Roll Out and Maintenance Integration of SIS Proof Test and Inspection

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ABSTRACT

Proof test and inspection serves two primary purposes within the safety lifecycle: to find and repair failures in the system, and validate the failure rate assumptions used in the Safety Integrity Level (SIL) calculations. Many facilities may have robust preventative maintenance systems, but lack sufficient or clear documentation on the failure mechanism to allow classification. There may also be differences in how individual facilities within the same corporation record test results.

It is highly beneficial for a corporation to record and classify failures in a consistent manner such that the instrumentation reliability data can be easily compared and compiled into metrics across multiple facilities or assets.

Challenges with implementing a new or modified approach to testing of Safety Instrumented System (SIS) instruments include issues such as education of participants and stakeholders, integrating the new proof testing procedures with the current maintenance plans and schedule, and documenting failures identified outside of testing. It is critical to create an implementation plan that deals with these challenges ahead of pushing SIS proof testing to facilities.

This paper reviews the technical and management challenges associated with implementing a standard SIS proof testing philosophy and documentation strategy across a multi-facility upstream oil and gas business unit.

INTRODUCTION

Over the past four years our company has been working with a major oil and gas exploration company to implement an ISA 84 compliant testing program across a 17 facility oil field. The implementation of this program was rolled out to the facilities in a slow paced phased project which focused on facility personnel engagement and education as well as work process modifications aimed at compliance. One of the primary components to the program was a database-driven approach to most of the aspects of the program including template-based, database-driven test procedures and collection methods. The implementation of this program had some specific challenges which fall into 4 broad categories; tool selection and usage, quality, managing change, and managing personnel. This paper will explore each of these issues and the challenges presented as part of this project.

INITIAL TEST PLAN GENERATION

Starting in 2007, the client company began standardizing their process for SIL Selection and SIL Verification using Hazard and Operability (HazOp) and Layers of Protection Analysis (LOPA) across the 17 facility oil field. The results of the selection and verification were imported into a database to facilitate Safety Lifecycle activities, including the generation of test procedures from generic templates. The initial generation of the test plans was carried out by the engineering team and included minimal field involvement.

TEMPLATE CREATION

Originally, a small set of test plan templates were developed based on typical process variable measurement technologies, installation details, and tools required for the test. For example, a template was created for a level instrument which was installed with a level bridle and a separate template for a level instrument which was hard piped into the vessel, because the testing methods would be different. Another example is a pressure instrument which always measures positive pressure uses a separate template than a pressure instrument which could measure vacuum pressure, since the type of pump and gauge required to simulate and measure vacuum pressure may be different.

Additionally, to ensure maximum flexibility for operations, three types of templates were developed to enable testing of either a single device, a full function test, or recording results of an emergency shutdown (ESD). The full function test procedure used very similar test steps as its accompanying device-only procedure with the addition of verifying the output elements functioned as a result of the input condition. The ESD test procedure was a list of outputs which should achieve a specified safe state upon activation of ESD.

The steps used in the test procedure were developed based on test procedures from similar industry examples and existing facility procedures. Due to the broad differences between the procedures at each of the 17 facilities, the templates tended to look very different from those which were currently in use.

INSTRUMENT RESEARCH AND TEMPLATE ASSIGNMENT

Each Independent Protection Layer (IPL) was researched to confirm the instrument information as listed in facility documentation (P&IDs, Cause and Effects, instrument datasheets, etc.). This information was entered into the database and used to assign a test procedure template to each instrument. During the initial research and template assignment, the engineers relied solely on the documentation that was listed as as-built in the documentation warehouse. Where discrepancies were identified, engineers used best judgment to determine which document was correct.

A flow chart was used to determine if an IPL could be tested using a full function test or if the devices should be tested individually at staggered intervals. The engineer would choose device level or full function testing based on the complexity of the IPL, complexity of the test, and/or operability factors. Facility engagement was minimal during this process.

