Integrity Operating Windows

API RECOMMENDED PRACTICE 584
SECOND EDITION, DECEMBER 2021

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Introduction

In today's operating environment, it is not enough to base future inspection plans only on prior recorded/known history of equipment condition. A fundamental understanding of the process/operating conditions and resulting damage mechanisms are required to establish and maintain an inspection program that yields the highest probability of detecting damage. Inspection plans should be dynamic and account for changing process conditions and current equipment condition. A fundamental step is to frequently rationalize and align the developed degradation knowledge base of the materials of construction with the operation of the equipment, its inspection history, measured corrosion rates and known industry problems. Whether utilizing time-based or risk-based methodology for determining inspection intervals, Integrity Operating Windows (IOWs) are useful to identify and track process information that either validates or might cause changes to existing inspection plans.

In order to maintain the integrity and reliability of pressure equipment in industry, multiple process safety management (PSM) systems may be necessary. Many of those management systems are oriented toward having a rigorous inspection program, as well as the supportive engineering activities. This may include the implementation of IOWs which can supplement process safety and inspection programs by identifying key process parameters potentially affecting mechanical integrity.

In addition to the application of industry codes, standards, and recommended practices, several other PSM systems are vital to support a rigorous inspection and mechanical integrity program to predict/avoid/prevent pressure equipment damage/corrosion; leaks and failures; and improve reliability. Three key elements of those supporting PSM programs include:

— the establishment, implementation, and maintenance of IOWs. See 3.6;

— an effective transfer of knowledge about unit specific IOWs to all affected personnel; and

— an effective MOC program to identify any changes to the process or the physical hardware that might affect the integrity of pressure equipment.

To operate any process unit, a set of operating ranges and limits should be established for key process variables, to achieve the desired results (i.e. product within specification, safe operation, reliability, etc.). These limits are generally called operating limits or operating envelopes. IOWs are a specific subset of these key operating limits that focus only on maintaining the integrity or reliability of process equipment. Typically, IOWs address issues that involve process variables that, when not adequately monitored or controlled, can impact the likelihood and rates of damage mechanisms, which may result in a loss of containment.

For purposes of this document, maintaining the integrity of the process unit means avoiding breaches of containment, and reliability means avoiding malfunctions of the pressure equipment that might impact the performance of the process unit (meeting its intended function for a specified time frame). In that sense, integrity is a part of the larger issue of pressure equipment reliability, since most breaches of containment will impact reliability. IOWs are those preset limits on process variables that need to be established and implemented to prevent potential breaches of containment that might occur as a result of not controlling the process sufficiently to avoid unexpected or unplanned deterioration or damage to pressure equipment. Operation within the preset limits should result in predictable and reasonably low rates of degradation. Operation outside the IOW limits could result in unanticipated damage, accelerated damage and potential equipment failure from one or more damage mechanisms.

Pressure equipment is generally fabricated from the most economical materials of construction to meet specific design criteria based on the intended operation and process conditions. The operating process conditions should then be controlled within preset limits (IOWs) to avoid unacceptable material degradation and achieve the desired economic design life of the assets.

Inspection plans are typically based on historic damage mechanisms and trends and are not generally designed to look for unanticipated damage resulting from process variability and upsets. Inspection plans generally assume that

the next inspection interval (calculated based on prior damage rates from past operating experience) are scheduled based on what is already known and predictable about equipment degradation from previous inspections. Without a set of effective and complete IOWs and feedback loop into the inspection planning process, inspections might need to be scheduled on a more frequent interval just to look for anything that might potentially occur from process variability. The owner-operator should implement and maintain an effective program for creating, establishing, and monitoring integrity operating windows. IOWs are implemented to avoid process parameter exceedances that may have an unanticipated impact on pressure equipment integrity.

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1 Purpose and Scope

1.1 The purpose of this recommended practice (RP) is to explain the importance of IOWs for process safety management and to guide users in how to establish and implement an IOW program for process facilities. Its express purpose is to minimize unexpected equipment degradation that could lead to loss of containment. It is not the intent of this document to provide a complete list of specific IOWs or operating variables that might need IOWs for the numerous types of process units in the industry (though some examples are provided in the text and a list of process variables for some example process units in included in Annex A); but rather to provide the user with information and guidance on the work process for development and implementation of IOWs to help strengthen the Mechanical Integrity (MI) program for each process unit.

The key goals of an IOW program are:

1) Defining IOW limits which will result in predictable and acceptable levels of equipment degradation to meet reliability expectations.

2) Enabling effective communication of equipment limits and exceedances between key Process, Operations, Maintenance, and other MI stakeholders to facilitate safe and reliable process operation and management.

3) Facilitating the reliable operation of equipment without loss of containment or the need for unplanned maintenance activities between scheduled outage or shutdowns.

1.2 The scope of this standard includes:

— definitions of IOWs and related terminology;

— creating and establishing IOWs;

— data and information typically needed to establish IOWs;

— descriptions of the various types and levels of IOWs needed for process parameters;

— risk ranking IOWs;

— documenting and implementing IOWs;

— monitoring and measuring process variables within established IOWs;

— communication of IOW exceedances;

— reviewing, changing, and updating IOWs;

— integrating IOWs with other risk management practices;

— roles and responsibilities in the IOW work process; and

— knowledge transfer to affected personnel.

1.3 This RP outlines the key elements in defining, monitoring, and maintaining IOWs as a vital component of integrity management (materials degradation control) and assisting in the inspection planning process, including Risk-Based Inspection (RBI). Other Process Safety systems may be affected by or involved with the IOW program, including management of change (MOC), process safety information (PSI), and training. For purposes of this RP, these systems are only addressed to the extent of mentioning the integration aspects that are needed with the IOW program.