3.2. Staffing and work organisation

Staffing, shift work arrangements and working conditions are critical to the prevention, control and mitigation of major accident hazards.

OT operators should ensure they can demonstrate that staffing arrangements are adequate to detect, diagnose and recover any reasonably credible hazardous scenario.
OT operators should develop a fatigue management plan, to ensure that shift work is adequately managed to control risks arising from fatigue.

OT operators should review working conditions, in particular for control room staff, and develop a plan.

OT operators should provide guidance to ensure safe operations by adopting criteria for minimum staffing of the OT at all times.

2.3.3.Process Safety Knowledge & Competence Assurance

Poor process safety knowledge & competence has often resulted in major accidents, due to the fact that it often reflects poor understanding of hazards, failure to properly identify and analyse hazards during the PHA, inadequate operator training, inadequate guidance in emergency response decisions and ultimately in poor management decision-making.

The OT Operator shall ensure that any person under its control performing tasks that can impact the OT's safety performance are competent on the basis of appropriate education, training or experience, and shall retain associated records.

The OT Operator shall identify the knowledge & competence requirements of all individuals working at the OT; subsequently, a competence gap analysis shall be made based on the actual competence availabilities. A risk assessment and prioritisation of training needs is the next step to develop a process safety competence assurance programme.

The OT Operator shall develop the competence assurance programme based on insights in safety critical functions, safety critical task inventories and minimum knowledge, skills and abilities for specified functions, such as control room operators, process operators, design engineers etc.

The OT Operator shall provide general risk awareness training and specific process safety training as defined in the training plan to ensure an adequate level of risk competence as addressed in the needs analysis.

The OT Operator shall define refresher training frequencies and updates of training needs based upon experience feedback and changes in legislation, to be able to bridge the gap between reality and expectations.

2.3.4.Education and training

The life-cycle approach to OT requires that personnel in a variety of different professions and institutions have a common understanding and knowledge of the technical and managerial aspects, and use complementary professional procedures in their work. This requires a certain level of training (and re-training) of various persons associated with OT, including contractors.

The personnel concerned should be identified along the “planning-design-construction-operation-decommisioning-rehabilitation” chain.

Personnel working at and responsible for safety of OT should be educated and trained in technology, standards and regulations as well as acting in emergency cases.

The inherent uncertainties surrounding all potentially hazardous OTs require special skills in risk assessment and management but also in risk communication and reporting.

Training of relevant personnel should include apart from the technical aspects of OT also the “context” subjects that concern related disciplines such as environment, social and financial areas, and the risks for the OT operating staff.

2.4. Operating Manual

The OT shall be operated and managed on the basis of an Operating Manual (in the meaning as further defined/outlined hereafter) which is developed in the planning phase and progressively modified. Its aim is to effectively manage the hazards / risks at the OT.

The Operating Manual should contain as a minimum:
(a) Description of the OT and its environment;
(b) Description of normal operations;
(c) The methodology for hazards identification and risk assessment;
(d) Description of all monitoring procedures (sampling locations, sampling frequency, checklists and compliance parameters;
(e) Procedures for reporting on non-compliance and failures;
(f) Procedures describing how corrective actions are to be applied in case of non-compliance situations;
(g) Emergency preparedness and response;
(h) Performance measurement and compliance assessment, including key performance indicators (leading and lagging indicators);
(i) An overview of applicable legal requirements and other requirements to which the OT subscribes (key stakeholder requirements);
    i. Internal auditing and follow-up;
    ii. Management review and continual improvement.

The OT Operating Manual should include or refer to internal inspection programmes.

2.5. Operating Procedures and Safe Work Practices

Operating procedures are those that govern planned activities in a normal sequence of converting raw materials to finished products. Unloading a ship is a typical routine task, described in a procedure and is often associated with a checklist describing the steps to follow.

Safe Work Practices typically control hot work, stored energy (lockout / tag out), opening process vessels or lines, confined space entry and similar non-routine operations. Non-routine work such as the simple removal of a pressure safety valve increases the risk level significantly and can directly lead to conditions that make a catastrophic accident more likely. Safe Work Practices are therefore critical in managing major accident hazards.

2.5.1.Operating procedures

The OT Operator should establish a task list for all routine tasks with the intent to screen those with a high risk potential. Consequently, a task-based risk assessment is recommended for each of the high risk tasks. Controls must be defined to reduce the risk to an acceptable level. The need for an operating procedure as control measure for a specified high risk task is decided by the assessment team.

The OT Operator should consider all operating modes in the task list, including normal and off-normal working conditions such as temporary shutdown, shutdown for annual maintenance, emergency shutdowns, initial start-up, preparing equipment for maintenance, decommissioning of a unit etc.

The OT Operator is due to put high attention on pre-start-up safety reviews (PSSR) as these reviews may provide a high level of safety when conducted in a comprehensive and professional manner.

The OT Operator should ensure an adequate level of detail in the operating procedures, and therefore address concise instructions where relevant: including Safe Operating Limits and consequences of deviation from these safe limits (also referred to as “operating windows”) are considered good industry practice.

The OT Operator should consider developing written procedures to control temporary or non-routine operations.

The OT Operator should hold their workforce accountable for consistently following the operating procedures and ensure that they are periodically reviewed.

2.5.2.Safe Work Practices for non-routine tasks

The OT Operator should define when and where safe work procedures apply. Typical applications are these non-routine tasks which involve several parties, usually the owner of the equipment and the crew assigned to do a certain job, either by own maintenance staff or by subcontractors. A short non-limitative list is given hereafter to clarify the type of work that usually requires safe work practices:

(a) Lockout/tag-out for control of energy hazards;
(b) Line breaking/opening of process equipment;
(c) Confined space entry;
(d) Lifting over process equipment;
(e) Excavation in or around process areas;
(f) Temporary bypassing of interlocks.

The OT Operator is responsible for providing adequate training to all OT employees and contractors involved, respectively the party responsible for issuing work permits and those who execute the work.

The OT Operator ensures that access controls to particularly hazardous areas are in place.

2.5.3. Shift Handover

Transfer of volatile fuels into storage frequently continues across shift changes, and there is little doubt that unreliable communications about plant or transfer status at shift change could potentially contribute to a tank overfill. It has been a contributory factor in several previous major accidents.

OT Operators should set and implement arrangements for effective and safe (recorded) communication at shift and crew change handover OT sites should include a summary of the arrangements for effective and safe communication at shift and crew change handover in the safety report.

2.6. Management of Change

Effective management of change (MOC), including organisational change as well as changes to plant and processes (further denoted as technical change), is vital to the control of major accident hazards.

OT Operators should establish a MOC system which allows for properly reviewed and authorized change requests, including risk assessments and risk controls appropriate to the proposed change.

2.6.1.Management of technical change

OT Operators should adopt and implement management procedures for planning and controlling of all changes in plant, processes and process variables, materials, equipment, procedures, software changes, design or external circumstances which are capable of affecting the control of major accident hazards.

OT Operators should ensure they have suitable guidance for their staff about what constitutes a plant or process change, and that they have suitable arrangements in place for management of the range of permanent, temporary, and urgent operational changes.

2.6.2.Management of organisational change

OT Operators should ensure that there is a suitable policy and procedure for managing organisational changes, including a risk assessment to evaluate the likely consequences of the change.

OT Operators should take appropriate measures for retention of corporate memory.

