Maintenance of Primary Containment Systems

Common Inspection Criteria
Seveso Publication Series

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Common Inspection Criteria (CIC) of the Seveso Inspection Series

- Intended to share knowledge about **technical and organisational measures and enforcement practices** related to implementation of the Seveso Directive

- **Developed by EU Seveso inspectors** to aid the dissemination of good enforcement and risk management practices for the control of major industrial hazards in Europe and elsewhere.

- Intended **for use by hazardous site inspectors** but may also offer inspiration to industry safety managers as well.

- The CIC can serve as a **reference framework** for inspecting how certain risk management elements are implemented and demonstrated at Seveso establishments.

- The CIC also offers a means to assess an operator's performance using **defined success criteria.**

- **Not intended as a technical standard** nor as a summary or replacement of any existing standards on the matter.


MAHB Major Accident Hazards Bureau

INSPECTION

Maintenance of Primary Containment Systems

DEFINITION AND SCOPE

BACKGROUND

PRIMARY CONTAINMENT SYSTEMS AND BARRIERS

European Commission

CIC on Maintenance of Primary Containment Systems

Purpose: To guide inspectors in assessing the adequacy of the arrangements made by operators of hazardous sites for maintenance of primary containment systems

Why it is important: Minimise the risk of loss of primary containment of hazardous materials (liquid leaks and gas releases) that could lead to a major accident

Research shows that 50% of European major hazard 'loss of containment' events are primarily due to ageing plant mechanisms such as erosion, corrosion, fatigue, as well as other physical stressors on the equipment.

The role of inspections: To verify the adequacy of both technical and organisational measures that should be in place to support each element.

Oil pipelines exposed for maintenance (Photo credit: Eric Jones)

Known weaknesses of primary containment systems

- Small bore piping and instrument tubing
- Pump seals
- Bolted joints / flanges
- Corrosion under insulation (CUI) and corrosion under pipe (CUP) supports
- High process temperatures, aggressive chemicals or high cycling rates (temperature or pressure)
- Obsolescence of electrical controls & instrumentation (EC&I) equipment
- Equipment items that are difficult to access
- Newly installed equipment
- Auxiliary items not directly involved in production such as secondary / back-up pumps, emergency shutdown (ESD) systems, alarms and trips, temporary and experimental equipment, and equipment shared between installations, such as internal connecting pipelines

What are primary containment systems?

They are specifically a subset of safety critical elements (SCEs) that form **the hardware components of preventive barriers**, such as:

- Pressure vessels (including heat exchangers, columns reactors, fired heaters, etc.)
- Atmospheric storage tanks
- Rotating equipment (pumps, compressors, turbines, etc.)
- Piping systems (pipe, fittings, flanges, supports, etc.)
- Pipelines inside the Installation (above ground or buried)
- Technology-specific containment systems, e.g., driers, filters, condensers, cooling towers, refrigeration systems, powder handling systems, underground storage, cryogenic storage vessels, oil and gas wells, wellheads, flowlines, mine tailings disposal ponds, dams, etc.

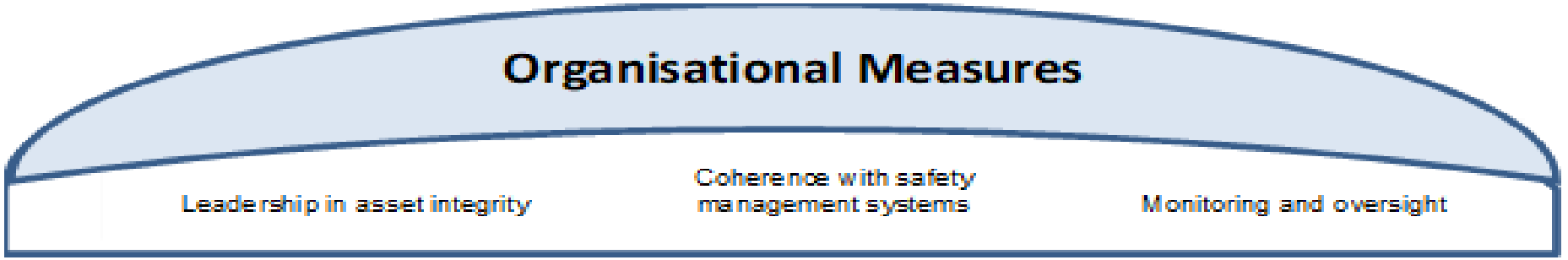
And also …

Subcomponents of these elements, such as valves, gaskets, flanges

Supporting structures, connections, and instrumentation: e.g., safety instrumentation, control systems, alarms and automatic shutdown systems associated with the above, including sensors, process connections, transmitters, tubing and fittings, cabling systems, etc. and

Relief systems (pressure relief valves, vent and flare systems, etc.)