PROJECT EXECUTION

The project used a four phase process to deliver, validate, and implement the test plans into the current facility maintenance plans. The phased approach to the implementation was developed to be part of the verification plan for the testing portion of the safety lifecycle. A staged approach helps prevent the project from overwhelming the facility and interrupting the normal operations of the facility.

PHASE 1: FACILITY PERSONNEL ENGAGEMENT AND ROLLOUT

Phase 1 is focused on efforts to educate and obtain buy-in from the stakeholders early in the project on why the project is important. At a minimum, the personnel involved should be Facility (Site) Leadership, Maintenance Leadership, and Instrument Technicians. Operations may not need to be involved in all of the parts of the rollout process, but should be kept up to speed on the project and how it will affect site operations. That being said, the more involvement from all facets of the facility, the better.

The primary objective of Phase 1 is to clearly identify the project objectives, goals, and drivers, as well as key milestones and deadlines. A rollout meeting should be held with all of the team members and leadership in order to communicate this information. Each person involved with the project needs to have an understanding of the timing of each Phase and any deadlines to completion of the phase and the overall project, if applicable. Another objective is to ensure that all stakeholders understand why they are involved in the project, and why the project is being implemented.

Obtaining buy-in at the beginning of the project is critical. In established sites, resistance to change can be very difficult to overcome. Having project team members and other stakeholders working varying shifts and having multiple priorities also serves to complicate project rollout and make project implementation difficult.

A packet of site specific information for the project team's review should be put together prior to the rollout meeting. This information should include, at a minimum, the following:

- Summary of all project objectives, goals, etc.
- List of acronyms/definitions
- Contact information of all project team members
- List of devices with associated information (tag number, description, location, etc.)
- Sample of each template, prefilled with facility specific information

Along with a rollout meeting (or meetings) and project information packet, a procedure for validating the test plans should be developed with the project team that clearly documents each team member's roles and responsibilities associated with the project. This procedure will also document any tools/methods that will be used throughout the project. It is highly recommended that, at the outset of the project, a database be developed in order to track validation and testing efforts in the later stages of the project.

It is highly encouraged that the rollout meetings be conducted face to face at each facility with the project leadership facilitating the meeting. This goes a long way in helping foster a team environment on the project and ensuring buy-in from all stakeholders.

At the conclusion of the rollout process, the facility should appoint a Single Point of Contact (SPOC) and Alternate for the project that is accountable for leading the effort on behalf of the facility. Ideally the SPOC is a senior instrument technician with extensive knowledge of the maintenance of the facility.

PHASE 2: INITIAL DEVICE AND PROCEDURE REVIEW

Phase 2 consists of two activities: instrument walk-down and review of the written test plans. This work is primarily carried out with the SPOC or Alternate from each facility, and may or may not be performed concurrently. It is beneficial to perform instrument walk-down first, depending on the data quality in the LOPA.

For our project, Phase 2 was carried out over a year with no set schedule of progression through the facilities. If possible, a staged progression through units/facilities would be preferable to more efficiently perform this Phase of the project.

INSTRUMENT WALK-DOWN

The instrument walk-down activity is a means to ensure the quality of the data used in the LOPA. Facilities are always in a state of change, and there is a high likelihood of things changing in the time elapsed between the LOPA study and commencement of this type of project. During this activity, a project team member works with the facility SPOC or his/her delegate to physically walk down each instrument in the project scope to verify the information associated with the instrument.

Depending on the anticipated data quality of the equipment list used in the LOPA, it is important to verify all of the associated information for the instruments in the project scope. It is important to verify manufacturer/make/model information, as well as trip point/fail state, alarm parameters/action, and any other information deemed necessary by the project team. It is also a good idea to make note of the physical location of the device, as some devices are hidden in an out of the way location within a module or building.

