Integrity management of corrosion under insulation (CUI)

JOINT INDUSTRY PROJECT OUTLINE

PROP304031

Summary

Corrosion Under Insulation (CUI) continues to present a major challenge across a range of process industries. We have no proven economic way to eliminate it by design and plant operators inherit the challenge of preventing failures. Industry consensus is that more work is needed to improve our understanding.

This project will build an improved risk-based CUI management tool based on recent fresh insights to the CUI problem and is supported by targeted plant data analysis, laboratory testing and field trials. Initial privately funded work in these areas shows much promise but industry collaboration is required to expand this.

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Introduction

CUI presents unique challenges. Prediction of where and when CUI failures will occur is limited. Typically, a small percentage of the equipment prone areas are affected by severe CUI. For highly critical equipment just one failure can have severe safety and indirect financial consequences. Confident failure prevention requires high coverage, high reliability inspection at conservative intervals and is resource intensive because there are no cheap inspection options. Sooner or later many plants face the challenge of embarking on costly inspection campaigns, whether planned or triggered by unexpected severe CUI findings or failures.

After five decades we have made progress but no step change improvements. It can take many years to gain confidence in new technologies. Many current risk-based CUI management schemes are prone to errors. Topical projects are still defining reliability and cost data for well-established technologies.

Project Concept

TWI working together with Kaefer, propose to build an optimised RBI tool for CUI based on the following:

1. Development of an RBI model based on strengths and weaknesses of existing CUI management methodologies and published guidance.
2. Expansion of the number of properly characterised industry CUI plant datasets in specific areas.
3. Focussed laboratory testing to improve understanding of coating performance limits.
4. Initiating field programs to build reliability data for a well-established NII technology.

Some valuable experience in these areas has already been gained and demonstrates the value of the proposed work (Watt et al, 2019). Specific areas of interest include RBI scheme layering, plant location and type, stainless vs carbon steel, common factors for severe CUI of piping and vessels. API 581 is the most promising CUI prediction tool in the public domain and we aim to align with and improve its key inputs. There is also potential to improve semi-quantitative approaches.

Objective

Develop an improved risk based methodology for applying RBI to CUI supported by recent new insights, field data collection (historical and new projects) and focussed laboratory testing of coating performance.

Key dates

- Come and join our launch workshop March 25th in Houston the week after NACE 2020.
- UK launch planned of June 2020 to be held at TWI, UK.

Benefits

- Improved personnel and plant safety.
- Cost saving from more reliable operations, less critical failures.
- Resource saving
- Relevant for both greenfield and brownfield plants.
- Complementary, not competitive, with other current industry initiatives.
- Programme benefits from pre-collected initial data and assessment knowledge.

Approach

Development of optimised RBI tool for CUI

Risk-Based Inspection (RBI) is still the most reliable way to prevent CUI failures in the oil and gas industry. Recent work highlighted gaps and inconsistencies in published guidance and eight in-house models used by operators. TWI working together with Kaefer have gained knowledge to make some improvements now, but the desired step change requires more data. The proposed tasks each look at a different aspect of CUI and, together with our recent learning, will feed into an optimised RBI methodology (Figure 1).

