A journal of the Institute of Corrosion

Corrosion Management

Issue 162 July/August 2021

A New Solution for Interrupted CP Surveys

INSTITUTE OF CORROSION

Stay up to date with all the latest in Institute news
Page 4

Our Informative Technical Article series continues
Page 18

Contents

INSTITUTE OF CORROSION

Issue 161 July/August 2021

Published on behalf of the Institute of Corrosion
Square One Advertising and Design Limited
Neepsend Triangle Business Centre, Unit 8,
1 Burton Street, Sheffield, S3 8BW.
Publisher and Managing Editor
Debbie Hardwick
Tel: 0114 273 0132
Email: debbie@squareone.co.uk
Consulting Editor
Brian Goldie
Email: brianpce@aol.com
Design
Square One Advertising & Design
www.squareone.co.uk
Advertising Manager
Jonathan Phillips
Tel: 0114 273 0132
Fax: 0114 272 1713
Email: jonathan@squareone.co.uk

Editorial copy date for September/October 2021 issue is:
10th September 2021
Subscriptions

UK	£70.00
Europe	£80.00
Outside Europe	£90.00 airmail £80.00 surface mail

Enquiries and subscriptions to the Institute of Corrosion at the address below:
The Institute of Corrosion
President
Bill Hedges
Past President
Gareth Hinds
Hon. Secretary
Dr. Jane Lomas

Institute of Corrosion, Corrosion House,
5 St Peters Gardens, Marefair,
Northampton, NN1 1SX

Tel: 01604 438222
Email: admin@icorr.org
Website: www.icorr.org

ISSN: 13 55 52 43

This publication is Recyclable.

The President Writes


Institute of Corrosion President, Bill Hedges.

Welcome to the summer edition of your magazine - at last it feels like some good weather has arrived and for me it's felt a long time coming this year.

Although things tend to slow down a bit over the summer months ICorr continues to move forward and there is a lot happening in the area of training, so I'll focus on that for this issue.

We have identified some gaps in our broader corrosion engineering training offering and have progressed with two new courses,

1. Microbially Influenced Corrosion (MIC): We recently signed a contract with Tony Rizk to develop a training course for MIC. Tony is a leading practitioner on MIC and, more importantly, how to control it, and we are delighted to have partnered with him on this project. The course content should be finished this year and be available in 2022.
2. Production Chemistry: At the end of 2020 BP generously donated their training materials related to production chemistry to ICorr. George Winning and myself are now working to turn this into a more generalised training programme which will provide corrosion practitioners with the relevant knowledge of production chemistry problems, and how they relate to corrosion and corrosion control activities. The initial focus will be on oil and gas production.

David Mobbs and Sarah Vasey recently ran a pilot programme for our new Fire Protection Coatings Inspector (level 3) training course with key industry practitioners. This was very successful, and provided useful feedback which will be incorporated into the programme.

We are also excited to have recently signed non-disclosure agreements with the Brazilian corrosion society (ABRACO) which will allow us to work together to develop training programmes for Brazil. Many thanks to Lucia Fullalove and Kevin Harold for making this possible.

The development and updating of our training programmes is covered by our training strategy, and this is now in need of a refresh which will be undertaken in the autumn with around ten ICorr members who are actively involved in developing our training materials. Related to this is a discussion around the best format(s) of our training materials, e.g. classroom, virtual classroom, on-demand.

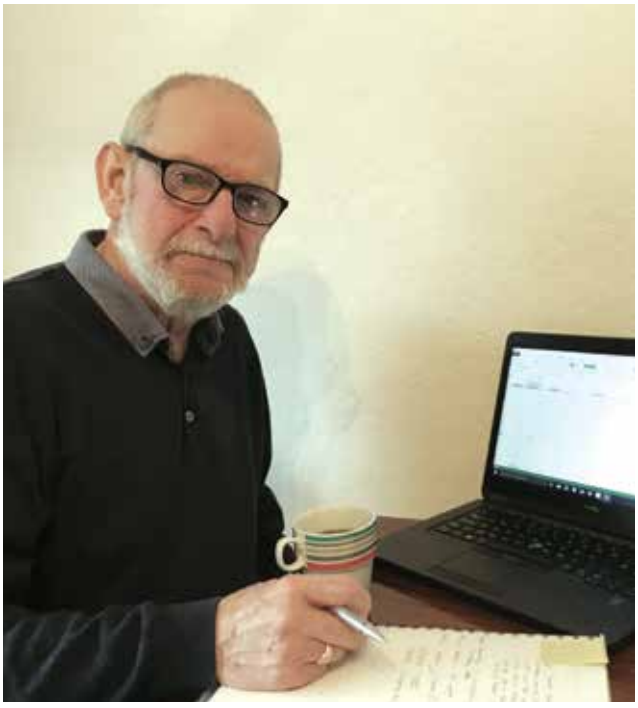
If you have any thoughts or suggestions on which format(s) we should use, or training, I'd love to hear from you using the email address below.

I hope you are able to take a break over the summer and get some well-deserved rest.

Until next time,

Bill Hedges, Institute of Corrosion President
Email: president@icorr.org

From the Editor



Summer has arrived, and with it more hope for returning to normality (whatever that may mean now!). The country is opening up and live events are starting up again, including with ICorr. The branches are restarting in person technical meetings and the CSD is taking part in a major conference (see later in this issue). Training is also beginning to be held face-to-face again, in addition to online courses.

This issue again features three technical articles, on CP surveys, and inspection of assets. Firstly, Jay Warner describes a new method of carrying out more accurate interrupted CP surveys, then Susan Osbeck and Mark Stone describe the advantages of non-intrusive inspection, and finally there is an example of using a risk based inspection technique to assess the residual life of a condenser column.

The "Ask the Expert" column covers monitoring CUI, and the pot life of 2-pack coatings, and the "Fellow's Corner" gives an introduction to paint technology. Readers are invited to send in questions/topics to be covered in these columns, and also let me know of any other areas which should be covered in the magazine.

I can be contacted at, brianpce@aol.com

Finally, I hope you enjoy the summer and manage to get away somewhere for a holiday.

Brian Goldie, Consulting Editor

ICATS/CORREX

With the prospect of travelling and restrictions finally being eased, training at Corrosion House, Northampton, is being considered again, and it is hoped to have to face to face ICATS in the near future.

Online training will also continue as it has proven to be very successful during the pandemic but with the potential of being able to offer an online or face to face training options.

The 2021 ICorr/CORREX audit was carried out virtually at the end of July, and all being well we will pass this surveillance audit with all boxes ticked and systems in place once more. Face to face audits will resume in the last quarter of this year

Some companies require this type of audit for their own management system, and if this refers to your company, please contact me on my normal email address.

Also, we are intending to add to our suite of ICATS courses in the near future, so watch this space for more information

Finally, I hope that the summer proves to be very successful for you all, and the recovery gives you an abundance of projects to work on.

Kevin Harold, CORREX Managing Director

Young ICorr

Young ICorr have been exploring options for future events in 2021, including a series of online events over a 12-month period called, "Meet your Mentors". These events will allow young engineers to network and engage with experienced industry and academic professionals across a number of disciplines. In addition to this, depending on local restrictions, an event will be held in London, UK, in person towards the end of 2021.

You can follow Young ICorr on LinkedIn to find out more information about previous events, and to ensure you do not miss out on future events.

Industrial Coating Applicator Apprentice scheme

The 2020/21 Industrial Coating Applicator Apprenticeship scheme concluded in June 2021 with the apprentices having their End Point Assessments at the Jack Tighe's, Foxs Hills facility in Scunthorpe.

Each of the seven apprentices completed a formal professional interview in the morning, and a practical examination in the afternoon witnessed by the two EPA assessors John Moody (BINDT) and Kevin Harold (Correx).

All of the students passed with Distinction, and are a great credit to both DN College and Jack Tighe Ltd.

In an interview with Alan Jones, the Contracts Manager at Tighe's, he informed ICorr that the apprentices from the 2020 intake are earning money for JTL already, which is a great turn round in a short period of time.

The apprentices: back row, from L - R: Danny Lings, Sonny Burnett, Samuel Proctor, Rici Short, Shaun Watkins, Filip Wajda, Kian Power. Front row: Alfie Dunn, Trainer, DN College, and John Whittaker, Training Manager, Jack Tighe.

Corrosion Science Division (CSD)

62nd Corrosion Science Symposium (CSD)

This year the CSS will join the "Advances in Corrosion Protection by Organic Coatings" meeting in Manchester (6th-9th Sept). The meeting will have a residential element (with live-streaming) and an online option – a hybrid event. CSD have approximately 40 "in-person" places available on a first-come basis and will run the conference, as much as possible, conventionally. Virtual participation as a presenter or listener is also possible, with conventional oral and poster ("three-minute thesis") presentations encouraged.

The abstract deadline is 27th August 2021.Advances in Corrosion Protection by Organic Coatings is a five-yearly international conference postponed from last year and held in curtailed fashion this year due to the pandemic.

The ICorr Corrosion Science Symposium is the annual meeting for students and researchers working in all areas of Corrosion Science and Engineering. The symposium is an ideal opportunity for early career researchers in corrosion to discuss their work, share ideas and, above all enjoy themselves in a stimulating/friendly environment. CSD believes it is important to keep the CSS running even during these restrictive times. Professor Mary Ryan will receive the UR Evans award 2021 at this Symposium for her outstanding contributions in the broad aspects of corrosion science and engineering. Mary's research is focused on understanding nanoscale materials, and nanoscale interfaces in and between materials and their environments. She has a particular interest in the development of operando approaches and has pioneered nanoscale methods in synchrotron science.

Further information will be available soon on the conference website, www.corrosionmanchester.org

ICorr Corporate Membership - BP leads the way

ICorr is excited to announce that BP has been become the first organisation to sign up to the Institute's newest grade of benefit-laden membership. ICorr's Corporate Membership programme offers membership for all corporate employees across all of ICorr's grades from Affiliate to Fellow.

The benefits of Corporate Membership are:

- Any number of employees can be included in the programme, which is costed based on the number of employees involved.
- Free admission for one employee to the annual Corrosion Science Symposium.
- A 10% discount for employees on all conferences and symposia.
- A free table for 10 people at the prestigious ICorr London Branch Christmas Luncheon, that in previous years welcomed guest speakers including former politician Ann Widdecombe and cricket legend Henry Blofeld.
- Free advertising in Corrosion Management magazine and on the Institute of Corrosion website.
- Access to ICorr's career progression and competence programme.
- Guaranteed places on the extremely popular and always oversubscribed Young Engineer Programme, which takes place every two years.

"We are delighted to be the first Corporate Member of ICorr and have signed up ten of our UK based employees. We value our relationship with ICorr and the benefits this membership will bring us" – Dr Chris Williams, BP Senior Advisor for Corrosion Engineering.

ICorr are extremely grateful to BP for being the first to sign up to our Corporate Membership programme which is a watershed moment for this initiative. and which has been in planning for some time.

If you feel Corporate Membership is right for your company, please contact us at, admin@icorr.org

New Sustaining Member

SEM

SEM believes that technology, industry, and conservation can – and should – work together to sustain people and our planet. Each of their chemical solutions embodies that ethos, they also harness innovative ideas and create new technologies with tried and tested methodologies. The end result - a safe, clean and productive equipment and infrastructure is maintained, while protecting personnel and preserving the environment, and conserving health and wealth.

Digital Strategy Update

As we continue developing The Institute of Corrosion's online presence both via the website and our increasingly popular social media channels our attention has turned to the user experience people enjoy (or don't enjoy) when they interact with our organisation online.

With traffic increasing across all platforms, it is now important that when people do visit the website, they can find what they want quickly and easily. It is also important that our members' experience is an enhanced one and that there are benefits in terms of resources and functionality. Our overall aim is to create a 'best in class' website for both the public and our members with an array of new features aimed at creating a better user experience.

The starting point for this part of the project is to find out what those new features need to be, and you will have hopefully taken part in the recent members survey to air your views on what you feel is important and what would be beneficial. This feedback will be vital in steering our thinking in future developments, so thankyou to everyone who took part. We will be assessing the responses over the coming weeks to develop an overall development plan. If you missed the opportunity to take part in the members survey but would like to voice an opinion, please email admin@icorr.org and we will ensure your comments are taken on board.

The overall digital strategy continues to deliver some encouraging results, monthly visitor numbers to the website continue to be strong with over 2000 visitors a month using the website.

The Institute's social media channels continue to go from strength to strength with over 6400 followers on Linkedin. Our social media posts have been enhanced by a series of video snippets promoting video presentations at branch events and the CED Day, which are now available on the website. Video content is an area which we plan to develop, so if you have and conferences or events which you think may be suitable, let us know and we can discuss setting up a campaign.

As members you can help by liking, sharing and engaging with the content that we put onto social media. We are always interested in potential new content so If there is anything that you would like to see more of, please let us know via the usual channels or a direct message on social media.

Branch News

Aberdeen branch

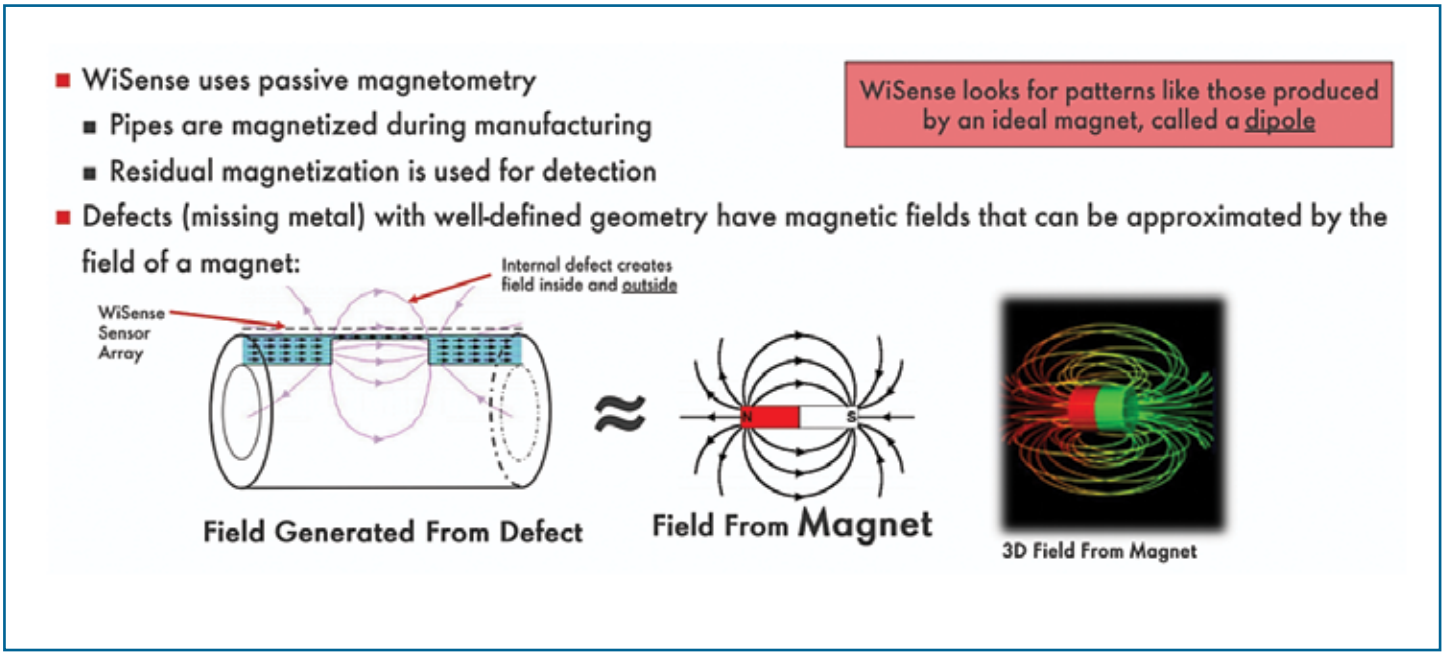
The branch held its last technical meeting of the 2020/2021 session on 25th May with guest speakers Sieger Terpstra (Shell Global) and Chetan Laddha (Sinclair Energy Partners). This most interesting 2-part talk was entitled: 'Passive magnetometry based corrosion monitoring and mechanistic simulation.'

