

# CCUS Storage Wells

## VAM® Qualification for CCUS Applications

### SETTING THE PATH FOR CONNECTION QUALIFICATION

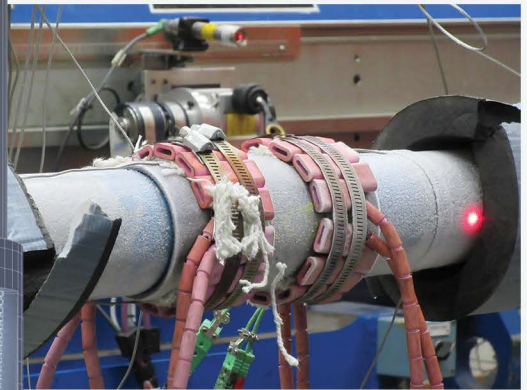
- Existing ISO 13679/API 5C5 do not cover CCUS applications.
- Tightness and integrity are key.
- Extreme low temperatures scenarios.
- Thermal and load cycling associated to CO<sub>2</sub> injection operations.
- Internal & external pressure cycling tightness.
- Low-temperature cycles with mechanical loading.
- Sudden temperature drop (extremely low).
- Mechanical loading with delta temperature pin vs coupling.

### OBJECTIVES

- Define a relevant connection validation protocol for CCUS/CO<sub>2</sub> injection applications.
- Define specific Finite Elements Analysis (FEA) to determine most critical sizes on CCUS conditions.
- Tribological assessment of metal-to-metal seal interface with lubricant at cryogenic temperatures.
- Full-scale validation testing with up to 100% CO<sub>2</sub>.

### DEDICATED R&D STUDIES INCLUDING ANALYTIC AND SMALL-SCALE TESTING

- Surface treatment evaluation at very low temperature and high-pressure washing.
- Proprietary FEA modelling for CCUS.
- Fretting evaluation at cryogenic temperature.
- Tailor-made testing equipment & methodology.**



### SUCCESSFUL QUALIFICATION

- Operational conditions: thermal cycling at very low temperatures.
- Survival condition: integrity in case of blow-out.
- Tightness validation after blow-out.

<b>Thermal cycles</b>	up to -35°C
<b>Absolute min. temperature</b>	-80°C
<b>Delta temperature</b>	60°C
<b>Testing fluid</b>	100% CO <sub>2</sub> & standard gas

### A SUCCESSFUL TESTING METHODOLOGY

- Specific testing methodology & equipment has been put in place.
- Testing fluid media used, up to 100% CO<sub>2</sub>.
- Testing sequences include thermal cycling at -35°C and absolute minimum temperature at -80°C.

