STOREGGA

Cold Duty SSSV Qualification Joint Industry Project (JIP)

Status Update and Way Forward

Important notice

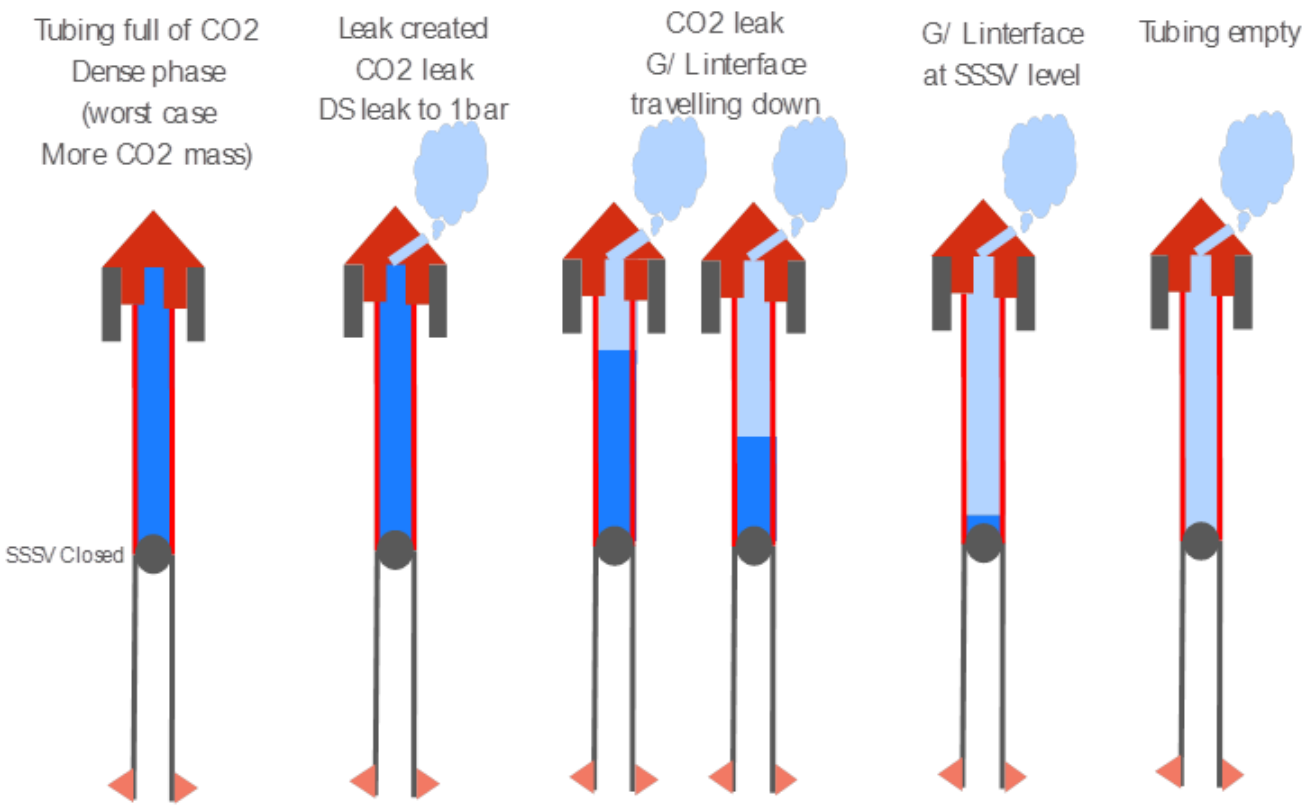
This presentation, together including any printed or electronic copies, any information provided or communicated during any presentation or delivery of this presentation, any oral briefing that accompanies it, and any question-and-answer session that follows such briefing (the presentation), are provided by Storegga Geotechnologies Ltd (Storegga) on the understanding that, whilst every care has been taken to ensure accuracy, no representation, warranty or undertaking (express or implied) is made and no responsibility is taken by Storegga or any employee, consultant, officer or other representative acting on it or an affiliate of its behalf (the Storegga Group) regarding its content. The Storegga Group excludes all representations, warranties, obligations and liabilities in relation to the presentation to the maximum extent permitted by law. In particular, nothing in presentation constitutes a valuation or financial, tax or legal advice, nor does it constitute an invitation to invest or otherwise provide financial support.