In corrosion monitoring there are a number of NDT techniques both automated and non-automated which can be used to detect and monitor integrity anomalies, but these techniques have limitations for remote areas like 'normally unmanned Oil and Gas platforms (NUI's) and for locations requiring rope access teams (RAT's). Additionally, they all require power to be provided for active probes / magnets and to enable wireless operation / data transfer. The Shell Global WiSense project which has been under development for many years, solves most of these issues as it can run on batteries for a 5-year time span and eliminates the need for routine NDT Inspector access, which is a great benefit in hazardous areas. It also eliminates human error in NDT measurement. The WiSense project uses passive magnetometry, a measurement principle that allows monitoring of localised and non-aged based degradation mechanisms, which pose a higher threat than uniform wall loss mechanisms. The passive magnetometry based corrosion monitoring technology has been developed to facilitate area coverage at the target CML's (corrosion monitoring locations) and provides continuous automated monitoring. Another major advantage is that the sensors do not require any contact with the metal surface – allowing placement on top of coatings or thin insulation and providing frequent, repeatable measurements for trend detection.

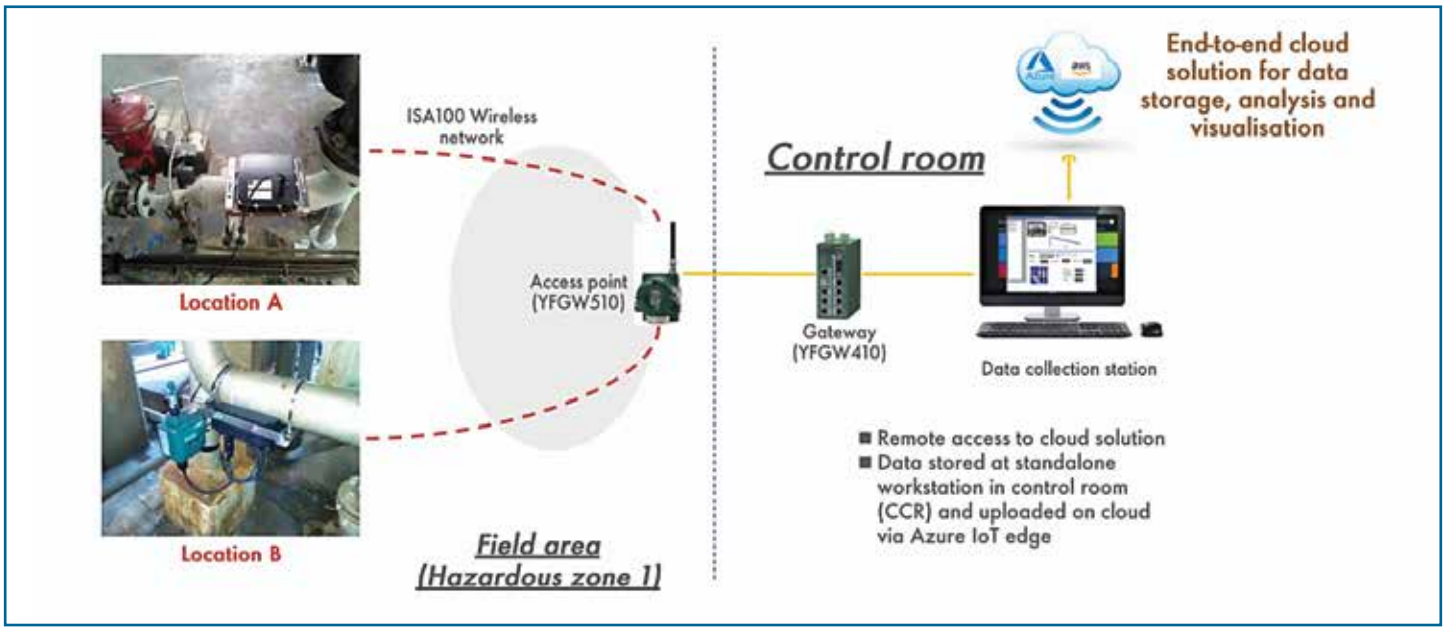
When pipes are manufactured they become magnetised and this residual magnetisation can be utilised for fault detection. Defects or 'missing metal' with well-defined geometry create detectable magnetic fields inside and outside the pipe. WiSense is a Non-Intrusive flexible patch containing arrays of 3 axis magnetometers sitting on the outer side of the pipe. The magnetometers sense the pipes' residual magnetic field, and time series subtraction differentiates defect fields from the common pipe baseline magnetic field. The sensor array within the mounted patch produces B-field 'maps' resembling dipole patterns and the built-in algorithms find corroded regions by searching for these dipole patterns. The WiSense patch can be deployed in a number of different pipework configurations including straight and elbow sections, reducer /diffusers, injection points, valves and orifices. The installations from area locations can be monitored on a wireless network through an access point to the control room gateway and a data collection station. In order to identify defect types, templates are set up by recreating typical defects on pipes using Teflon masking and acid etching of the surfaces to create different types of defects that can then be scanned by the system and used as a model to identify the real and naturally created defects on the pipe. This has been performed on straight and elbow bent pipes both inside and outside. Validation testing can be performed by acid etching on the inside of the pipe while the sensor is on the outside of the pipe monitoring the defect being created. As the magnetometers are detecting dipoles, which are essentially point sources, it is important that real defect geometry is included in the models as they have lateral dimensions and depth, and it leads to a better match than a pure dipole. The technology has been piloted for over 3 years at multiple facilities in downstream as well as upstream areas of Shell operations. Additionally, the technology has gone through independent validation testing with TWI to verify its performance.

In the second part of the talk, the practical benefits of the WiSense technology were further described in relation to commonly applied chemical treatments for corrosion prevention. A mechanistic model was developed to simulate the performance of corrosion inhibition and thereby prediction of inhibited corrosion rates. The overall impact and benefits from corrosion monitoring technology can be significantly enhanced if they are used in parallel with a prediction or simulation technology. The root cause of the majority of Loss of Primary Containment (LoPC) incidents or accidents can often be traced back to degradation mechanisms.

The main driver behind this project development has been that corrosion inhibitors are provided as a "black-box" from the suppliers (exact formulations being closely guarded secrets), which makes it extremely difficult to model the performance of corrosion inhibitors. Additional electrochemical modelling allows testing and simulation of the piping process inhibition mechanisms, without needing to know the underling chemistry of the inhibitor chemical. The simulation can be used to identify both over and under inhibited systems and further, to reduce the cost (corrosion inhibitor qualification programmes. The corrosion monitoring and prediction technologies are used as two complementary tools. Using each tool on a standalone basis has limited value and applicability, however integrating prediction with a real-time feedback loop from sensing allows a step-change in integrity management capability. The combined technologies can help with generating early warnings of integrity issues and facilitate the transition to predictive operation and maintenance.



Principle of WiSense Technology based Self-Magnetic Flux exclusion.



Installation and Deployment Overview.

A comprehensive Q&A session followed this event and all slides may be found on the Aberdeen Branch website page.

Upcoming Events

The branch has several significant events scheduled for later in the summer, including its Annual Corrosion Forum (ACF) on 24th August. This year the event will be held at the TRAC Oil and Gas premises close to Aberdeen Airport. This will be the first branch event in more than a year to be held in person. The theme for the ACF this year is external corrosion management. The programme consists of 8 presentations from speakers from various companies, all very active in the integrity management field. Practical demonstrations in the TRAC workshops will follow in the afternoon. Those interested in joining this event should register their interest with the branch events co-ordinator, Amir Attarchi (amirattarchi@gmail.com), giving full name, company and contact email address

The branch is also supporting the Institute's 'Fundamentals of Corrosion for Engineers (FOCE)' course, which is to be held between 13th – 17th September at the Aberdeen City Jurys Inn Hotel. This course is designed to provide non-corrosion specialists with insights into the principles of corrosion processes and causes which are specific to a range of common industries including: concrete, coatings, cathodic protection, oil and gas, water and renewables sectors. This an intensive one week, classroom-based course with an examination on the final day.

Applicants will gain a basic understanding of underlying corrosion processes in a wide range of industries which may offer career growth to an engineer, or to anyone who wants to investigate potential job opportunities in corrosion or related fields. On successfully passing the course exam allows personnel with relatively limited work experience in corrosion to apply for Professional Membership of the Institute of Corrosion. Those wishing to attend should download the Application Form from the ICorr Website and submit to: admin@icorr.org.
Other general enquiries should be addressed to the Course Leader Dr Jane Lomas on jane7lomas@gmail.com

The branch will also be inviting applications soon for the ICorr Young Engineer Programme (YEP) which it is very pleased to support, following in the footsteps of the highly successful and extremely popular London Branch programmes. For the Aberdeen rotation, the YEP course will reflect the extensive locally based Oil and Gas related Industries and of course also the rapidly growing Renewables Energy Sector. Initial enquiries may be sent to Hooman Takhtechian HTakhtechian@oceaneering.com

London Branch

The branch will again be holding face to face meeting at the Lancaster Hall Hotel, starting with a joint meeting with the London Materials Society (LMS) in October. As the virtual technical meetings held over the past 18 months allowed a wider participation than just from the London area, the branch are planning to also stream this meeting, so those from other parts of the UK, or abroad will be able to join in. Dates and details of speakers, can be found on the diary page and on the ICorr website.

North East Branch

Those members that live or work in the North East area of England may recall that Neil Wilds and his committee ran a very successful ICorr NE Branch with technical evenings and social events for several years. Sadly, the branch has not been active over the last three years and ICorr are keen to reinvigorate activity in the NE of England. We are seeking members to become involved in forming a new committee for the NE Branch, and would request anybody that is interested to contact either myself or David Mobbs on the emails below. The intent is to keep time involvement to a minimum as we know everyone is very busy.

If you feel you could spare an hour or so every few months then please consider getting involved – you will find it rewarding.
Email: president@icorr.org, david.mobbs@c-i-m.co.uk

Industry News

New NDT Training School in Scotland

Fife NDT Training Staff and Office Manager.

IMechE Fife NDT has opened a new training centre offering a full range of courses, including Magnetic Particle Inspection, Radiographic Interpretation, Weld Inspection, Liquid Penetrant, Visual and Ultrasonic testing. Based in Dunfermline, it will also be the first training school in Scotland to offer the advanced courses of Eddy Current, Phased Array Ultrasonic Testing and Time of Flight Diffraction.

IMechE Fife NDT is easily accessible from the M90 motorway or from Rosyth railway station. The facility has extensive car parking and has been fully refurbished with modern classrooms and a comfortable student breakout area where free student lunches will be provided. Most importantly, the training centre has excellent equipment and an extensive range of training and exam samples.

IMechE Fife NDT is headed by Training Manager, Peter McPherson, who has been training NDT technicians for over 20 years. Peter is supported by Graeme Innes who has a lifetime's experience in NDT, including 7 years as a trainer at Fife College, and Stewart Gray who has 6 years training experience in a variety of methods. IMechE Fife NDT will be fully supported by IMechE Argyll Ruane, and will benefit from access to their extensive resources, including Level 3 Services, advanced UT tutors and training material.

CorrosionRADAR and Bureau Veritas alliance in the Middle East

CorrosionRADAR Ltd has signed a Memorandum of Understanding with Bureau Veritas in the Middle East to deliver an integrated solution that helps oil and gas companies manage Corrosion Under Insulation (CUI). Bureau Veritas is the first organisation in the region to integrate the CorrosionRADAR® predictive corrosion monitoring system with its Opex solutions portfolio.

According to the company, the collaboration which captures the expertise of both organisations and aims to deliver a quality controlled end-to-end solution for asset integrity management, signals new momentum in the Middle East to adopt digitalisation to solve the challenges presented by CUI. It comes at a time when industry confidence and investment in digital systems for risk-based inspection (RBI) is accelerating and an accurate and reliable data-driven response for CUI management is achievable.

The automated solution combines real-time field data and predictive analytics generated via CorrosionRADAR's wireless sensing waveguides under the asset insulation, with Bureau Veritas field experience, quality assurance, integrity and risk-based inspection expertise to save costs through prioritising of maintenance activities, repair and rehabilitation schedules. For operators, this means informed decision making, optimised inspection and maintenance programmes, safer and more reliable operations with decreased risk, and more production uptime. The integrated solution is equally suitable for existing brownfield plants and incorporation in new greenfield build, concluded the company.

CorrosionRADAR is planning a series of online discussions and workshops for companies in the Middle East who are interested in learning more about digital collaborations for combatting CUI. Please contact James Rosenshine, Head of Business Development, CorrosionRADAR, if you would like to join an event.

Remotely controlling corrosion

According to cathodic protection specialist Omniflex, they have partnered with Malaysian company IEV Group to supply remotely monitored and controlled cathodic protection (CP) systems to the South East Asia region. The first product available through the partnership is PowerView CP, a system that can be installed to monitor the performance of new or existing impressed current and galvanic CP installations.

