In the refining and petrochemical industry, there is an ongoing struggle to improve quality, increase production and reduce incidents, especially catastrophic events. A significant share of these unplanned events can be attributed to essentially the lack of adequate procedures or a failure to follow procedures. There are three identifiable groups within a manufacturing plant with the responsibility to ensure compliance with these procedures.

1. Management is responsible for providing adequate procedures for operations and maintenance to follow; enforcement of the established procedures; management of change for any modifications to procedures, equipment or operations; and the training that is required for any function in the plant.
2. Operations is responsible for following the procedures, reporting operational problems to management and contacting maintenance to resolve equipment issues.
3. Maintenance is responsible for timely validation and testing of equipment according to the procedures, obtaining the training to be knowledgeable, repair of equipment and thorough documentation of repairs or corrections.

These three areas are equally important in the safe operation of any facility, but compiling the maintenance documentation required for the reliability analysis and validation of instrumentation and control devices can be challenging. One of the major documentation challenges is the ability to consistently capture failure mode descriptions. The lack of efficient data could potentially increase the risk of inaccurately analyzing failure rates. Validation, testing and documentation must be completed properly and in accordance with established criteria. These exercises help to assess and demonstrate that the assigned testing frequency has been appropriately applied. Maintenance personnel are often overwhelmed with the challenges of tracking the testing frequencies, inspection procedures, due dates and compliance for the devices in their plants.

In recent years, to help improve process safety and instrument maintenance decisions, the Center for Chemical Process Safety Process Equipment Reliability Database (CCPS PERD) and the Mary Kay O’Conner Process Safety Center (MKOPSC) Instrument Reliability Network have emphasized the need for more extensive documentation and programs to extract useable data. Recognizing this opportunity, numerous functional safety related companies have been working to develop better validation and testing tools to provide high quality functional programs that will yield trustworthy data.

To comply with the requirements in IEC 61511, the user is required to maintain records to certify that proof tests and inspections have been completed as required. This testing and inspection documentation must include dates, names of personnel involved, identifiers of the systems, "as-found" and "as-left"
condition and other pertinent information. The demand that has driven innovation in better control systems technology has driven the need for improvements and significant changes in programs and equipment used to document data and the ability to extract reliability, repair, and failure information.

**IEC 61511 Compliance**

IEC 61511 documentation requirements for safety functions to ensure equipment is validated include:

- Description of safety instrumented functions
- Safety integrity levels
- Process measurements
- Trip set points
- Response times
- Safe state of the process
- Established work processes
- Approved validation procedures
- Complete equipment records

This program has the capacity to have these data points readily accessible or referenced for easy access and provide technicians with the means to document compliance. The work processes and training associated for these activities were developed for use in the petrochemical industry and have been employed over the last few years in a wide variety of projects.

To meet the onerous requirements of IEC 61511, an easy-to-use program was developed to provide a versatile, easy and repeatable process for the testing crew to have ready access to all of the information needed for proof testing, validation, and reporting. Information from existing databases and spreadsheets can be imported into this program; in which unique information for each device can be entered as needed.

This presentation will review some of the procedures and work processes that have been developed specifically for testing and validation of safety and control devices in almost 100 petrochemical projects.

Attached are some screenshots from the program to illustrate a few of the features which can be used to not only simplify the management of the process, but significantly improve the documentation process.

**Instrument Database**

The program is designed to provide flexibility in sorting the data by identifying each piece of equipment through attributes it is associated with. These attributes can include individual tag identifiers, SIF function, Plant ID, device type and equipment location. It is very easy to then extract maintenance and reliability data according to the individual requirements at the time.