The Challenge

Det Norske Veritas (DNV) Group, “Dense phase CO2 8" NB pipe rupture,” DNV, 2013. [Online]. Available: https://www.dnv.com/oilgas/laboratories-test-sites/dense-phase-spadeadam-video.html. [Accessed 3 February 2022].

Background

- **The challenge –** Barrier Failure Causes CO_2 Boil-Off/JT Cooling



Acevedo, L., & Chopra, A. (2017). Influence of phase behaviour in the well design of CO_2 injectors. Energy Procedia, 114, 5083-5099.

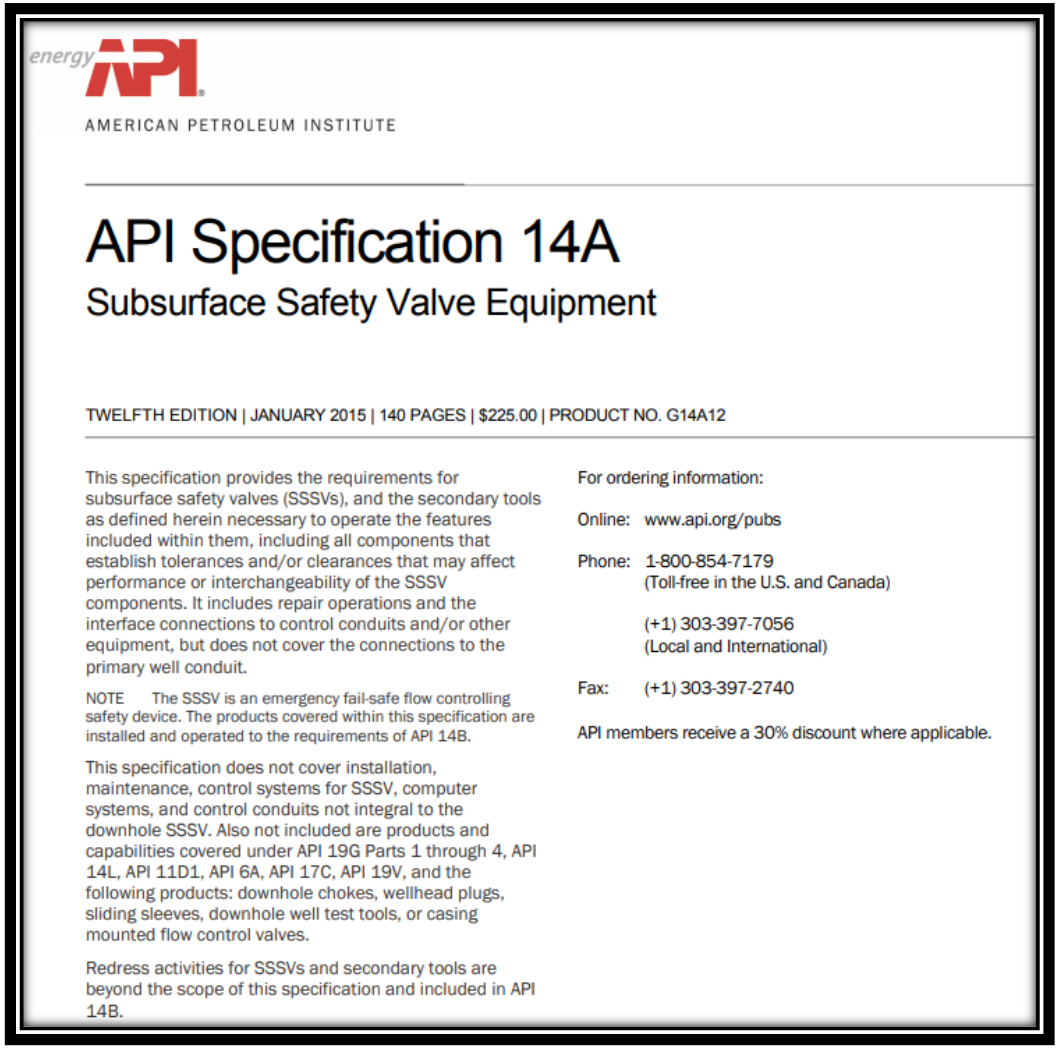
- **Qualified well barrier requirement.**
- **SSSV low-temperature performance**
- **Valves currently on market are not certified below -5°C.**
- **Few work done based upon testing individual SSSV components.**
- **Need identified for a general solution**
  - Full valve testing
  - Range of sizes
  - Cycling to -78°C
  - Capability to extend testing to other well components
- **JIP formed to address above challenge**
  - Currently 9 members

