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| Process Safety Management Program |
| **Title:** Compliance Guidelines for Mechanical Integrity  **Document #:** PSM-SY-UN-011 **Issued:** 08/08/14 |
| **Responsible Dept.:** EHS **Version:** New  **Approved By:** PSM Focus Group **Page:** 1 of 3 |

**1.0 Purpose:** This document summarizes the method The Pennsylvania State University uses to comply with the requirements relating to the Mechanical Integrity Element of the Process Safety Management (PSM) Program.

**2.0 Scope:** The intent of this element is to ensure that the on-going reliability of process equipment is maintained thereby minimizing or avoiding premature failure in certain process equipment that is critical to the continued safe operation of a process. The Mechanical Integrity (MI) element is primarily focused on maintaining the equipment in proper safe working order through implementation of the following components:

1. The identification and categorization of equipment and instrumentation
2. Development of written preventive and routine maintenance procedures
3. Training for inspection, testing and maintenance activities
4. Inspection and testing schedules
5. Correction of equipment deficiencies identified

**3.0 Guidelines:** For each covered process area, a list of the equipment that is included within the MI Element will be generated. The list shall include all equipment that contains the highly hazardous chemical or is critical to safe guarding the operation of the process (e.g. ventilation fans, scrubber systems, etc.). The following items shall be included in the MI equipment list; however, it is not intended to be an exhaustive list:

1. Pressure vessels (e.g. receivers, compressors, boilers, heat exchangers, etc.) and storage tanks
2. Piping systems (including piping components such as valves)
3. Emergency relief devices and vent systems
4. Emergency shutdown systems
5. Controls (including monitoring devices and sensors, alarms and interlocks)
6. Pumps
7. Electrical system components
8. Safety systems (including fans, fire suppression, etc.)

In addition, any other devices designated by the facility/operation personnel for the covered process as being potentially critical (a device which is more likely than another to result in or contribute to a major problem or loss if not properly maintained) to the safe operation of a process as a result of operating history or identify through a process hazard analysis.

To facilitate data maintenance for each piece of equipment specified on the MI list, an Equipment Master File for the process will be created and maintained. The data to be included within the Master File shall include:

1. Unique identification number
2. Manufacturer’s operating instructions
3. Manufacturer’s recommendations for equipment inspection and testing including criteria and intervals (include a basis statement to deviate from manufacturer’s recommendations – RAGAGEP, equipment history, etc.)
4. Manufacturers maintenance procedures and recommended preventive maintenance schedule
5. Equipment design specifications
6. Fabrication code certificates
7. Detailed as-built drawings
8. Detailed maintenance history
9. Detailed modification history
10. Results of previous inspection/tests

If this data is maintained within a robust and readily accessible system, the location and method to access the appropriate information shall be identified within the Equipment Master File.

The MI element requires written preventive maintenance procedures for the process equipment that is present in a covered process. The written procedures are to address the required inspections and tests for the equipment, schedules for the inspections and tests, and procedures on how to perform a particular inspection or test or make a particular repair.

In addition to the preventive maintenance procedures, written procedures for each type of routine repair performed by operations and/or maintenance employees on those pieces of critical process equipment shall be prepared. To satisfy this requirement, these procedures must contain the following information:

1. A step-by-step description of how the repair work is to be performed
2. An understanding of the hazards associated with the chemicals, equipment, and tasks involved with the repair
3. The type of PPE required to protect the employee form the identified hazards
4. Notification that certain permits for hazardous tasks (e.g. Hot Work, Confined Space Entry, Hazardous Line Break, etc.) must be obtained and the applicable procedures followed
5. Any special precaution that must be observed while the work is being performed

Identical or similar pieces of process equipment in similar service need not have individualized maintenance procedures established. Procedures may be specific to a group of equipment, such as a general maintenance procedure for compressors.

Employees who are involved in maintaining the on-going integrity of process equipment used in a covered process must receive appropriate training consisting of an overview of the process and its hazards. Additionally, employees are to be provided with training for the on the job tasks (i.e., welding, electrical work, repair/installation activities, inspections/tests, etc.) that the employee is required to perform. The training will be appropriately documented or referenced in the Training and Awareness Element (#09).

The primary emphasis of the MI program is placed on routine checks of process equipment to ensure the equipment receives careful, appropriate and regularly scheduled preventive maintenance, inspections and tests to assure its continued reliable and safe operation. As such it is important that any deficiencies identified through this element are corrected before further use or in a safe and timely manner when necessary means have been implemented to assure safe operation.

