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GETTING THE MOST OUT OF YOUR CORROSION CONTROL DOCUMENTS

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INTRODUCTION

Corrosion Control Documents (CCDs) are dynamic and critical components of well-maintained mechanical integrity (MI) programs. It is very important to devote the time and resources necessary to properly develop these highly informative documents.

While API's (American Petroleum Institute) RP 970: Corrosion Control Documents goes into depth on the creation of CCDs, realizing the full value of this effort requires both dedication—to ensure proper engagement & buy-in from normally isolated groups during the creation phase—and drive—it is critical for all these groups to feed information back, to assist in maintaining the CCD.

The process of galvanizing so many different groups during CCD creation, with an extensive knowledge of a unit's history and operation, makes this document a fantastic repository of insights and experiences. It has the potential to become a critical tool for Mechanical Integrity (MI) decision making and for integrating institutional knowledge back into a unit's operational safety culture. A well-assembled CCD is an effective aide in improving reliability and preventing potential pressure boundary failures, which in turn, reduces unanticipated downtime and its associated costs. As such, when it comes time for turnaround and inspection planning, a stakeholder's first question should be: "Where is the CCD for this unit?"

THE CCD DEFINED

A CCD, when developed correctly, is a centralized document that encompasses all necessary and relevant mechanical integrity information for a given process unit. It should outline the process description, all current or potential corrosion, and degradation threats. The document should also summarize the relevant histories, including: the year of construction, the details of any revamps, redesigns, expansion projects, or any major feed changes to the unit.

A CCD can also include a Corrosion Materials Diagram (CMD), which is a modified process flow diagram (PFD), showing a visual breakdown of systems/corrosion loops, operating conditions, materials of construction, and all applicable damage mechanisms. Additionally, there should be a section for the selection basis of the unit's materials of construction.

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For each specific process unit, a CCD should break the unit into systems (also referred to as Corrosion Loops), either by unique process chemistry or by similar damage mechanisms. Each system should be a well-defined section in service of a common functional step (e.g., desalted crude, tower overheads, reactor effluents). Within each system, the CCD should describe the critical inputs for determining corrosion and degradation susceptibilities, along with a historical listing of past damage.

To be effective, each system should include, but is not limited to:

- A description of the system's boundaries and function (e.g., heating, cooling, stripping)
- Operating conditions, process chemistry, contaminates or corrosion precursors, and potential Health/Safety/Environmental (HSE) conditions (e.g., flammability, toxicity, H_2S content)
- Physical equipment and piping components and corresponding mechanical data including: materials of construction, insulation and post-weld heat treatment (PWHT), coatings or lining, and cladding
- Damage mechanisms and failure modes, along with an explanation of applicable reasoning, monitoring/mitigation methods, and reference to any pertinent inspection history (this should include any significant failures, repairs, or replacements)
- Any monitored or controlled IOWs within that system
- Injection and corrosive mix points, deadlegs, changes in general material, bimetallic welds, or any other feature that would warrant emphasized inspection or monitoring
- A description of any operating concerns that can affect or promote increased damage, such as: start-up, shutdown, steam-out, history of excursions, carryover, or acid runaway
- Maintenance practices and procedures performed with regard to mechanical integrity, such as: Maximum Pressurization Temperatures (MPTs), welding precautions, or soda ash wash

All these traditionally scattered inputs combine in the CCD to provide a narrative of how the unit functions, what damage is anticipated, what previous damage has been observed, and the limits to mitigate potential damage in a way that is highly complementary to the operation of an MI program. This data is a snapshot which should feed into the MI/Risk-Based Inspection (RBI) decision making so that any MI/RBI events can be updated in the document to maintain its relevance. Failure to gather many of these data points will greatly hinder the functionality of a CCD, as will a failure to update the document when any of the collected information changes in the future. Therefore, to remain effective, CCDs should be treated as living documents.

WHAT VALUE WOULD A CCD BRING MY ORGANIZATION?

To be most effective, the process of creating a CCD cannot be the work of a single person. Rather, a team of people with different experiences and interests in the unit should be involved. The value created by a document containing this centralized knowledge can impact a diverse group of people in different ways, but the main and most immediate impacts come from the CCD serving as a historical record, a succinct training document, and a tool for inspection and turnaround planning and documenting Integrity Operating Windows (IOWs).

Historical Record

First and foremost, well-developed CCDs provide valuable historical records containing the efforts made within the history of a facility to understand and control corrosion. This historical information includes things like corrosion-related RBI inputs and/or assumptions and previous mitigation efforts and changes to the unit/system to control damage potential or rates. This information represents the defining characteristics of normal operation and reasoning for the risk assessment.

Often, during RBI implementation, there is an urge to dive straight into the project with less consideration towards the living program that it will ultimately become. Once the RBI program is in the "evergreen" phase, those initial inputs and assumptions will undoubtedly become a priceless historical record for a variety of initiatives, especially to the RBI revalidation activities that will be around the corner. A CCD easily acts as a record for those inputs and assumptions and allows verification as the program matures.

In our experience implementing CCDs, the most value in these documents comes from their function as the shared collection of experiences. Companies leverage increasingly more value out of these documents as more users in different groups strategically consult these documents.

Training Document

Where knowledge of the unit is limited, CCDs serve as living records of all pertinent corrosion-related information, making them invaluable training tools for new or transitioning employees—especially when legacy knowledge is absent. Using CCDs provides access to knowledge of all current and potential corrosion threats. This understanding of how to mitigate or manage any unexpected deterioration of assets due to corrosive environments makes the CCD a proactive decision-making tool.

