The increased focus on mechanical integrity (MI) from jurisdictions and operating facilities has prompted the development of two new API documents. API RP 970, currently under development, will provide a work process and standardized approach to develop Corrosion Control Documents (CCDs). A CCD incorporates knowledge of the unit operation, equipment inspection histories, and the damage mechanisms specific to the unit. A CCD enhances MI by documenting the specifics of managing degradation on a unit for operations, technical, inspection, and integrity personnel. API RP 584 – Integrity Operating Windows (IOWs) – provides a work process for the development and implementation of IOWs. IOWs strengthen the MI program for each process unit. IOWs are typically included in a CCD, or they can be developed as a separate smaller study.

WHAT IS AN IOW?

IOWs are established limits for process variables (parameters) that can affect the integrity of the equipment if the process operation deviates from the established limits for a predetermined length of time. There are three types of IOWs: critical, standard, and informational. Each IOW has a recommended response or monitoring action within a specified period of time. Response times for critical IOWs are the shortest, while standard and informational IOWs tend to be longer (less urgent).

Each IOW contains the following information in table format:

- IOW 
- System/Component Name 
- Current Material 
- Monitor Parameter 
- Materials/Corrosion Concern 
- Data Source (e.g., Process Tag, Lab ID) 
- Parameter Range/Limits (Min/Max/Target) 
- Suggested Monitoring Frequency 
- IOW Excursions
  - Recommended Response Timing 
  - Potential Actions 
- Comments

CONTACT

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Operation outside of IOW limits can result in accelerated damage to equipment. Conversely, operation within the recommended limits will result in predictable damage rates. E2G believes developing IOWs as part of the CCD is the most robust process.

WHAT IS A CCD?

A CCD is a document that provides a road map to the unit-specific damage-related information, impacts, and supporting data within a process unit that can be used by all disciplines. The CCD is developed for a single process unit with the purpose of providing guidelines for degradation control.

A CCD is evaluated at the corrosion loop level. Corrosion loops are characterized by similar operating conditions resulting in similar damage mechanisms. Establishing and documenting the data required for the damage mechanisms paves the way for estimating corrosion rates, assessing cracking susceptibilities, and developing the IOW limits. This will allow for improved plant mechanical integrity and focused inspection efforts.

CCD BY E2G

E2G’s Materials and Corrosion group has been providing CCDs since 2001. Based on our experience and client feedback, we have developed a CCD product that is best in class. Our standard CCD template is consistent with the current API RP 970 draft. The main body of the CCD is divided into corrosion loops and unit-specific degradation discussions. Each corrosion loop along with the metallurgy is identified visually on the PFD level (see example PFD below).

The corrosion loop will identify and discuss the following items:

- Short process description
- Equipment and material listing
• Process conditions and reason for materials of construction
• Active damage mechanism identification, descriptions, and unit impact
• IOWs that impact the corrosion loop
• Operation history affecting MI
• Equipment and piping inspection considerations (outside of API 510/570)
• Injection/mix point and dead leg inspection considerations
• Start-up and shut-down consideration
• Relevant short-term and long-term corrosion control recommendations

Each corrosion loop is intended to summarize current and past corrosion issues within an IOW. This section of the document contains the detailed corrosion information and history specific to the unit being analyzed.

In addition, the CCD will provide a detailed discussion for each of the degradation issues specific to the unit based on the past, current, and expected operational factors (including the positive impact that IOWs will provide for the unit). The CCD provides users with a comprehensive background and insight on how the degradation issues are impactful specifically to their unit, which is much more beneficial to the user than the generic degradation discussions found in industry standards.

WHO IS INVOLVED IN THE DEVELOPMENT OF CCDS AND IOWs?

Because a CCD is a detailed document, the best results have been found when input is obtained from a multidisciplinary team of stakeholders and subject matter experts. The personnel on this team may be required to provide data for review in the development stages of the document, and they will be required to participate in document review meetings. The team should consist of the following personnel:

• Experienced Materials and Corrosion Expert (E2G)
• Plant Materials and Corrosion Engineer
• Unit Process/Production Engineer
• Unit Operations personnel
• Unit Inspector
• Unit Reliability Specialist (optional)
• Chemical treatment vendor (as needed)

Additional personnel can attend the review meetings to provide expertise and/or understanding of the unit operation (e.g., mechanical engineer, rotating equipment specialist, inspection specialist). To achieve a quality document, an experienced materials and corrosion expert is required to analyze and interpret the information provided.

HOW DO CCDS AND IOWs SUPPORT AN RBI PROGRAM?

CCDs, IOWs, and RBI are all integral components of the MI program, which manages damage mechanisms in a plant. Figure 1 is a schematic showing their integration.

The CCD document provides the basis for understanding how each damage mechanism affects the fixed equipment and piping within the unit. RBI is most effective when the damage mechanisms are fully understood. IOWs can be used to protect the basis of the RBI analysis and to control damage mechanism rates.

WHO CAN BENEFIT FROM OR USE A CCD?

All plant personnel benefit from a CCD. The primary user of the CCD is the unit inspector. The unit inspector should use this as a reference document for understanding where and what to inspect. The site materials and corrosion engineer will refer to it often. A well-written and updated CCD should also be used as
a training document for newly hired personnel and junior mechanical/reliability and process engineers. The unit operators and process engineers who will be responsible for maintaining and controlling many IOW limits can use the CCD as part of their training to understand the basis for the limits.

**EVERGREENING A CCD**

The CCD should be owned and updated by the personnel responsible for the MI program within the plant. This could be the plant materials and corrosion engineer, a reliability engineer, or the inspection department. The CCD should be incorporated into the management of change (MOC) process to ensure any changes are incorporated. A CCD should be reviewed and updated every 5 years or after every major turnaround (TA). The IOWs should be reviewed as part of a major TA work plan to validate if conformance has occurred or whether the degradation and RBI requirements should be updated to reflect recent operating conditions.

**HOW DO CCDS AND IOWs BENEFIT YOUR FACILITY?**

A CCD (with IOWs) is a proactive tool that can manage damage rates, create operating limits, and assist in establishing monitoring programs. Turnaround planning can use the information within a CCD to support the basis for integrity-based inspections. When developing shutdown/startup strategies and procedures, the CCD will provide guidance to ensure minimal damage. The recommendations that result from performing a CCD review can include equipment upgrades, replacements in kind, or process changes. The CCD will also provide supporting information for other programs like RBI, PHAs, and any future failure analysis.

When CCDs are part of a site’s MI program, they are an invaluable tool for ensuring safe and reliable operation.