It is common for CP systems to be used to protect steel and concrete structures such as tanks, bridges, wharves and industrial pipelines from corrosion. However, asset managers have traditionally relied on physical site inspections to check the performance of equipment that can be located in dangerous or difficult-to-access locations. This is a costly and inefficient approach and businesses looking to increase their efficiency while reducing costs, are opting for remotely monitored CP systems instead.

David Celine, MD of Omniflex, noted that with the widespread adoption of the Internet of Things (IoT), the benefits of remotely monitoring cathodic protection systems are becoming more compelling than ever, and with data accessibility and transparency becoming more important than ever, remote monitoring platforms offer a single, easy-to-access, repository for all live and historical CP data.

According to Christopher Do, CEO of IEV, there are a lot of ageing assets in South East Asia, so the importance of corrosion control technology has soared in recent years, so remote monitoring represents the most convenient and cost-effective.

PDA Europe

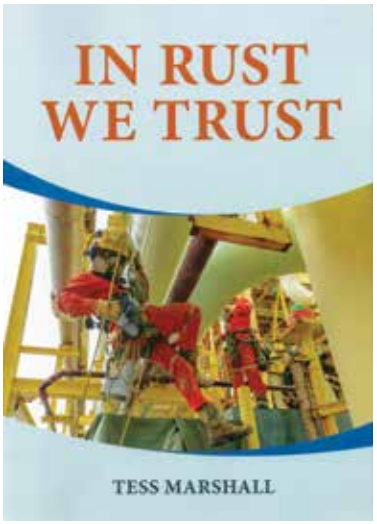
The new date of the virtual annual conference is 4 November 2021.

PDA EUROPE VIRTUAL ANNUAL CONFERENCE & GENERAL ASSEMBLY 4 NOV 2021

The programme will be a mix of learning and networking sessions designed to maximise the engagement for the entire audience. More details on the programme and registration will be posted on their website as they become available.

For further information, contact the PDA Europe secretariat at info@pda-europe.org

Book Review - In Rust We Trust



This text book is intended to be a reference text for all those working in, and with an interest in, corrosion protection by organic coatings. It will be particularly valuable as a reference for plant engineers and maintenance managers, as well as contractors and inspectors, and equipment suppliers.

There is a detailed opening chapter on corrosion theory, and the different types of corrosion encountered in industrial operations, which sets the scene for the rest of the book. There are chapters on surface preparation, and why it is needed, including a very detailed section on abrasive blasting equipment. Similarly, the chapter on paint application includes information on the many methods used, together with a detailed section on airless spray equipment.

There are also chapters on the commonly used generic types of protective coatings, and on typical defects. The relevant international standards are also referenced throughout the text, found in the applied coating.

The author, Tess Marshall, has more than 25 years experience in global coatings industry, he is a Professional member of ICorr, a NACE Protective Coatings Specialist, NACE Senior Corrosion Technologist and Level 3 Coatings Inspector. He now works as a coatings consultant within the oil and gas industry.

The book, ISBN: 978-1-914195-20-4 can be ordered directly from, tesscmarshall@gmail.com, at a cost of £95, or from Amazon.

Hempel acquires ground-breaking coatings technology

According to coatings manufacturer Hempel, they have acquired a ground-breaking technology that will change the market for insulation coatings, whilst enhancing workers' safety and lowering their customers' environmental footprint.

The new technology was developed by Das Lack Enertherm (DLE), a German-English company. When this is combined with their in-house expertise, the technology will enable Hempel to develop and launch coating products with insulating properties within the next year, according to the company.

By offering customers better insulation choices, Hempel can also help to reduce the ever-present risk associated with CUI, in addition, the new insulation coatings will also lower the customers' carbon footprint and will reduce heat loss significantly compared to current insulation coatings – both of which mean helping customers deliver on their sustainability agendas, concluded the company.

Latest Literature

Steel protection via Zn graphene oxide composite coatings

Zn-based coatings are extensively used for the protection of steel structures. Efforts toward further enhancement in the corrosion resistance performance of Zn coatings are therefore an area of continued interest. In this new work, Zn-graphene oxide (Zn-GO) composite coatings containing different volume fractions of GO were electrodeposited on mild steel substrates using an electrolyte bath with different concentrations of dispersed graphene oxide.

The electrodeposition parameters used yielded compact and crack-free morphology for all the coatings. Incorporation of GO led to a refinement of the Zn crystallites in the coating matrix. Potentiodynamic polarisation measurements clearly showed that all the Zn-GO composite coatings exhibited higher corrosion resistance performance when compared to the pure Zn coatings, and further, the corrosion rate decreased with the increase in the volume fraction of the GO in the composite coatings.

The study was published in Journal of Coatings Technology and Research Volume 18, 2021.

A multi-functional coating based on acrylic copolymer

In a new study, the chemical modification of acrylic copolymer was performed through copolymerisation of vinyl-terminated polydimethylsiloxane (PDMS) and acrylic monomers to synthesise acrylic-PDMS copolymers that could possess multi-functional properties required for application in harsh industrial environments.

The acrylic-PDMS copolymers were designed to possess the combined advantages of the PDMS and acrylic copolymer, and featured more flexible copolymer chains, allowing the surface of acrylic-PDMS copolymer films to form with minimum defects, compared to the acrylic copolymer film, and with significantly decreased surface energy.These copolymer coatings exhibited high hydrophobicity with contact angles of more than 90°, and this high contact angle and low surface energy contributed to the low water absorption ratio and low dirt-pick performance of the films. The enhanced anti-corrosion performance of the copolymers was verified by electrochemical impedance spectra (EIS) and salt spray tests. The incorporation of PDMS segments in the acrylic-PDMS copolymers has been shown to be an effective approach to developing multi-functional coating with high chemical, corrosion and thermal resistances.

The study was published in Progress in Organic Coatings, Volume 156, July 2021.

STANDARDS UP-DATE

ISO

The following documents have obtained substantial support during the past two months and have been submitted to the ISO member bodies for voting, or formal approval.

ISO 11125-9 Preparation of steel substrates before application of paints and related products — Test methods for metallic blast-cleaning abrasives — Part 9: Wear testing and performance,

ISO/DIS 16925 Paints and varnishes — Determination of the resistance of coatings to pressure water-jetting (Revision of 2014 standard).

ISO/FDIS 14922 Thermal spraying — Quality requirements for manufacturers of thermal sprayed coatings — Quality assurance system (Revision of 1999 standard).

ISO/FDIS 18797-2 Petroleum, petrochemical and natural gas industries — External corrosion protection of risers by coatings and linings — Part 2: Maintenance and field repair coatings for riser pipes

ISO/DIS 23936-1 Petroleum, petrochemical and natural gas industries — Non-metallic materials in contact with media related to oil and gas production — Part 1: Thermoplastics (Revision of 2009 standard).

New international standards published during the past two months

ISO 3613:2021 Metallic and other inorganic coatings — Chromate conversion coatings on zinc, cadmium, aluminium-zinc alloys and zinc-aluminium alloys — Test methods

ISO 1463:2021 Metallic and oxide coatings — Measurement of coating thickness — Microscopical method

ISO 28199-2, 3:2021 Paints and varnishes — Evaluation of properties of coating systems related to the spray application process — Part 2: Colour stability, process hiding power, re-dissolving, overspray absorption, wetting, surface texture and mottling - Part 3: Assessment of sagging, formation of bubbles, pinholing and hiding power.

Innovative Products

New Passive Fire Protection Coating

Global coatings manufacturer Hempel has launched Hempafire Pro 400, a new passive fire protection coating that maintains the stability of steel structures in the event of a fire for up to 120 minutes and has been optimised for maximum efficiency in the loadings for a 90-minute duration.

Passive fire protection (PFP) coatings insulate steel during a fire, which extends the steel's load-bearing capacity and gives valuable extra time for evacuation and emergency response. According to the company, their Hempafire Pro intumescent PFP coatings are known for their low loadings, which can improve project efficiency. These coatings can be used for all steel profile types – for both in-shop and on-site applications. They can be used in exterior conditions and corrosion environments up to C4 according ISO 12944. The Hempafire Pro 400 is available in two versions, standard and fast drying. Other attributes according to the company are, excellent aesthetic appearance when correctly applied, excellent application properties – designed with applicators in mind, and it can be applied up to 1,600 microns DFT in one coat to minimise the number of coats required.

CorrosionRADAR launches StarterPACK™ to unlock the value of predictive corrosion monitoring

CorrosionRADAR has launched StarterPACK™ which allows industry to try out predictive moisture and corrosion monitoring in a specially designed evaluation project. It is a quick and easy way for companies to weigh up the benefits of Predictive Corrosion Management (PCM) in tackling the challenges of Corrosion Under Insulation (CUI).

It enables:

- Continuous CUI detection, localisation and monitoring
- Understanding on how data is transmitted, integrated and visualised
- Understanding on how data is analysed for effective decision support
- Reporting on business cases and ROI calculations

And at the end of the project, companies will have generated, a system performance report, a business case and a recommended field deployment plan for scale-up, concluded the company.

corrosion® RADAR

Ask the Expert

This month, the questions relate to the topical subject of CUI, and 2-component protective coatings. Remember to send your technical questions to the editor for answer by our panel of experts.

Question:

What is the best approach to detect and monitor CUI ? **CL**

Answer:

The most reliable method to detect and monitor CUI is a full strip of the insulation and visual inspection, although once CUI is detected with this method it is rarely monitored. The key disadvantage of this approach is the high cost and required resources associated with access, stripping, possible refurbishment of the coating, and reinstatement of the insulation. The need for a reliable screening technique to focus CUI inspection efforts has been recognised for many years. Various non-destructive techniques (NDT) are available to detect CUI directly without removing the insulation, such as real time radiography (RTR) and pulsed eddy current (PEC). However, the drawback of these techniques is the uncertainty around probability of detection (POD), despite significant technique improvements in recent years and development of technologies through joint industry projects such as those done by HOIS (Harwell Offshore Inspection Service). Possible presence of CUI can also be detected with indirect techniques which are based on detection of water or humidity in the insulation system. Techniques such as thermography, neutron & x-ray backscatter, and more recently various types of sensors are all capable of detecting water or humidity but similar to direct methods there is still uncertainty around the POD and questions about the reliability. Another drawback is that detecting water does not necessarily mean that CUI has occurred at the points where water is located. Much development work continues especially with sensors which may offer better monitoring capability including direct detection of corrosion. Improving CUI predictive capability through greater sharing of data and analysis can also help focus where to inspect, but the CUI still needs to be located and there are many instances of CUI "surprises" in the industry especially if 100% stripping of insulation is not done during service of the facility. It should also be recognised that it can take 15 to 20 years to fully validate CUI technology developments and therefore compromises will inevitably be sought. A complementary approach involving direct NDT, water detection, sensor monitoring and the application of better data analysis and CUI prediction is probably the optimal way forward to focus efforts with CUI inspection planning, but full strip and visual inspection remains the most reliable approach.

Steve Paterson, Arbeadie Consultants

Question:

"How do you know when the pot life of a 2-component paint has expired ? Can you extend pot life, if so, how?" **PS**

Answer:

The reaction or cure of a two-component paint or coating is initiated when the two parts are mixed together. The manufacturer will state a pot life at a given temperature on the product data sheet.

Generally speaking the reaction rate doubles for every 10 degrees C increase and halves for every 10 degrees C reduction in temperature, this can be used to estimate the pot life at different temperatures if this is not stated on the data sheet. The age of the product can affect the pot life, depending on the chemistry of the particular product this could produce a longer or shorter pot life. Furthermore, the type of pump, fluid friction and pressure in the pump also have an effect and therefore it is also good to know the signs of when the material is towards the end of it's pot life.

There are other variables in material chemical composition and properties such as the viscosity, lubricity and level of fillers but generally speaking a sudden increase in blockages, viscosity, reduction in fan pattern and atomisation are a sign the material is past its best, also most reactions are exothermic therefore the product will start to get hot.

One method that can be used for extending pot life at higher temperatures is cooling the product, or cooling the pump. Care should be used when cooling the product as it could be below dew point and take on moisture during mixing and atomisation.

Some products have a pot life inhibitor available to increase pot life in hot climates, this is mixed into the product prior to adding the Part B and applicable to products cured by free radical polymerisation. Some products are also available with tropical or winter grade hardeners.

Any attempt to extend a pot life after mixing will affect the final cure and other properties of the material and could poison the reaction completely, for example mixing in additional solvent. Of course solvent should only be added when it is recommended by the manufacturer and only up to the maximum percentage stated.

Phillip Watkinson, Corrocoat

Advertise in Corrosion Management
a leading industry organisation publication

Key Facts

Corrosion Management

- Circulation of 1500 subscribers
- Published bimonthly – 6 issues a year
- 75% of subscribers UK Based
- Majority of readers employed at senior level as decision makers and specifiers in their field
- The main focus of each issue is a themed technical article
- Editorial also includes: Institute News, Industry News, Innovative Products, Diary of Events, Recruitment and currently the Sustaining Members Directory

Don't delay

We have a range of advertising opportunities in Corrosion Management Magazine. However because this is a technical journal, space is limited and is booked on a first come first served basis.

Display Advertising

Full page from £400.00

Recruitment advertising full pages from £600.00

To help you target your advertising effectively we have developed a features list

2021 Features List

September/October Issue – Bridges

November/December Issue – Oil and Gas

Fellow's Corner

In this series of articles by practitioners who have made a significant contribution to the field of corrosion protection, the editor discusses paint technology.

Over the past 18 months this column has concentrated on topics relevant to the corrosion engineers, however, there is a need to address the part that protective coatings play in the corrosion protection of structures. In an attempt to address this imbalance, this issue will feature an introduction to paint technology, and how protective coatings fit into the overall corrosion protection scenario.

Paints and coatings are used to protect and decorate, however, before we consider the properties of paints and how they work, it is necessary to consider "what is a paint".

All liquid paints are composed of three basic ingredients, resins, pigments and solvent. The resin is the film forming portion of the paint - it holds together the pigment particles and binds the paint to the surface. The resin plays the main part in contributing to the durability, strength and chemical resistance of the final film. Paint types are often referred to by the type of resin in the formulation, so when we talk about an alkyd or epoxy for example, we are referring to the main resin used to make the paint.

