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Spotlight

PSIN

NEWSLETTER

PROCESS SAFETY INITIATIVE OF NIGERIA

MEANING OF PROCESS SAFETY MANAGEMENT (PSM)

Process Safety Management refers to a systematic approach to managing hazards associated with industrial processes involving hazardous substances.

PSM focuses on preventing major incidents rather than minor workplace injuries, enhance design integrity, operating procedures, and risk control systems, also aim to avoid unplanned release of hydrocarbons or energy.

WITHIN THIS VOLUME:

INTEGRITY OPERATING WINDOWS AND PROCESS SAFETY

INTRODUCTION

To minimise the impact of any potential degradation mechanisms, it is appropriate to establishing the required boundaries for long and short-term safe process operation. Such boundaries are called Integrity Operating Windows (IOW's)

Integrity Operating Windows (IOW)s

IOWs can further be referred as established limits for process parameters that affect the integrity of fixed equipment and piping. When operating parameters deviate from these limits, degradation is more likely to occur. IOWs should be considered a subset of a larger group of unit operating parameters. If operations are kept within these limits, degradation should be predictable; however, this does not necessarily mean low rates of damage.

- **Three Types of IOWs:** API 584 defines categories based on the speed of damage if breached:
    - **Critical:** Immediate or fast damage (hours/days).
    - **Standard:** Increased damage over a longer period (weeks/months).
    - **Informational:** Long-term trends.
- **Data-Driven:** Limits are derived from equipment design (Maximum Allowable Working Pressure - MAWP, Minimum Design Metal Temperature - MDMT) and previous inspection data.

Integrating into PSM Elements

- **Mechanical Integrity (MI):** IOWs are a cornerstone of a robust MI program, ensuring that inspections are focused on the actual risks driven by process conditions rather than just time-based schedules.

Note

exceedance reviews and MOC changes, a robust IOW program will facilitate conversations between different facility functions about the importance of mechanical integrity.

it is critical to integrate the IOW program into other PSM processes.

- **Management of Change (MOC):** Any change to process variables, feedstock, or equipment configurations requires a review of the IOWs to ensure they remain valid.
- **Operating Procedures:** IOW limits and, crucially, the required operator actions to rectify deviations must be integrated into standard operating procedures.

Monitoring and Proactive Control

- **Automation:** IOWs are frequently programmed into the Distributed Control System (DCS) or historian software to provide immediate, actionable alerts to operators.
- **Actionable Response:** When an IOW limit is exceeded, it must be documented and a pre-defined, formal action taken to restore the process to a safe condition, reducing the risk of catastrophic failure (e.g., as highlighted by the Tesoro incident).
- **Continuous Improvement:** The IOW program must be reviewed and updated to reflect changes in equipment condition or process conditions.

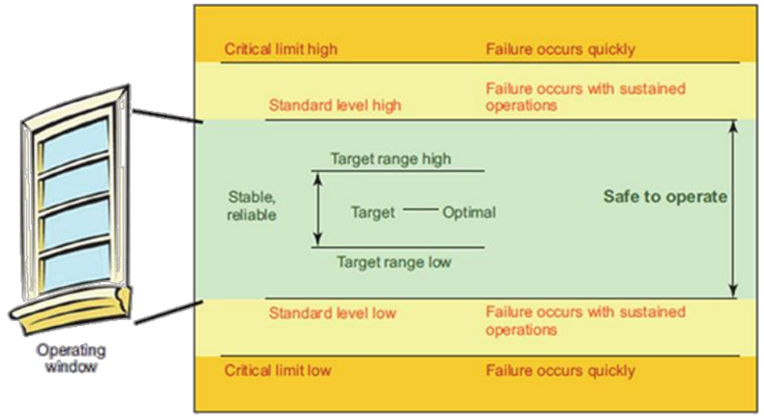
Process Safety Management (PSM) is a multi-faceted program, involving mechanical integrity assurance, management of change, operator training and procedures, process hazards analysis, along with numerous other elements of a comprehensive process safety-quality management system.

Designing an effective Operating Window (OW) within Process Safety Management (PSM) involves defining safe, reliable limits (temp, pressure, flow) for equipment, integrating them into PSM elements like Mechanical Integrity and MOC, using tools (HAZOP, LOPA) to set these limits, and monitoring them to prevent degradation and ensure safe, long-term asset function, moving beyond just immediate alarms to proactive risk control, these are outlined in API 584.

