Isotractm technology for mechanical integrity compliance during process plant construction

7th Middle East NDT Conference and Exhibition

Jonathan Burns & Russ Davis
Development and implementation of the Asset Integrity Program

- Typically started after a new facility is designed, constructed and commissioned.
- Dependent upon the size and complexity of the new facility, can take several years to fully implement a comprehensive program.
- Regulatory requirements that these facilities are required to comply with do not designate a time period for plant to become compliant.
- Regulatory bodies assume that a facility is in compliance with the regulations at the introduction of Highly Hazardous Chemicals.
- The risk of operation can be greatly impacted by designing and implementing a comprehensive Asset Integrity Program during the engineering and construction phase of new facility development.
Asset Integrity Program – Equipment incl.

- Pumps & compressors
- Pressure vessels: drums, columns, heat exchangers, towers, etc.
- Emergency shutdown systems: Safety Instrumented Systems (SIS)
- Piping system (including piping components, in-line devices, valves, etc.)
- Controls: monitoring devices, sensors, alarms and interlocks
- Relief valves, vent systems and devices
ISOTRAC™ Asset Integrity Program Development

- Systemization
- Circuitization
- Extract from 3D Design Model
- Develop Inspection & Test Plan using corrosion/damage potential - Assign CML's
- Generate Inspection Isometric

Data ready for IDMS entry

Damage Review

Inspection & Test Plan
Program Implementation

• PSI is reviewed and validated by various subject matter experts (SME) as it is received from the vendors.

• Asset integrity policies, procedures and guidelines developed and structured to the facility organization and work processes

• Damage/corrosion analysis – each process & by-product processes analyzed to determine what damage mechanism could affect the assets
  • PFD’s
  • Heat & Material Balance
  • Process Overview

• Each process system is analyzed and all potential damage mechanisms are evaluated
Example damage potentials include (reference API RP 571)

- Ammonia stress corrosion cracking
- Ammonium bisulfide corrosion
- Ammonium chloride corrosion
- Boiler water condensate corrosion
- Carbonate stress corrosion cracking
- Caustic stress corrosion cracking
- Chloride stress corrosion cracking
- CO2 Corrosion
- Corrosion fatigue
- Corrosion/erosion
- Flue-gas dew-point corrosion
- Wet H2S damage (HIC/SOHIC/SCC)
- Refractory degradation
- Reheat cracking
- Steam Blanketing
- Sour water corrosion
- Corrosion under insulation (CUI)
Systemization/Circuitisation

Systemisation
• Each process is divided into applicable systems, i.e. *interconnected piping and equipment that are subject to the same set of design conditions, process service parameters and damage mechanism*.

Circuitisation
• The systems are then divided into applicable circuits, i.e. *sections of piping and equipment that are exposed to a similar process environment, corrosivity or expected damage mechanism and is of similar design conditions and material of construction*.
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**NOTE:** (1) PCMS screening temp is 400°F

**NOTE:** (2) When condensation occurs

**NOTE:** (3) All material identified as CS is Carbon Steel, 316L is Austenitic Stainless Steel, and 9Cr is 9% Chromia.

Create a system index to show system number, system color, and damage mechanisms for each system within the unit.
Example 3D Design Model – Plant Overview
3D Design Model – Unit View
• Each defined corrosion circuit is then extracted from the 3D design model and formatted into inspection Isometrics.
Inspection and Test Plan (ITP)

- ITP’s developed based on the results of the damage and corrosion analysis and on recognized and generally accepted good engineering practices (RAGAGEP)

- **CML’s**: Located in a representative location in the circuit or on the equipment

- **PSV test plans**: ITPs developed to note the requirement for periodic testing, where frequency is initially based on industry recommendations and any potential damage mechanisms

- **Safety instrumented system (SIS) inspection & test plans**: ITPs determined based on code requirements for the safety integrity level associated with each SIS

- **Controls**: ITPs developed and assigned to the specific controls, monitors, and sensors based on industry and manufacturers recommendation

- **Pumps/Compressors**: ITPs developed based on manufactures recommendations and any potential damage mechanism that could adversely affect the performance of the pump or compressor.
Condition Monitoring Locations (CMLs)

- API 510/570/653 certified inspectors assign CML’s to the corrosion circuit and indicate these on the inspection isometric.

- Effective/efficient inspection and test plans are developed based on the potential damage mechanism and assigned to the CML’s.

- CML’s are located based on damage mechanism and accessibility.

- Each CML location and test plan is documented for entry into Inspection Data Management Software (IDMS).
Baseline Data Collection

- Each equipment item and piping circuit are being entered into Inspection data management system (IDMS), together with material of construction, operating parameters, design data (PSI).

- UT thickness readings of each circuit & equipment item are taken to collect baseline thickness readings for determination of corrosion rates, next inspection date and remaining life. Data is entered into the IDMS.

- The IDMS will set the next inspection frequency based on RAGAGEP recommendations or based on the facility anticipated corrosion rates until subsequent thickness readings are taken.

- The IDMS will then calculate (1) corrosion rates (2) next inspection frequency and (3) remaining life.

- Plant will have a fully compliant proactive system for managing inspection & testing data for the life of the facility.
• Once all the equipment and piping are entered into IDMS the RBI can be performed for each Unit

• The risk of operation for each equipment item, PSV and piping circuit will then be calculated

• The plant will establish forward looking inspection & test plans based on the most effective & efficient methodology in order to maintain an acceptable level of risk of operation.
Summary

1. Mistras extracts the equipment & piping from the 3D Design Model and configures into the identified circuits.

2. Condition Monitoring Locations (CML) are assigned based on applicable code, client procedures, and best industry practice.

3. Analysis is performed by experienced and qualified personnel to determine the best Non-destructive examination (NDE) methodology for detecting the identified damage mechanism that may effect the equipment.

4. Inspection Isometrics are generated through ACAD ready for inspector’s use with CMLs shown.

5. CML data can be prepared for loading into Client Inspection Data Management System (IDMS).
Benefits of Isotrac™

**Safety**
- Pro-Active development of the Asset Integrity Program allows the Plant to startup in Compliance with regulatory requirements
- No need for drafters in the field
- Less man-hours of time at risk in the units
- No need for working at elevations for drafting personnel
- CML’s located at accessible locations at every opportunity

**Cost**
- Work is performed in the office. There is no need for multiple drafting teams and API Inspectors in the unit to generate sketches and assign CML’s
- By using the 3D model CML’s are located in most accessible locations minimizing the need for scaffolding

**Time**
- Considerable time savings over traditional field drafting

**Quality**
- Quality is verified each step of the process. By using the 3D model CML’s are located in most efficient locations without personnel being in the Unit