The second ingredient in a paint is the pigment. This is a relatively insoluble finely divided powder, or more commonly a mixture of powders. The pigment(s) primarily provide hiding power (opacity), and colour, but they also improve corrosion and weathering resistance, increase paint adhesion, decrease moisture permeability and control gloss. The final ingredient, the solvent, "carries" the resin and pigment(s) and controls the viscosity, such that the paint can be applied to a surface. The chemical ingredients in each of the components vary widely from one generic type of paint to another, in addition each of the components (resin, pigment and solvent) are also usually mixtures of different materials. For example, a paint formulation may contain three or four solvents - one solvent dissolves the resin, while some are used to control evaporation, and others are used to dilute the solution (control viscosity). It is not important for a user to know all the ingredients in a paint, suffice that he knows the properties.

The words, paint and coating, are used interchangeably - they mean virtually the same thing. However, it is necessary to distinguish between a coating system and a coat of paint. A coating system is more than just the material applied, it also refers to other factors such as the surface preparation requirements, the application of a number of coats of paint, in a specific order, and the thickness of each coat of paint. A coat of paint is a single layer, applied to form a coherent film when dry.

The common designation of a series of coatings applied to a surface is primer, intermediate or build coat, and top coat. Normally each coat contains properties that contribute to the success of the total coating system.

Function of each coat

The primer is the first coat applied to the surface. The main function of the primer is to provide adhesion to the substrate - if the primer doesn't stick, then the whole coating system will fail. The primer also provides a key for the rest of the system.

The intermediate coat is required in many coating systems to provide one or more of the following functions; increase film build, improve chemical resistance, or serve as an adhesion or tie-coat between primer and topcoat where they are not compatible.

The topcoat is intended to be the last coat applied. This provides the weather and/or chemical resistance and also imparts characteristics such as colour, gloss wear resistance, abrasion resistance.

Considering the two main reasons for painting - protection and decoration, this article will concentrate on the protection properties. A paint can protect against, amongst others, abrasion, chemicals and fire, but probably the most common protection use is to prevent corrosion of steel.

There are three recognised ways that coatings protect steel against corrosion, providing a barrier, inhibition and sacrificial action.

Barrier protection is just as the name implies, the dried paint film blocks moisture from reaching the steel surface. All coatings do allow moisture and oxygen to penetrate them to some extent, this is called permeability. Coatings which protect by a barrier mechanism have very low permeability. Typical barrier coatings are 2-pack epoxies and polyurethanes, although there are additives which can reduce permeability further (see below).

Coatings that protect by inhibition contain active pigments to inhibit or interfere with the corrosion reaction on the steel surface. Typical traditional inhibitive pigments were lead compounds and chromates. However, concerns about toxicity and environmental pollution have led to their replacement with so called non-toxic anticorrosion pigments such as phosphates, and many proprietary materials. As moisture passes through the film, the anti-corrosive pigments slowly dissolve and depending on their chemistry interfere with either the anodic or cathodic reaction and thus retard corrosion.

The third mechanism is sacrificial action and is the way that zinc rich primers protect steel. These primers are highly loaded with zinc, such that the zinc is in contact with itself and the steel surface. As zinc is more active than steel, and if the elements necessary for corrosion are present, then the zinc will corrode in preference to the steel (i.e. sacrifice itself), and hence protect the steel. Zinc rich paints are classified into two types, inorganic and organic. This classification refers to the resins used in the formulation and not the form of the zinc. The binder (resin) in inorganic zinc rich coatings is a form of silicate, and organic zinc rich paints are nowadays typically epoxy based.

Returning now to the paint system. This is designed to give optimum protection to the steel or metal substrate by combining the properties of the various coats. Thus for very long term protection, an inhibitive primer, or more particularly a zinc rich primer, would be combined with a barrier intermediate coat and topcoat. In this way, two protective mechanisms are used to give long life protection.

The permeability of a paint and hence its barrier properties are related to the resin used, with oleoresinous and alkyd paints having high permeability and epoxy and polyurethanes having lower permeability due to their highly cross-linked structure. Within each generic class of paint, permeability can be further reduced by formulation, and in particular the use of plate-like pigments such as micaceous iron oxide (MIO) and aluminium flakes. These special pigments orientate themselves parallel to the surface when the paint dries and provide an extremely low permeability film (they effectively increase the path length moisture has to take to reach the metal surface). In a similar manner, permeability can be reduced by increasing film thickness although there is a limit to this before other properties start to suffer.

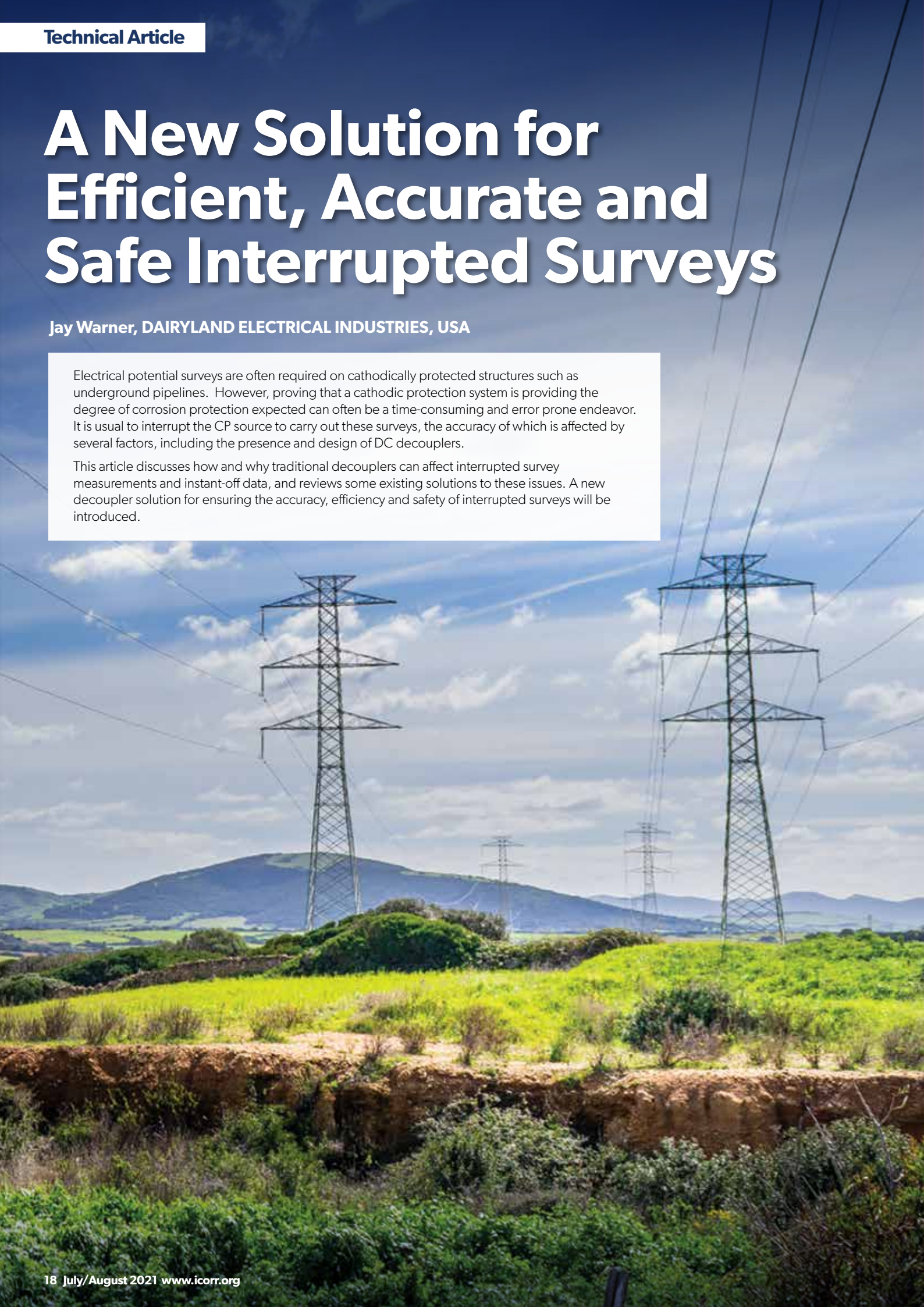
No matter which type of paint is used, if proper surface preparation is not carried out then vastly inferior performance will be obtained. Surface preparation is essential in two important areas, it provides an anchor for the coating and it allows intimate contact between the coating molecules and the metal surface, and this will be the topic for a future column.

A New Solution for Efficient, Accurate and Safe Interrupted Surveys

Jay Warner, DAIRYLAND ELECTRICAL INDUSTRIES, USA

Electrical potential surveys are often required on cathodically protected structures such as underground pipelines. However, proving that a cathodic protection system is providing the degree of corrosion protection expected can often be a time-consuming and error prone endeavor. It is usual to interrupt the CP source to carry out these surveys, the accuracy of which is affected by several factors, including the presence and design of DC decouplers.

This article discusses how and why traditional decouplers can affect interrupted survey measurements and instant-off data, and reviews some existing solutions to these issues. A new decoupler solution for ensuring the accuracy, efficiency and safety of interrupted surveys will be introduced.



Interrupted Surveys and Decouplers

Watch your waveforms

The purpose of potential surveys is to evaluate the effectiveness of the cathodic protection (CP) system by measuring the polarised potential of the pipeline. However, pipe-to-soil potential measurements are influenced by the CP current, which introduces a measurement error known as IR drop. To eliminate this error, CP sources are synchronously interrupted momentarily, after which the potentials are measured, but before the pipe depolarises. The potentials measured in this way are referred to as instant-off potentials. Such interrupted measurements are typically collected over the length of the pipeline as part of a Close-Interval Survey (CIS) or Close-Interval Potential Survey (CIPS). A typical instant-off potential response is shown in Figure 1.

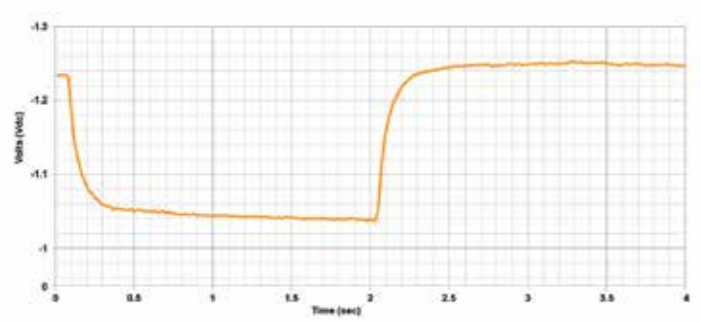


Figure 1 – A typical instant-off response measured on a pipeline.

Ideally, instant-off measurements are taken within 300-400 milli-seconds (ms) after interruption. This is usually a long enough time to avoid any spiking that may occur following the interruption, yet short enough to minimise depolarisation of the pipeline and to minimise the duration of the OFF cycle, and thus the total time required to conduct the survey.

However, the interrupted response of pipeline systems can vary greatly depending on system parameters such as soil resistivity, length and diameter of the pipeline, pipeline coating, coating holidays and the number of decouplers present. Certain combinations of these parameters can significantly change the response and, if not accounted for, can lead to instant-off readings that are more electro-negative than the true polarised potential. Therefore, before recording instant-off measurements, CP Technicians should evaluate the interrupted response to determine the appropriate ON-OFF cycle durations and instant-off measurement times, as well as to account for any interference issues.

The decoupler dilemma

DC decouplers play a critical role in most CP systems by providing effective DC isolation of cathodically protected structures from other objects and earthing systems, while simultaneously bonding the structure to earth for AC (induced steady state and faults) and lightning. Commonly employed in AC mitigation systems, decouplers utilise a capacitor to provide a continuous conduction path for steady state induced AC current to pass to ground. The capacitor must be large enough to present a suitably low impedance to the induced AC and so minimise the AC voltage on the pipeline. However, this capacitance can have a detrimental effect on the instant-off response of interrupted surveys. This effect can be observed by comparing the waveforms shown in Figure 2.

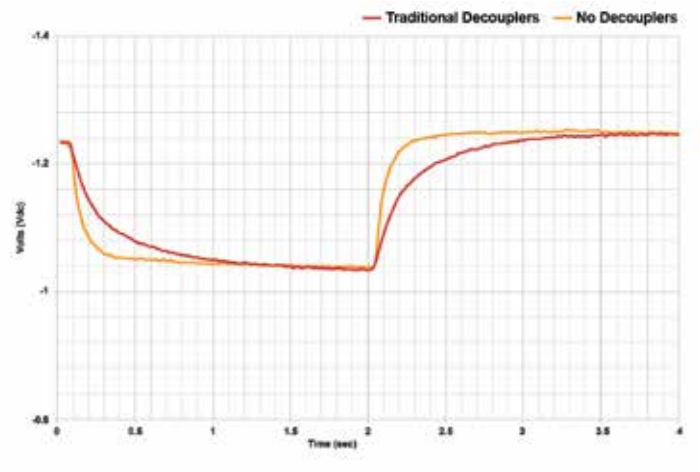


Figure 2. Instant-Off Response with and without a traditional decoupler.

In this example, there were eight decouplers installed on a segment of pipeline approximately 53 km long. Note that the change in the response due to the addition of the decouplers can introduce a significant error in the instant-off measurement, depending on when it is sampled.

Knowing this phenomenon, several questions arise: At what point in the OFF cycle should the instant-off data be sampled? How late in the OFF cycle can an instant-off measurement be taken with confidence that the pipe has not depolarised? How consistent is this effect over the length of the pipeline? These are questions that have plagued CP technicians for years.

Why decouplers affect the interrupted response – a simple electrical model

Much as the ride of a car depends not only on the spring rate of the suspension, but also on the shock absorbers and the mass of the vehicle, the instant-off response on a pipeline is influenced by decoupler capacitance in combination with other physical parameters in the pipeline/ICCP/decoupler system, predominantly pipeline coating and soil resistivity.

To better understand how these parameters influence the interrupted response, it would be helpful to analyse the pipeline/ICCP/decoupler system using a simple electrical circuit as shown in Figure 3.

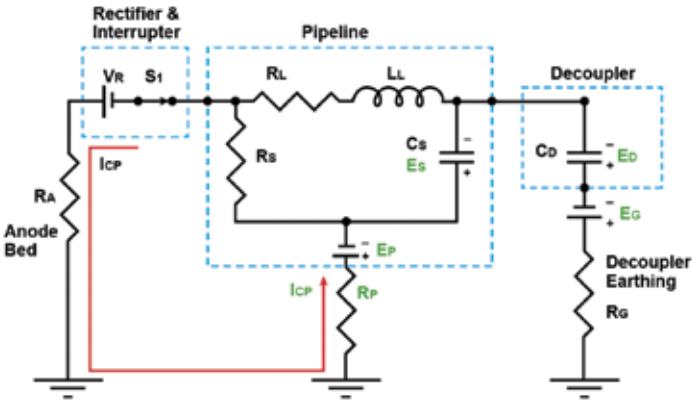


Figure 3. Simple Electrical Model of a Pipeline, ICCP System and Traditional Decouplers.