OT Operators should ensure that they retain adequate technical competence and 'intelligent customer' capability when work impacting on the control of major accident hazards is outsourced or contracted.

2.7. Good Industry Practice for transport and storage of hazardous materials

Due to the specific activities in OTs a set of Principles and Good Industry Practices is compiled together for transport and storage of hazardous materials:

2.7.1.Principles for safe transfer management

OT operators involved in the transfer and storage of hazardous material should adopt good practice principles for a safe transfer management.

OT operators involved in the transfer and storage of fuel should review 'job factors' to facilitate safe fuel transfer. This would normally be via written (and periodically trained) operating instructions for all OT operations.

2.7.2.Operational planning

Human factors issues are important at various safety-critical stages in transfer operations including operational planning. OT operators that are receivers or senders of hazardous material should develop procedures for successful planning and review them with their senders/receivers and all appropriate intermediates.

2.7.3.Operational controls

The following operational controls apply for areas where hazardous substances are used / stored:

(a) OT operators should ensure the ready availability of a list of all hazardous substances in their facilities, with safety-related information. This includes an updated inventory of actual storage amounts in the tanks.

(b) Areas are clearly marked, properly supervised, and regularly inspected

(c) Stakeholders in the vicinity of OT should share information and experience related to chemical safety. OT operators should coordinate with ship's masters and the individuals responsible for other transport modes (e.g. pipelines) to ensure that all relevant regulations and codes are followed for the proper transfer and storage of hazardous substances.

Operators have to take care of the following basic safety requirements:

(a) All functional units of an OT have to be closed, stable and sufficiently resistant against mechanical, thermal and chemical influence (primary safety);

(b) Principally a leakage proof and a durable secondary containment have to be put in place;

(c) Leakages of water-endangering substances must be detected in time with reliable devices, retained and properly treated or disposed of. This practice is also relevant for any resulting waste.

OT Operators should regularly monitor the OT (e.g. capacity, groundwater level, functioning of the drainage system, surface water diversion).

2.7.4.Principles for consignment of transfer agreements

The sender is primary responsible for the safe transfer of the agreed consignment quantity to the receiving storage.

The following principles apply to all modes of transfers where separate parties control: the supply of material to a tank or tanks; and the tank or tanks. This includes, for example, transfers between sites belonging to one business. It does not apply to transfers where a single person or team controls both 'ends' of the transfer, although an equivalent standard of control is necessary.

For transfers from ships into tanks, internationally recognized safety guides should be the appropriate standard.

OT operators involved in inter-business transfer should agree on the nomenclature to be used for their product types.

OT operators receiving transfers should, for each relevant terminal, carry out a review to ensure compliance.

2.7.5. Procedures for control and monitoring of transfer of hazardous materials

Procedural problems are frequently cited as the cause of major accidents. In the major hazard industries, fit-for-purpose procedures are essential to minimize errors and to protect against loss of operating knowledge (e.g. when experienced personnel leave).

OT operators should ensure that written procedures are in place, and consistent with current good practice, for safety-critical operating activities in the transfer and storage of fuel.

2.7.6. Communications during transfer activities

When transferring from e.g. a pipeline or ship, the OT Operator should have arrangements in place to ensure the receiving installation (e.g. storage tank) has ultimate control of tank filling.

The receiving installation control should be able to safely terminate or divert a transfer (to prevent loss of containment or other dangerous conditions) without depending on the actions of a remote third party, or on the availability of communications to a remote location. These arrangements will need to consider upstream implications for the pipeline network or ship.

Events such as level alarm activation should be communicated rapidly to the receiving and sending facility control to avoid the loss of containment and potential problems upstream.

2.8. Management of abnormal situations

Management of abnormal situations often depends on the effectiveness of dealing with large number of alarms centralised in a control room environment when equipment failures are observed. A different type of abnormal situation which is relevant to OTs is dealing with large numbers of contractors on-site during a large turnaround (large stop of activities for maintenance, repair and inspection work).

2.8.1.Alarm Management

Increased automation provides a relatively calm operating scenario when the plant is in a steady state. However, given the importance of alarms in times of upset, the display of alarm information has to be given high priority. Even if there are relatively few alarms on the system and the system is not a distributed control system (DCS) the same principles apply, to ensure a reliable response to alarms.

OT operators should proactively monitor control systems, such as the tank gauge system, so that designated level alarms sound only in situations requiring a response from OT staff.

OT operators should ensure that their control room information displays, including human-computer interfaces and alarm systems, are reviewed in relation to recognised good industry practice.

Where reasonably practicable, OT operators should put plans in place to upgrade control room information displays, including human–computer interfaces (HCI) and alarm systems, to recognized good industry practice.

OT operators should ensure that modifications or development of new control rooms or HCIs comply with recognised industry good practice both in their design, and their development and testing.

2.8.2.Contractor/Turnaround Management

OT Operators should ensure to implement specific controls when preparing for a large turnaround (activity stop) which usually involves large number of contractors working on-site the facility. Turnaround Management should therefore be done according to standards and GIP as applicable in the refining industry.

In addition to the basic requirements on selection and evaluation of contractor performance (ref. para 54 of Part 1), the following additional requirements are considered as GIP for managing contractors:

(a) Classify the selected contractors as High / Medium / Low Risk Contractors, based on well-defined criteria and define controls appropriately;

(b) Designate OT contractor coordinators for the High & Medium Risk Contractors;

(c) Organise pre-job meetings with High & Medium Risk Contractors;

(d) Ensure that competence requirements are met at all times for the High & Medium Risk Contractors; conduct periodical compliance checks and involve them as much as possible in the OT training programmes.

2.9. Investigation of incidents and aftercare

2.9.1. Incident/Accident investigation

As technical systems have become more reliable, the focus has turned to human causes of accidents. The reasons for the failure of individuals are usually rooted deeper in the organisation's design, decision-making, and management functions.

OT operators should ensure they have suitable procedures for:

(a) Notification and reporting of incidents/accidents and near-misses;
(b) Identifying incident/accident/near miss potential;
(c) Investigating according to the identified potential;
(d) Identifying and addressing both immediate and underlying causes;
(e) Sharing of lessons learned;
(f) Tracking of remedial actions;
(g) Evaluating the effectiveness of corrective / preventive actions.

OT operators should make periodically statistical evaluations of trends in root causes and other system errors and take adequate measures to avoid recurring incidents/accidents.

2.9.2. Aftercare and Damage review

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

The damage review follows the course of an event to the immediate activities of crisis management. After having been fighting/mitigating the causes and effects of the incident/accident and bringing them under control and having interrupted the spread of the acute release of pollutants , then; the factors and circumstances which led to the development must be analysed. It is to assess the severity of how severe the impact damage effectively.

The purpose of damage review is:

(a) To prevent future incidents/accidents of the same kind or at least mitigate the consequences; and
(b) To estimate and to assess the damage extent.

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

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

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

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

2.10. Performance monitoring and compliance assurance

Measuring performance to assess how effectively risks are being controlled is an essential part of the OTMS.

Proactive monitoring provides feedback on performance before an accident or incident (e.g. leading key performance indicators), whereas **reactive monitoring** involves identifying and reporting on incidents to check the controls in place, identify weaknesses and learn from mistakes (lagging performance indicators) (API 754).

OT Operators should ensure that a suitable active monitoring programme is in place for key systems and procedures for the control of major accident hazards.

OT Operators should develop an integrated set of leading and lagging performance indicators for effective monitoring of process safety performance (API 754 Process Safety Performance Measurement for the Refining and Petrochemical Industries.).