<table>
<thead>
<tr>
<th>Plant ID</th>
<th>Equipment</th>
<th>Unique Location Identifier</th>
<th>Equipment Category</th>
<th>Equipment Class</th>
<th>Equipment Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>A01</td>
<td>PT170</td>
<td>Z92523-A01-PT170</td>
<td>Instrumentation</td>
<td>Input Device</td>
<td>Pressure Transmitter</td>
</tr>
<tr>
<td>A01</td>
<td>PT171</td>
<td>Z92523-A01-PT171</td>
<td>Instrumentation</td>
<td>Input Device</td>
<td>Pressure Transmitter</td>
</tr>
<tr>
<td>A01</td>
<td>PT172</td>
<td>Z92523-A01-PT172</td>
<td>Instrumentation</td>
<td>Input Device</td>
<td>Pressure Transmitter</td>
</tr>
<tr>
<td>A01</td>
<td>PT173</td>
<td>Z92523-A01-PT173</td>
<td>Instrumentation</td>
<td>Input Device</td>
<td>Pressure Transmitter</td>
</tr>
<tr>
<td>A01</td>
<td>PT174</td>
<td>Z92523-A01-PT174</td>
<td>Instrumentation</td>
<td>Input Device</td>
<td>Pressure Transmitter</td>
</tr>
</tbody>
</table>

**Surveillance Reporting**
It is essential to capture the time period for which the devices are being evaluated to help determine the reliability and to calculate a relative MTBF of the devices. One of the features included in this program provides a section to document the period of surveillance and the date which the validation data was entered.

**Surveillance Report**

<table>
<thead>
<tr>
<th>Surveillance Start Date ▼</th>
<th>Surveillance End Date ▼</th>
<th>Equip_Failure ▼</th>
<th>Date Entered ▼</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/1/2012</td>
<td>12/31/2013</td>
<td></td>
<td>7/12/2013</td>
</tr>
<tr>
<td>1/1/2012</td>
<td>12/31/2013</td>
<td></td>
<td>7/12/2013</td>
</tr>
<tr>
<td>1/1/2012</td>
<td>12/31/2013</td>
<td></td>
<td>7/12/2013</td>
</tr>
<tr>
<td>1/1/2012</td>
<td>12/31/2013</td>
<td></td>
<td>7/12/2013</td>
</tr>
</tbody>
</table>

**Data Lot Report**

The Data Lot Report provides an analysis of the total number of failures reported for an instrument type and the number of devices entered for that data pool.

**Data Lot**

<table>
<thead>
<tr>
<th>Subscriber ID</th>
<th>Data Lot Number</th>
<th>Equip Count</th>
<th>SSD</th>
<th>SED</th>
<th>Prior Equip Count</th>
<th>Equip Fail Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z9Z9Z9</td>
<td>2013-1005</td>
<td>99</td>
<td>1/1/2012</td>
<td>12/31/2013</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Z9Z9Z9</td>
<td>2013-1005</td>
<td>99</td>
<td>1/1/2012</td>
<td>12/31/2013</td>
<td></td>
<td>14</td>
</tr>
</tbody>
</table>

**Device Calibration Sheet (As found, As left)**

Critical to the proof testing for each device is a calibration sheet that lists the type of device, range, and other relative information for the device. The proof test documentation will also include details regarding how the device was found, e.g. "As Found" - problems, errors, needed repairs or other corrective actions, hence "As Left". The documentation will also provide the status of how the device was left.
**Failure Analysis**

When performing a proof test, any problems, errors, and corrective actions must be fully documented. This documentation provides reporting options to maintenance or reliability functions that can determine if further actions (by user or supplier) are necessary.

**Test Validation Report**

This program has the capability to include testing data such as: the date the device was last tested; the frequency of testing, the next testing date; and a color coded current status alert that provides a quick indication of whether the device is in compliance.
Discrepancy and Pass Reports

A "Discrepancy Report" can be generated with a summary list of the devices found to have issues; notes about those issues; and the current status of each device. Complimenting this report is a "Pass Report" which provides a complete listing of the devices tested, the dates and a numeric summary for the devices that have passed.

Status Report

The Status Report is one of the reporting tools that is used as a high level tracking report. This report generates a snapshot of records categorized by production unit. The user can easily manage the number of detected repairs, out of service equipment, schedule devices for testing that are within 90 days or past due, and evaluate how the maintenance program is performing per compliance. The Status Report tool can be a valuable management asset in determining which unit in the plant requires more attention.
Summary

SIS-TECH has been very successful using this program, in conjunction with our proof testing and validation work processes, to provide refining and petrochemical companies with the assurance they require to continue operating their plants safely and in compliance with IEC61511 required guidelines. This is a tool that can be utilized for day to day activities to maintain records and receive alerts for upcoming testing requirements. Our customers can utilize the documentation and data contained within the program to plan future maintenance activities; determine reliability criteria; and report compliance information.