By focusing on the reasons for the DOW violations, a site can resolve systemic or design problems that are resulting in the design window violations i.e. operational, maintenance, compliance etc. IOW violation monitoring allows a site to proactively determine if a specific material degradation mechanism was favoured which could result in a loss of containment. Monitoring DOW violations can help focus on the “big issues” by gaining control of the des envelopes and working inward instead of being overwhelmed with trying to control the operating envelope violations. Process safety incidents typically refer to fires, vapour cloud explosions or toxic releases. These incidents have consequences of fatalities or asset damage which need to be prevented. The PI (Plant Information) system which is a plant data historian software can interface with Microsoft Excel which allows plant data to be viewed in a spreadsheet format. In addition to data viewing functionality, the PI Data Link Excel Add in, allows the user to view data subject to a user defined formula e.g. data can be viewed on a daily or hourly average basis. For the purposes of developing the DOW monitoring tool, the PI Time Filtered function is used.

The inclusion of Integrity Operating Windows (IOWs) in the violation monitoring framework has allowed sites to proactively determine if a specific material degradation mechanism was favoured which could result in a loss of containment. The addition of Product Quality (PQ) Window limits is utilised to minimise the potential of having an off spec product. These additions show that the monitoring tool can be customised to focus and report on any type of violation as long as the limits are clearly defined and correctly specified. A key requirement for implementation, is having an

online historian like PI which can interact with Microsoft Excel. Lastly, equipment parameters need to be measured online in order to be incorporated into the tool.



Integrity Operating Windows (IOWs) are an important component of a world class mechanical integrity program. IOWs are not a new concept, as they have been around in different forms for many years.

Implementing a new IOW program can have many challenges, which can be mitigated through attention to detail in the planning and implementation stages of the program to ensure that it will remain evergreen. The list below provides best practices that owner-users have followed when planning and implementing an IOW program.

- IOWs should focus on parameters that affect mechanical integrity. Operational and Product Quality limits should not be included in the list of IOWs to allow focus on integrity concerns.
- Less is more – IOWs should be limited to important operating variables to allow focus on the parameters that truly affect integrity. Too many IOWs can lead to lack of focus.
- IOW exceedances should be logged and responded to in a formal and documented approach.
- IOWs are often programmed into the distributed control system or plant historian software in order to alarm/notify responsible parties and aid in documentation.
- IOWs should be developed by a team of differing backgrounds supplemented by

Parameters should be selected based on known or potential damage mechanisms. Sources include corrosion control documents, inspection histories, risk-based inspection (RBI) assessments, and process safety information studies. If a process ***variable can accelerate or trigger damage mechanisms, it likely needs an IOW.***

WHAT IS THE DIFFERENCE BETWEEN A CRITICAL, STANDARD, AND INFORMATIONAL IOW?

IOWs are categorized into three levels (per API RP 584), based on their impact on equipment integrity and required response:

- **Critical IOW:** An established IOW level that if exceeded could result in rapid deterioration such that the operator is required to take immediate predetermined actions to return the process variable back within the IOW to prevent significant defined risks of potential equipment damage or hazardous fluid release.
- **Standard IOW:** An established IOW level defined as one that if exceeded over a specified period of time could cause increased degradation rates or introduce new damage mechanisms beyond those anticipated.
- **Informational IOW:** An IOW Informational limit is a parameter that may be used to predict a change in corrosion potential. It may simply be trended rather than having a specified limit or range. Informational IOWs are used for parameters that cannot be controlled by operators.

HOW CAN IOW LIMITS (UPPER/LOWER BOUNDARIES) BE ESTABLISHED?

Limits are set using data from industry practices e.g. corrosion control documents, damage mechanism manuals, historical operational and inspection data, maintenance information, and engineering judgment. For example, if a vessel is a service where equipment can be susceptible to stress corrosion cracking above a certain temperature, that excursion temperature becomes an IOW.

WHO IS RESPONSIBLE FOR IOWS?

Operations, process engineers, and mechanical integrity disciplines all share responsibility.

- **Mechanical integrity/inspection teams** own the IOW process and ensure excursions are investigated, understood, and reflected within the integrity program.
- **Operations** enable the monitoring of IOWs in real time through monitoring systems.
- **Process Engineers** help define and validate limits.

HOW CAN AN IOW EXCURSION BE MANAGED WHEN IT OCCURS?

THE RESPONSE DEPENDS ON THE SEVERITY:

- **Critical excursions** require immediate corrective action—possibly including equipment shutdowns or inspections.
- **Standard excursions** require engineering review, mitigation actions, and potential adjustments to inspection plans.
- **Informational excursions** are logged and trended but may not trigger immediate intervention.

CONCLUSIONS

At times, Mechanical Integrity employees can feel like they are fighting an uphill battle. While the focus of these resources is specifically on Mechanical Integrity, there are competing priorities throughout the facility. One important side benefit an IOW program offer is a structured communication between different functions within the facility. From development of IOWs to