

Integrity Management and Risk Based Inspection

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Integrity Management

What is Integrity Management??

BS ISO 55000:2014 says that it

“enables an organization to achieve its objectives through the effective and efficient management of its assets. The application of an asset management system provides assurance that those objectives can be achieved consistently and sustainably over time.”

Integrity Management

What is Integrity Management??

But what does that actually mean for O&G ? (or indeed other industries that must main integrity?)

Essentially IM is a process with many contributing parts

It starts at the design phase by (hopefully!) getting the design & materials selection correct.

Continues during the construction phase (QA / QC) to ensure the build is as per the specification

And finally onto the operational phase where the equipment has to be managed over the expected lifespan (and frequently beyond) and where “we” normally get involved

Integrity Management

What is Integrity Management??

In terms of the operational phase, asset Integrity Management includes the following

Risk Based Assessments & Risk Based Inspection (which we'll cover later)

Corrosion Control Matrices

Integrity Operating Windows

Anomaly Management

Failure Investigations

Ageing and Life Extension

Integrity Management

What is Integrity Management??

Corrosion Control Matrices & Integrity Operating Windows

- **Defines the parameters relevant to corrosion (and by extension the RBA) and sets limits on what the acceptable variations are. The simplest example would be pipework with a 3mm CA and a 20 year design life which implies a design CR of 0.15 mm/yr. A higher corrosion rate implies the pipework probably won't meet its design life but spending a lot of money on chemical inhibition to achieve a very low corrosion rate may be a “waste” of money**

Integrity Management

What is Integrity Management??

Anomaly Management & Failure Investigations

- **Anomaly management is a defined process that initially defines what is and what isn't considered anomalous and then sets out the actions to be taken when an anomaly is discovered. In almost all cases this is a client led process but with input required from numerous parties including corrosion engineers. The information from anomaly reports is extremely useful and should be considered during the RBA process. Where unexpected failures occur then these should always be subject to a detailed failure investigation as once again this provides vital input into the RBA (and corrosion control matrix)**

Integrity Management

What is Integrity Management??

Ageing and Life Extension

- **Ageing is a consideration for every platform including brand new ones. Ageing is generally seen as problematic but in itself it shouldn't be seen this way. Assuming a good IM system is in place, then whilst the equipment is getting older, we should actually know more about its current condition and its service performance than we did when it was new.**
- **Ageing is about managing the condition until we reach the decommissioning phase but it is a fine balancing operation – we don't want to not be able to reach the design life but equally we don't want to be decommissioning a platform that still appears brand new!!**

Integrity Management

What is Integrity Management??

Ageing and Life Extension

- **This is all very good until someone decides that the asset should continue to operate beyond its original design life!! That carefully managed 0.15mm/yr corrosion rate now looks to be an issue because we need another 15 yrs life!!**
- **UK approach is led by the HSE who launched their KP4 program in 2011 in order to ascertain that the risks were being actively managed and to encourage improvements.**
- **Norwegian approach to ALE requires formal approval from the PSA (Petroleum Safety Authority) for operation beyond the original design life.**

Risk Based Inspection

What is Risk Based Inspection??

API 581 – Risk Based Inspection Technology

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The API Risk-Based Inspection methodology may be used to manage the overall risk of a plant by focusing the inspection efforts on the process equipment with the highest risk. API RBI provides the basis for making informed decisions on inspection frequency, the extent of inspection, and the most suitable type of Non-Destructive Examination (NDE / NDT)”

Risk Based Inspection

So the next question is what actually is Risk?

Essentially it is the combination of the probability (likelihood) of something failing and the consequence (what happens) due to that failure.

Risk = PoF x CoF

There are different methodologies available which have their own pros and cons that need to be considered before deciding which approach is best for your asset

Quantitative

Qualitative

Semi-Quantitative

Risk Based Inspection

Quantitative

API581 is the best known example of a quantitative RBI methodology but its very heavily focused on the downstream refinery sector. Requires large amounts of data. Not used very much in offshore O&G

Qualitative

Reliant on Subject Matter Experts (SMEs) and experience to assign broad categorisations of probability and consequence. Difficult to challenge assumptions when updates are required and easy to get the answer you want!!

Risk Based Inspection

Semi-Quantitative

The most common methodology in offshore O & G. Combines SMEs and experience with hard data to quantify PoF and provides a data benchmark to use in subsequent RBA updates.

Risk Based Inspection

PoF and CoF are then plotted on a matrix to give a “risk level” and to generate an inspection frequency

PoF	Very High	5	96	84	60	48	36
	High	4	108	96	72	54	48
	Medium	3	121	108	84	72	60
	Low	2	144	121	108	96	84
	Very Low	1	144	144	121	108	96
			1	2	3	4	5
			Very Low	Low	Medium	High	Very High
			Consequence of Failure				

Risk Based Inspection

The risk (and associated inspection frequency) needs to be calculated for each applicable damage mechanism.

The option then is to carry out the inspection for each damage mechanism at its prescribed frequency or to use a “compromise” frequency and inspect for all damage mechanisms at the same time.

Note though that the compromise frequency can't be greater than the highest risk, lowest monthly inspection frequency.

The first option of individual frequencies is theoretically the most efficient but virtually no-one follows this method as in reality it is very difficult to manage – multiple Work Orders in the MMS and with “bitty” inspection data it is hard to update the RBA post inspection.

Risk Based Inspection

The consequence assessment should also consider the probable failure mode – eg a pin hole leak v a full bore rupture as these have a markedly different consequence

Its interesting to note that although the use of corrosion resistant alloys generally leads to an increase in the time between inspections, the subsequent inspection of those CRAs is normally significantly more problematic than say on Carbon Steel

Also the use of CRAs (v CS) doesn't normally lead to a significant increase in the periodicity for the first in-service inspection as this is more about identifying fabrication type defects than in-service dmaage.

Risk Based Inspection

On completion of the RBA, best practice would be to create a “Written Scheme of Examination” (WSE). Now it should be noted that this WSE terminology has a specific meaning in terms of the PSSRs (which only apply onshore UK) and so a little bit of care is required particularly for UKAS Accredited Inspection Bodies (ISO 17020).

This WSE should detail the applicable degradation mechanisms, and the precise location and inspection technique that will be used in order to try and either find the mechanism or confirm its absence.

The locations and techniques chosen is critical to the whole RBA process as there is no point in looking for a mechanism in a location where it is unlikely to be found using a technique that couldn't find it anyway!!

Risk Based Inspection

Normally an inspection / NDT SME would define the applicable technique based on proven probability of detection (POD) for the material, location and nature of corrosion (for pitting the aspect ratio for example)

Some corrosion on some materials is harder to find than others and this has to be considered at the RBA stage. DONT consider theoretically impossible mechanisms just to “cover yourself” as these will normally be the most difficult to inspect for – especially by Non Intrusive Inspection (NII)

For example, internal chloride stress cracking of stainless / duplex / clad vessels is almost impossible by NII!!!

Any Questions??

Thank you for your attention...

Q & A