In this model, the pipeline is represented by the longitudinal resistance, R_L, and inductance, L_L, together with the coating resistance, R_S, in parallel with the capacitance of the pipe/soil interface, C_S. The voltage that is developed at the pipe/soil interface due to polarization is denoted by E_S. Further, the pipe metal exhibits a DC corrosion potential with respect to the soil E_P, which typically has a magnitude of approximately -0.6V_{CSE}. Finally, there is a resistance, R_P, between the outer surface of the pipeline coating and remote earth. The CP system rectifier and interrupting switch are denoted by V_R and S_1 respectively. When the pipeline is protected by the CP system, S_1 is closed allowing DC current, I_{CP}, to be supplied to the pipeline via an anode bed with resistance R_A.

When decouplers are installed, an additional capacitance (C_D) is added to the system, along with the associated voltage across the decoupler (E_D). The decoupler earthing system has a corrosion potential denoted as E_G and a resistance to remote earth, R_G.

With CP current applied, once the decoupler capacitor has fully charged, the DC current through the decoupler falls to zero and, following Kirchoff's law, the voltage equilibrium in this circuit can be represented by the following equation:

$$E_S + E_P + I_{CP} \times R_P = E_D + E_G$$

When the CP current is interrupted, I_{CP} drops to zero and, since corrosion potentials E_P and E_G remain constant, the voltages E_S and E_D respond to compensate for the change in I_{CP} (i.e., the pipe begins to depolarize and the decoupler capacitor dissipates stored charge). This results in a transient flow of current from the decoupler that essentially acts as an uninterrupted source and will introduce error in instant-off measurements until the charge across the capacitor is fully dissipated.

Although the actual system is much more complex, in general, the interrupted response of this system can be characterised by that of an RC (Resistors + Capacitors) circuit. The step response of an RC circuit has exponential decay for which the rate of decay over time is inversely proportional to the product of the circuit resistance and capacitance, commonly referred to as the RC time constant. In a pipeline circuit, the larger the RC time constant is, the longer it will take for the decoupler charge to dissipate after interruption, and the greater will be the challenge to collect accurate instant-off measurements in a timely manner.

In a typical cathodically protected pipeline, the resistance portion of the RC time constant is influenced by both the pipeline's resistance to remote earth, R_P, and the pipeline's coating resistance, R_S. Soil resistivity near the pipeline is the major contributor to R_P and the overall circuit resistance. As improvements in pipeline coatings have been made over the years, the R_S portion of the total circuit resistance has increased. But R_S tends to reduce with greater pipeline surface area (i.e., larger pipe diameter and longer pipeline segment) since the number of possible holidays typically increases with surface area. The decoupler earthing system resistance, R_G, is typically low by design and so usually does not significantly influence the RC time constant. The circuit capacitance is controlled mostly by the decoupler capacitance.

Given these relative parametric influences on the pipeline/ICCP/decoupler system, combinations of the following trends can result in greater system RC time constants and thus increased likelihood of experiencing challenges with collecting accurate instant-off measurements within 300-400 ms after interruption.

- A higher density of traditional decouplers (number of decouplers per length of pipeline)
- Higher soil resistivity
- Higher resistance pipeline coating
- Smaller diameter pipeline
- Shorter pipeline segment

Traditional solutions

So, how can accurate and timely interrupted surveys be conducted if decouplers are part of the system? Historically, there have been methods to deal with the effects described above. However, as will be explained, each of these traditional solutions has significant shortcomings.

Disconnecting Decouplers

One common solution is to temporarily disconnect the decouplers from the pipeline during the survey. This is effective in eliminating the transient current flow during the OFF cycle and the resulting IR drop, as the decoupler capacitance has been removed from the system. This can be accomplished by physically disconnecting leads or by the installation and use of decoupler isolation switches. However, there are several reasons why this option should be evaluated carefully. First and foremost, while the decouplers, and thus the AC mitigation system, are disconnected, the pipeline is not protected from induced AC, AC faults or lightning and unsafe voltages may be present on the pipeline. This presents a safety hazard to those conducting the interrupted survey or anyone else in contact with the pipeline or its appurtenances. In addition, while the decouplers are disconnected, the pipeline may be exposed to the damaging effects of AC corrosion. Another drawback of this approach is the significant amount of time required to disconnect and reconnect all decouplers in the pipeline circuit being studied, compounding the time and cost needed to perform an interrupted survey.

Extending the OFF Cycle

Another method of conducting accurate and timely interrupted surveys is to extend the OFF cycle of the rectifier to ensure the response has stabilised. Sample waveforms should be evaluated at several locations along the pipeline to determine the optimum ON-OFF cycle time required. The obvious drawback to this approach is that it could make for a much slower and more expensive survey. Some applications have been observed which would require OFF cycles on the order of 10 seconds for the capacitor charge to sufficiently dissipate.

A new solution – decoupler "Camouflage"

A new decoupler technology is now available that can overcome the slow interrupted response associated with the capacitance in traditional decouplers, while providing all the same benefits of traditional solid-state decouplers. The decoupler remains in the circuit at all times during an interrupted survey to provide continuous protection from AC interference, yet virtually eliminates the effect of capacitance common to traditional decouplers. This decoupler technology uses sophisticated and proprietary signal handling that results in interrupted responses similar to that of having no decouplers present in the circuit. Decouplers having this technology provide the same DC isolation performance as traditional designs and are available with standard ratings similar to those of traditional decouplers.

Field test results

Decouplers employing this next generation technology have been tested on several pipeline AC mitigation installations over a wide variety of system conditions, such as soil resistivity, pipeline diameter and length of pipeline segment, decoupler density, and isolated and non-isolated pipeline segments. Since several factors other than decoupler capacitance can influence the interrupted response, the performance of the decouplers was measured by comparing interrupted response waveforms with and without the decouplers installed.

Figure 3. AC Mitigation System with Next Generation Decoupler.

A sample waveform from an interrupted survey conducted on a pipeline located in the western United States is shown in Figure 4. The pipe was 24 inches in diameter and electrically continuous for approximately 53 km and coated with a fusion bonded epoxy (FBE). There were eight decoupler installation sites along the length of this pipeline segment and the soil conditions were sandy and dry. Each of the waveforms shown were taken within the same day.

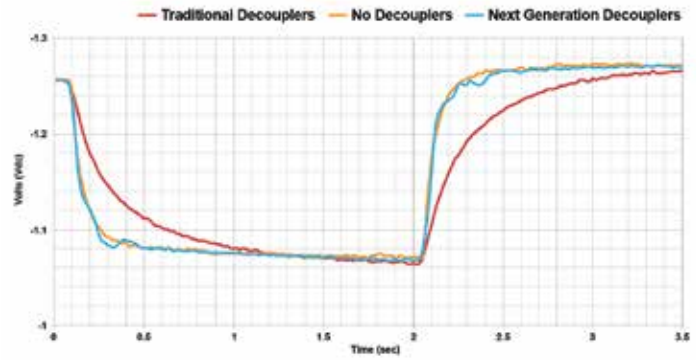


Figure 4. Interrupted Response Waveforms. Test Location CK-810.

Note that the response with the next generation technology decouplers installed closely mimics the response of having no decouplers. The measurement error associated with decoupler capacitance is eliminated.

Figure 5 shows another set of waveforms taken on a different pipeline in the midwestern United States. This lateral pipeline segment was 3.2 km long and a mix of 6 in and 8 in diameter piping, all with FBE coating. There were eight decoupler sites along this segment. However, this pipeline segment was not isolated from the main pipeline, on which additional decouplers were installed. The soil was moist farm topsoil.

Comparing these waveforms with those of Figure 4, it is interesting to note the extremely slow response of each waveform, especially that with the traditional decouplers installed (Note that the OFF cycle was cut short for the test with traditional decouplers, but the trend is still apparent.). The lower soil resistivity in the later example would lead one to expect a smaller RC time constant and thus a faster decay of the interrupted response. However, in this installation, the density of traditional decouplers averages 16 times that of Figure 4 and this difference in decoupler capacitance overwhelms the difference in soil conditions between the two applications.

It is also notable that even the interrupted response with no decouplers installed is extremely slow and would result in erroneous instant-off measurements roughly 70 mV too electronegative if taken within 0.5s of interruption. This slow response is due to the tested pipeline segment not being isolated from the main pipeline where other decouplers are installed and highlights the need, at least in this case, to apply these new decouplers at all decoupler sites.

As in the previous example, the response with these decouplers again aligns with the response of having no decouplers installed. This behaviour was similar across all testing performed using these new decouplers, validating the performance of this new technology.

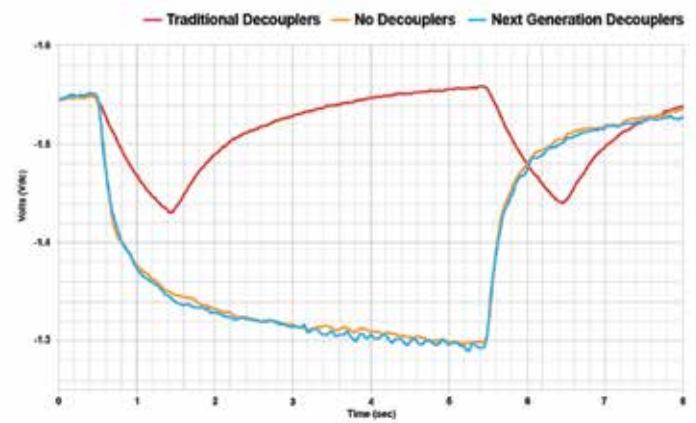


Figure 4. Interrupted Response Waveforms. Test Location CK-810.

The benefits of "Camouflage" decoupler technology

More accurate potential surveys

When properly installed on isolated pipelines, the next generation decoupler can virtually eliminate the measurement error associated with decoupler capacitance. Due to the capacitive effects of traditional decouplers, unless considerable attention is given to waveforms and the proper timing of instant-off measurements throughout a survey, there is significant chance of recording overly electronegative OFF potentials and thus potentially not identifying an insufficiently protected pipeline.

Safer surveys

With the next generation decoupler in place, there is no need to disconnect the decouplers during a survey. Induced AC current, as well as potential AC faults and lightning, passes to ground and the AC voltage on the pipeline remains at safe levels throughout the survey. This also ensures that the measures for mitigating AC corrosion remain in place during the survey.

Faster/lower cost surveys

Finally, the time and cost to conduct the survey are likely reduced from that using traditional solutions. The additional time required to either disconnect/reconnect decouplers or to extend OFF cycles sufficiently to collect a valid measurement can add many hours and significant cost to a typical survey. The next generation decoupler eliminates this added time and the associated recurring costs.

Summary

Interrupted surveys on cathodically protected structures are subject to many variables that influence the accuracy, time, and cost of the survey. Often used for AC mitigation, DC blocking and safety grounding, traditional DC decouplers can have a notable effect on the potentials measured during an interrupted survey which can result in inaccurate conclusions about the protected state of the structure. A few key CP system circuit parameters, including the capacitance of traditional decouplers, have significant influence on the interrupted response. When these factors result in excessively long decoupler dissipation times during the OFF cycle, it is likely to either cause measurement error or require considerable effort to mitigate.

This article described a new decoupler technology which allows for more accurate and efficient interrupted surveys, while maintaining the safety benefits for which decouplers are intended. The new decoupler virtually 'camouflages' itself following interruption and results in interrupted responses and instant-off measurements nearly identical to those measured with no decouplers installed. The technology has shown to be effective over a wide range of field conditions.

Editor: This article is based on a presentation given to London Branch in February this year. The presentation can be found at, https://www.icorr.org/london-branch-virtual-event-dc-decouplers-applications/

Non-intrusive inspection in action

Non-Intrusive Inspection reduces backlog and helps avoids failures

Dr Susan Osbeck and Dr Mark Stone, ESR Technology Ltd

With the recent low oil price and continuing restrictions imposed on working practices due to Covid-19, many turnarounds have been strategically postponed. Integrity and inspection engineers are now considering how to manage their increasing backlog as inspections and maintenance activities are put on hold. Often, companies look to defer the work, postponing the inspections until the next shutdown, but this is likely to have a cascade effect on the inspection dates of other items and an associated impact on the risk of failure as defects go undetected and unremedied. It is worth noting that periods of reduced spend on maintenance and health and safety has historically shown to be followed by periods of increased frequency of loss or larger losses [1] suggesting that attempts at short term cost saving measures by avoiding carrying out inspections may not save money in the long run and could lead to more serious consequences than just lost production.

One option for pressure vessels and tanks is to consider using non-intrusive inspection as a replacement for internal visual inspection (IVI). While IVI requires the item to be shutdown, isolated, cleaned internally, and requires confined space entry (an activity with increased complexity in a socially distancing world), NII can often be carried out while the vessel is in-service, with less people involved, and over a longer period of time.

Non-Intrusive Inspection

Non-intrusive inspection (NII) is distinctly different to non-destructive testing (NDT). Whereas NDT describes a set of inspection techniques that can be applied to the external surface of a vessel to gain insight into the condition of the internal surface (such as radiography, or ultrasonic corrosion mapping), NII describes a whole process that includes historical review, planning, inspection (with NDT techniques) and evaluation as shown in Figure 1. It is only by applying NII in a robust manner, that confidence in the knowledge of the integrity of the vessel can be gained and IVI avoided.

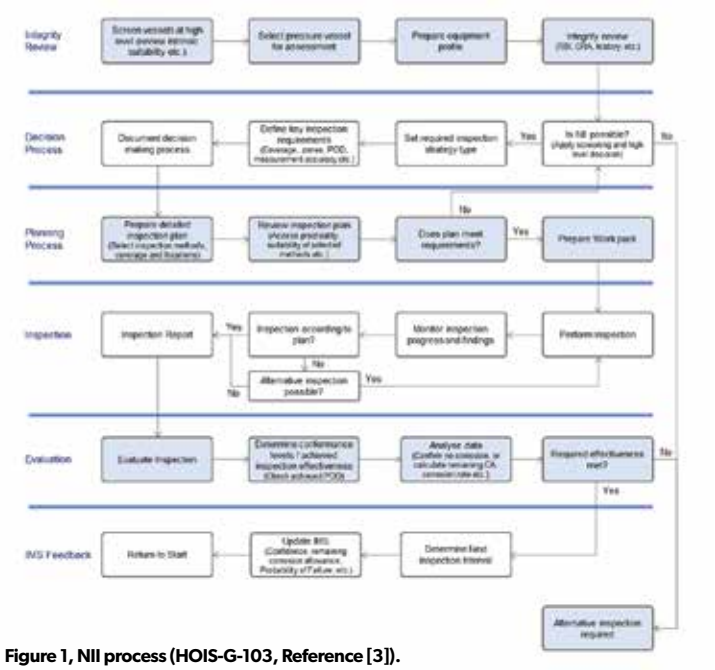


Figure 1, NII process (HOIS-G-103, Reference [3]).