Technical and organizational measures



Technical Measures

Asset register	Inspection plan	Roles & responsibilities	Supervision of contractors
Degradation mechanisms	Inspection intervals	Competence requirements	Permit To Work
Preventive maintenance	Systematic process	Competence assessment and development	Isolation
Quality management	Competence involvement		Task specific safety
Record-keeping	Documentation		Management of overrides
Documentation of remnant life			Communication
			Fitness to work
			Management of change
			Emergency measures

Expectation: Maintenance programme strategy

Objective: Optimize systems and process to ensure that equipment in operation is always fit for service and that degradation does not happen faster than it should.

Structural elements:

- **An asset register with** SCEs by tag numbers, locations, operating limits, performance criteria, etc.
- **Degradation mechanisms for each SCE, e.g.,** Corrosion (internal and external, chemical, galvanic, microbial, erosion), fatigue, stress, radiation, etc.
- **Preventive maintenance plans,** for each SCE, including applicable standards, codes of practice, etc., and associated degradation and trend analyses
- **Quality management protocols,** quality control of completed work, procurement
- **Records of all preventive and reactive maintenance,** for each SCE, date, type, reason why, etc.
- **Records of other maintenance-related issues**, e.g., operation outside of design envelope, maintenance errors, unmanaged changes, etc.
- **Documentation justifying each SCE remaining in service**, calculations, fitness-for-service evaluation

Expectations: Operator inspection programme

Objective: To have a documented inspection plan defining inspection intervals for each SCE

Structural elements:

A periodic examination and assessment plan based on the principles of risk-based inspection

Inspection intervals, established to confirm that minimum performance criteria are met

A systematic process and documentation for routine inspection of an SCE and reverification of after the SCE operating limits have been exceeded beyond predefined values.

Involvement of the necessary competences in inspections planning as appropriate to the different types of SCEs in service and processes and substances involved.

Records of all examinations and assessments of each SCE:

- Date, type of examination performed, and results
- Historical trend analysis to identify degradation mechanisms and rates
- Recommendations to management from the operators' inspection and technical integrity personnel

Expectations: Competence of maintenance staff – including contractor personnel

Objectives:

- Maintenance planning and execution and maintenance decisions are taken with involvement of relevant expertise.
- Maintenance tasks are conducted by personnel with appropriate skills and training.

Structural elements:

Defined roles, responsibilities, accountability, authority and interrelation of all people who manage, perform or verify the maintenance and inspection of primary containment systems

Defined competence requirements of all the above people, taking into account individual responsibilities for specific types of work, and the hazards of the establishment

Records of competence assessments and skills development of personnel assigned to specific maintenance tasks

Expectations: Safe systems of work, integrating human factors good practice

Objective: Standard safety practices are followed in all aspects of the maintenance work.

Structural elements:

Safe working practices, clear and accessible procedures and records for each job, developed with task performers, ccovering, in particular:

- All maintenance tasks
- All periodic examination and assessment (‘operator inspection’) tasks
- Supervision of contractors
- Permit To Work
- Isolation and making the area safe for maintenance and activities
- Management of overrides of process safeguarding systems and process safety alarms
- Communication within and between shifts, including handover
- Fitness to work
- Any other human factors good practice applicable to the task
- What to do in an emergency or if a safety risk emerges
- Management of changes to the maintenance task as planned

Organisational measures

Objective: To define responsibilities and accountability, systems and processes for achieving the maintenance programme goals

Structural elements:

Assignment of clear overall responsibility for asset integrity of the establishment (e.g., a nominated ‘asset manager’), to communicate, facilitated and ensure effective implementation

Demonstration of compatibility and coherence with the safety management system, including personnel management, risk assessment, management of change, operations management, etc.

Monitoring and oversight of asset integrity and maintenance operations, e.g., through routine audit and review and performance metrics

Links related to the CIC on Maintenance of Primary Containment Systems

The CIC is available on the MAHB Minerva website in html format so that it can be translated with online translation applications.

https://minerva.jrc.ec.europa.eu/en/shorturl/technical_working_group_2_seveso_inspections/cic_maintenance_of_primary_containment_systems

The CIC on Maintenance of Primary Containment Systems also includes links to a number of reference documents including publications in the Seveso Inspection Series. Links to all publications in the series can be found at the Seveso Inspection Series webpage:

https://minerva.jrc.ec.europa.eu/en/shorturl/technical_working_group_2_seveso_inspections/seveso_inspection_series

The CIC also has links to other relevant references within the text and at the end following the text.

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