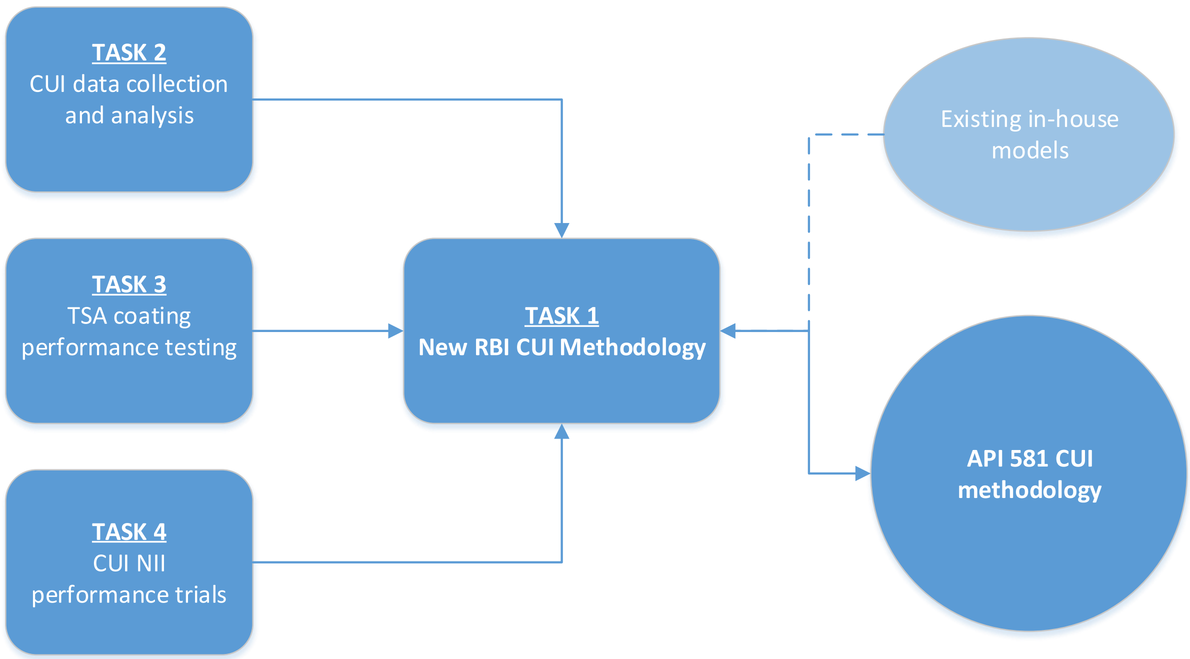

Figure 1 Data sources for the proposed new RBI CUI Model

Task 1 Development of a new CUI RBI Methodology

The new CUI RBI Methodology developed will take into consideration the strengths and eliminate weaknesses of existing reviewed models. The detailed strengths and weaknesses of a number of existing approaches has already been identified and some of our work was published at Eurocorr 2019 (Watt et al, 2019) and has been well received by operators and service providers. The findings of this work will be used to create a framework that is effective and practical. As part of this project we will include new guidance / updates and any in-house approaches. The development of the new CUI predictive model will be aligned to API 581, and any improvements made to key inputs for the model will be shared with the API 581 committee in order to enhance this also.

Task 2 CUI data collection and analysis

Published CUI prediction knowledge is underpinned by a few plant datasets which are powerful but insufficiently characterised. Just one additional plant dataset recently called into question key assumptions and demonstrated opportunities for cost and failure reduction (Watt et al, 2019). There is evidence that different types of plant may suit different approaches which current RBA models cannot account for. Existing plants aged 10-20+ years have data that could better link influential CUI severity factors to timing and location which are key RBI outputs for inspection and maintenance schemes. This includes the performance of promising CUI design solutions.

Task 3 Coating performance testing

Coating life is not a fixed constant and varies with CUI environment severity as well as quality. The limitations of quality applied coatings is little explored. TWI has a long history of experience in the testing of thermal-sprayed aluminium (TSA) coatings. Unlike organic coatings, TSA is better suited to extrapolation of laboratory testing results to the field. TSA is commonly specified as the preferred coating under insulation. Recent TWI work funded by a major oil and gas company suggests that testing under simulated CUI conditions can expand our knowledge about where TSA can achieve long life and where life is limited. This may help to explain different experiences in the marine offshore and petrochemical industries.

Task 4 Evaluation of NII for CUI in the field

Pulse Eddy Current (PEC) is a promising CUI detection or screening technology. PEC deployment costs are often similar to insulation removal and re-instatement but the technology is constantly evolving and offers advantages such as short interval screening to catch early failures and minimising intrusive work. This requires high reliability of detection. Quoted CUI detectable defect sizes depend on volume and are influenced by shape. To assess reliability would need a library of volume/shape sizes of actual in-service CUI defects. Small scale trials are encouraging but do not include enough representative test specimens. We propose the most cost-effective way to generate PEC field reliability of detection of CUI aligned with programs that are removing large amounts of insulation to build data and confidence.

Detailed scope of work and schedule

The project scope depends on levels of interest in the three tasks outlined above. The proposed work programme will be discussed at the two launch meetings planned in March and May 2020. Potential sponsors are encouraged to comment on the activities described in this outline, and indicate any specific requirements regarding project content. It would also be helpful to know of any data sets available within the participant group to support Task 2. Potential sponsors not able to attend the meetings in person are asked to forward email comments to the Project Leader.

Following the meetings, a detailed technical proposal will be prepared describing the planned scope of work and price.

References

- API Recommended Practice 583 Corrosion Under Insulation and Fireproofing, First Edition, May 2014.
- ASTM G189-07 (2013) Standard Guide for Laboratory Simulation of Corrosion Under Insulation.
- EFC55 Corrosion-Under-Insulation (CUI) Guidelines, Revised Edition, 2016. ISSN 1354-5116.
- NACE SP0198-2017 Control of Corrosion under Thermal Insulation and Fireproofing Materials – A Systems Approach.
- Thomason WH: Cathodic protection of Submerged Steel with Thermally Sprayed Aluminum Coatings, Corrosion 84, Paper 338.
- Watt C, Lee, C-M, Paterson S, Jopen A; "Using industry data to compare performance of different risk-based methods for the management of corrosion under insulation", Paper 226986, Eurocorr 2019 Conference, Seville, Spain, Sept 2019.

Further Information

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