It is also a good idea to verify that the information on the P&IDs used for the LOPA, is verified as correct in the field. If any discrepancies are found on the P&IDs or instrument data, check if any MOCs have been initiated since the last LOPA. There is usually considerable lead time between LOPA and field validation, and MOCs can cause significant changes to the instruments in scope. This requires working closely with the MOC coordinator onsite, and that information is shared as much as possible to ensure optimum data quality. Along with MOCs changing devices or SIFs, there is the potential for instruments to be abandoned in place or not in service at the time of field validation. This is especially common at well pads as they frequently change status, often without a traditional MOC process.

During instrument walk-down, identification barcodes are hung on each instrument for easy identification in the field. Each class of instrument (SIL rated or other) are given a unique color barcode in order to differentiate between device classes. Barcodes are hung in a manner that is easily accessible and allows for easy scanning by the data collection handheld.

TEST PROCEDURE REVIEW

In this activity, a member of the project team and the facility SPOC go through each written test plan to evaluate the feasibility of each with conditions at that facility. No live testing is performed in this phase of the project. It is important to perform this activity in advance of live testing as we've seen that validating the test plan and gathering the supporting information in advance makes the live testing phase much more efficient.

In this stage of development, the written test plans may not contain all of the supporting information needed to perform the testing. It is important to verify or add the following information:

- tools required, permits needed
- set point
    - confirm that it matches the P&ID and is in the correct engineering unit needed for testing (i.e. inches of H2O as opposed to psig)
- alarm parameters/actions
- verify if bypasses, gags, jumpers are needed to perform the test and record the bypass method and other associated information
- loop sheets, wiring diagrams, etc. that may be needed

Along with verifying the data associated with the test plan, the step by step procedures should be assessed. The facility will need to determine if the test plan can be performed as written within the unique constraints of their specific facility. Even though many of the facilities are similar, each has its own unique details that lead to some templates not working as well as they might at another facility. Care should be taken to ensure that changes made to a template at one facility do not impact similar

test plans at another. It is important to investigate alternate template assignment before making any changes to an existing template. Often times, incorrect template assignment is the cause of the test plan needing to be changed, and not the template itself being incorrect. Again, every effort should be taken to avoid altering the steps in the template as this can cause serious adverse effects at other facilities.

During test plan validation, the facility should also consider whether the test can be conducted online, offline, or only during a TAR. Online refers to a test that can be performed while the process is running in normal operation, and offline refers to a test that will need to be performed when the process is not in operation. Offline does not necessarily mean that the entire module or facility cannot be operating, only that the specific process to which the test applies is offline. In our experience, online testing is the preferred method of testing, though many facilities are not set up in a way to allow for extensive online testing. This, in turn, leads to the need for extensive data collection during the live testing phase of the project in order to ensure successful execution of Phase 4 of the project.

There are times when a facility is reluctant to test a device at all, or rarely have a TAR in which the instrument can be tested. It is important to not catalog a device as "untestable" during this phase of the project, unless absolutely necessary. Even if the device is deemed "untestable" by the project, a test plan still needs to be validated for the rare times when the device can be tested. A more detailed discussion of "untestable" devices will follow later in this paper.

Once the test plans have been reviewed with the facility SPOC, the redlined documents should be submitted to the project engineering team for updating. The engineering team will review all redlines to assess potential template impacts, and work with the field team to resolve any questions. Copies of all redlined documents should be retained through the end of the project for reference. The revised test plans are reissued to the facility team prior to progressing to Phase 3 of the project.

The engineering team should also review all MOC or related changes found in the field during Phase 2 before progressing to Phase 3. It is important to communicate any changes found in the field to the appropriate parties (i.e. other projects, facility leadership, etc.) The field walk-down activity is in a unique position to uncover changes that may not have been noticed during other projects and activities. If possible, a path forward for any changes found in the field should be developed before progressing to Phase 3.