OT Operators should establish and maintain procedures for testing and calibrating instruments and equipment which is considered safety-critical for a safe operation, and shall maintain records of calibration and maintenance activities thereof.

OT Operators shall establish and maintain procedures for periodically evaluating compliance with applicable legal requirements and other commitments to which it adheres.

OT Operators shall keep records of the results of the periodic compliance evaluations.

2.11. Records management

The OT Operator should define which records are necessary to demonstrate legal compliance and compliance to other commitments to which the OT subscribes, in addition to conform to the requirements of its OTMS.

The OT Operator should maintain the abovementioned records and establish the duration and location of storage for reasons of traceability and easy retrieval.
Retention of relevant records is also necessary for the periodic review of the effectiveness of control measures, and the root cause analysis of those incidents and near misses that could potentially have developed into a major incident.

OT operators should identify those records needed for the periodic review of the effectiveness of control measures, and for the root cause analysis of those incidents and near misses that could potentially develop into a major incident.

OT operators should use the periodic review results in the training of OT staff.

2.12. Audits and Management Reviews

Audits and reviews should be performed at all stages of the lifecycle of the OT, i.e. to the routine monitoring of performance (i.e. active monitoring).

2.12.1. Audits

The OT Operator should carry out periodic audits of the OTMS as a normal part of its business activities.

An audit is a structured process of collecting independent information on the efficiency, effectiveness, and reliability of the total OTMS. It should lead to a plan for corrective action. Intervals between audits should not exceed 3 years.

2.12.2. Management Reviews

Reviews are a management responsibility. They need to take account of information generated by the measuring (active and reactive monitoring) and auditing activities, and how to initiate remedial actions.

The requirements for audit and review are well established. The main issue is to ensure that process safety is adequately included in audit and review programmes.

OT operators should adopt and implement audit plans defining:

(a) The areas and activities to be audited, with a particular focus on process; safety/control of major accident hazards;
(b) The frequency of audits for each area covered;
(c) The responsibility for each audit;
(d) The resources and personnel required for each audit;
(e) The audit protocols to be used;
(f) The procedures for reporting audit findings; and
(g) The follow-up procedures, including responsibilities for implementation.

OT operators should ensure that they have implemented suitable arrangements for a formal review of the suitability of the OTMS and effectiveness of controls of major accident hazards, including:

(a) The areas and activities to be reviewed, with a particular focus on process safety/control of major accident hazards;
(b) The frequency of review (at various levels of the organisation);
(c) Responsibility for the reviews;
(d) The resources and personnel required for each review;
(e) Procedures for reporting the review findings; and
(f) Arrangements for developing and progressing improvement plans

Feedback of audit findings should be within e.g. 1 month of the audit to all parties including management and staff at the OT. Corrective actions need to be covered in follow-up reviews scheduled within 1 year of the audit.

2.13. Learning from experience

The management review should form the basis for providing an effective feedback mechanism.

The OT Operator shall consider the past performance to learn from observed deviations, near-misses and accidents occurred as part of its commitment to continual improvement.

A policy statement should be established by the OT Operator which sets a framework to demonstrate its commitment towards management of the major accident hazards to acceptable levels and towards performance improvement and legal compliance.

3. Asset Integrity & Reliability

Asset Integrity is a key element of process safety, including the systematic implementation of activities ensuring that equipment is designed, procured, fabricated, installed, tested and inspected in accordance with agreed specifications, and that it remains fit for purpose throughout its lifetime until it is decommissioned. Asset integrity activities range from equipment design to plant operators conducting routine rounds spotting leaks, unusual noise or detecting other abnormal conditions.

Reliability engineering is the process of evaluating how long a system and its components can be operated safely before they should be taken out of service for maintenance or replacement. Reliability engineering enables the planning of inspection and maintenance intervals, and is therefore of paramount importance for safety critical equipment and instrumentation.

The safe design standards as specified in section 1.3 shall be integrated in a comprehensive OT Requirements Database for further reference throughout all other phases of the OT lifecycle.

When assets and infrastructure reach the end of their design life, the OT Operator shall make appropriate decisions for either decommissioning or for extension of the operating lifetime.
A selected set of good industry practices governing the reliable operation of the OT is given hereafter:

3.1. Inspection, Testing and Preventive Maintenance (ITPM)

ITPM practices should be in place to help ensure that equipment is fit for service at commissioning and remains fit for service throughout its lifetime.

3.1.1. ITPM during plant commissioning:

The OT Operator should conduct initial inspections and tests during fabrication and installation as part of plant commissioning. Eventually, this can be done partially at the fabricator’s shop for special-order items (when judged to be highly critical that equipment is fabricated according to design specifications).

3.1.2.ITPM during operations:

An ITPM plan shall be established by the OT Operator, and ITPM tasks clearly defined:

(a) Storage tanks and the mechanical equipment attached should be maintained to good industry practice (e.g. API 65328), represent relevant good practice and should form the basis of minimum industry standards for tank integrity management and repair to prevent loss of primary containment

(b) Inspection and Testing:

i. OT Operators should have a process for determining the scope of the asset integrity program and frequency of inspection and testing. This includes the storage and transfer hardware facilities, measurement and control systems, emergency response equipment, communications, security controls.

ii. Inspection and testing should include the operator training programmes, emergency response procedures and liaison with emergency services and the local community during emergencies.

iii. Inspection and testing shall be done regularly: The methods will typically be Non Destructive such as Ultrasonic, X ray, Magnetic Particle, etc. and should be carried out to methods and frequency set out by industry standards organisation.

iv. OT Operators should establish and implement procedures for inspecting and calibrating safety critical equipment and instruments, and keep records thereof. Inspection and testing should apply to all equipment such as piping, valves, pumps, and emergency equipment such as fire pumps and fixed and mobile fire fighting equipment.

v. Control and safety instrumentation (level, pressure, temperature) should be comprehensively tested (whole loop – field sensor, logic solver and final element) in accordance with normal industry practice and standards (such as IEC standard 61511).Where the system is protected by alarms, testing should include the operator response, recognising the need to understand an alarm and the time need to respond and correct the hazardous state.

vi. Condition monitoring is done according to the planned schedule and deviations or overdue ITPM tasks are monitored and followed up.

vii. ITPM tasks are conducted by trained and qualified individuals using approved methods /procedures.

viii. Repair work should be done in conformance with design codes, agreed engineering standards and considering manufacturer's recommendations, as applicable.

ix. A spare parts management plan should be applied to ensure timely availability of critical spare parts.

x. A mechanism should be in place to correct deficiencies and to apply the lessons learned from deviations or near miss incidents to other equipment / systems.

3.2. Managing the lifetime of ageing assets

All assets and infrastructure (facilities) are subject to ageing phenomena as time goes by. The term "ageing" is not about how old an equipment is; it is about its condition, and how that is changing over time. Ageing facilities are therefore facilities which are, or may be, no longer considered fully fit for purpose due to age-related deterioration in its integrity or functional performance.

A well described approach and methodology is applicable for lifetime extension for offshore facilities, power plants and the nuclear industry; the design lifetime is well defined upfront as well as a predefined decommissioning time. A severe regulatory scheme is in place when an operator considers extending the operating lifetime. The key activities to be considered are: a thorough assessment of the asset integrity, risk assessment / risk mitigation and gap analysis against legal compliance to justify for life extension.