**4.0 Definitions:** The following definitions provide guidance regarding common issues surrounding the Mechanical Integrity Element.

*Critical Process Equipment –* any process equipment that prevents, protects, or mitigates a release from the covered process

*RAGAGEP –* recognized and generally accepted good engineering practices (such as those specified by ASME, ASHRAE, ASTM, IIAR, NFPA, API, ANSI, etc.).

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| Process Safety Management Program |
| **Title:** Mechanical Integrity Procedure  **Document #:** PSM-SOP-UN-016 **Issued:** 02/11/2015 |
| **Responsible Dept.:** EHS **Version:** New  **Approved By:** PSM Focus Group **Page:** 1 of 7 |

**1.0 Purpose:** This document provides guidance to employees of The Pennsylvania State University (Penn State) in the requirements of preparing and maintaining the appropriate information associated with the Mechanical Integrity Element within the Process Safety Management (PSM) Program.

**2.0 Scope:** The intent of this element is to ensure that the on-going reliability of process equipment is maintained thereby minimizing or avoiding premature failure in certain process equipment that is critical to the continued safe operation of a process. For each covered process area, a list of the equipment that is included within the Mechanical Integrity (MI) Element shall be generated. The list shall include all equipment that contains the highly hazardous chemical / biological agent or is critical to safe guarding the operation of the process (e.g. ventilation fans, scrubber systems, etc.).

**3.0 Responsibility:** The following employees have specific responsibilities assigned to them in accordance with the requirements of the PSM MI Element. Specific Budget Executives and Budget Administrators may assign these responsibilities to a Department or individual other than the one identified in this procedure as appropriate.

Budget Executives and Budget Administrators:

1. Assume primary responsibility to maintain a safe work environment within their jurisdiction, by monitoring and exercising control over their assigned areas.
2. Assign a representative from their respective academic or administrative units to ensure compliance with this procedure.
3. Ensure appropriate mechanisms exist for the development of required MI documentation within the academic departments or administrative units for which they are responsible.

Director Design & Construction:

1. Ensure employees within their area(s) of responsibility are aware, understand, and adhere to the MI requirements outlined in this procedure.

Manager Engineering Services:

1. Ensure employees within their area(s) of responsibility are aware, understand, and adhere to the MI requirements outlined in this procedure.

Project Managers:

1. Coordinate identification, collection and maintenance of documentation required within this procedure.
2. Assist with the development of inspection and/or testing frequencies on appropriate equipment.
3. Collect and update MI documentation as required.

Building Operations / Utility Engineers:

1. Coordinate identification, collection and maintenance of documentation required within this procedure.
2. Ensure inspection and/or testing frequencies are developed for appropriate equipment.
3. Collect and update MI documentation as required.

Physical Plant Supervisors:

1. Ensure employees within their area(s) of responsibility are aware, understand, and adhere to the MI requirements outlined in this procedure.
2. Assist with the development of inspection and/or testing frequencies on appropriate equipment.
3. Provide appropriate opportunities for employees to actively participate in the collection and maintenance of necessary MI documentation.
4. Take prompt corrective action when unsafe process safety conditions or practices are observed or reported.

Operations / Facility Manager:

1. Ensure employees within their area(s) of responsibility are aware, understand, and adhere to the MI requirements outlined in this procedure.
2. Provide appropriate opportunities for employees to actively participate in the collection and maintenance of necessary MI documentation.
3. Take prompt corrective action when unsafe process safety conditions or practices are observed or reported.

Safety Officer:

1. Coordinate implementation of the MI element requirements within the work unit.
2. Take prompt corrective action when unsafe process safety conditions or practices are observed or reported.

Process Safety Program Manager – EHS Department:

1. Oversee all aspects of the University’s Process Safety MI program.
2. Maintain documentation collected by various individual(s) and/or departments within the Process Safety Equipment Master File.
3. Coordinate auditing compliance to the MI element requirements.

Employees:

1. Assist with the identification, collection and maintenance of documentation required within this procedure.
2. Assist with the development of inspection and/or testing frequencies on appropriate equipment.
3. Adhere to the requirements outlined within this procedure.
4. Report Process Safety issues or concerns to appropriate line management and/or Process Safety Program Manager.