Effective implementation of NII has been supported for the last fourteen years by the Recommended Practice for Non-Intrusive Inspection of Pressure Vessels. Developed by the HOIS joint industry project, but previously published through DNVGL as DNVGL-RP-G103, it has recently been updated and published as a HOIS document: HOIS-RP-103 [2]. The Recommended Practice (RP) has had some major revisions aimed at making the application of NII easier and more consistent. These revisions have been based on the substantial industry experience gained since the last technical revisions of the RP in 2011 and include:

- A quantified approach to inspection strategy type and selection.
- Calculations created to aid decisions on coverage requirements.
- Clearer definitions of conformance levels and categorisation of degradation are provided.
- A simplified approach to technique selection.
- Additional guidance provided on clad vessels, design for inspectability, repeat NII, and NII as the first in-service inspection.

In addition to the updated RP, a set of guidance notes (HOIS-G-103) were published at the same time; these were funded through a joint project between HOIS and the Net Zero Technology Centre (called the Oil & Gas Technology Centre, OGTC at the time of publication) [3]. The guidance notes highlight the key parts of the NII process and the RP and provide a substantial set of worked examples which cover a range of vessels both suitable, and unsuitable for NII. They also provide practical advice for implementing NII aimed at management who are not involved at a technical level within the integrity field.

New definitions in latest update

The NII process starts with an assessment of the suitability of the vessel for NII. This involves a review of the historic integrity of the vessel and the current degradation risks, and the success of this phase relies heavily on good knowledge of the likely condition of the vessel and which involves input from several disciplines including, process, integrity, inspection, corrosion management and data science. The corrosion engineer plays a vital role in ensuring the inspection is aimed at the correct morphology and likely location of degradation.

One update in the RP that will be of interest to corrosion engineers, is the introduction of two new concepts in the description of degradation: spatial homogeneity and density. These factors are unlikely to be already included in any degradation risk assessments or risk-based assessments, but are required in order to select the most appropriate inspection strategy. Spatial homogeneity refers to how similar the degradation is across the inspection area. High homogeneity means you could take a small sample anywhere within the defined area, and it would be sufficiently similar to any other area (Figure 2); low homogeneity means some areas may be substantially more corroded than others (both in depth and number of affected areas) and sampling at a low coverage is less effective (Figure 3). Density refers to how many pits or flaws you are likely to find in the inspection area. High density means a small sample area would contain lots of flaws, low density means a much larger sample area would be needed to capture a similar number of flaws.

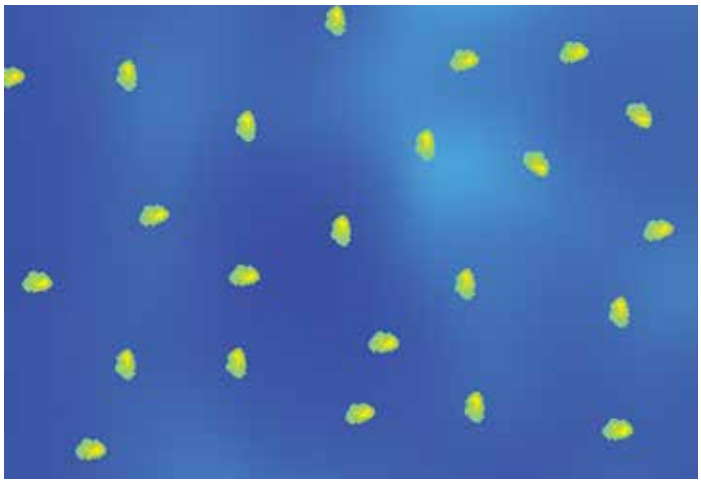


Figure 2: Simulated high density and high homogeneity corrosion map.

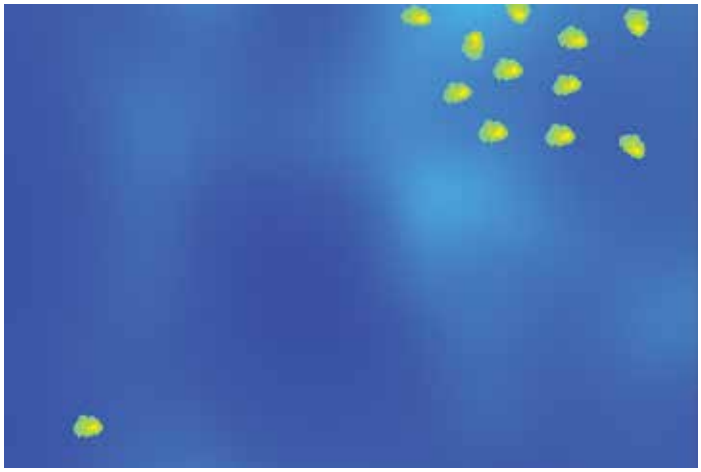


Figure 3: Simulated low homogeneity corrosion map.

While the concepts are straightforward, the decision on what level of homogeneity and density to use is not, unless the degradation mechanisms are well understood and there is historical evidence to base the decision on (e.g. known areas of corrosion). HOIS-G-103 provides some guidance on selecting the appropriate levels when there is no historical precedent. Under deposit corrosion, for example, will understandably be more likely to be low density and low spatial homogeneity as corrosion occurs randomly beneath areas of fouling which cannot be predicted. Further background to these concepts is available in the HOIS Recommended Practice for Statistical Analysis of Inspection Data, (HOIS (12)R8) [4].

Advantages of NII

However, NII is not a quick fix and is not suitable for all situations and even when the assessment shows that NII is possible, it does not mean that it is the most appropriate inspection solution. For example, where the main aim of the inspection is to ascertain the integrity of the internal "furniture" of a vessel, NII cannot provide this information. Operators can, however, consider using a blended approach of different inspection techniques. It is possible, for example, to use NII along with some form of remote internal inspection (RII) which will reduce man-entry requirements while still largely retaining the benefits of NII.

> **Cost savings through the use of NII can be significant. One Operator carried out an NII campaign, based on application of HOIS-RP-103, on 27 vessels which reduced the shutdown duration from 21 days to 14 days, and the inspection costs by more than half.**

Unlike IVI, NII campaigns can be carried out in a staged manner with individual inspection tasks undertaken when inspectors and inspection equipment are available and work priorities allow it, and it can also be aligned to other inspection tasks such as when insulation or PFP is removed for a corrosion under insulation (CUI) inspection. While this may not generally be the most efficient way to inspect a vessel, it allows flexibility in the times we are living in and can often be carried out with social distancing in place.

Case study

While removing the need for vessel entry is a positive outcome of NII, it is not sufficient grounds to replace IVI if the risk of major accident would increase; the risks involved in confined space entry, after all, can be managed. However, IVI comes with other risks as in the case of a hydrogen sulphide absorber which was due internal visual inspection (Figure 4). Carrying out the IVI would have required:

- Removal and replacement in the correct order and orientation of more than 30 trays – there is a risk of improper replacement of the trays which may lead to process failure and increased risk of degradation/damage.
- Internal scaffolding required – scaffolding can cause damage to the internal surfaces, increasing the likelihood of degradation, and/or increasing the risk of failure.
- Complicated internal structure where some surfaces would be obscured from visual inspection anyway.

The Operator had an NII assessment carried out, which determined NII was suitable, and proceeded with the inspection phase of the NII in advance of the planned shutdown. Carrying out the NII early ensures that if degradation that requires repair is found, it can be planned into the shutdown. The outage for IVI was expected to last 5 weeks; the NII took 3 weeks, but the vessel was in operation the entire time. The NII also cost almost 50% less than the IVI. Additionally, the Operator used the opportunity to review the need for insulation on the vessel and took the decision to permanently remove it.

Applying NII

To apply a robust NII, substantial time and a unique set of skills are required to undertake the NII assessment, plan the inspection, and finally evaluate the results. Many operators find it easier to outsource this work, in a similar manner to fitness for service assessments, rather than place additional load on their integrity or corrosion engineering team. Between the guidance notes and the RP, however, there is plenty of information available to help an organisation implement NII.

Indeed, the new documents have been met with great interest from the integrity community with almost 200 of downloads of the updated RP and the Guidelines in the first month of release.

All HOIS guidance documents and recommended practices are free to employees of HOIS member companies and can be downloaded via the HOIS members website. A selection of HOIS documents including the NII RP (HOIS-RP-103) and the RP for Statistical Analysis of Inspection Data (HOIS(12)R8) are now available for purchase by non-members from the BINDT store (https://www.bindt.org/shopbindt/hois-documents/) along with a selection of free documents including the NII Guidance notes (HOIS-G-103).

There are a number of current HOIS projects of direct relevance to NII:

- Development of a recommended practice for remote internal inspection (RII) of pressure vessels.
- Digitalisation of NDE and asset integrity in the energy sector including development of guidance notes for the use of mini-digital twins in inspection and integrity.
- Guidance on NII for internally clad vessels.
- Ultrasonic NDT for NII at elevated temperatures.

Summary

Using NII to replace IVI can help maintain inspection due dates and reduce backlog without compromising integrity providing it is applied wisely. The HOIS Recommended Practice for NII has recently been updated and provides a robust starting point for deciding if NII is suitable for an item.

The second part of this article will feature "NII - a corrosion engineer's perspective" by Neil Wilson, ENGTEQ.

Acknowledgements

HOIS would like to thank the Net Zero Technology Centre for their support and funding of the Guidance Notes for HOIS-RP-103 [3].

References

[1] Marsh, "Can Energy Firms Break the Historical Nexus Between Oil Price Falls and Large Losses?," 2016.

[2] HOIS, "HOIS-RP-103: HOIS Recommended Practice for Non-Intrusive Inspection of Pressure Vessels," HOIS, February 2020.

[3] HOIS/ OGTC, "HOIS-G-103: HOIS/OGTC Guidance Notes for HOIS-RP-103," HOIS, February 2020.

[4] HOIS, "Recommended Practice for Statistical Analysis of Inspection Data Issue 1," HOIS, April 2013.

[5] The OGTC/ ABB, "Non-intrusive inspection could deliver £242 million benefit to the UKCS," 17 December 2017. [Online]. Available: https://www.theogtc.com/newsroom/news/2017/non-intrusive-inspection-could-deliver-242-million-benefit-to-the-ukcs/. [Accessed 4 May 2020].

Editor: This article is based on a presentation at Aberdeen Branch, and this can be accessed on the branch web page.

If your company is interested in joining HOIS, please contact Helen Peramatzis Helen.Peramatzis@esrtechnology.com, and any queries on NII can be addressed to susan.osbeck@esrtechnology.com

For all the latest news, events and debates join us on

LinkedIn

icats

Visit the ICATS website

www.icats-training.org

INSTITUTE OF CORROSION

Visit the ICorr website for all the latest news

www.icorr.org

FOR ALL THE LATEST CORROSION INDUSTRY JOBS

VISIT THE ICORR JOB BOARD

or job seekers

- Over 60 jobs currently being advertised
- Set up job alerts for immediate notifications
- Upload your CV so employers can find you
- Free to use

or employers

- Place your job in front of our highly qualified members
- Over 10,000 visitors every month
- Fill your jobs quickly with great talent

All sustaining members receive a 15% discount

https://jobs.icorr.org/

For more information contact Jonathan Phillips on 0114 273 0132 or email jonathan@squareone.co.uk

Risk Based Inspection - A Case Study

Umair Niaz Bukhari, Bureau Veritas, Dubai-UAE

Risk Based Inspection (RBI) is a systematic approach that attempts to minimise the risk exposure of plant equipment by optimising the use of inspection resources. RBI has been recognised as an efficient Inspection and risk optimisation approach to foresee various risks associated with pressurised process equipment and its associated piping systems. The risks recognised are localised corrosion, general corrosion, pitting, cracking, and mechanical loading and vibrations.

As an example of the use of the RBI approach, this article describes the results of a Residual Life Assessment (RLA) study of a Turbine Condenser, located in oil and gas production facility in the gulf region. The article also presents the objectives of the study, the scope of work, the methodology applied, an analysis of the results including remaining life assessment as well as appropriate recommendations arising out of the study. Further, it also summarises Fitness for Service (FFS) of the Turbine Condenser.

Case Study

During a normal shut down, the surface of the Turbine Condenser was assessed for Residual Life Assessment (RLA). Since the unit was already in outage, it was quite easy to perform the various tests at the surface of the condenser, and it gave an opportunity to also inspect the inside surfaces of the condenser shell. The condenser carried steam condensate.

The planned scope of work consisted of covering the following areas systematically:

- Collection and review of engineering, design and operating data
- Collection and review of inspection history data
- Review, validate and update existing potential damage mechanisms and corrosion loop drawings
- Calculation of corrosion rates and remaining life
- Fitness for Service (FFS) study of selected equipment and piping systems.
- Review, validate and update existing RBI Assessment
- Recommendations to improve condition of equipment for future operation

Various engineering data were collected from the plant side for RLA assessment which included piping and instrumentation diagrams (P&ID's), process and flow diagrams (PFD's), general arrangement (GA) drawings, data sheets, operating manuals and procedures and engineering design documents.

Numerous inspection data elements, for example, visual inspection reports, ultrasonic testing, magnetic particles inspection, dye penetrating testing, radiography testing, failure analysis reports and metallographic reports of equipment and piping systems, were received and reviewed.

Basic Details	
Design Code	ASME Section VIII Div.1
Commissioning Date	1991
Equipment Type	Cylindrical
Orientation	Horizontal
Design Pressure (Shell Side)	17 psig
Design Temperature (Shell Side)	140 C
Service/Fluid (Shell Side)	Steam Condensate
Insulation	No
Inner Diameter (Shell)	46.3 inch
Corrosion allowance	4.5 mm
Material of Construction for Shell	Carbon steel, SA 106 B
Allowable Stress Value	15,100 Psig

Table 1: Basic details of the condenser equipment.

Initially close visual inspection was performed, and the condenser shell surfaces were found to be corroded. It was therefore recommended that ultrasonic thickness measurements be performed, which later on helped in calculating remaining life assessment.

