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## **Stephen F. Nowaczewski**

### **Executive Consultant**

#### **Executive Summary**

Mr. Nowaczewski has 37 years' experience in developing and operating underground natural gas storage facilities in the continental U.S. and Canada. His specific areas of expertise include geology, reservoir engineering, field development and enhancement. He has a multitude of professional geographic and geologic experience, such as: innovation in the study and use of inert base gas; life-cycle planning/execution for well and reservoir integrity; and reliability, process safety and risk management. Mr. Nowaczewski is well versed with Federal (FERC, EPA-UIC) permitting and certification; has been an expert witness in regulatory proceedings both in the U.S. and Canada; and was instrumental in the development and application of asset management system standards, and engineering standards.

#### **Accomplishments/Experience**

As the Director, Storage Technical Services, for a Fortune 500 company, Mr. Nowaczewski's underground gas storage projects included assets from some of North America's largest, deepest and highest pressure storage fields; wells aged from several years to 100+ years; gas pressure depletion and water drive reservoirs; dry gas, retrograde gas condensate and oil as native fluids; sandstone and carbonate reservoirs of Silurian to Cretaceous age. He was responsible for safe execution of ~\$30-100M annual capital well work and ~\$9M annual well work expense program. His project experience also includes:

- Storage reservoir operations, engineering, geologic services, well drilling and maintenance, gas process engineering, staff training and development, reservoir and well integrity and reliability assessment, new storage developments and existing storage facility enhancements.
- Led a team developing foundational risk management standards, process safety framework documents, and numerous risk management guidance documents for a corporate operating management system. Involved in the management system as a governance/steering team member for Facilities Integrity and Practice of Engineering programs.
- Managed the development of a corporate Storage Integrity Management Framework, including written engineering standards, procedures, operating practices, and awareness training modules covering the entire life cycle of wells and reservoirs (prospecting, planning, construction/project development and management, operation, intervention, decommissioning). Led structuring and adaptation of the Well Integrity and Reservoir Integrity Assessment protocols and oversaw development/implementation of risk assessment tools and processes.



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- Directed the team effort for storage technology applications and prospecting, including Compressed Air Energy Storage, initial gas storage in Mexico, and US and Canadian reservoir and cavern gas storage prospect analysis and screening, including innovative use of petrophysical ranking tools.
- Drilling and well workover projects including many horizontal-directional storage wells, well integrity upgrades, well plugging, and plugged well re-entry and re-plugging.
- De-commissioning of several fields from active storage service and production of base gas.
- Regional structural/stratigraphic mapping of Michigan Basin storage formations. Well site geological services, cuttings and core descriptions, and ROP analysis; bit, mud, casing, cementing, completion, logging, and testing program design; open/cased hole log evaluation.
- Reservoir modeling and simulation to optimize new well locations for storage field enhancement. Compositional modeling and simulation for implementation of partial base gas replacement with inert gas.
- Pressure transient testing and analysis of over 400 wells; annual review of stimulation procedures, results, and optimization of stimulation program.
- Casing inspection program analysis of results, follow-up integrity investigations, and adaptations of lessons learned to optimize program procedures and inspection frequency.

### **Education**

Bachelor of Science with Distinction, Geology, University of Michigan, Ann Arbor, Michigan, May 1980.

### **Certifications/Training**

SPE, AAPG and related training courses in open hole well logging, reservoir engineering, pressure transient test analysis, reservoir simulation, and safety management.

### **Associations/Affiliations**

Mr. Nowaczewski has had an active engagement with industry associations, serving as chairman, co-chair on various committees and on Joint Industry Task Force task teams creating white papers and draft products on storage well integrity, emergency shut down valves, and storage well risk management.

- American Association of Petroleum Geologists, Member #364793 since 1982
- American Gas Association (AGA), Underground Gas Storage Committee, 2000-2018
  - AGA Silver Award of Merit, 2011 and AGA Gold Award of Merit, 2018
  - Trailblazer Award: Development of API 1171, advocacy for implementation aspects in PHMSA rules, 2017
- American Petroleum Institute (API)
  - Co-chaired the API RP 1171 task group for "Functional Integrity of Underground Natural Gas Storage Facilities in Depleted Reservoirs and Aquifers," pub. Sept 2015.



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- API/INGAA/AGA Joint Industry Task Force on Gas Storage Integrity, member and lead; white paper publications on well integrity, emergency shut down valves, risk management processes, 2015-2018
- Canadian Standards Association - Z341 Committee, 2015-2016
- INGAA - Storage Integrity Task Group 2011-2012
- Institute of Asset Management: Asset Management Team Achievement Award for development and implementation of TransCanada's Risk Management Framework, 2015
- Society of Petroleum Engineers, Member #0875005, since 1983
- Technical Advisory Committee Member 2018-2019: California Energy Commission Natural Gas Program and Gas Storage Project PIR-16-028, "A Barrier-Based Quantitative Risk Management Approach for Underground Storage of Natural Gas," DNV GL
- Technical Advisory Panel Member, C-FER Technologies Project "Risk Assessment and Treatment of Wells"

### **Presentations and Publications**

Nowaczewski, Stephen, "The Role of Hydraulic Fracturing in Hydrocarbon Resource Development," in BUSMGT 7254I, Guest Lecturer 2013-2016 at the Ohio State University.

Nowaczewski, Stephen, "Introduction to the Global Energy Industry: Applications, Technologies & Original Equipment Manufacturers, Guest Lecturer 2013-2016 at the Ohio State University.

Nowaczewski, Stephen, "Inert Gas Applications in Natural Gas Storage: Studies in the Michigan Stray Sandstone," American Gas Association Operating Section Proceedings, 2001.

Nowaczewski, Stephen, "Gas Storage Project Development, Operation, and Analysis: Basic Guidelines for Gas Storage Project Development, Operation, and Operations Analysis," Northeastern Geology and Environmental Sciences, v. 18, No.1 & 2, 1996.

Nowaczewski, Stephen, "Relevance of Trapping Mechanisms in Certain Michigan Formation Stray Sandstone Gas Reservoirs to Gas Storage Operations," A. I. Levorsen Memorial Award, Best Paper, AAPG Eastern Section Meeting, 1994.