**4.0 Definitions:**

*Covered Process* - any process where a highly hazardous chemical / biological agent or extremely hazardous substance deemed by Penn State is used, handled or stored. This also includes critical process operations identified by the University that would benefit from PSM program implementation.

*Critical Process Equipment –* any process equipment that prevents, protects, or mitigates a release from the covered process

*Equipment Master File* – the location where information on the critical process equipment associated with a covered process is located or describes where the specific information is located.

*Operations/Facility Manager* – a person who has control / oversight of building use, stewardship, operation, repair, and general administration of campus facilities. Also includes the operational responsibility of a specific unit operation within a facility.

*Physical Plant Supervisors* – individuals within the Office of Physical Plant that manage employee(s) expectations, training, resource allocation, evaluates performance and ensures that work is carried out in accordance to University policies in such a manner that no one’s security, safety or health is jeopardized.

*RAGAGEP –* recognized and generally accepted good engineering practices (such as those specified by ASME, ASHRAE, ASTM, IIAR, NFPA, API, ANSI, etc.).

*Safeguards* – an engineering or administrative control either in the design or operation of the process that may prevent a scenario from occurring, or that mitigates the consequences should it occur. It is an existing measure that detects or warns of a hazard or consequence, prevents a hazard or consequence, or mitigates the effects of a hazard or consequence.

*Standard Operating Procedure (SOP)* - established or prescribed methods to be followed routinely for the performance of designated operations or in designated situations.

**5.0 Procedure:** Equipment used to process, store, handle or control highly hazardous chemical / biological agent’s needs to be designed, constructed, installed and maintained to minimize the risk of releases. The Mechanical Integrity (MI) element is primarily focused on maintaining the equipment in proper safe working order through implementation of the following element components:

1. Identification and categorization of equipment and instrumentation
2. Written preventive and routine maintenance procedures
3. Training for inspection, testing and maintenance activities
4. Inspection and testing schedules
5. Correction of equipment deficiencies identified

The following steps outline the requirements relating to the MI element:

1. For each covered process area, a list of equipment that is included within the MI Element shall be generated. The list will include all equipment that contains the highly hazardous chemical / biological agent or is critical to safe guarding the operation of the process (e.g. ventilation fans, scrubber systems, etc.). The following items shall be included in the MI equipment list; however, it is not intended to be an exhaustive list:
   1. Pressure vessels (e.g. receivers, compressors, boilers, heat exchangers, etc.) and storage tanks
   2. Piping systems (including piping components such as valves)
   3. Emergency relief devices and vent systems
   4. Emergency shutdown systems
   5. Controls (including monitoring devices and sensors, alarms and interlocks)
   6. Pumps
   7. Electrical system components
   8. Safety systems (including fans, fire suppression, etc.)

In addition, any other devices designated by the facility/operation personnel for the covered process as being potentially critical (a device which is more likely than another to result in or contribute to a major problem or loss if not properly maintained) to the safe operation of a process as a result of operating history or identify through a process hazard analysis.

1. Once a new facility / process has been approved to proceed and has been identified as covered within the PSM Program, the Director of the Design and Construction group will ensure the Process Safety Program Manager (PSPM) is notified of the associated design and construction schedule for the project. The PSPM will work with the Project Manager, Operations / Facility Manager, and Engineering Services personnel to create the equipment list.
2. For existing operations the PSPM is part of the review and evaluation team to assess applicability of the PSM Program to the specific process in question. After the decision to include an existing operation in the PSM Program, the PSPM will work with the Engineering Services personnel, Operations / Facility Manager, Supervisor Area Services, Safety Officer and equipment operators to create the equipment list.
3. As equipment is identified as covered within the MI program, the appropriate data can be collected by the responsible individual(s). The data collected will be maintained in an Equipment Master File for the process. The data to be included within the Equipment master File shall at a minimum include:
   1. Unique identification number
   2. Manufacturer’s operating instructions
   3. Manufacturer’s recommendations for equipment inspection and testing including criteria and intervals (include a basis statement to deviate from manufacturer’s recommendations – RAGAGEP, equipment history, etc.)
   4. Manufacturers maintenance procedures and recommended preventive maintenance schedule
   5. Equipment design specifications
   6. Fabrication code certificates
   7. Detailed as-built drawings
   8. Detailed maintenance history
   9. Detailed modification history
   10. Results of previous inspection/tests

For newly constructed covered processes, the Project Manager is responsible to ensure the above information is provided by equipment suppliers, contractors, and sub-contractors. Certain data is required as part of the Process Hazard Analysis (PHA – Element #03) and shall be provided in sufficient time for the PHA Review Team to conduct the necessary design assessment.