It is also important to develop a schedule for the live testing of the instruments before progressing to Phase 3. We've found that there are usually many previously planned maintenance activities occurring in the facility that testing can "piggy back" on, and this greatly enhances the efficiency of the testing phase of the project. Endeavour to at least set up the early portion of testing before progressing to Phase 3. The final schedule can be set up once testing has commenced, but there should be a plan in place for the beginning of testing in order to gain momentum. Once the first few tests are accomplished, the operations generally becomes much more efficient.

PHASE 3: TEST PLAN EXECUTION AND VALIDATION

Phase 3 of the project consists of live testing of all of the instruments in scope. This gives the project team the opportunity to completely test all of the steps in the test plan to ensure their viability. The goal of Phase 2 was to get the main parts of the test plan ready for testing, and now the goal of Phase 3

is to fine tune the test procedures to the highest degree feasible while working within the constraints of a template approach.

During testing, each test plan should be walked through step by step, with an eye toward detail in the procedures. As with in Phase 2, the test plans are redlined by the facility team and any changes from Phase 2 should be noted and logged. It is highly likely for there to have been changes in the facility between Phases 2 and 3, and the project team will need to address these changes as they come up. The process is the same as in the earlier phase, i.e. gathering any associated documentation and communicating the changes to the appropriate parties in the facility for follow up.

During testing, all failures and associated details will be recorded and logged for follow up. This is a very powerful set of information, as it allows the project to more easily communicate the benefits of implementing a testing program. We've seen many different cases of systematic failures that may never have been found other than with an incident occurring. The main point of logging the failures is not to show a failure frequency or any trends along those lines, rather, it is better used to show the risk that is eliminated from the system from a robust testing program. Device failures are better found during planned testing than during an incident or a root cause analysis. It is very important to try and remove the negative context of the term "failure" and use it in a beneficial manner.

If a device cannot be tested during Phase 3, all applicable details should be collected and flagged for follow up. It is important to not focus on the small subset of "untestable" devices, and not let that stand in the way of testing progress. Usually, these devices will need some engineering work performed in order for them to be able to be tested, or potentially removed from the LOPA altogether if they're truly not able to be tested.

In preparation for Phase 4, any applicable testing detail for each instrument should be recorded. Details such as preferred testing method or schedule, other testing synergies at the facility, any testing that can coincide with regularly performed maintenance (i.e. turbine water washes), and any other details that will be useful for maintenance planning should be documented. In most cases, more detail is always better; this will greatly enhance the effectiveness of Phase 4 of the project.

Another important aspect of Phase 3 is testing the data collection database and handheld functionality and ensuring the data that is loaded in the data collection database is of high quality. It important to verify that all instruments are correctly loaded into the data collection database (or other tool) and that their associated routes are able to record data as intended. This is also an opportunity to identify problems with the handheld, wireless data reception, and other potential problems or areas of improvement well in advance of the program going live.

PRIDE is a data collection program that was used to collect testing data during Phase 3 and in the future of the program. The PRIDE system utilizes data collection front end that runs on a Windows CE based handheld computer with a barcode scanner. The instrument tech uses the handheld to scan the instrument barcode before testing and hand inputs data (As Found/As Left condition, pass/fail result, failure mode, etc.) during and after the test for collection in the PRIDE database. Reports can be generated from the PRIDE data to determine failure rates, overdue tests, etc.

About midway through Phase 3, it is a good idea to begin planning for the sustainability of the program in the future. At this point, the facility and the project teams generally have a good idea of how the process is going to work, and are able to discuss any potential problems or ideas for successful implementation. This will also help shape the format of Phase 4, and identify the areas of focus for that activity. Be sure to involve the key stakeholders and the key personnel involved in the project to this point, and don't solely focus on the maintenance teams. Operations and other facility leadership will need input to the long term success of the program.

PHASE 4: FACILITY TURNOVER AND MAINTENANCE INTEGRATION

The main goal of Phase 4 is to provide the tools and information to the facilities so they are able to effectively implement the testing program in the future without project support. This is accomplished through meetings with the facility leadership and the project team, along with supporting documentation compiled throughout the project.