However, in most ECE Member States (except for France and the UK) a similar regulatory framework is not in place for lifetime assessment and lifetime extension in the onshore process industry (including land-based oil terminals).

The Health & Safety Executive (HSE, 2006) concluded that plant ageing does constitute a threat to health and safety performance of onshore hazardous installations. Within the uncertainties of the review, a reasonable statement to describe the size of the ageing issue is that "approximately 60% of major hazard loss of containment incidents are related to technical integrity issues and, of those, 50% has ageing as a contributory factor". It may be concluded that plant ageing mechanisms are a significant issue in terms of increased risk of major hazard accidents.

When the OT assets or infrastructure are approaching the intended design or service life, or the OT in its entirety is reaching the end date of the license to operate, decisions in terms of decommissioning, lifetime extension or extending the license to operate become vital. At this point, the OT Operator needs a workable approach and good industry practice to make sound decisions. On the other hand, the CAs should provide adequate guidance and apply decision criteria for extending or not the lifetime of OT operations. Considering the different inspection regimes and approaches in regulatory frameworks of controls for assets in the ECE Member States, the following two situations are further described as GIP to manage ageing assets / infrastructure: (i) Managing assets with predefined operating lifetime and (ii) Managing assets with undefined operating lifetime.

3.2.1. Managing assets with a predefined operating lifetime

Offshore structures are typically designed and built for a pre-defined lifetime of typically 20 to 30 years, followed by a planned decommissioning. Although this approach of building with a specified design lifetime is not applied for OTs, the same methodology can be applied for lifetime assessment and lifetime extension for OTs.
The objective of a life extension assessment for an existing facility is to document that the asset or infrastructure is fit for its intended purpose over the extended service life, and that the consequences in terms of risk are acceptable from a safety, environmental and financial point of view (return on investment).

The overall methodology consists of six subsequent activities:

a) Technical Condition Assessment
b) Life Extension Evaluation
c) Regulatory Compliance Check
d) Technical Qualifications for Life Extension
e) Obsolescence Preparedness
f) Life extension operating costs

a) Technical Condition Assessment:
The technical condition assessment is a high level review to identify equipment of high risk for safe and reliable continuation of production. The condition review may be based on site observations, review of documentation, management systems and interviews of personnel. It should cover the following elements: safety, operations history, engineering, documentation, inspection and maintenance. A risk based condition equipment assessment model is used to rank the equipment, while considering current operational disposition, consequence of failure and probability of failure/unavailability. An asset risk register is compiled as a result of this technical condition assessment.

b) Life Extension Evaluation
The objective is to evaluate the future operating conditions and production scenarios and identify the challenges for the facility to continue operations with equipment considered as critical.

The remaining lifetime of critical assets with a high risk ranking is estimated based upon considerations, such as (not limited to):

- Original design life (specified in years or number of operating cycles).
- Current equipment age and condition.
- How long ago the damage initiated and how fast it is accumulating.
- Rate of degradation (whether constant, variable, or exponential).
- Expected future operating conditions and degradation mechanisms.
- Maintenance plan
    - Vendor support and spare part availability.

c) Regulatory Compliance Check
The objective is to identify current regulatory gaps and assess the risk taken when operating with the gaps. The gap analysis may give input to an ALARP process(As Low As Reasonably Practicable) to minimise the risk of major accidents and provides insights on the efforts needed to comply with future applicable legislation.

d) Technical Qualifications for Life Extension
The objective is to ensure that equipment has safe and reliable operations when operating beyond original design life. This qualification will normally be used by the Operator to seek consent and technical assurance for extended design life. In case the technical qualifications do not provide the required assurance, the OT Operator should consider decommissioning at end of current design life.

e) Obsolescence Preparedness
Out-of-date or obsolescent assets and equipment, particularly electrical control and instrumentation equipment. The objective of this assessment is to create an overview of equipment where spare parts are no longer available or where vendor support does not exist. The review will propose alternative solutions in order to be prepared when obsolete equipment fails.

f) Life extension operating costs
To establish operating costs including the need for modifications into the future, a transparent cost estimation model is required. The cost model should include overhauls, replacements experienced from operations of similar facilities and it should be based on estimations of min/mean/max time for the modification as well as min/mean/max cost for the modification.

3.2.2. Managing assets with undefined operating lifetime

Onshore process plants are usually not designed with a planned design life and a decommissioning time limit in mind. The average estimated design life of a typical process plant is about 25 years. Onshore process plants are continuously maintained and repaired as soon as ageing of assets is observed. Turnarounds are usually the triggering points to assess the integrity status of critical assets and those with the highest deterioration rate; this periodic "rejuvenation" takes place during large turnarounds every 3-5 years.

To address the shortcomings of legal / regulatory inspection regimes in the ECE Member States, the following approach[1,2,3] should apply as GIP for OTs aiming at sound management of ageing assets to prevent and control major accident hazards.

1Source: COMAH, Ageing Plant Delivery Guide (June 2010)
2 Source: HSE, Plant ageing Study (RR823, 20100
3 Source: France Ministry of Environment, Plan de modernisation (January 2010)

OT Operators using assets, equipment, instrumentation and infrastructure subject to ageing should adopt a two-steps approach to ensure their continued fitness for purpose: (1) Step 1: Establish an ageing plant inspection regime and (2) Step 2: Implement an asset integrity management system to address ageing assets.

Step 1 – Establish an ageing plant inspection regime

It is recommended to adopt as "red thread" a risk-based inspection approach across the entire ageing plant inspection regime.
The ageing plant inspection regime can be subdivided in 4 asset categories:
Primary containment systems
Infrastructure
Process Safeguards
Electrical controls & instrumentation (EC&I systems)

a) Primary containment systems
Target assets/ equipment:
Group 1: Process primary containment - pipework / static elements, whether at significant pressure or not, e.g. pressure vessels, columns, heat exchangers, storage tanks, open top tanks, pipework, and pipework fittings such as valves and flanges etc.
Group 2: Process primary containment - rotating / motive elements e.g. pumps, compressors, turbines, agitators, fans, solids handling equipment

Corrosion, including corrosion under isolation, is a significant recurrent issue. Failure mechanisms that can lead to rapid failure by age are fatigue and stress corrosion cracking. The regulatory framework in most of the ECE Member States is weak for the majority of the target assets. Risk-based planning of inspection and maintenance activities significantly influences the results in terms of optimized inspection efforts.

b) Infrastructure
Target assets / equipment:
Supporting structures, civil features and foundations for primary, secondary and tertiary containment, including fire-water lagoons and basins
Foundations providing impact protection (e.g. protection from vehicle collision, blast, lifting operations, gas cylinders, etc.)
Civil structures and foundations for safe places of work, e.g. controls rooms, offices, workshops, emergency shelters, roadways, ladders, stairs etc., gantries, walkways, etc.
Civil structures and foundations for safety critical services and utilities, e.g. power distribution, equipment and battery rooms, etc.
General structures and civil features that could impact major hazard plant, pipelines or equipment (including EC&I, cabling, tunnels, bridges, underground caverns, bunds, etc.) were they to collapse / fail, or which could disperse hazardous material if they were to leak/ fail (e.g. culverts, etc.)

