

Non-Intrusive Inspection (NII) – An effective NII Process

Overview

Internal Visual Inspection (IVI) has historically been used as the main method for determination of the condition of pressure equipment as part of the integrity management process. IVI can however be a hazardous, time consuming and costly exercise. Non-Intrusive Inspection (NII) is increasingly being considered as an alternative to the traditional IVI approach. The benefits of NII in comparison to IVI are significant and include the following.

- Reduced production losses associated with shut-down.
- Reduced manpower requirements – this can lead to reduced shut-down cost and
- Shorter overall shut-down times since greater capacity is available for other tasks.
- Removal of hazards associated with man entry of vessels.
- Removal of the need to clean vessels internally.

It is widely recognised that NII is different in many respects to IVI hence

a different approach to planning is needed. For example, while IVI has the capability to detect a range of different defect types without specific knowledge of what to expect, the capability of NII is very much technique driven. Hence an up-front knowledge of what degradation may be present takes on added significance when planning an inspection by NII. This also means that successful NII is very much dependent on knowledge of the capabilities and limitations of available inspection techniques so that the most appropriate is selected. Definition of the inspection requirements is also linked closely to what defects are of concern and what represents a threat to integrity. In order to ensure effective NII, a multi-disciplinary approach is required that combines skills and knowledge in corrosion engineering, inspection technology and mechanical integrity.

Identification of Vessels for which NII is appropriate

Before NII can be carried out on a vessel it is important to establish that the inspection will be capable of providing the necessary level of assurance. There are two main approaches in this respect. Firstly, the assessment can be made using the industry accepted HOIS

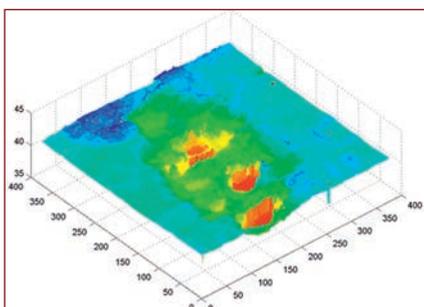
NII Decision Guidance that is based on a comparison to IVI. Secondly, in certain situations it is appropriate to make a more quantified assessment to demonstrate that the level of assurance can be achieved. In this approach a probabilistic assessment, including consideration of degradation types, degradation rates, inspection technique performance and mechanical integrity, is used to define the requirements.

Corrosion Risk Assessment

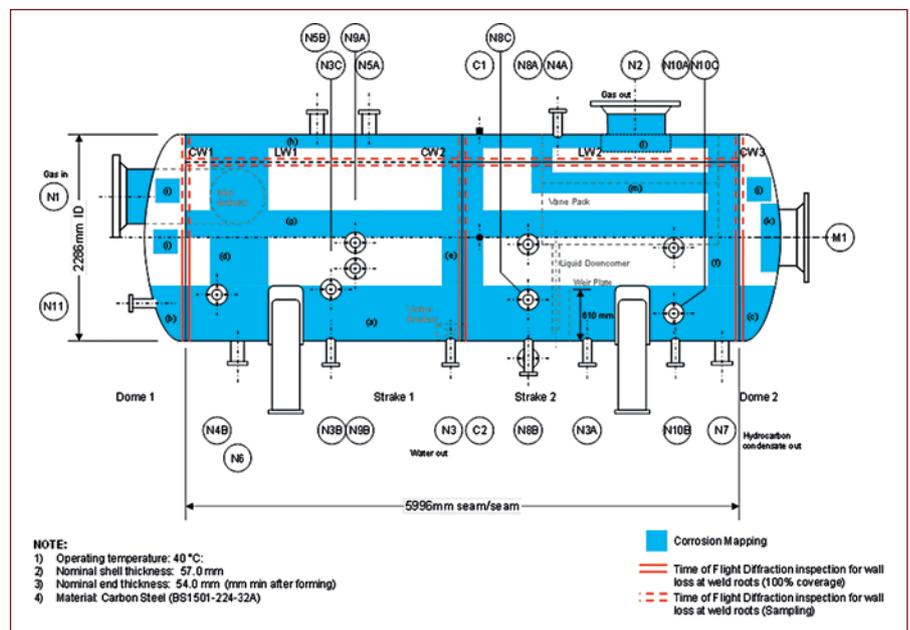
An understanding of potential degradation mechanisms and their rates is essential to being able to confidently specify NII as an alternative to IVI. In many cases a significantly more detailed corrosion assessment is required prior to NII than would be the norm for management of integrity using IVI as the primary means of inspection. Providing corrosion assessments to the required level of detail is essential. This is achieved through working closely with the asset owner to ensure that all relevant data (including process and inspection history) is included and state of the art corrosion models are applied.

