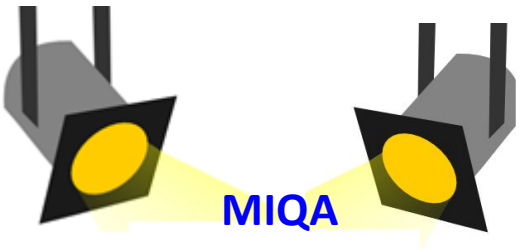

What is Mechanical Integrity (MI) ?

MI is the programmatic implementation of activities necessary to ensure that important equipment will be suitable for its intended application throughout the life of an operation. It varies according to industry, legal requirements & regulations, geography and company culture.

Good MI program's characteristics are :

- Incorporate activities that ensure that equipment is designed, fabricated, procured, installed, operated and maintained in a manner appropriate for it intended use only.
- Prioritize equipment to help optimally allocate resources (e.g. personnel, money, storage space).
- Helps plant staff recognize when equipment deficiencies occur and includes controls to help ensure that deficiencies do not lead to serious accidents.
- Incorporate Recognized and generally accepted good engineering practices (RAGAGEPs).
- Helps a plant staff perform planned maintenance and reduce the need for unplanned maintenances.
- Helps ensure that personnel assigned to inspect, test, maintain, procure, fabricate, install, decommission, and recommission process equipment are appropriately trained and have access to appropriate procedures for these activities.
- Maintain history of service documentation and other records to enable consistent performance of MI activities and to provide accurate equipment information to other users, including other process safety and risk management elements.

Why MI is required ?

Can you use 15 years old two-wheeler which is not undergone any maintenance throughout its life ? Answer will be NO. So why should any chemical plant & equipment be any different ? Similar aspects are applicable for any industry. MI ensures that the integrity of the **manufacturing process equipment is maintained to the original design specifications.**

What is Quality Assurance (QA) ?

Quality Assurance (QA) considers quality from the time the equipment is designed until the time it is taken out of service (for retirement or reuse). QA also incorporates QC activities and vary from company to company terminology. QA efforts focus on ensuring that new process equipment is:

- Designed, Procured & fabricated in accordance with RAGAGEP specifications.
- Delivered & Stored in proper condition & location with retrieval system.
- Assembled and installed properly.

Why Quality Assurance (QA) is required ?

A facility should examine existing practices at each stage of equipment life to determine whether Quality deficiencies exist and if so, develop a quality improvement plan to upgrade areas of vulnerability.

RAGAGEP : Recognised And Generally Accepted Good Engineering Practice are the standards, be they International, National, Local or even company that are considered best practice, If followed/used then "experts" would consider them appropriate for the application.

MIQA :

The primary reason for doing MIQA is to **eliminate process safety incidents** and the **sufferings** and the **cost** that they cause.

MIQA : MI and QA are 2 different elements of facility sector of Process Safety Management (PSM).

Successful MIQA program includes effective plans for recognizing and reacting to equipment deficiencies. A deficiency is identified through the evaluation of equipment condition based on MI activity results or by the observation of substandard equipment performance or condition during normal operation. Deficiency is reported when parameter is outside the established acceptance limits that define the equipment integrity.

How Deficient Equipment can be discovered ?

- During acceptance testing for new equipment fabrication or installation
- Observed during Inspection, Testing and Preventive Maintenance (ITPM) activity
- Parameters measuring during a repair

Expectations from the MIQA implementation

- Improved equipment reliability
- Reduction in equipment failures that lead to safety, health and environmental incidents
- Improved product consistency
- Improved maintenance consistency, efficiency & effectiveness
- Reduction of unplanned maintenance time and costs
- Reduced operating costs
- Improved Spare parts management / Zero Inventory concept
- Improved contractors performance & accountability
- Compliance with applicable government regulations
- Clarity on Roles & Responsibilities matrix

MI :

1. Maintenance Procedure System : It requires, Top document which provide Site Management system for Procedures and Safe Work Practices, Identification of critical tasks, guidance for procedure writing, procedure control, types & number of procedures and its training. Complete system should be valid, periodically reviewed and accessible to those who need them.

2. Training : All/Any person involved in process critical task must be verified as competent to do the work. Company Training program can be developed considering training requirement & identification matrix, Trainer's training, validation & competency assessment, documentation/ record keeping. Refresher Training should be arranged. Employees and contractors all should be covered under training.

3. Spares : Team efforts should include :

- Defined spares specification must meet RAGAGEP
- Only use approved supplier(s)
- Appropriate receipt, storage & retrieval system to avoid damage/deterioration
- Segregation of critical & noncritical spares
- Last chance inspection must be performed immediately before use
- No changes without approval
- Authenticate origin of spares.

4. Maintenance Strategy : All important / critical equipment must have documented maintenance strategy which must be evergreen (updated immediately based on own or others experience, changes in operation etc), reflect the condition and usage of the equipment and reviewed before decisions are taken. Strategies can be predictive maintenance, preventive maintenance or run to fail. It should capture :

- Potential failure mechanisms
- Potential consequences
- Methods to monitor equipment conditions
- Monitoring frequency
- Tests and inspections which may help measure performance and/or condition
- May include assumptions on spares

5. Tests & Inspections : Tests and inspections should follow and approved methodology (conform to RAGAGEP) be done by trained and approved personnel and changes/deferments approved. Tests & Inspections are to Evaluate equipment condition, Demonstrate equipment functionality and Measure a physical characteristic. It can be regulatory, part of maintenance strategy or Integrity check of equipment. Planning is the most important step in Test & Inspections. Planning team should consist of

- Area Engineers
- Maintenance Supervisor
- Operations Supervisor
- Materials Engineer
- Reliability Engineer
- Inspector

6. Repairs & Changes : Typically repairs are driven by a "fitness" for use issue. Hence, All repairs and changes must ensure continued compliance with RAGAGEP. Approval and Management of Change must be followed for Repairs & Changes. They are :

- Temporary repairs
- Replacement
- Re-rating
- Alteration

Major accidents involving inadequate mechanical integrity are :

Chevron Refinery Fire, Carbide Industries Fire and Explosion, Hoeganaes Corporation Fatal Flash Fires, NDK Crystal Inc. Explosion with Offsite Fatality, Silver Eagle, Allied Terminals Fertilizer Tank Collapse, Technic Inc. Ventilation System Explosion, BP America Refinery Explosion, DPC Enterprises Festus Chlorine Release, Motiva Enterprises Sulfuric Acid Tank Explosion, Tosco Avon Refinery Petroleum Naphtha Fire