Joint Industry Project (JIP)

STOREGGA

Project scope and objectives:

- Develop/agree a qualification protocol for SSSV for low temperature CO_2 service.
- Improve understanding of performance envelope of well components at low temperatures and address any outstanding gaps.
- Demonstrate satisfactory performance of hydraulically operated SSSV suitable for use in agreed partner applications under low temperature service conditions.



energy API

AMERICAN PETROLEUM INSTITUTE

API Specification 14A

Subsurface Safety Valve Equipment

TWELFTH EDITION | JANUARY 2015 | 140 PAGES | $225.00 | PRODUCT NO. G14A12

This specification provides the requirements for subsurface safety valves (SSSVs), and the secondary tools as defined herein necessary to operate the features included within them, including all components that establish tolerances and/or clearances that may affect performance or interchangeability of the SSSV components. It includes repair operations and the interface connections to control conduits and/or other equipment, but does not cover the connections to the primary well conduit.

NOTE The SSSV is an emergency fail-safe flow controlling safety device. The products covered within this specification are installed and operated to the requirements of API 14B.

This specification does not cover installation, maintenance, control systems for SSSV, computer systems, and control conduits not integral to the downhole SSSV. Also not included are products and capabilities covered under API 19G Parts 1 through 4, API 14L, API 11D1, API 6A, API 17C, API 19V, and the following products: downhole chokes, wellhead plugs, sliding sleeves, downhole well test tools, or casing mounted flow control valves.

Redress activities for SSSVs and secondary tools are beyond the scope of this specification and included in API 14B.

For ordering information:

Online: www.api.org/pubs

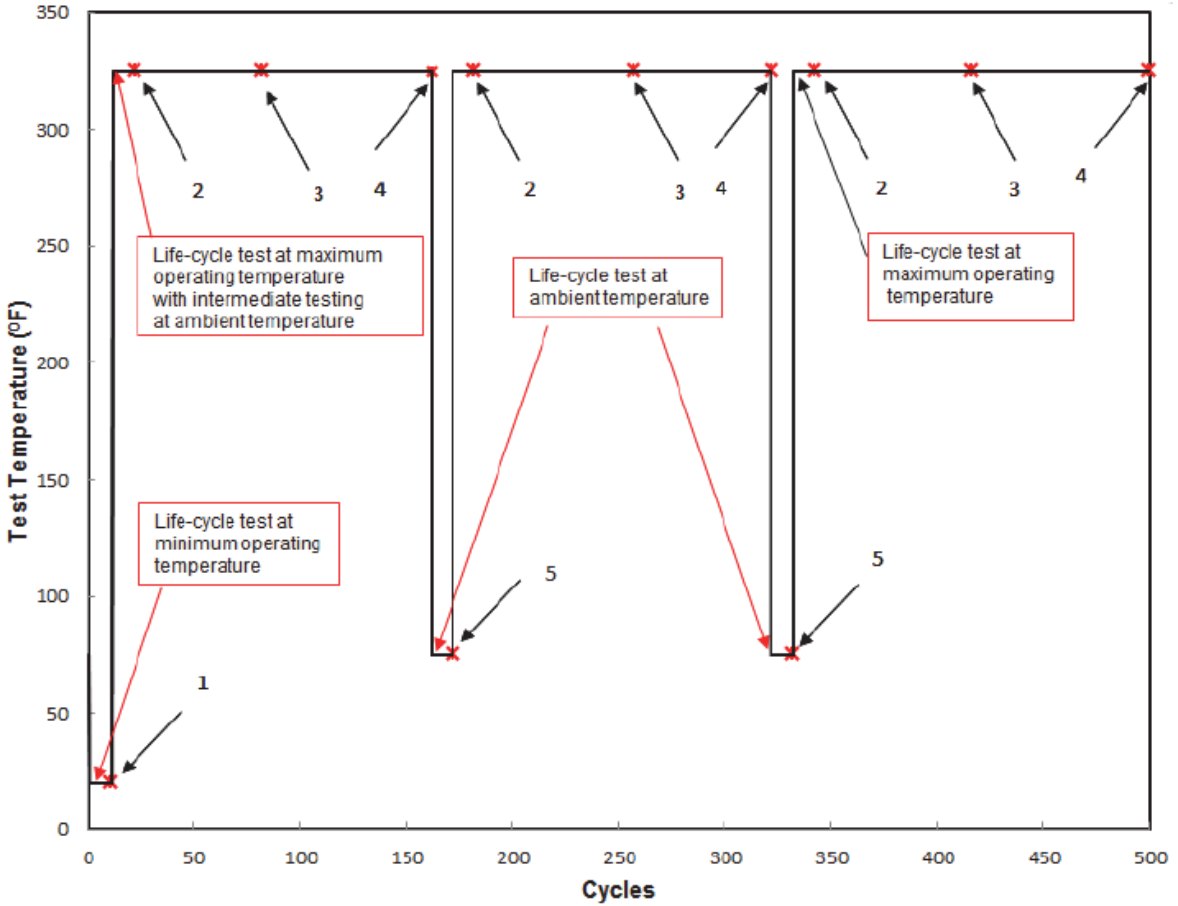
Phone: 1-800-854-7179
(Toll-free in the U.S. and Canada)

(+1) 303-397-7056
(Local and International)

Fax: (+1) 303-397-2740

API members receive a 30% discount where applicable.

API 14A [Existing Higher temp qualification → Lower temp qualification]



Key:
X-axis number of operating cycles
Y-axis test temperature

1 Repeatability evaluation of 10 operating cycles at end of minimum rated operating temperature cycling
2 Repeatability evaluation of 10 operating cycles at start of the maximum rated temperature cycling
3 Repeatability evaluation of 10 operating cycles at midpoint of the maximum rated temperature cycling
4 Repeatability evaluation of 10 operating cycles at end of the maximum rated temperature cycling
5 Repeatability evaluation of 10 operating cycles at end of the ambient temperature cycling

Figure G.1—Example of an Operating Life Test Profile
API SPEC 14A, 12th Edition, January 2015 - Specification for Subsurface Safety Valve Equipment

Annex G: Validation Grade V1 Requirements

G.3: Operating Life Testing

Minimum of 500 operating cycles

- **Minimum Rated Operating Temperature Testing**

Minimum of 10 operating cycles

- **Maximum Rated Operating Temperature with Intermediate Ambient Temperature Testing**

Minimum of 300 cycles or 60 % of the total operating cycles (including a minimum of 10 operating cycles at ambient temperature at the approximate midpoint)