The first main activity in Phase 4 is a facility handover meeting, which is a holistic review of the project tailored for each facility. This meeting should involve facility management, the key personnel that participated in the project, and the project team. The meeting provides a "refresher course" on the project from inception through testing, and also lays out the plan for turnover to the facilities.

Prior to the meeting, a document is created that focuses on the findings from Phases 2 and 3, device failures, and information vital to the sustainability of the program. This document is used to communicate the project information to the facilities and serve as a reference during set up and scheduling of the test plans in the work management system.

There are four main pieces of information that need to be reviewed during the facility handover meetings.

- All failures that occurred during testing and the lessons learned from those failures should be reviewed.
- Any devices that were deemed to be untestable will also need to be reviewed. It is helpful to provide recommendations on how testing of these devices can be implemented, but generally, more research is needed in order for testing to occur.
- Review the next steps in the process, and how to prepare (i.e. PM leveling efforts, future support, scheduling, etc.)
- Discuss roles and responsibilities for the future. The more detailed the information, the better. The facility leadership needs to understand the role of each person at the facility, and the role of the support groups outside of the facility.

CHALLENGES TO PROGRAM IMPLEMENTATION

TEST RESULT COLLECTION AND DATA INTEGRITY

One of the fundamental requirements of the project was to ensure that test results were collected in a database that enforced a standard method of test result entry. Towards the end of the initial test plan

creation, the project began reviewing the existing corrective maintenance work orders for the feasibility of using the existing work management system to collect test results and failure documents. The review of existing work order records showed that there was a very robust system for collecting failure causes and the repair steps necessary. The work management system used three coded fields which would indicate the identified failure, root cause, and repair work. While the system was specifically setup to handle failure collection, the usage of these fields was inconsistent. Reviewing the system with the users (instrument technicians), they indicated they did not completely understand how to use these fields and it was common practice to ignore these fields and instead use free text comment fields to document the test results and any corrective work activities required. The number of combinations for the three coded fields was in the millions and even if used correctly it would still require a review by an SIS Instrument Engineer to classify the failure.

TOOLS FOR PREVENTATIVE MAINTENANCE RESULTS

The project decided to explore other database options to determine a more user friendly and fit for purpose collection option. The project found that there was currently a system in place that is used for operator rounds and fire and gas testing results. The system is a commercially available database application with the trade name PRIDE. It utilizes a handheld barcode scanner that can be customized to have data points and routes that match the templates. While this option was not a perfect solution, it had a few major benefits; allowed a consolidated set of data points that matched the assigned paper copy test procedure, reduced the amount of hand written and free text documentation, and allows reporting capabilities to track time between testing.

HANDLING UNTAGGED DEVICES

Very early during the initial instrument research, it was discovered that the client's master equipment list, housed in the work management system, did not contain records for all devices involved in IPLs. These untagged devices were typically minor components such as relays, motor buckets, I/O cards, or valve actuator accessories. Without a record in the master equipment list for a device, there was not a standard and uniform method to identify these on the test procedures or in the PRIDE database. A project was initiated to perform clean up and expansion of the equipment list; however, waiting for the completion of that project would have put test procedure validation years behind schedule.

To move forward with the test procedure validation project, the PRIDE route was structured such that upon the selection of "failed" during the test, a checklist of potential untagged devices would be presented for the technician to choose from. The primary tagged device associated with an input or output element in an IPL was chosen to collect test results against. Since the collection system utilized a template approach, the list of untagged devices presented was a standard list of expected devices that could be associated with the generic input or output type.

LEVERAGING OPPORTUNISTIC TESTING

While working with the facilities, the project attempted to keep an open dialog with respect to improvements to the testing program. One of the big pushes from the facilities, specific to final element outputs, was to take credit for ESD, IPL demands, and planned outages. The facilities indicated that many of the final elements involved in IPL's within the project scope were brought to a

safe state based on one of the previous conditions at least as often as the required test frequency. In a joint effort, the project team and the facility reviewed methods to validate that an instrument was working as intended in the absence of a planned test procedure.