The incident data do not support any general conclusions regarding ageing of structures. However, it is not clear to what extent ageing of structures is taken into account within the plant inspection and maintenance schemes given the often safety critical nature of the structure's function. The key question for structures appears to be that from the review of management systems, i.e. whether or not inspections extend to civil and structural features of the plant and safeguards.

c) Process Safeguards

Target assets/ equipment:

Primary containment of key safety critical utilities and services: pipework / static elements (e.g. instrument air, nitrogen, hydraulics, cooling water, steam, heat transfer oil, etc.)

Integrity and availability of key services such as power supply, UPS, emergency back-up generators, battery units, etc.

Mechanical pressure protective systems: pressure/ vacuum relief valves, bursting discs, vents and flares.

Mechanical overfilling protective systems - overflows, emergency dump systems.

The extent of age related shortcomings in safeguards systems is difficult to assess from the limited data available from major accident statistics. However, those reported indicate a lack of appropriate testing, inspection or maintenance, or violations of safety arrangements over long periods of time.

Reported shortcomings related to safeguard systems also revealed that they were either: a) insufficiently designed, manufactured, or sized, or b)set to an unsuitable set point, or c) defeated or disconnected, or d) ignored or cancelled (e.g. alarms). In addition, the HSE data (ref. Plant Ageing Study,RR823, 2010) also highlight many situations where basic 'good industry standard safeguards were not provided, such as high level alarms on tanks and suitable isolation valves(manual or remote operable),

d) Electrical controls & instrumentation (EC&I)

Target assets / equipment:

EC&I - safety critical process safeguarding systems (trips, alarms, process ESD, etc.)

EC&I - safety critical leak detection and response systems (fire and gas leak / area detection, emergency shutdown systems)

Ignition source control equipment, e.g. earthing, equipment enclosures, etc.

Inerting systems (e.g. nitrogen blanketing and purging)

CCTV Monitoring of plant areas and escape routes, etc.

It is worth noting that for EC&I equipment, lifecycles are often significantly shorter (10 to 15 years)than lifetimes of main plant (typically of the order of 25 years). EC&I accidents that could have been prevented by improved maintenance and testing represent a significant percentage of all major accidents caused. The biggest single factor in all EC&I failures is associated with Level Detection, often resulting in vessel overfill and loss of containment. The root causes of for the majority of these failures are associated with inadequate maintenance and testing.

An effective Electrical Inspection and Testing regime should therefore be adopted, providing recording of the values measured, rather than just pass/fail, in order to track deterioration of the plant. Testing of safety-related functions should be from end to end whenever possible, to confirm that they work as designed. Test intervals should be reviewed periodically, unless specified during the design process, to maintain the integrity of the system.

<u>Step 2: Implement an asset integrity management system to address ageing assets</u>

It is vital that there is coordination, leadership, ownership and senior management engagement in the ageing plant inspection regime as described above. The effective management of plant ageing is fundamental to the maintenance of process safety on a high hazard site. As such, it is imperative that the OT Operator has a clear understanding of the processes in place to manage the issue and that they monitor their effectiveness. Key elements in this will be the presence of suitable Key Performance Indicators (KPIs) and evidence of commitment from the leadership team to the maintenance of the integrity of plant across the site. Assuring that sufficient and competent resources are available to manage plant ageing is also one of the outcomes demonstrating senior management commitment.

The key elements of an asset integrity management system are:
- Maintenance Management Plan & Performance Standards
- Asset Register, with flagged safety critical assets
- Asset Risk Assessment procedures tailored for ageing phenomena
- Management of Change
- Plant inspections and technical audits
- Anomaly & incident reporting and investigation routines
- Statistical analysis & trending
- Corrective actions and action tracking system
- Learning from events
- Review

The above mentioned asset integrity management system can be integrated in the overall OTMS, as described earlier.

4. Crisis Management, Emergency Planning and Response

Potential emergency risk, including large-scale accidents occurrence, exists during all lifecycle phases of a complex industrial facility. The best and the most non-hazardous technologies and equipment selection during design phase, high level of culture during construction and commissioning phases, system approach to process safety management implementation reduce accidental possibility, but does not exclude it completely. Accident progression, provisioning no measures for the accident localization will cause significant damage, including transboundary impacts.

Emergency action plan, correct estimation of required forces and equipment planned to be engaged in the process of accident localization and response, maintaining constant alert level for emergency response teams, material and technical resources, as well as other significant issues require projection and constant control of oil terminal operator and inspection authorities.

One of the most important aspects in this respect is oil terminal personnel and other interacting structures, involved in the processes of oil terminal accident localization and response, practical skills availability.

Subsequent parts of the chapter contain recommendations on projecting and emergency action plans for oil terminals.

4.1. Crisis Management – Introduction

The main role of crisis management is to ensure there is a fast and effective response if there is an industrial accident. On-site (internal)emergency plans, developed by the OT-operators and approved by competent authorities, are created for OT facilities where accidents might happen. Off-site (external) emergency plans, developed and implemented by the CA with the input from OT operators, will also cover wider areas with industrial facilities capable of causing transboundary effects. The off-site (external) emergency plans should be compatible with the on-site (internal) emergency plans, and should include the harmonisation on e.g. the use of alert and warning systems, the establishment of response procedures and schemes in order to provide effective emergency response and where relevant in order to provide the capability of mutual assistance between OT operators. An overview on good industry practices with regard to emergency plans and emergency response are given hereafter:

4.2. Emergency Plans

Emergency plans are the most important part of crisis management. Therefore emergency plans should be established for each OT for phases of construction, operation and closure. The appropriate emergency plan needs to be established prior to accepting construction, operation or closure by authorities. Hence, they shall be drawn up within the periods set by local or international rules.

Emergency plans should be established and tested by OT operator (internal plans) and by authorities (external plans), and reviewed and updated where relevant after occurrence of accident or emergency situation at the site or other similar sites. The revision should be made also when the emergency service organization was changed or new technical knowledge was developed. Updates should be carried out on a frequency not exceeding 5 years.

The plan should consider flooding hazards and inundation maps should be provided in an annex. The emergency plans should include:

(a) The scope and objective of the emergency plan;
(b) Evaluation of emergency scenarios, hazards, potentially affected areas etc.;
(c) Responsibilities of each member of the organization (chain of responsibility and authority for actions to be taken) ;
(d) Organization of communication and notification procedures;
(e) Available equipment for interventions;
(f) Procedures for emergency response for each of the determined emergency scenarios;
(g) Involvement of ship crews (communication and action) ;
(h) Procedures for remediation;
(i) Requirements for annual emergency drills and practices with external agencies involvement (Fire, Police, Ambulance, Local Hospitals).

4.2.1. Internal Emergency Plans

The internal emergency plans should be part of the operating manual. The internal emergency plan, specific for each site and situation, should be developed and continuously revised. The revision should be done when:

(a) New risks are identified that are associated with the OT;
(b) Design values are approached or exceeded as a result of changes, mismanagement, structural problems, equipment modification or natural events.

The internal emergency plans should contain estimation on amounts and types of construction materials and equipment needed for emergency repairs based on the structural, foundation, and other characteristics of the OT; design and construction history; and history of prior problems.

Plans for notification of key personnel and the public should be an integral part of the emergency plan and should be prepared for slowly developing, rapidly developing, and instantaneous failure conditions.