JIP Test Requirements

Adequate test facilities
- Full SCSSSV testing

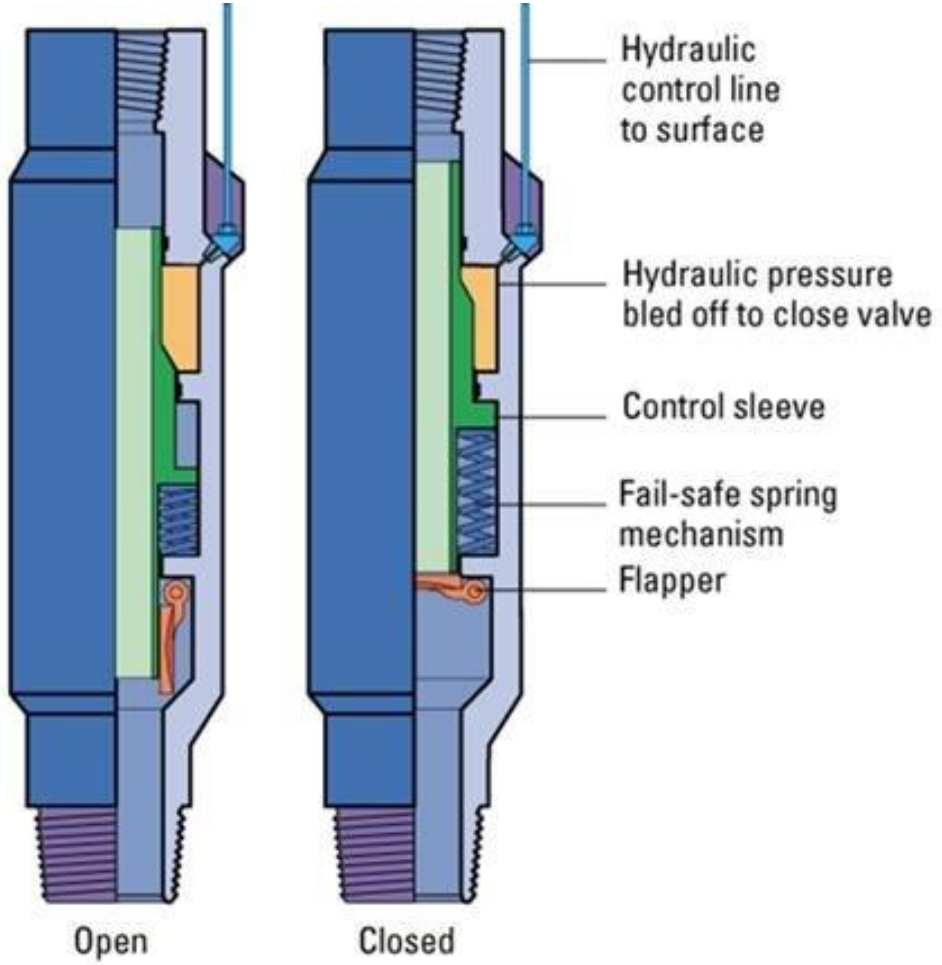
Range of sizes:
- 3 ½” – 5 ½”

Injection pressure and temperature parameters:
- Survival temp: -78°C
- Max ambient temp: 80°C
- Transient & Steady state temp
- Rated working pressure

Number of cycles:
- >500 cycles

Additional Testing:
- Functional Test (Annex C)
- V3-V2 validation testing (Annex B)
- Differential Opening Test (slam open test)