Remaining life was calculated based on the corrosion allowance and latest thickness measurements reports. Measured corrosion rates (MCR) were calculated based on the available inspection thickness results of the condenser. These corrosion rates were measured as per API-510 (1).

Measured Corrosion Rate for Condenser				
Equipment type	Nominal Thickness (mm)	Minimum Measured (mm)	Metal Loss (mm)	Measured C.R (mm/yr)
Shell Tube Exchanger	12.00	8.5	3.5	0.110

Table 2: Measured corrosion rate calculation.

Design Corrosion Rate for Condenser				
Equipment type	Nominal Thickness (mm)	Corrosion Allowance (mm)	Design Life (Yrs)	Measured C.R (mm/yr)
Shell Tube Exchanger	12.00	0.5	20	0.025

Table 3: Design corrosion rate calculation.

Remaining Life Assessment for Condenser					
Equipment type	Nominal Thickness (mm)	Corrosion Allowance (mm)	Metal Loss (Yrs)	Measured C.R (mm/yr)	Rem. life (Yrs)
Shell Tube Exchanger	12.00	0.5	3.5	0.110	-2.543

Table 4: Remaining Life Assessment summary.

The remaining life assessment concluded there was a metal loss defect. Therefore, the equipment was further assessed for Fitness for Service (FFS) per criteria given in API 579 (2). This assessment was performed to make re-rate / repair / retire decisions.

The semi quantitative RBI approach, in accordance with API-580 (3) / API-581 (4) was adopted for this assessment. A 5x5 API RBI 581 matrix for risk assessment Inspection Effectiveness and Selection of Inspection Interval was done in accordance with API 510, API 571, API 580 and API 581 (5).

After assigning all the probability and consequence parameters, the risk prediction obtained is shown in Table 5.

Overall Risk Assessment for Condenser					
Equipment type	Applicable Damage Mechanism	POF*	COF**	Risk	Mitigation
Shell - Erosion	Erosion / Erosion - Corrosion	3	C	MH	Inspections on time
Shell - Internal Corrosion	Boiler Water / Condensate Corrosion	5	C	MH	Inspections on time
***Probability of Failure **Consequence of Failure**					

Table 5: Overall risk summary.

FSS Assessment

It was observed that metal loss in shell side of the turbine condenser has already failed the criteria given in API 510; because of this the shell side was further assessed in accordance with API 579. As per the inspection history provided by the client and API 579 Table 2.1 & Figure 2.1, metal loss was identified as the flaw type for which the associated Part-4 (General Metal Loss) assessment was performed.

The approach adopted for evaluation of these assets followed the eight-step methodology defined in API Recommended Practice 579-1/ASME FFS-1 2007.

- Step 1 Flaw and damage mechanism identification.
- Step 2 Applicability and limitations of the fitness for service assessment procedure.
- Step 3 Data requirements.
- Step 4 Assessment techniques, acceptance criteria and Results.
- Step 5 Remaining life evaluation.
- Step 6 Remediation.
- Step 7 In-service monitoring.
- Step 8 Documentations.

According to API 571 (Damage Mechanism Effecting Fixed Equipment in Process Industries), a Natural Gas-Fired Gas Turbine Condenser with steam service at shell side, is susceptible to the following damage mechanisms.

- Erosion/erosion-corrosion.
- Boiler water / condensate corrosion.

The remaining life assessment of the NGC Turbine Condenser was performed in accordance with following codes by using PV Elite 2015 software and spread sheets.

- ASME Sec VIII Div.1.
- API RP 579-1/ASME FFS-1 2007 Part 4 Level-I (Fitness for Service).

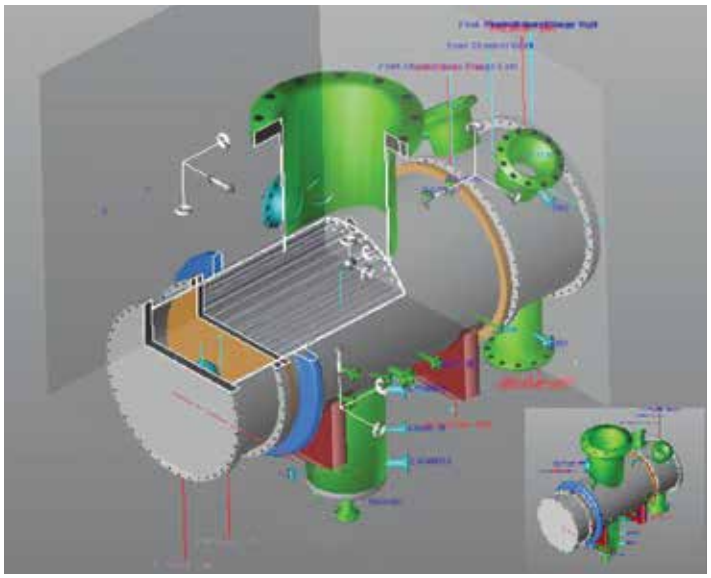


Figure 1: Design Verification (PV Elite software).

Design Verification as per ASME SEC VIII, Div. 1 (PV Elite Software)			
Description	Design Code	Evaluation	Conclusion
Case-1 (Design Verification)	ASME Sec VIII Div.1	Design Analysis 0.1259" CA as per ASME Sec. VIII Div.1 (PV Elite software)	Results found acceptable

Table 6: Design Verification as per ASME SEC VIII, Div. 1.

General Metal Loss Assessment as per API 579-1 / ASME FFS-1 (6)			
Description	**Design Code**	**Evaluation**	**Conclusion**
Case-2 (General Metal Loss)	API 579-1 / ASME FFS-1	API 579-1/ASME FFS-1 2007 Part 4- General Metal Loss, Level-I Analysis	Results found acceptable

Table 7: General Metal Loss Assessment as per API 579-1 / ASME FFS-1.

The fitness for service assessments that have been completed using the most recent inspection results showed that the equipment was fit for service in its current condition.

Description	Details
Pressure Case	Internal Pressure
Nominal Thickness (inches)	0.51181
Minimum Measured Thickness (inches)	0.3346
Year of Inspection	2005
Corrosion Rate (inches/year)	0.0047
Interval Years (from the date of Inspection)	20
Future Corrosion Allowance (inches)	0.141
Remaining Life (years)	>20

Table 8: Calculation for Remaining Life Based on Corrosion Rate.

On the basis of above calculations, the remaining life is estimated to be greater than twenty (20) years for components assessed based on minimum measured thickness (based on UT report 2009) and calculated corrosion rate. However, estimated remaining life is indicative only with respect to prevailing conditions.

Although this study has focused on defect analysis, it is acknowledged that there are other failure mechanisms that can influence overall equipment integrity including, but not limited to, abnormal operating conditions (upset), third party damage and any other defects (non-assessed) in the equipment. It should also be noted that this result is only valid for the assessed defects (as per the inspection report) when the equipment is operated within the specified design operating and service conditions.

It is important to remember that the results of an FFS assessment are valid only if:

- It is considered that the fabrication, welding and commissioning of the component were as per design and appropriate procedures/ qualifications were complied.
- The vessel was operated within operating range without any variation
- The region of metal loss has relatively smooth contours without notches (i.e. negligible local stress concentrations).
- The component is not in cyclic service: component subjected to less than 150 cycles (i.e. pressure and/or temperature variations including operational changes and start-ups and shutdowns) throughout its previous operating history and future planned operation
- The component is not in creep regime.

To ensure the future safe operation of assets, the following should be carried out:

- Baseline / shutdown survey records should be properly maintained so that these results could be used in future Remnant Life Assessment.
- Extensive regular monitoring by visual inspection and UT scanning techniques should be in-place, to check for defects (metal loss, crack etc.) in the component.
- Implementing RBI for these types of scenarios doesn't necessarily demand costly tools and outsourcing; rather it can be a simple, qualitative effort done by in-house reliability and corrosion personnel.
- For high and medium high risk components, it is recommended that effective inspections should be performed in time in order to avoid any unexpected failure.

Conclusions

Using an RBI approach (Qualitative, Quantitative or semi quantitative) at all levels of an inspection and testing plan's development and implementation is an important step in keeping the reliability and integrity towards the organisational goal of a facility.

References

1. API-510, Pressure Vessel Inspection Code: In-service inspection, rating, repair, and alteration
2. API Standard 579-1/ASME FFS-1, Fitness-For-Service
3. API RP 580 Risk based inspection, second edition
4. API RP 581 Risk based inspection technology, second edition
5. API RP 571 Damage mechanisms affecting fixed equipment in the refining industry
6. ASME SEC-VIII Rules for construction of pressure vessels

The Institute values the support of the companies and organisations who are Corporate or Sustaining Members. A detailed listing of these members is published annually as a stand-alone supplement to the January/ February issue of Corrosion Management, and a regularly up-dated searchable listing is published on the Institute's website.

CORPORATE MEMBER COMPANIES

BP

GOLD SUSTAINING MEMBER COMPANIES

CATHODIC PROTECTION CONSULTANCY SERVICES

SGK
Technoparkstr 1, Zurich 8005, Switzerland
Tel: +41 44 2131590 Email: sgk@sgk.ch

CATHODIC PROTECTION AND MONITORING

BAC
Stafford Park 11, Telford TF3 3AY, UK
Tel: +44 (0) 1952 290321 Email: sales@bacgroup.com
www.bacgroup.com

CATHODIC PROTECTION CO LIMITED
Venture Way, Grantham, Lincolnshire, NG31 7XS, United Kingdom
Tel: +44 (0) 1476590666 Email:sales@cathodic.co.uk

3C CORROSION CONTROL COMPANY AB
Box 324, 23 Landskrona, Sweden
Tel: +46 418 411 900 Fax: +46 418 411 935
Email: info@3ccc.se Website: www.3ccc.se

CORROSION CONTROL INCORPORATED
494 Fairplay Street, Rutledge, Georgia 30663, USA
Tel: +706 557 9624 Email: engineering@corrosioncontrolinc.com

CORROSION TECHNOLOGY SERVICES EUROPE LTD
11 & 12 Merlin Park, Mildenhall, Suffolk IP28 7RD
Tel: 01638 711955 Fax: 01638 711953
Email: enquirieseu@ctsonline.com www.ctsonline.com

CORRPRO COMPANIES EUROPE LTD
Adam Street, Bowesfield Lane, Stockton On Tees, Cleveland
Tel: 44(0) 1642 614 106 Fax: +44(0) 1642 614 100
Email: ccel@corrpro.co.uk www.corrpro.co.uk

DAIRYLAND ELECTRICAL INDUSTRIES
P.O. Box 187, Stoughton, WI 53589, USA
Tel: (608) 877 9900 Email: marketing@dairyland.com www.dairyland.com

INTERPROVINCIAL CORROSION CONTROL CO. LTD
930 Sheldon Court, Burlington, Ontario L7L 5K6, Canada
Tel: 905-634-7751 Email: contact@rustrol.com
www.rustrol.com

MAPEI UK LTD
Mapei House, Steel Park Road, Halesowen B62 8HD
Tel: 0121 5086970 Email: info@mapei.co.uk
www.mapei.co.uk

MGDUFF INTERNATIONAL LIMITED
1 Timberline Estate, Gravel Lane, Quarry Lane, Chichester, West Sussex, PO19 2FJ
Tel: +44 (0) 1243 533336 Fax: +44 (0) 1234 533422
Email: sales@mgduff.co.uk www.mgduff.co.uk

MILLER FABRICATIONS LTD
Overtown Road, Waterloo, Wishaw, Scotland, ML2 8EW
Tel: 01698 373 770 www.millerfabrications.com

OES GROUP LTD
Unit 12, 6 Amos Ayre Place, South Shields NE34 9PE
Tel: 0191 7316010
Email:rforsyth@oesgroupltd.com
www.oesgroupltd.com

PENSPEN
Corrosion Engineering and Cathodic Protection Field Services
Tel: 0800 0328210 / 0191 2606200
Email: b.kelly@penspen.com / l.jones@penspen.com www.penspen.com

VOLKERLASER
The Lodge, Blackpole Road, Worcester, WR4 9FH
Tel: +44 (0)800 022 3292
Email: enquiries@volkerlaser.co.uk
www.volkerlaser.co.uk

COATING APPLICATOR

MIDIS ENERGY SERVICES LTD
Tel: +234 8027218985

PIPELINE TECHNIQUE
Deveronside Works, Steven Road, Huntly, Aberdeenshire, AB54 4PS
Tel: 01466 795888
Email: coatingsenquiries@pipeline-technique.com

OWENS CORNING FOAMGLAS® INDUSTRY
31-35 Kirby Street, Hatton Garden, London, EC1N 8TE
Tel: 07789 507094 Email: kevin.bauld@owenscorning.com

CONSULTING TESTING AND INSPECTION

PIPELINE TECHNIQUE
Deveronside Works, Steven Road, Huntly, Aberdeenshire, AB54 4PS
Tel: 01466 795888
Email: coatingsenquiries@pipeline-technique.com

SGK
Technoparkstr 1, Zurich 8005, Switzerland
Tel: +41 44 2131590 Email: sgk@sgk.ch

SUPPLIERS COATINGS

DENSO (WINN & COALES DENSO LTD)
Denso House, Chapel Road, London SE27 0TR
Tel: 0208 670 7511 Fax: 0208 761 2456
Email: mail@denso.net www.denso.net

HEMPEL UK LTD
Berwyn House, The Pavillions, Cwmbran, Torfaen, South Wales, NP44 3FD, United Kingdom
Tel: 01633 874024 Fax: 01633 489012
Email: sales@hempel.co.uk www.hempel.com

JOTUN PAINTS (EUROPE) LTD
Stather Road, Flixborough, Scunthorpe, North Lincolnshire DN15 8RR
Tel: 01724 400 125 Fax: 01724 400 100
Email: enquiries@jotun.co.uk Web: www.jotun.co.uk

PPG PROTECTIVE & MARINE COATINGS
Huddersfield Road, Birstall, Batley, West Yorkshire, WF17 9XA
Tel: 01924 354700
Email: PMCcustomerservice@ppg.com
www.ppgpmc.com

SHERWIN-WILLIAMS PROTECTIVE & MARINE COATINGS
Tower Works, Kestor Street, Bolton, BL2 2AL, UK
Tel: +44 (0)1204 521771 Email: enquiries.pm.emea@sherwin.com sherwin-williams.com/protectiveEMEA

SPECIALTY POLYMER COATINGS INC (BEANNY LTD)
Contact our UK based stockist & certified distribution centre
Tel: +44 (0) 7748 993326 Email: jglynn@beanny.co.uk
www.spc-net.com