Internal emergency plans should at least include:

(a) Names and/or positions and contact data of persons authorized to set emergency procedures in motion and of the person in charge of and coordinating the onsite mitigation action;
(b) Name and/or position and contact data of the person responsible for liaising with the CA in charge of the external emergency plan;
(c) Arrangements for initiating and activating the alert and call-out procedures continuously;
(d) Arrangements and devices for receiving warnings of incidents;
(e) For foreseeable conditions or events which could trigger an accident, a description of the actions which should be taken to control those conditions or events and to limit their consequences e.g. fire protection and fire water retention, including a description of the safety equipment and the resources available;
(f) Arrangements for limiting the risks to persons on site, including the way in which warnings are to be given and the actions which persons are expected to take upon receiving a warning;
(g) Arrangements for providing early warning of the accident to the CA responsible for setting in motion the external emergency plan; the type of information which should be contained in an initial warning; and arrangements for the provision of more detailed information as it becomes available;
(h) Arrangements for training staff in the duties they will be expected to perform and, where necessary, coordinating this with emergency services.

4.2.2. External Emergency Plans

External emergency plans are prepared and implemented by the CA, however OT operators are obliged to provide the local authorities with all necessary information with the type and degree of occupancy of the potentially affected area.

Public should be given the opportunity to participate in the preparation and revision of the external emergency plans.

It should be also ensured that in border areas the contingency plans of two regions of neighbouring countries are compatible with each other and include contact details to allow proper notification. The Public of neighbouring countries should be given the same rights as public of the concerned country to participate in preparation and revision of external emergency plans.

External emergency plans should at least include:

(a) Names and/or positions and contact data of persons authorized to set emergency procedures in motion and of persons authorized to take charge of and coordinate action;
(b) Arrangements for receiving early warning of accidents and for alert and call-out procedures;
(c) Arrangements for coordinating the resources necessary to implement the external emergency plan;
(d) Arrangements for providing assistance with mitigation action;
(e) Arrangements for off-site mitigation action;
(f) Lists/maps of vulnerable areas and objects with their specifications;
(g) List of the agencies and organizations that can assist with the management of
(h) the incident;
(i) Arrangements for providing the public with specific information on the accident and the actions it should take;
(j) Arrangements for notifying the emergency services of neighbouring countries in the event of an accident with possible transboundary consequences, in accordance with internationally accepted and established warning- and alert-systems.

4.3.Emergency Response

4.3.1. Warning and alert Systems

Leakage into receiving waters can cause far-reaching and often transboundary damages.

Essential instruments of disaster preparedness are early warning- and alert-systems. Integral part are **Early Warning Systems** which need first, a suitable *organization* (distribution of the measuring devices, networks of stations with each other, etc.) and the other a technical equipment for *event detection* and *assessment of warning and alert relevance*. These Early Warning Systems are often integrated in International Warning- and Alarm Plans established by International River Commissions.

Early warning systems are to be set up by the operator at the OT and the state bodies for the whole river catchment.

At OT a continuous „online monitoring“ has to be set up and adjusted to different alarm levels. These alarm levels have to be agreed with the CA and should be in line with the respective threshold levels of International Alarm plans (i.e. Rhine, Maas, Danube).For scenario-calculations regarding a discharge, established flow time-modelling should be used (i.e. Rhine-model, ALAMO).

4.3.2. Emergency Response Equipment/Installations

The OT Operator should identify the emergency needs based on risk assessments of major accident scenarios; the safety report should be used as guidance document.

For preparedness to potential accidents the following emergency response equipment has to be in place and operational:

(a) Fire protection:
Fire water sources (Storage tanks, City water supplies, harbour water), Fire pumps, Sprinkler Systems, Fire Fighting Foam systems, Deluge systems, Steerable Deck Monitor nozzles (with or without foam injection). Also portable equipment, like fire trucks/pumpers, Fire Hoses, Portable Monitors, Fire extinguishers
(b) Emergency Power supply;
(c) Hazard Detection systems: gas & fire detection equipment;
(d) Emergency & Rescue Equipment for potential Human- and/or Environmental Damages.
(e) Fire Water Retention Basins

4.3.3. Emergency Teams

The OT Operator should ensure that an Emergency team is established which is capable to respond to the defined major accident scenarios. The Emergency Team should comply as a minimum to the applicable legal requirements.

The OT Operator should ensure that training programmes are organised and executed based on a needs assessment, and compliant to legal requirements.

The OT Operator should ensure that an adequate number of emergency drills are executed, which corresponds as a minimum to applicable legal requirements.
The CAs may require specific scenarios to be tested jointly with other Emergency Teams located in the same region.

A system should be in place to evaluate the adequacy of the emergency team's capability to deal with the major accident scenarios.

5. Decommissioning

The features dominating the decommissioning activities are the pollution prevention and control requirements). This requires establishing a Decommissioning Plan for both existing and new industrial facilities and to use Best Available Techniques to prevent or minimise pollution to the environment. A distinction is made between temporary closure and final decommissioning.

5.1. Temporary closure (“preservation”)

The industrial facility can be considered for temporary closure, partly or completely, when there is insufficient fuel demand / raw material supply, in case of poor market conditions or due to other economic reasons. The following considerations are recommended as GIP during this de-activation phase, also denoted as “mothballing” or “hibernation phase”. This hibernation phase is typically about 1 year and should not last longer than 3 years, after which re-activation or decommissioning should take place.

The OT Operator shall develop a Temporary Closure Plan, considering at least the following issues:

(a) The closure will not cause adverse environmental impacts or imminent threat to human health at the site;
(b) The closure will not cause significant harm or significant burden on public facilities and other plants or land areas adjacent to this industrial facility;
(c) Existing components and waste are properly disposed of and harmlessly utilized or destroyed without harm.

It should be clear that a temporary closure is not a site abandonment. Before undertaking any work on temporary closure, the OT Operator should agree with the Competent Authority on surveillance of the Temporary Closure Plan, which covers following recommendations:

(a) The parts of the industrial facility containing substances hazardous to water must be drained, decontaminated and if necessary inactivated with a substance not hazardous to water (e.g. water or nitrogen);
(b) All piping must be separated from storage tanks and cisterns and tightly flanged;
(c) All storage tanks and piping left in situ should be cleaned and inerted for mothballing with inert gas or hydrophobic foam, as applicable;
(d) Devices showing leakage must remain under control / supervision;
(e) All parts of the industrial facility that are temporarily closed must be protected against illegal use;
(f) It is considered unacceptable to store barrelware with substances hazardous to water. If this is impossible/not cost effective due to the temporary closure – it is necessary to

comply with the relevant recommendations of international river commissions. These warehouses with barrelware should not be considered as a closed industrial facility;

(g) Those parts of the industrial facility that are temporarily closed and located at areas prone to floods, should be protected in accordance with international River Commissions' recommendations for flood protection;

(h) Before re-activation of the mothballed facility or parts of the industrial facility, it should be inspected in accordance with the recommendations of River Commissions and other recommendations, as applicable. The conditions for re-activation should be reflected in the Temporary Closure Plan.

5.2. Final Decommissioning

Decommissioning means the permanently taking out of service of the plant or industrial facilities. Decommissioning includes dismantling, demolition & disposal of terminal buildings and infrastructure and last but not least dealing with the potential liabilities associated with the partial closure or complete cessation of the OT activities.

OTs shall be closed:

(a) If the relevant conditions stated in the permit have been met and continued operations through lifetime extension are not justifiable from an economic viewpoint;

(b) At the substantiated request of the operator, after authorization of the CA; or

(c) If the CA so decides for obvious and justified reasons (e.g. observed environmental damage or notified imminent threat of such damage).