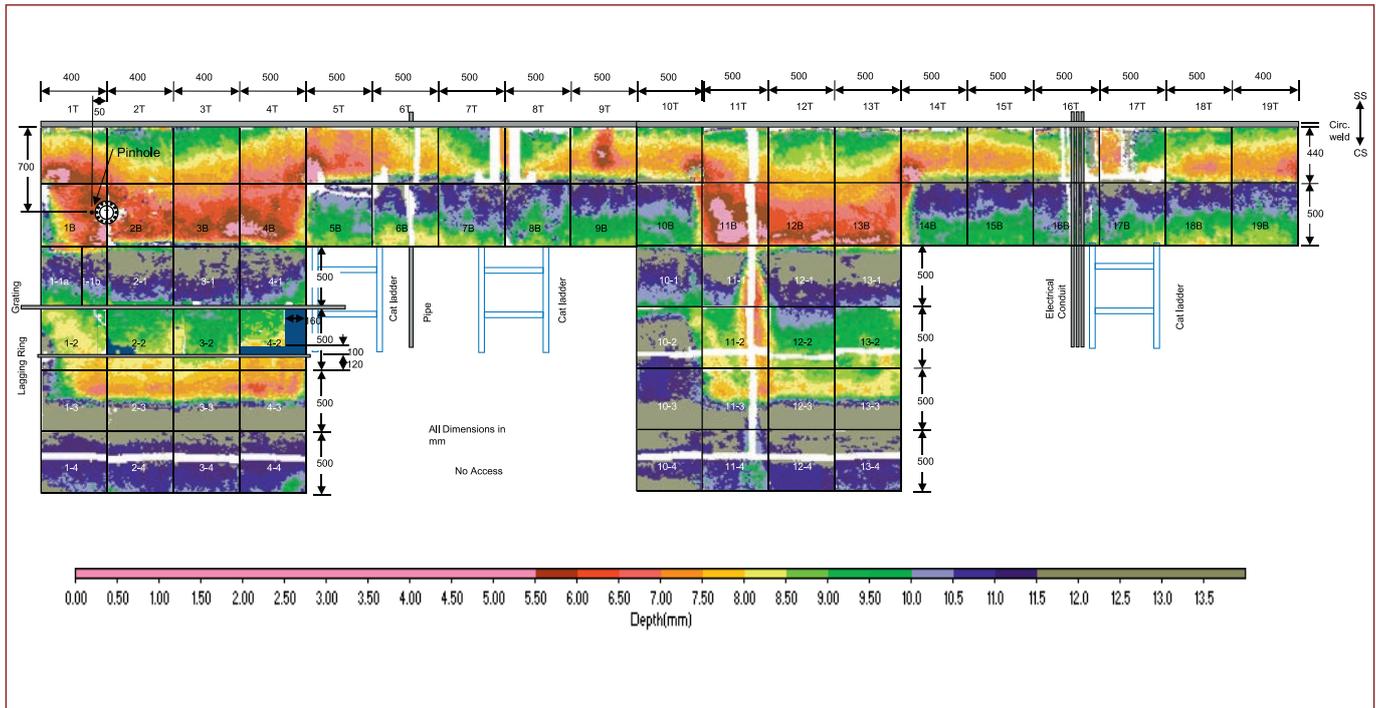
Detailed NII planning

The NII plan defines the techniques and procedures to be used and



TOFD SCREENING result composite Corrosion mapping Image.





Corrosion mapping image of a vessel.

the locations for coverage by each inspection technique. The findings of the corrosion risk assessment together with knowledge of technique capability and limiting conditions are used to define an effective plan for each equipment item considered. This recognises that the requirements must be closely aligned to each specific case. For example, the NII requirements in a situation in which little or no degradation is expected would focus on validating the assumptions of the corrosion assessment, and would be different to those in a situation where there is a reasonable probability of substantive degradation being present.

Inspection Techniques

Effective NII relies on techniques which include digital collection of data to allow quantitative analysis and validation that the inspection has been performed as per the requirements. There are a range of advanced ultrasonic techniques, covering inspection for corrosion, erosion and cracking, including but not limited to the following.

- Corrosion mapping for detection and sizing of localised and general wall loss.
- Time of Flight Diffraction (TOFD) for detection and sizing of weld cracking and erosion. This technique can also be used for determination

of wall thickness as it allows production of detailed corrosion maps for plate material.

- Automated pulse echo for the detection and sizing of weld defects. Pulse echo is also effective for the identification of certain pitting mechanisms.
- Creeping Head-wave Inspection Method (CHIME) and Multiskip Shear Wave for the detection of wall loss. These are effective screening techniques that allow rapid coverage of large areas.

In addition, there are other techniques including a variety of radiographic and electromagnetic techniques that might be required in an offshore NII program.

Evaluation of inspection

On completion of an inspection by NII, it is important to evaluate the work carried out to ensure that the requirements of the inspection plan have been met. This includes a detailed review of the work actually achieved against the work scope specified. In addition, evaluation is required to assess the condition of the equipment compared to expectations and previous inspections. Sampling inspection, with less than 100% coverage, is fundamental to the approach in the HOIS Recommended

Practice for NII. Statistical analysis of the data collected is therefore a key element of the evaluation.

The evaluation includes an assessment, with respect to integrity and remaining life, based on the inspection results. The outcome of the evaluation is, where possible, a justification for replacement or deferment of internal visual inspection.

Summary

By working closely with the asset owner to ensure rapid and effective communication of information, an NII program enables the benefits of NII over IVI to be maximised while retaining full confidence in equipment integrity.

Sonomatic offers integrity driven inspection solutions with over 30 years' experience in advanced NDT inspection and delivery of successful NII for over 450 process pressure vessels with major operators. Sonomatic is capable of delivering all stages of NII from identification of suitable vessels and detailed NII assessments through to enactment of the physical inspection phase and evaluation of the achieved inspection to provide a formal decision on replacement or deferment of IVI.

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