For planned process outages, an instrument technician would review the list of final elements in the testing scope against those involved in the safe out of the process. The operator or instrument technician would walk down these instruments to confirm the pre-outage state of the valve and confirm it is in the normal, or non-safe, state. Operations would then initiate the process shutdown, and perform a subsequent walk down to ensure all final elements achieved the safe state as required. After both inspections are complete, the results of the walk down and inspection would be entered into the data collection database. Any failures or deficiencies would be noted in PRIDE and a corrective work order generated in the work management system to repair the failed instrument.

For unplanned outages or demands on a SIF, the projected looked to the historian for confirmation of proper functionality of a final element. If a valve had position indicators which were recorded in the historian, the historian record could be used to verify valve went to the proper safe state within a timely manner based on the demand.

While both of these methods test a majority of the undetected failures for outputs, it was recognized that some portions of failure modes would not be detected with this procedure. Stipulations were added to the testing philosophy to ensure that the full documented test procedure was performed at some frequency, such as every scheduled turnaround, regardless of how often these opportunistic validation tests were utilized.

QUALITY

REVIEW OF RESULTS AND MODIFICATIONS

During the Phase 4 of the project, every failure was reviewed along with the corrective work order listed in the work management system. The original intent of this effort was to provide feedback to the facility regarding problem devices or common failure modes which are seen across different facilities. While it was strongly encouraged that corrective work order be written for failures found during Phase 3 of the project, it was not specifically required if the repairs were simple and quick (i.e. calibration). The project team recorded short notes regarding the identified failure during Phase 3.

A very interesting pattern was discovered when comparing the notes left in the corrective work order against the initial failure cause determined during the proof test. If the technicians did not perform troubleshooting or repair work immediately following the failure found during the proof test, the initial assessment was not very often a reliable source for the failure classification. In some cases the differences between the initial assessment and the actual failure mode were wildly different, even to the point of selecting the incorrect failure mode. Since some proof tests could be executed while the IPL was not required, such as a process shutdown, repair work would not necessarily be required at the time of failure.

These findings lead the project to rethink the work process of failure classification. PRIDE would now only be used for the primary purposes of look ahead or overdue testing reports and recording of pass/fail proof test information. The final failure classification would need to be done after the repair work was completed by an engineer or technician specifically trained on failure classification of IPL devices. This activity would be done by a centralized person or group which was responsible for evaluation of failures for all facilities to aid in consistent reporting as well as providing a holistic view problem devices, types, or service conditions.

RECORD KEEPING

Due to the above mentioned slight re-purposing of PRIDE, a new system was needed to house failure classification and test results. The database selected to house failure classification results was aeShield™ due to it also containing the information about all of the devices involved in each IPL. Some of the data was collected from the work management system, but the most important aspect to the database is its ability to generate a real world model of how the instrumentation is connected.

The application of the real world model to IPLs allows the user to attribute failures to the specific device within a system, and then provide flexible reporting on failures. Failure reports can be generated based on a multitude of filtering and sorting criteria. For instance, a report could be run at a high level to show failure rate of all level switches, or at a very detailed level such as a specific make, model, and service condition.

Two other benefits achieved using aeShield™ to house test results and failure classification details are imports from other systems and enforcement of data entry. In an effort to more effectively leverage the opportunity function tests discussed above, aeShield™ is being updated to allow the import of specific information from automated systems such as the historian. The import utility from the historian will reduce the amount of time and energy a maintenance technician would need to spend processing the results of the opportunity test results. Additionally the import utility will include the ability to receive corrective work order information from the work management system and compare instances of failures to work orders written against a failed device. Combining these two features will allow reporting on missing corrective work orders post failure, as well as reducing the amount of research the failure classification expert would need to do by utilizing a database which links all of the relevant information back to the tagged instrument or IPL in question.