When designing new industrial facilities it is important to anticipate on the decommissioning activities and to incorporate them in the design phase; the so-called "design for decommissioning" principles are recommended as GIP for new facilities / plants (see also Chapter 1.5.1.).

5.2.1. Obligations of the OT Operator prior to decommissioning

(a) Regulatory Framework:

It is vital to identify all the legal requirements at an early stage in the planning phase and to make contact with the appropriate authorities to understand their requirements. Besides the relevant international legislation, the OT operator should identify the applicable regional and national legislation and compile an overall Regulatory Framework related to decommissioning issues.

(b) Notifications:

Appropriate notifications need to be made to different local and national authorities when decommissioning activities are planned. Additional pollution prevention measures or remediation can be required depending on the planned future uses of the land.

(c) Environmental Liability:

Upon definitive cessation of the activities, the OT Operator shall assess the state of soil, waters& groundwater contamination by relevant hazardous substances used, produced or released as a result of the terminal operations and compare this with the “baseline conditions”.

The OT Operator should apply sound risk assessment procedures to establish the actual environmental situation and level of significance of the pollution of soil and groundwater at cessation of its activities.

In case of significant environmental damage resulting from the OT operations or in case of an imminent threat of such damage, the OT Operator shall adopt measures and develop practices for remediation of land damage and to minimise the risks of environmental damage, aiming at reaching the baseline condition (return the site to the state described in the baseline report).

It is worth noting that international legislation do not prevent Member States from maintaining or adopting more stringent provisions in relation to the prevention and remedying of environmental damage.

(d) Best Available Techniques (BAT):

The permit should include all the measures necessary to achieve a high level of protection of the environment as a whole and to ensure that the installation is operated in accordance with the general principles governing the basic obligations of the operator.

BAT’s, when applicable, should be incorporated by the CA in the permit. The permit should also include emission limit values for polluting substances, or equivalent parameters or technical measures, appropriate requirements to protect the soil and groundwater and monitoring requirements.

5.2.2. Obligations of the OT Operator during decommissioning

The OT Operator is bound to adopt general SHE guidelines for prevention and control of community health and safety impacts that may occur at the end of the project lifecycle, including decommissioning.

The key topics to address and for which procedures and best practices should be in place relate to mitigation of adverse impacts and prevention of safety incidents:

(a) Noise and vibration (e.g. during earth moving, use of excavation equipment, cranes and transportation of materials and people);

(b) Soil erosion (e.g. by exposure of soil surfaces to rain and wind during earth moving and excavation activities); this may mobilise and transport sediment /soil particles which in turn may impact the quality of natural water systems;
(c) Air quality (decommissioning activities may generate emission of fugitive dust, uncontrolled release of asbestos fibres and other hazardous materials);
(d) Hazardous materials (release of petroleum based products such as lubricants, hydraulic fluids, PCB's, oil etc. during storage, transport or use in equipment, spill clean-up material etc.),
(e) Solid waste (release of non-hazardous materials such as scrap and cement building materials),
(f) Exposure to occupational health and safety hazards (e.g. ergonomic injuries during manual handling, slips and falls, work at height, struck by objects, moving machinery, confined spaces and excavation, traffic).

In addition, the OT Operator is responsible for maintaining 3 key activities up and running:

(a) The implementation of the Closure Plan
(b) Depending on outcome of the environmental risk assessment and degree of environmental damage caused, the OT shall take the necessary actions aimed at the removal, control, containment or reduction of relevant hazardous substances, so that the site, taking into account its current or approved future use.
(c) Environmental monitoring and reporting as defined in the permit and the outcome of the environmental risk assessment (e.g. storage tank emissions to air & water, effluent discharges, groundwater monitoring and waste disposal).

5.2.3. Obligations of the OT Operator after decommissioning

After an OT site has been closed, the operator remains responsible for monitoring, reporting and corrective measures until the site is returned to the satisfactory state as described in the environmental baseline report.

The OT Operator shall also be responsible for sealing the OT industrial facility and removing the facilities. The above obligations shall be fulfilled on the basis of a post-closure plan designed by the OT Operator based on Good Industry Practices. A provisional post-closure plan shall be submitted to the CA.

Prior to the final closure of the OT site, the provisional post-closure plan shall be:
(a) Updated as necessary, taking account of the risk analysis outcome, GIP and technological improvements;
(b) Submitted to the CA for its approval; and
(c) Approved by the CA as the definitive post-closure plan (final decommissioning).

The approved definitive post-closure plan is considered as the formal transfer of responsibility from the OT Operator to the CA. The CA shall then be responsible for further monitoring and corrective measures, considering the future destination of the OT site.

PART 3: SOURCES & FURTHER READING

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ANNEX

Annex to Part 1– Matrix with key topics to be addressed during the lifecycle of an OT

PHASE 1: Strategy – Feasibility - Engineering Design Stages – Planning	
ECE Member States	➢Inform and raise awareness towards Competent Authorities and OT Operators on applicable policies, national legislation & international agreements on facility siting, insurance issues, civil liability and compensation for damage caused by transboundary effects (para 17, 19, 20). ➢To develop a framework for Notification of the Competent Authorities in case of leakages or significant irregularities endangering the environment. ➢Facilitate international cooperation in the set-up and implementation of external emergency plans (para 18 & 33). ➢In case of possible transboundary effects, the Member State in whose country the permit is granted shall inform the other Member adjacent Member State of the potential impact.
Competent Authorities	➢Apply criteria for land-use planning and facility siting (para24&26) (1.2.2). ➢Check whether legal (national) requirements are met by the OT Operator. ➢Evaluate whether the OT Operator is able to provide a high level protection of health & safety to people and the environment. ➢Ensure on behalf of the Member States that the public hearing consultation arrangements are carried out prior to granting a permit to construct / operate an OT (para 26). ➢Public Authorities to ensure compliance with the Aarhus Convention (para 9). ➢Evaluate the Environmental Baseline (1.1) and the Environmental Impact Assessment as part of the permitting process (para 26). ➢ Set permit conditions based on the Environmental Baseline (IPPC-IED/2010/75/EU). ➢ Include Best Available Techniques in the permit conditions. ➢To establish a framework for dealing with Notifications of the OT Operator in case of significant irregularities or leakages (loss of containment) endangering the environment.
OT Operators	➢ Stakeholder mapping and analysis of stakeholder needs to enable effective communications (para 48). ➢ Licensing requirements and applicable procedures (1.1. to 1.5). ➢ Establish the Environmental Baseline report (1.1) ➢ Environmental Impact Assessment in a transboundary context (para

	28) (1.1). ➢ Land-use planning considerations in view of OT facility siting (para 26) (1.2). ➢ Feasibility Study (financial aspects & decision criteria): to provide in the construction budget the costs of measures to reduce risks (e.g., outsourcing experts, non-destructive testing, training & coaching, etc.). ➢ Inherent Safe Design and operation of OT installations according to GIP, while making maximum use of the most secure and certified equipment (1.3.3). ➢ Apply GIP for design of tanks, piping, valves, alarms, overfill protection and other control systems and instrumentation (1.3). ➢ Hazard and Risk Assessment addressing the risks for operating personnel and risks that go beyond the OT boundaries, e.g. by Process Hazards Analysis (1.5). ➢ Safety Report (incl. loss of containment scenarios and related preventive / mitigation measures such as overfill protection systems) (1.5.1). ➢ Apply the principles of "design for decommissioning"

