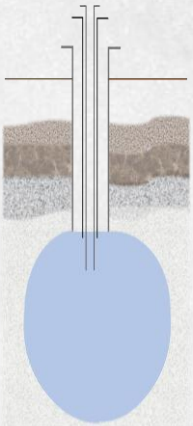
BIG GUNS ENERGY SERVICES

Your Trusted Partner in Hydrogen Storage GeoContainment™

BGES stands at the forefront of Canada's subsurface testing and evaluation, featured in the 2023 Energy Business Review and honored as the 2022 “Company of the Year” and Oil & Gas Awards Canada’s “Consultant of the Year”. Our expertise spans traditional oil & gas and emerging fields like carbon capture, utilization & storage (CCUS), and underground hydrogen energy storage. Leading the charge in exploring geologic hydrogen storage amid growing interest in sustainable clean energy resources, BGES has been chosen as the designated lab for National Resources Canada's Caprock Integrity study for Underground Hydrogen Storage. This positions us to unravel the mysteries of hydrogen behavior in various subsurface environments.



Current understanding of hydrogen's behavior in Underground Hydrogen Storage (UHS) is limited by its unique physical and chemical properties. Salt caverns stand out as viable options due to their relatively inert and impermeable characteristics. However, as demand grows, porous formations such as depleted oil & gas reservoirs may become alternatives, requiring assessments for suitability, leakage risks, and chemical reactivity, etc. Stress from recurrently retrieving stored H2 for energy applications raises concerns about potential diffusion, loss, or leakage. Therefore, geocontainment is vital for the safe and effective storage of hydrogen energy.

BGES excels in geocontainment and caprock integrity evaluations for storage caverns, utilizing a comprehensive approach including geotechnical lab testing, in-situ testing, mechanical integrity testing, and computer modeling. Furthermore, we are leading research on UHS, collaborating with National Resources Canada in a study aimed at developing recommendations for caprock integrity standards at potential sites across Canada.

GeoContainment Evaluations for UHS

1

Core Preservation & Geotechnical Lab Testing

The evaluation begins with careful management of cores obtained from the storage and caprock formations. Laboratory caprock assessments for H2 storage involve obtaining geomechanical and hydrological attributes through triaxial tests, Brazilian indirect tensile strength tests, and permeability measurements.

Our current research comprises geotechnical lab tests on samples from salt, depleted reservoirs, and carbonate formations soaked in hydrogen. With an advanced laboratory equipped with high-temp full core triaxial apparatus and salt testing capability, BGES stands among the few in North America.

2

In-situ Stress Testing

Field in-situ testing such as Diagnostic Fracture Injection Tests (DFITs) and Step-Rate Tests (SRTs) are performed by skilled technicians using advanced injection units. Insights into in-situ stresses of the storage formation and caprocks are provided in a report by a specialized Professional Engineer (P.Eng / IntPE).

3

Mechanical Integrity Testing

BGES introduces an enhanced, patented Mechanical Integrity Test system for underground caverns, employing a modified density tool for precise interface detection and minimized environmental risks. Additionally, we boast extensive expertise in well and casing integrity assessments.

4

Sonar Surveys & Cased-Hole Logging

For over two decades, BGES has excelled in cased-hole services, offering extensive expertise in conducting logs and surveys to assess casing, cement, and cavern integrity. Leveraging our partnership with SOCON, we are experienced in performing sonar surveys for both open and cased caverns in different media.

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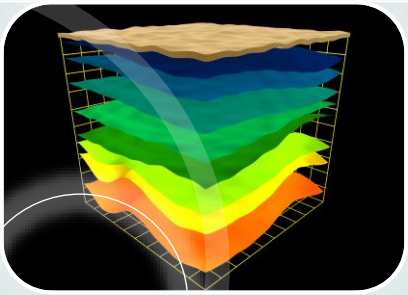
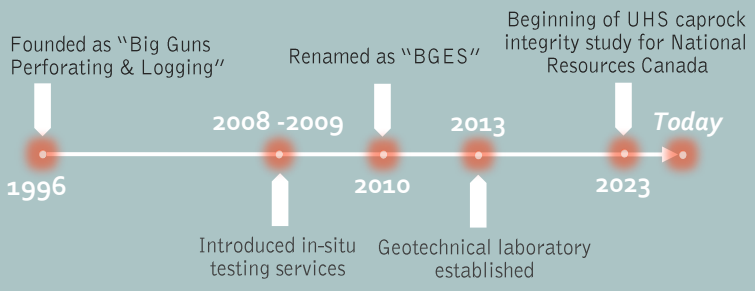


Modelling & Simulation

A series of geological, reservoir/flow and geomechanical models are vital for predicting the operation of UHS and ensuring caprock integrity. BGES employs a staged modelling approach, utilizing a 3D Mechanical Earth Model to forecast long-term changes in in-situ stresses and parameters for hydrogen storage in underground caverns.

COMPANY HISTORY

Established in 1996 as a conventional wireline company, BGES has evolved into a technology-driven firm specializing in geoscience, engineering, and data acquisition. Our esteemed clientele comprises Canada's Big 4 oil producers and major utilities. As a leading provider of geocontainment evaluation for global clean energy initiatives, we are honored to be National Resources Canada's trusted partner in pioneering caprock integrity research for underground hydrogen storage.



Scientific

Expertise

Quality-Focused

BGES excels in merging science and practice, leveraging expertise, and prioritizing work quality through real-world experience, cross-disciplinary knowledge, R&D, technology, and advanced testing methods.

Integrated

Flexible

Cost-Effective

We provide cost-effective solutions by seamlessly integrating services, streamlining field operations, and offering customized, flexible options to meet specific requirements.

THE BGES ADVANTAGE

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