SUPPLIERS GENERAL

COMSOL
36 Park House, Castle Park, Cambridge, CB3 0DU
Tel: 01223 451580 Email: info.uk@comsol.com
www.uk.comsol.com

HODGE CLEMCO
36 Orgreave Drive, Handsworth, Sheffield, S13 9NR
Tel: 0114 2540600 Email: sales@hodgeclemco.co.uk
www.hodgeclemco.co.uk

SEM ENERGY LTD
Unit 17-19 Innovation Centre, Aberdeen Energy Park
Bridge of Don, Aberdeen, AB23 0GX
Tel: 01224 900122 Email: kevin.leiper@sem.world
www.sem.world/

SUSTAINING MEMBER COMPANIES

CATHODIC PROTECTION CONSULTANCY SERVICES

BEASY
Tel: 02380 293223 www.beasy.com

CESCOR UK LTD
Tel: 0208 996 5111
Email: Dimitrios.mamalopoulos@cescor.co.uk

CORROSION CONTROL LTD
01785 711560 Fax: 01785 711561
www.controlcorrosion.co.uk

ECHEM CONSULTANTS LIMITED
Tel: 01225 650103 www.e2chem.co.uk

CORROSION ENGINEERING SOLUTIONS LTD
Tel: 01442 767 899 www.corrosionengineering.co.uk

PRO-TECH CP LTD
Tel: 01684 298679 www.protechcp.com

SEGCORR LTD
Tel: 07484838232 Email: paul.segers@segcorr.com

CATHODIC PROTECTION AND MONITORING

AQUATEC GROUP LIMITED
Tel: 01256 416010 Email: inquiry@aquatecgroup.com

CATHELCO
Tel: +44 (0) 1246 457900 www.cathelco.com

CATHODIC PROTECTION ENGINEERING LTD
Tel: 07399607344
Email: awhittaker@cathodicengineering.co.uk

CCSL
Tel: 01952 230900 www.corrosioncontrolservices.co.uk

CORROCONSULT UK LIMITED
Tel: 01952 740234 www.corroconsult.com

DEEPWATER EU LTD
Tel: +44 (0) 1483 600482 www.stoprust.com

DUVINE
Tel: +44 (0)1440 706777 www.duvine.co.uk

ICR INTEGRITY LTD
Tel: 01224 822822 www.icr.world.com

IMPALLOY LTD
Tel: 01922 714400 www.impalloy.com

METEC CATHODIC PROTECTION LIMITED
Tel: 0191 7316010 714411
Email: Robert.forsyth@metecgroup.com

OMNIFLEX UK LTD
Tel: 0161 491 4144 www.omniflex.com

PHOENIX CPC LTD
Tel: 07486076800 www.phoenixcpc.com

PMAC Inspection Ltd
Tel: 01224 703032

R&R CORROSION LTD
Tel: 01358 729644 www.rrcorrosion.com

SAITH LTD
Tel: 01425 207555 www.saithlimited.com

SILVION LIMITED
Tel: 01476 590932 www.silvion.co.uk

SPECIALIST CASTING LTD
Tel: 0191 5108843 www.specialistcastings.com

VECTOR CORROSION TECHNOLOGIES
Tel: 01384 671400 Email: davids@vector-corrosion.com

COATING APPLICATORS

ALFRED BAGNALL & SONS LTD
Tel: 01274 714800
Email: info@bagnalls.co.uk www.bagnalls.co.uk

APB GROUP LIMITED
Tel: 01538 755377 www.apbgroup.co.uk

AW RAIL SERVICES LTD
Tel: 01303 257462

BRIDGECOAT LTD
Tel: 02392 666161 Email: info@bridgecoat.co.uk

CARNWADRIC LIMITED
Tel: 01376 322600 www.carnwadric.com

CORROSERVE
Tel: +44 (0) 113 2760 760 www.corroserve.com

DENHOLM INDUSTRIAL SERVICES
Tel: +44 (0)141 445 3939
Email: Damian.O'Brien@denholm-industrial.com

D.F. COATINGS LTD
Tel: 02380 445634 Email: info@dfcoatings.co.uk

DYER & BUTLER LTD
Tel: 02380 742222 www.dyerandbutler.co.uk

F A CLOVER & SON LTD
Tel: 020 89486321 Email: ian@cloverpainting.com

FIRESAFE SERVICES (NE) LIMITED
Tel: 01670 351666 Email: info@firesafelimited.com

FORWARD PROTECTIVE COATINGS LTD
Tel: 01623 748323 Email Pete@forwardpc.co.uk
www.forwardpc.co.uk

FOUNTAINS (PART OF THE OCS GROUP)
Tel: 07876 556197
Email: Donovan.gosher@fountainsgroup.co.uk

HANKINSON PAINTING GROUP
Tel: 0870 7892020
Email: Stephen.hankinson@hankinson.co.uk

HDM TUBES LTD
Tel: 07710080845 www.hdmtubes.co.uk

HERRINGTON INDUSTRIAL SERVICES LTD
Tel: 0191 516 0634 www.herringtonltd.co.uk

HRS RAIL LTD
Tel: 01797 329421 www.hrsrail.co.uk

INDUSTRIAL COATING SERVICE
Tel: 01543 450167 www.industrialcoatingservices.co.uk

JACK TIGHE LTD
Tel: 01652 640003 Email: sales@jacktighe.com

JPV (PAINTERS) LTD
Tel: 01277 201515 Email: enquiries @jpvpainters.co.uk

KAEFER LIMITED
Tel: 01642 371850 www.kaeferltd.co.uk

KUE GROUP LIMITED
Tel: +44 (0)1274 721188 www.kuegroup.com

MCL COATINGS LTD
Tel: 0151 423 6166 Fax: 0151 495 1437 www.mcl.eu.com

MCL SITE PROJECTS LTD
Tel: 0151 423 6166 Email: info@mclcoatings.com

NUSTEEL STRUCTURES
Email: scott.arnold@nusteelstructures.com
www.nusteelstructures.com

ORRMAC COATINGS LTD
Tel: 0114 2461237 www.orrmac.co.uk

PAINTEL LIMITED
Tel: 01752 719701 www.paintel.co.uk

PIPERCREST LTD T/A HALLS SPECIALISED SERVICES
Tel: 01375 361408 www.hallsspecialisedservices.co.uk

Q A COATINGS LTD
Tel: 01752 813260 www.qacoatings.co.uk

R & W RAIL LTD
Tel: 02380 845379 www.rwcivilengineering.co.uk

RailX UK LTD
Tel: 07961764943 www.railxuk.com

SAFINAH LTD
Tel: 01670 519900 Email: enquiries@safinah.co.uk

SCA GROUP LIMITED
Tel: 01202 820820 www.sca-group.com

SOLENT PROTECTIVE COATINGS LTD
Tel: 02380221480 Email: info@solentpc.co.uk
www.solentpc.co.uk

SPECIALIST PAINTING GROUP LTD
Tel: 01733 309500 www.specialistpaintinggroup.co.uk

SHUTDOWN MAINTENANCE SERVICES LIMITED
Tel: 01634 256969
www.shutdownmaintenanceservices.co.uk

STANDISH METAL TREATMENT LTD
Tel: 01695 455977 Email: stuart.croft@standishmetal.co.uk

SURFACE TECHNIK (OLD HILL) LIMITED
Tel: 1384 457610 www.surfacetechnik.co.uk

TAZIKER INDUSTRIAL
Tel: 0844 8800 385 www.ti.uk.com

WEDGE GROUP GALVANIZING LTD
Tel: 0845 271 6082 www.wedge-galv.co.uk

WESCOTT INDUSTRIAL SERVICES LTD
Tel: 0191 497 5550 www.wescottis.com

W G BEAUMONT & SON LTD
Tel: 01708 749202
Email: tom.costello@wgbeaumont.co.uk

WILLIAM HARE LTD
Tel: 0161 609 0000 www.williamhare.co.uk

CONSULTING TESTING AND INSPECTION

AW CORROSION SOLUTIONS LTD
Tel: 01732 700924
Email: info@awcorrosionsolutions.co.uk

CAN
Tel: 01224 870100 Fax: 01224 870101 www.cangroup.net

EQUILIBRANT LTD
Tel: 02890 767227 www.equilibrant.co.uk

ERIMUS INSULATION
Tel: 07968828825 www.erimusi.com

HYDROCOMM LTD
Tel: 07779333781 Email: hydrocomm@btinternet.com

HYDROSAVE UK LTD
Tel: +44 (0) 1536 515110 www.hydrosave.co.uk

LBBC BASKERVILLE
Tel: 0113 2057423 www.bbcbaskerville.com

OCEANEERING INTERNATIONAL SERVICES LTD
Tel: 01224 758500

PAINT INSPECTION LIMITED
Tel: 0845 4638680 www.paint-inspection.co.uk

PLANT INTEGRITY MANAGEMENT LTD
Tel: 01224 798870
Email: info@pim-ltd.com www.pim-ltd.com

SAFINAH LTD
Tel: 01670 519900 Email: enquiries@safinah.co.uk

SCALED SOLUTIONS LTD
Email: enquiries@scaledsolutions.co.uk www.scaledsolutions.co.uk

SONOMATIC LTD
Tel: 01925 414000 www.sonomatic.com

STEEL PROTECTION CONSULTANCY LTD
Email: Wil.deacon@steel-protection.co.uk
www.steel-protection.co.uk

SPECIFIERS

SSE LTD
Tel: 01738 456000

SUPPLIERS COATINGS

CARBOLINE
Tel: +44 (0) 116 2697777 www.carboline.com

CHEMCO INTERNATIONAL LTD
Tel: 01236 606060 www.chemcoint.com

CORROCOAT
Tel: +44 (0) 113 2760 760 www.corrocoat.com

HEXIGONE INHIBITORS LTD
Tel: 01792 606494 www.hexigone.com

INDESTRUCTIBLE PAINT LTD
Tel: 0121 7022485 www.indestructible.co.uk

SUPPLIERS GENERAL

CORRODERE ACADEMY
Tel: 01252 732220 www.protectivecoatingseurope.com

FISCHER INSTRUMENTATION (GB) LTD
Tel: 01590 684100 Email: mail@fischergb.co.uk

FUTURE PIPE LIMITED
Tel: 0207 8388660 www.futurepipe.com

GMA GARNET (EUROPE) GMBH
Tel: 01606 836223

INFRASTRUCTURE ANALYTICS LTD
Tel: 028 9532 0131 Email: info@ infrastructureanalytics.co.uk

LAKE CHEMICALS & MATERIALS LTD
Tel: 01527 594630 Email: philip.collier@lakecm.co.uk

LBBC BASKERVILLE
Tel: 0113 2057423 www.bbcbaskerville.com

LLEWELLYN RYLAND LTD
Tel: 0121 4402284 Email: research@llewellyn-ryland.co.uk

PRESSERV LTD
Tel: 01224 772694 Email: Rennie@presserv.com

RENTAJET GROUP LIMITED
Tel: 02380 817160 Email: sales@rglservices.co.uk

SCANGRIT
Tel: 01469 574715
Email: sales@scangrit.co.uk www.scangrit.co.uk

RECIPROCAL ORGANISATIONS

ELSEVIER SCIENCE LTD
Tel: 01865 843000

INSTITUTE OF METAL FINISHING
Tel: 0121 6227387 www.uk-finishing.org.uk

QUALITY CONTROL

ELCOMETER
Tel: +44 (0) 161 371 6000 www.elcometer.com

DEV4 ONLINE LTD
Tel: 0795 2203531 https://condi.online

TRAINING AND COATING INSPECTORS

CORRODERE ACADEMY
Tel: 01252 732220 www.corrodere.com

IMECHE ARGYLL RUANE
Tel: 0114 245 0600 www.hodgeclemco.co.uk

Institute Events
DIARY DATES 2021

BRANCH CONTACT DIRECTORY

ABERDEEN:
Dr Muhammad Ejaz (Chairman)
Email: itsejaz@yahoo.com
Email: icorrabz@gmail.com
Dr Nigel Owen (Secretary External)
Email: nowen0606@gmail.com

LONDON:
Benjamin Moorhouse (Chairman)
Steve Barke (Secretary)
Email: icorrlondon@gmail.com

MIDLANDS BRANCH:
Paul Segers

NORTH EAST:
Email: icorrne@hotmail.com

NORTH WEST:
Michael Leahy (Chairman)
Email: michael.stash.leahy@gmail.com)

YORKSHIRE:
Richard Green

CSD DIVISION:
Julian Wharton
Email: J.A.Wharton@soton.ac.uk

CED DIVISION:
Nick Smart
Email: nick.smart@jacobs.com

Due to the ongoing restrictions, ICorr meetings are being held online. At the time of going to press, the following branch meetings are expected to be held.

BRANCH DATES

24th August 2021
Aberdeen Branch
09.00 – 17.00
Annual Corrosion Forum

September 2021
Aberdeen Branch
Industrial visit – Stork

28th September 2021
Aberdeen Branch
Joint meeting with TWI
"In-service Ultrasonic Tank Floor Inspections"
Ian Daniel/Matthew Beatty, Sonomatic

14th October 2021
London Branch
Joint meeting with LMS

11th November 2021
London Branch
"Coating Developments"
Alex Garner

ADDITIONAL DIARY DATES

13th – 17th September 2021
Fundamentals of Corrosion for Engineers course
Aberdeen city Jurys Inn Hotel

19th – 23rd September 2021
Eurocorr 2021
Virtual event

4th-8th October 2021
Fundamentals of Corrosion for Engineers course
Corrosion House, Northampton

4th November 2021
PDA Europe Conference

IMechE courses at the Sheffield Training Centre

6th September 2021
Paint Inspector, Level 1

13th September 2021
Pipeline coatings Inspector, Level 2

4th October 2021
Paint Inspector, Level 1

11th October 2021
Paint Inspector, Level 2

14th October 2021
Hot dip galvanising

25th October 2021
Paint Inspector, Level 2

CP courses at the ICorr Training Centre, Telford

25-27 October 2021
Buried Level 1

Online Corrodere courses plus online assessments and practical workshops via Zoom

14-15th September 2021
ICorr Coating Inspector Level 1&2, Workshop and Assessment

16th September 2021
ICorr Coating Inspector Level 3, Mandatory Workshop

17th September 2021
ICorr Coating Inspector Level 3,Theoretical Assessments

INSTITUTE OF CORROSION

Visit us on our website or on social media for all the latest news

www.icorr.org
www.twitter.com/instofcorrosion
www.linkedin.com/groups/4308333/
www.facebook.com/icorradmin/
www.instagram.com/institute_of_corrosion/