PHASE 2: Construction & Installation – Commissioning	
ECE Member States	➢To provide a framework for Notification of the Competent Authorities in case of leakages or significant irregularities endangering the environment.
Competent Authorities	➢Establish and communicate to the OT Operator the applicable inspection regime and controls that will be executed during the construction, commissioning and operational phases (para 30). ➢Evaluate the OT Operator's capability to effectively implement the Internal Emergency Plan (para 31 &35). ➢Draw up and implement an External Emergency Plan, aligned with the OT Operator's capabilities in emergency planning & response (para 34 & 35). ➢Adopt a system for acting on Notifications of leakages or significant irregularities endangering the environment.
OT Operators	➢ Stakeholder mapping and analysis of stakeholder needs to enable effective communications (para 48). ➢ Prior to construction to obtain permits, approvals, licenses and other documents in state and local authorities. ➢ Internal Emergency Plan (para 46) (4.1.1). ➢ Hazard and Risk Assessment during construction and commissioning, including Pre-start up safety reviews (para 45) (1.5 & 2.5.1). ➢ Purchasing of equipment & materials according to GIP (para 43) (1.4). ➢ Ensure an adequate level of quality control of purchased equipment and related construction work (incl. non-destructive testing of piping

	according to planned arrangements) (1.4). ➢ Ensure inspections are carried out as required / planned in accordance with legal requirements, including material certificates testing. (para 41, 44, 55). ➢ Proof-testing overfill protection systems to ensure a reliable operation (1.3.3&2.3). ➢ Ensure adequate involvement of specialized construction and commissioning companies where needed ➢ Ensure that contractors work only with trained, qualified personnel (para 4&5). ➢ Monitor the conditions of temporary storage of equipment at construction site and follow-up the level of pollution, while respecting the ALARP principle. ➢ Monitor performance and compliance with all contractor work. ➢ Performance monitoring making use of leading & lagging indicators (2.10). ➢ Internal audits of the OTMS (para 53) (2.12). ➢ Lessons learned and feedback mechanism (2.13). ➢ Notification of the CA when leakages or significant irregularities occur during construction or commissioning of the OT.

PHASE 3: Operation & Lifetime Extension	
ECE Member States	➢To provide a framework for Notification of the Competent Authorities in case of leakages (loss of containment) or significant irregularities endangering the environment. ➢Ensure that Competent Authorities organize a system of routine and non-routine inspections for the monitoring the effects on the environment and on human health.
Competent Authorities	➢Apply a control framework on asset integrity by periodical inspections (para 28, 29, 30). ➢Adopt a system for acting on Notifications of leakages or significant irregularities ➢Conduct audits to verify implementation of OTMS (para 31). ➢Assess periodically emergency preparedness of OT Operators (para 27, 31, 35). ➢Assess the justification of a request for life extension considering compliance to applicable new legal requirements.
OT Operators	➢ Stakeholder mapping and analysis of stakeholder needs to enable effective communications (para 48). ➢ Hazard and Risk Assessment: Structured-What-If-Analysis or checklist methods (para 45) (1.5). ➢ Implement a system for inspection & maintenance of mechanical integrity (3.2). ➢ Maintain an updated inventory of stored hazardous materials (2.7.2). ➢ Implement an OT Management system (OTMS) to manage HSE

	aspects and major accident hazards (para 44) (2. ➢ Management of Operations / Process Safety leadership & culture (para 3) (2.2). ➢Operating Manual available (para 52) (2.4). ➢ Process Safety Management: adopt Safe Work Practices and Management of Change (2.5). ➢ Organizational issues: roles & responsibilities of key stakeholders (internal and external) (para 47) (2.3.1). ➢ Competence assurance of all personnel working for the OT, ensuring training is provided to operate the OT in normal and emergency situations (para 50) (2.3.4). ➢ Management of technical and organizational change (para 45) (2.6). ➢ Management of contractors by enforcing to adopt Safe Work Practices (2.8.2). ➢ Key principles & procedures for fuel transfer and storage (2.7). ➢ Operational Controls (2.7.3). ➢ Maintain a reliable overfill protection system by periodic testing of functionality according to agreed arrangements / standards (e.g. IEC 61511) (1.3). ➢ Maintenance of emergency response equipment to defined GIP (4.2.2). ➢ Learning from experience: investigation of incidents and near-misses (2.9 & 2.13). ➢ Performance monitoring: leading & lagging indicators (2.10). ➢ Internal audits and review of the OTMS (para 53) (2.12). ➢ Lessons learned and feedback mechanism (2.13). ➢The OT Operator should conduct a technical condition assessment of the OT to ensure that the OT infrastructure and related assets remain fit for their intended purpose over the planned operating lifetime. ➢Based on the condition assessment, the OT Operator may consider extending the lifetime, while adopting best practices to obtain a lifetime extension of the OT (3.2.1 &3.2.2). ➢ Notification of the Competent Authorities when leakages or significant irregularities of the safe operation of the OT or leakages occur.

PHASE 4: Closure – Mothballing - Decommissioning	
ECE Member States	➢Ensure that the Competent Authorities organize a system of routine and non-routine inspections of OT's for the purposes of monitoring the effects on the environment and on human health. ➢To provide a framework for Notification of the Competent Authorities in case of leakages or significant irregularities endangering the environment. ➢To provide a framework for closure and post-closure obligations and for transfer of responsibility to be adopted by the Competent Authorities

Competent Authorities	➢ Adopt a system for conducting routine and non-routine inspections of OT's for the purposes of monitoring the effects on the environment and on human health. ➢Apply legal considerations pertaining to liability for closure and post-closure activities, such as monitoring the abandoned site: this should cover all legal obligations relating to monitoring and corrective / remedial measures further to observed leakages. ➢Adopt a system for acting on Notifications of leakages or significant irregularities. ➢ Notify the OT Operator on remaining degree of monitoring & liability during decommissioning, based on environmental state of pollution of soil & groundwater, compared with the baseline report. ➢Adopt the final decision on transfer of responsibility via an approved post-closure plan.
OT Operators	➢ Stakeholder mapping and analysis of stakeholder needs to enable effective communications during the inactive state and during decommissioning (para 48). ➢ Staff responsible for the control of the state of the inactive facility should be trained on the safe control (GIP for mothballing to apply). ➢ Performance monitoring: leading indicators to monitor the safety status of the inactive facility. ➢ Apply the best available technology for ensuring a safe state during the entire duration of conservation of the inactive facility. ➢ Establish project documents for the preservation of the OT on the basis of best available technologies. ➢ Competence assurance of all personnel working for the OT, including hired experts in closure, post-closure and decommissioning activities (para 4, 42, 51 & 56). ➢ Internal Emergency Plan for decommissioning and abandonment (para 56) (5.2). ➢ Consider temporary closure when poor market conditions exist and apply BAT in those cases. ➢ Establish a Decommissioning Plan and implement when relevant (Closure Plan) (5.2.2). ➢ Due Diligence Considerations ➢ Apply equipment for demolition of the OT should to ensure trouble-free work to avoid harm to the environment and injury to people. ➢ Apply the best available techniques for waste management and for bringing the area into a safe state for the environment ➢ Consider after-care issues in line with closure and post-closure plans (e.g. monitoring ground water pollution at long term) and liability issues (5.2.1&4). ➢ Notification of the Competent Authorities when leakages or significant irregularities occur during mothballing or decommissioning of the OT. ➢ Establish a document of transfer of responsibility, based on a condition assessment and post-closure plan.