MANAGING CHANGE

INTERACTION BETWEEN ROLLOUT AND OTHER PROJECTS

By implementing the testing program through a project with a slow schedule, the project will be presented with changes to the field instrumentation or functionality that would directly affect the scope of the validation project. Operations and Maintenance activities are constantly occurring, especially with older facilities. The project should be cognizant of the fact that changes may occur between any phase of the project and tracking of these changes in a methodical way is critical.

Outside of projects or MoC, one of the most important activities that will affect the scope of the proof testing and inspection program is the 5 year revalidation of the hazards analysis and protection layer assignment. Depending on the study methodology and organizational philosophy for these revalidations, the magnitude of the changes between revalidation studies can be significant. Regardless of how the changes have come about in the facility, these changes should be carefully evaluated and handled.

FEEDBACK FROM PROJECT TO ADDITIONAL STAKEHOLDERS

Part of the validation project results will be the identification of items which require feedback to stakeholders not directly involved in the validation project. Some very good examples of these are instruments or functions found out of service, testability concerns, and bad actor identification.

OUT OF SERVICE INSTRUMENTS OR FUNCTIONS

When instruments are found out of service, either temporarily or permanently, ensure proper documentation is available to document why the change was made and how process safety was affected. It is imperative to research and maintain this documentation. When instruments or functions were replace by a different protection layer, these new devices are potential scope for the test plan validation project. There is an option for the project to incorporate these new devices into scope, or delay until the project is complete to go back and catch up on these other devices and update the associated test procedures to match the testing program format and rules.

If it is found that the safety connotations associated with the removal of protection layers were not properly assessed, this needs to be flagged immediately for resolution. It is beneficial for the project to have a well-defined process for how to handle these issues, including details on who needs to be informed and how potential deviations are addressed and by whom.

TESTABILITY CONCERNS

Part of Phases 2 and 3 involved the identification of devices which the facility believes cannot be tested at the frequency prescribed by the SRS or IPL testing philosophy. Specifically dealing with brown field protection layers, the layers of protection assignment team were likely making assumptions about the testability of devices involved in protection layers. The project should be validating these assumptions and documenting discrepancies. During this project, three main types of testability concerns were found; accessibility, operational upset avoidance, and procedural issues.

Accessibility issues are categorized by instruments which can be tested and were tested; however, special permits or additional installations were required to perform the test. For example, level instruments which are mounted above an accessible grade and require temporary scaffolding or man lift to perform the test. For instruments which are identified as in this category, facility management should be informed and should begin working on a solution that will streamline the test execution in the future.

Operational upset avoidance issues are categorized by instruments or functions which would cause major impacts to operations if tested while online. These issues can be identified prior to the test execution or as a result of unexpected upset while testing. When these issues are identified, the facility and project team should work together to evaluate options on how and when to test. If a solution is determined, it should be validated as an acceptable approach before the project is turned over to the facility.

Procedural issues are categorized by instruments that can't follow any available procedure template due to either safety concerns or inability to detect unrevealed failures. Instruments falling into this category will need special review on a case by case basis. Some types of instrument measurement technology or installation details can be problematic to develop a test plan which can safely detect the unrevealed failures, such as an instrument which is directly mounted onto a pressurized piece of process equipment without an isolation method.

MANAGING RISKS TO THE PROJECT

As with any project, scope management is a critical part of the project execution plan, and the activities driving scope change should be listed in the project risk management plan very early in the project.

Through creating and maintaining a risk management plan, the project was able to avoid some events that could have completely derailed progress. Involving the key personnel from the facilities and the project team proved to be an incredibly powerful tool at uncovering potential pitfalls.

