PRODUCTION

Detecting corrosion through data

Riser and slip joint on a semisubmersible oil rig. Photo from iStock.

Matt Jones and Jim Sokolowski, of Tessella, show how data analytics can give insight into corrosion rates to reduce risk and maintenance costs.

Corrosion is a fact of life in offshore environments, and offshore production costs are significantly impacted by it. It is often a known unknown, and this makes business and investment decisions that need to consider its impact harder and riskier.

This offers an even trickier proposition when facilities are nearing the end of their life and alternatives, such as carbon capture and storage (CCS) in depleted reservoirs, are being considered.

Such an alternative was being considered by an operator in the North Sea. But, the firm wanted to understand the possible causes of corrosion on its existing facility, to be able to predict future corrosion accurately. These insights could be used to make other decisions, such as how to optimally plan expensive corrosion re-measurement campaigns.

The company had just less than 10 years of historical eddy current data about surface casing and conductor corrosion from scheduled measurement campaigns, as well as original spud data. However, there was a need to truly understand what this data meant. The data showed that some wells had significantly worse corrosion than others that appeared to be "similar," but they were unsure why.

As mentioned, some of the historical data was eddy current measurements – a common corrosion test by which a magnetic field is applied to the material, and variations in the electrical conductivity and magnetic permeability are used to map corrosion – and there were significant questions about the validity of these measurements. Taking accurate corrosion measurements like these are complex and often the uncertainties and errors can be so large that the measurement ranges from useful, to useless.

Tessella started a first principles analysis to deepen the understanding of the root cause of corrosion by exploring 20GB of data acquired from historical operational measurements from the PI historian, captured over nearly 20 years. The data did not require special processing or cleaning prior to use.

Our data scientists explored the time histories of all the operational data for temperatures, pressures, production rates and water rates, and used a range of statistical techniques (principal component analysis, dimensionality reduction and cluster identification) to find structure in this history. They examined whether any of these clusters correlated with the corrosion levels, then drilled down into the underlying variables to understand what element in the historical record was driving this.

By applying knowledge of corrosion chemistries and environmental mechanisms that accelerate the corrosion process, the operational details from the historic data could be used to determine possible likely causes of the high corrosion in the affected casing.

Next, Tessella's data scientists focused imating the future corrosion of ıgs in a new study in a depleted ıd, to help assess its potential long- ɹrm use in a CCS capacity.

This work had started from a scientific publication in 2005 that had presented a methodology to estimate corrosion rates more effectively. The approach assumes a particular stochastic corrosion model, and then uses Bayesian probability techniques to estimate the associated parameters, such as mean corrosion rate.

The analytics team then enhanced this Bayesian approach to be more appropriate to the issue of interest. This required analyzing and modeling the errors in the corrosion measurement process, developing a new understand- ꞌng, as well as leveraging prior informa- ꞌon using data from previous fields.

The resulting models were able to pre- ˌict mean corrosion rates of well casings across the second depleted field, as well as associated uncertainties and also sensitivities of the results to the various assumptions made. This allowed our data scientists to understand how far existing infrastructure has corroded, and predict the associated future lifetime, and hence suitability, for use in the CCS context.

In addition, the analysis showed the ability to optimize future corrosion measurement campaigns based on individual well corrosion predictions and uncertainties, with associated cost savings.

The key to successful data projects

There are several factors that made this data project a success. First, there was a clear objective and business question. The approach was then focused on using the data to look for the insight needed.

Second, those involved understood the business, scientific and engineering challenge, as well as the data. Meaning, the context of what the data was telling them was understood, and they could hypothesize about what correlations mean, and then rigorously test them to establish causation.

Finally, the project looked at how data could quickly address a specific problem and in a timescale of weeks, not years. By taking the right approach, data analytics can deliver real business value, quickly. OE

Multiphase gaps

Michael Reader-Harris, of NEL, outlines the risk that absent multiphase flow measurement standards pose to industry.

Michael Reader-Harris

While accurately measuring a complex mixture of oil, water and gas is a major challenge for the oil and gas industry, production from aging fields with reducing reserves has increasingly made it a necessity. Multiphase flow meters were developed in the early 1990s to support more economical development of marginal, deeper and more complex fields, and they will play a major role in the shift to subsea production in deeper waters.

While industry recognizes the vital role that these meters will play in the future, no ISO (International Organization for Standardization) standards have yet been published. This expanding meter market lacks the ISO guidelines that assure both operators and authorities of consistency. Also, international standardization lowers barriers to trade and provides confidence in the product.

A lack of multiphase meter standardization could therefore have a substantially negative impact on accuracy in allocation or well testing for the industry, and discourage introduction of a technology that is required for the development of marginal fields.

However, work has started to fill the gap in international standards. Using the Norwegian Handbook of Multiphase Metering from 1995, which NFOGM has permitted ISO to use as its basis, the new ISO Technical Report, ISO/TR 21354 will provide up-to-date guidance. It will contain sections on multiphase flow, multiphase meter technologies, the aims of multiphase flow measurement, the production envelope, performance specification, testing, field installation and commissioning, and verification during operation. It will also include an annex on inter-comparison between laboratories, which shows the level of agreement between laboratories and reduces retesting.

This Technical Report will show how using a two-phase flow map to plot the trajectory (production envelope) of wells, and then overlaying the measurement envelope of possible multiphase meters, can ensure that the correct one is chosen; moreover, appropriate maintenance and verification strategies will be introduced that will save cost and increase reliability for the user.

ISO committee, ISO/TC 28/SC 2/WG 4: TC 28/SC 2, is responsible for oil flow measurement, within it WG 4 oversees metering and meter calibration. To develop ISO/TR 21354, WG 4 members include myself, and experts from China, France, the Netherlands, Norway, the UK and the US. Some of the experts work for major operators and are including reliable information that has arisen from their experience. Such information, for instance on performance testing requirements, will reduce the risk of poor performance, and ultimately failure, in the field.

The intention is that the technical report will be published in 2018. Then there will be an internationally agreed document that avoids both inaccuracy through inadequate specification and excessive cost through over-specification. OE