

# **HTHA Inspection with Advanced Techniques and API 941, 586 Updates**

**Joseph (Walter) Krynicki<sup>1</sup>, Lujian Peng<sup>1</sup>, Greg Pioszak<sup>2</sup>, Simon Alain<sup>3</sup>**

<sup>1</sup>Materials Engineering, ExxonMobil Research and Engineering Company, USA, <sup>1</sup>Materials, ExxonMobil Technology and Engineering, USA, <sup>1</sup>Scientific, Evident, Canada

Significant improvements to NDE (Nondestructive Evaluation) technology and inspection practices for equipment susceptible to HTHA (High Temperature Hydrogen Attack) have recently been attained. This has been accomplished through multiple joint industry programs, efforts by equipment Owner-Operators, and API. The result of this broad and comprehensive industry effort is reflected in the latest updates to API 941 (Steels for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants) and API 586 (NDE Methods for Equipment Damage Mechanisms). These latest versions of API 941 and 586 provide more comprehensive content and have undergone significant modifications providing new NDE techniques, inspection effectiveness considerations, and operator qualification and general inspection guidance. The contemporary NDE approach now proposes the use of both traditional techniques (e.g., TOFD) as well new ones such as Full Matrix Capture/Total Focusing Method (FMC/TFM) and Phase Coherence Imaging (PCI) Phased Array UT, all being applied using HTHA specific parameters and interpretation approaches. Additional guidance on technique limitations, potential for false positive calls, use of encoded UT data, and operator qualification and training will also be discussed. In addition to the API 941 and 586 updates, this presentation will include data from HTHA damaged material demonstrating the value of multiple and complementary NDE techniques, recommending the use of metallurgical sampling for improved interpretation of NDE results, and integration of NDE results with Fitness for Service analysis. Ongoing work to assess new TFM imaging techniques (e.g., scattering matrix), and develop HTHA damaged samples for qualifying NDE techniques, operator performance and mechanical property assessment will also be discussed.