For existing operations the PSPM, Engineering Services personnel, Operations / Facility Manager, Supervisor Area Services, Safety Officer and equipment operators are responsible to collect the equipment outlined within this section. Since this is a team approach, the PSPM will be responsible to pull the appropriate personnel together and outline specific responsibilities and schedule within 90 days of the process being deemed covered.

If this data is maintained within a robust and readily accessible system, the location and method to access the appropriate information shall be identified within the Equipment Master File.

1. To facilitate data collection and maintenance of the appropriate information required, an Equipment Master File Tracking Worksheet has been developed (see Attachment A). This Worksheet shall be created and maintained for all equipment designated as critical process equipment. The PSPM is responsible to generate the Equipment Master File Tracking Worksheet template for new processes covered within the PSM program. Individuals collecting the data or modifying equipment data shall ensure the Equipment Master File Tracking Worksheet is maintained accordingly. A copy of this Worksheet will be maintained within the Process Safety Master File for the specific unit operation.
2. To ensure the on-going safe operation of equipment, written preventive maintenance procedures for the critical process equipment shall be developed. The written procedures shall outline the required inspections and tests for the equipment, schedules for the inspections and tests, and procedures on how to perform a particular inspection or test, or make a particular repair.

In addition to the preventive maintenance procedures, written procedures for each type of routine repair performed by operations and/or maintenance employees on those pieces of critical process equipment shall be prepared.

To ensure the procedures contain the appropriate information, they must at a minimum contain the following information:

6.1 A step-by-step description of how the repair work is to be performed

6.2 An understanding of the hazards associated with the chemicals, equipment, and tasks involved with the repair

6.3 The type of PPE required to protect the employee form the identified hazards

6.4 Notification that certain permits for hazardous tasks (e.g. Hot Work, Confined Space Entry, Hazardous Line Break, etc.) must be obtained and the applicable procedures followed

6.5 Any special precaution that must be observed while the work is being performed

Note: Identical or similar pieces of process equipment in similar service need not have individualized maintenance procedures established. Procedures may be specific to a group of equipment, such as a general maintenance procedure for compressors.

A work unit’s Maintenance Work Order or similar system could also serve as a modified version of a written maintenance procedure provided the information identified above has been included.

1. Results of inspections and tests performed on process equipment are to be recorded and maintained in either the Equipment Master File, the Process Master File, or electronically in a transparent platform available to the affected individuals (e.g. equipment operators, Engineering Services, Operations / Facility, EHS, etc.).
2. Individuals performing preventive maintenance or routine repairs other than the equipment operators must adhere to the requirements outlined within the Maintenance Systems (#12) or Contractor Management (#10) Elements.

If an established inspection / test schedule is unable to be achieved, the Management of Change (#14) Element requirements must be initiated to address any issues that may arise due to the deviation.

1. Employees who are involved in maintaining the on-going integrity of process equipment used in a covered process must receive appropriate training consisting of an overview of the process and its hazards. Additionally, employees are to be provided with training for the on the job tasks (i.e., welding, electrical work, repair/installation activities, inspections/tests, etc.) that the employee is required to perform. The training will be appropriately documented as outlined within the Training and Assessment Element (#09).
2. The primary emphasis of the MI program is placed on routine checks of process equipment to ensure the equipment receives careful, appropriate and regularly scheduled preventive maintenance, inspections and tests to assure its continued reliable and safe operation. As such it is important that any deficiencies identified through this element are corrected before further use or in a safe and timely manner when necessary means have been implemented to assure safe operation.

Employees discovering any deficiencies shall immediately report them to their supervisor and follow the appropriate established work flow process to correct the issue. Depending on the type of deficiency identified, the Management of Change (#14) Element requirements may be required to address any issues that could arise due to the deficiency.

1. The PSPM will periodically evaluate performance against established inspection and testing schedules. Metrics will be established for achieving on-time completion by the designated due dates. Metric goals will be established and communicated by senior leadership responsible for the covered process areas.
2. The PSPM will periodically evaluate performance within the requirements of this element and provide input to the affected departments. This will include review of training records, management of equipment deficiencies, maintenance of Master Equipment Files and availability of written procedures.

**6.0 Attachments**

* 1. Attachment A - Equipment Master File Tracking Worksheet