Hydrogen Storage in Salt and Hard Rock Caverns

PREPARED BY:
LANE POWER & ENERGY SOLUTIONS, INC
Caverns are Our Core EPC Business

- **Team Experience**
  - 13.5 million Bbl in nine caverns
  - Delivered the only hard rock caverns constructed in US in the last 35 years
  - Reactivated two abandoned caverns for NGL service
  - Converted 73 million Bbl mine to crude oil storage

- **Salt Caverns**
  - 100+ salt cavern projects
  - 25+ leach plants
  - *One Hydrogen cavern (2015)*

- **National Energy Security**
  - Strategic Petroleum Reserve
  - Waste Isolation Pilot Plant – nuclear waste
Storage Caverns Overview

- **Products stored**
  - Gas & liquid hydrocarbons
  - Compressed air
  - Hydrogen
  - Ammonia
  - Helium

- **Solution mined salt caverns**
  - 60+ year operational history
  - 2000+ caverns worldwide
  - Several in H₂ service

- **Hard rock caverns**
  - 60+ year operational history
  - 200+ caverns worldwide
  - Demonstrated performance to 800 psi (@ 1800’ depth)
  - None presently in H₂ service
Global interest in hydrogen.
Design and operation similar to gas storage caverns.
Special treatment of production casings.
Very large volume.
Presently (3) caverns in the US, (3) caverns in UK.
Much attention to new development throughout Europe.
Where is the Current US Interest?

CAES & Hydrogen

Appalachia

TX Coast
Existing $\text{H}_2$ Caverns/Conversion Potential

- Existing $\text{H}_2$ caverns
  - Teeside, UK. (3) - brine compensated salt caverns
  - Texas. (3) - domal salt caverns

- Convert existing caverns?
  - Well casings not suitable
  - Requires installing well liner
Key Takeaways

1. Hydrogen is forecast to become a $130 - $170 billion US industry by 2050. *(Forbes, Oct 7, 2019)*

2. Biden’s Infrastructure plan allocates $73bn for clean energy, transition and H₂

3. DOE H₂ “Earthshot” - $1 / kg by 2030

4. Hydrogen can be stored in salt and hard rock caverns.

5. Caverns are far less costly than large volume pressure vessels.

6. Green Ammonia NH₃ will be part of the energy mix

7. Caverns take a long time to construct - *Let’s start early!*

Image by Big Guns Energy Services