



FIGURE 4 Corrosion anomalies growth predicted by CORLIS.

microbes such as sulfate reducing bacteria and SRA levels are $\geq 10^3$, then biocide treatment should be designed.

The life extension has avoided substantial replacement cost.

References

- 1 Z. Mustafa, "System Reliability Assessment of Offshore Pipelines," master thesis, Hydraulic Engineering Section, Faculty of Civil Engineering and Geosciences, Delft University of Technology, The Netherlands (2011).
- 2 Committee on the Safety of Marine Pipelines (1994), "Improving the Safety of Marine Pipelines" (Washington, DC: National Academy Press).
- 3 ASME B31G, "Manual for Determining the Remaining Strength of Corroded Pipelines" (New York, NY: ASME, 2012).
- 4 ASME B31.4, "Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids" (New York, NY: ASME, 2010).
- 5 ASME B31.8, "Gas Transmission and Distribution Piping Systems" (New York, NY: ASME, 2010).
- 6 X. Tang, et al., "Effect of Oil Type on Phase Wetting Transition and Corrosion in Oil-Water Flow," CORROSION 2007, paper no. 07170 (Houston, TX: NACE International, 2007).
- 7 S. Nestic, J. Cai, K.J. Lee, "A Multiphase Flow and Internal Corrosion Prediction Model for Mild Steel Pipelines," CORROSION 2005, paper no. 05556 (Houston, TX: NACE, 2005).
- 8 K.B. Tator, R. Lanterman, "Coating Deterioration—A Mechanistic Overview," CORROSION 2016, paper no. 07065 (Houston, TX: NACE, 2016).
- 9 R. Norsworthy, "Coatings used in Conjunction with CP Shielding vs Non-Shielding Pipeline Coatings," CORROSION 2009, paper no. 09043 (Houston, TX: NACE, 2009).

F.M. AL-ABBAS is an upstream corrosion consultant at Saudi Aramco, email: faisal.abbas@aramco.com. He is the chair of the Saudi Aramco Corrosion Control Standards Committee. He is an adjunct assistant in the faculty of the Materials Science and Engineering Department, King Fahd University of Petroleum and Minerals. He has worked with the company for 25 years and has a B.Sc. in mechanical engineering from King Fahd University of Petroleum and Minerals. He has been a member of AMPP for 15 years.

L.S. TEH is a corrosion engineering specialist at Saudi Aramco, Dhahran, Saudi Arabia. He has worked for the company since 2014. He previously worked as a materials & corrosion engineer for PETRONAS in Malaysia and as an asset integrity consultant for DNV GL in Singapore. He has a Ph.D. in mechanical engineering from the University College London. He has been a member of AMPP for 11 years.

Q. SALEEM is a subsea engineering specialist at Saudi Aramco, email: qasim.saleem@aramco.com. He has worked at the company since 2014. He previously worked as lead subsea pipeline engineer for Saipem UK Ltd. in the U.K. He was a principal subsea pipeline engineer for Subsea 7 in the U.K. and senior subsea pipeline engineer for Worley Parson and Woods Group, U.K. He has an M.Sc. in advanced mechanical engineering from Imperial College London and a Ph.D. in fracture mechanics from Loughborough University, U.K.

E. HAQUE is an engineer I at Saudi Aramco. He has worked in the Consulting Services Department since 2011 as a coating engineer. He has been a member of AMPP for 11 years.

B. BAKTHAVATCHALU is a cathodic protection specialist at Saudi Aramco. He has 25 years of industry experience in corrosion control and cathodic protection. He is currently responsible for providing expert advice and assistance to company organizations, outside vendors, manufacturers, and design firms on matters relating to corrosion and cathodic protection and development and maintenance of Saudi Aramco Engineering Standards and Design Best Practices, Design Manuals, as well as conducting training programs for employees. He has an M.Sc. in corrosion control engineering from the University of Manchester. He is a fellow member of ICorr and professional member of AMPP and a NACE certified Corrosion and CP Specialist. **MP**