The slow rollout of the project, while providing many benefits to implementation, proved to be not without its difficulties. Changes to the instruments in scope have been well covered, but changes stemming from individual facilities proved to provide many challenges, also. Having numerous stakeholders, each with their own needs and wants, is a critical aspect of the project to manage. The needs and goals of the project need to be weighed with each need and want of the individual facilities. One of the goals of the project was to establish consistency across the business unit, and significant deviations from standard at any individual site will erode any consistency gained for the group. This is not a new concept, but cannot be overemphasized in its role in the success or failure of the project.

Another aspect of managing risk on the project is to have a robust documentation strategy for dealing with changes. Each proposed change to the templates, or changes found in the field will require a minimum level of documentation to be considered. This needs to be communicated to all stakeholders on the project, and will help ensure consistent implementation of the project across the board. Even if the facility has an impeccable MOC program, there is still opportunity for an undocumented or under-documented change to occur. Ensuring a standard of documentation is followed on the project will allow for effective communication of changes within the project, and with other projects that are occurring at the same time.

MANAGING PERSONNEL

By and large the most important aspect to a successful rollout of a new program is understanding and engaging the people involved. The perceptions associated with the change being implemented must be closely attended to by the entire project team. This begins with communication.

INITIAL ENGAGEMENT

Maintenance activities are already in place at some level in every industrial facility. The modification of these activities will be met with varying degrees of skepticism by those involved in maintenance work. The requirements associated with an ISA 84 compliant testing program go beyond what is perceived as a maintenance group's primary responsibility. The program requires more than just periodically ensuring that instruments are functioning properly, and requires an extra step of documenting when and exactly how instruments are failing. Instituting the testing program could also change the way maintenance is prioritized and scheduled.

Through the years of operating a facility, operations and maintenance begin to see certain instrumented functions as extremely important for various reasons. The application of protection layers through PHA and LOPA studies may challenge the perceived importance of various instruments. Initially, facility maintenance personnel challenged the set of instruments deemed as "safety critical".

For some, instituting this program will be seen as a criticism of the current work processes and culture. Opening a dialog with those most affected is a critical first step to long term sustainability. The initial conversations regarding the testing program should focus on defining why the work process must change. The project team and facility management should ensure that these drivers of change are well understood and present how the new program will benefit the organization in the long term.

Allowing the personnel that will be involved in the future program to have a voice in the progression of the program will help enable long term acceptance of the program. Facilities who were engaged from the onset of the project began to be great champions and owners of the program. Those facilities who understood the relationship between failure rates and testing intervals, began asking for the implementation of the program's tools and techniques to be used in all instrument maintenance.

EDUCATION AND TRAINING

Sustainability of the program after the project is closed out requires the goals and tools to become part of the organization’s culture. Beyond development of initial champions and owners during the project, a detailed education and training plan must be implemented based on the lessons learned of the project. The education plans should, at a minimum, include sections regarding the role of maintenance in compliance with ISA 84 and the details of the work process utilized to meet the requirements.

The results of dialog with the stakeholders during the project should be reviewed to identify the root causes of any initial resistance to the program. Any other common questions or discussion topics should be recorded by the project for use to expand the training associated with the long term program.

CONCLUSION

Implementing an ISA S84 compliant proof testing program is a difficult task, but not impossible. With planning and an effective rollout strategy, it can be successfully implemented anywhere.

Below are some key takeaways from the project to help ensure success in the future.

Begin the process with an idea of what the program will look like in the future. It doesn't need to be exact, but having a long term vision of the program will help guide decisions made during the project.

Staging the implementation helps ensure success by preventing too much from happening too fast. Any change is difficult to implement in an organization, and oftentimes the elephant is too big to eat all at once.

Be sure to engage the key stakeholders and all others affected by the program, however indirectly, early and often. Fostering buy-in from the very beginning helps set the stage for project success.

Effective change management is critical. Facilities are in a constant state of change, and the impact of not managing change is a recipe for disaster for the project.

Be sure to be flexible and balance the current needs of the facility and the needs of the project. A small amount of compromise can go a long way to ensuring long term success.