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In a newly constructed fertilizer plant, the decision to create CCDs prior to startup stemmed from the desire to document the anticipated corrosion from the design conditions and to help proactively mature the mechanical integrity (MI) program. In another refinery, which had been completely out of service for years, CCDs were used to train all incoming personnel on the various units. In both situations, the lack of experienced individuals with legacy information created a gap that made training difficult. CCDs helped fill this gap by succinctly packaging knowledge in an easily accessible narrative format. Even for facilities that have been in continuous operation, there will always be new employees for whom it is imperative to provide an understanding of the major integrity-related risks, and in this capacity the CCD excels.

Inspection/Turnaround Planning

CCDs can be used to identify specific areas of piping and/or equipment most susceptible to damage, making them useful tools for operations and inspection personnel to plan turnarounds and optimize inspection techniques. As a combination of a theoretical model and record of past actual issues, the CCD should ensure no potential issue is missed when planning effective inspection scopes.

As previously discussed, the CCD can also complement the training for anyone being brought in to assist in the inspection effort—be it internal or third-party personnel. Worth noting, the completion of a turnaround provides a fantastic opportunity to update the CCD, which will ensure that the CCD remains up to date, accurate, and ready for the next turnaround.

Documenting Integrity Operating Windows

IOWs, whose limits are recorded for each system, are critical pieces of information found within a CCD. IOWs provide guidance that directly influences operational decisions on how to run a unit or a system most efficiently while maintaining asset reliability. IOWs help process engineers or operators quickly understand how certain limits prevent damage and help preserve the unit over time. Often, a CCD will also contain many of the major data points that validate the placement of specific limits, but IOWs give a structure to assist in operational management. Effective usage allows operations to act judiciously and better understand the impact of potential excursions. This should help them balance the increased risk to integrity against the rigors of profitable operation.

Figure 1. Developing and Implementing CCDs

From a document control standpoint, CCDs add value by condensing multiple documents, spread across multiple groups, with multiple owners, into a single, easily shared document. In addition to the increase in accountability from having a single document owner, having this simplified corrosion document accessible between groups helps promote cross-communication and breaks down the traditional barriers that can form information silos in large organizations.

HOW DO I EFFECTIVELY DEVELOP AND IMPLEMENT CCDS?

After you decide CCDs would be a valuable addition to your MI program, you will next need to develop and implement them. During the development stage, challenges that may threaten success can arise. As such, care must be taken to ensure the buy-in of multiple stakeholders, while a single owner must be identified to champion the initiative and prevent it from stalling. This effort will require a decent amount of data collection and discussion, all of which requires commitment to the end-goal.

1. Assemble Team

First, assemble your CCD Team. As mentioned, a cross-functional collaborative team made up of Subject Matter Experts (SMEs)—typically from the Engineering (Corrosion/Materials, Process, and Fixed-Equipment), Inspection, Operation, and Maintenance groups—is imperative for quality data inputs. The created "brain trust" will provide the first steps in breaking down any departmental silos and will ensure the breadth of information being recorded in the CCD isn't blind to the experience of any group.

2. Develop CCDs

Next, determine whether all pertinent information/data is available. An initial question to ask is "Has a damage mechanism review (DMR) or an assessment of credible threats for the facility been completed recently?" If so, great; most of the information has already been gathered. If the facility has not undergone a DMR or IOW development, the CCD development process can serve as a starting point to establish these programs. At this stage, the stakeholders, typically represented by the SMEs, should develop a CCD template, complete with the different sections and data points to be collected. A sample, which typically contains about three systems of a main process unit, can be useful to reference. After finalizing feedback, this can be the point where the actual data collection and initial CCD drafting can be outsourced. The internal CCD team can then focus on validating the collected data, listing any relevant experience, and approving the finalized drafts.

3. Integrate CCDs with Existing Programs

Once CCDs have been developed, their value can be maximized by integrating them with existing programs like Management of Change (MOC), Inspection and Turnaround Planning, Process Hazard Analyses (PHAs), and Maintenance and Operating Procedures. Assign an owner to ensure CCDs are kept up-to-date, or "living," when changes occur, or new information becomes available. CCDs should be reviewed/updated in the event of significant process changes, turnarounds, corrosion related failures or major IOW excursions, and revalidated after a set period of time to ensure continued accuracy and completeness. Although no significant changes may have taken place, small changes can accumulate over time and limit the effectiveness of those initial assumptions. Here lies the major threat to the implementation of CCDs: while the value of CCDs can be severely undermined if they are not produced effectively, they can be rendered ineffective through a lack of periodic attention and updates.

Effective CCD generation requires an intentional, collaborative effort across corrosion and materials, inspection, operations, process, and fixed equipment engineers to ensure quality data inputs are captured. Additionally, because CCDs are "living" documents, they must have an owner and be maintained when changes occur, to retain maximum value. Like an asset in the field, without periodic examination of the document's condition, the data and assumptions may degrade to the point where they can no longer effectively serve their intended function: to be a holistic record of reliability and MI experiences.

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CONCLUSION

CCDs undoubtedly capture valuable information that can lead process safety management and mechanical integrity initiatives to a higher level of safety, reliability, and efficiency. Having a single source of centralized information allows the document to be versatile in its usage across multiple groups. In addition, its narrative structure is easy to follow, putting greater corrosion and reliability data into the hands of groups that would not normally have such easy access to this information. With such utility and flexibility, a CCD truly makes a fantastic complement to any incipient, existing, or mature MI/RBI program. So as your MI program grows, and the complexity of operations increases, the only remaining question is, "Where are your unit's CCDs?" ■

For more information on this subject or the author, please email us at inquiries@inspectioneering.com.

REFERENCES

1. API Recommended Practice 970 Corrosion Control Documents First Edition, December 2017
2. Corrosion Control Documents Revisited – An essential element of a mechanical integrity and risk-based inspection program By David Hendrix, P.E., January 2011


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