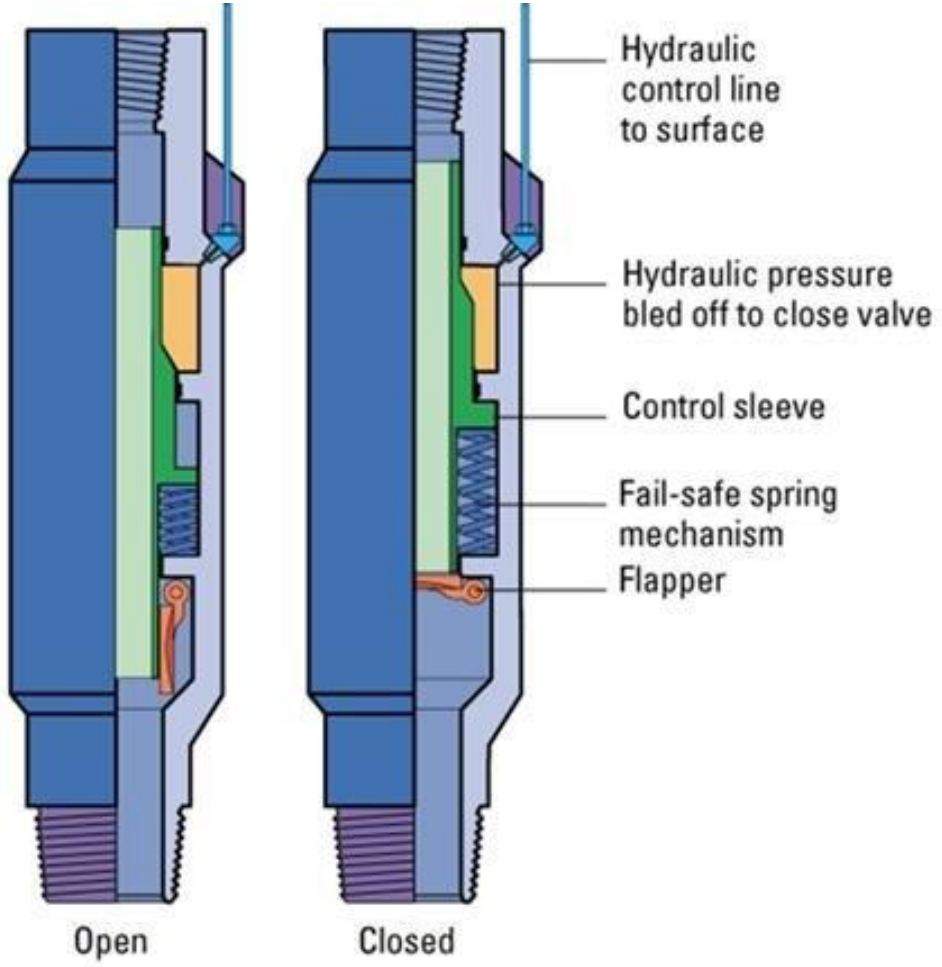
Test Requirements being finalised



Schlumberger Limited, “Subsurface safety valve (SSSV),” Oilfield Glossary, 2022. [Online]. Available: https://glossary.oilfield.slb.com/en/terms/s/subsurface_safety_valve_sssv. [Accessed 15 January 2022]

Other Considerations

- **Flapper design for size scalability**
- **Acceptance criteria**
- **Control lines fluid selection**
- Hydraulic fluid checks during cycles?
- **Consideration for other components such as clamps and connections, etc.**
- **Material Selection - Corrosion and Cracking concerns**



Schlumberger Limited, "Subsurface safety valve (SSSV)," Oilfield Glossary, 2022. [Online]. Available: https://glossary.oilfield.slb.com/en/terms/s/subsurface_safety_valve_sssv. [Accessed 15 January 2022]

Lessons learnt & Next steps

STOREGGA

Key Lessons

- **Need for a range of experts to derive a robust FOAK qualification protocol**
- **Industry rose to this challenge working collaboratively to achieve a new test protocol for cold duty SSSV qualification.**
  - Especially operators + manufacturers
- **Duration of such collaboration in excess of 1 year.**
  - Inclusive of qualification protocol agreement & JIP funding and contracting

Next Steps:

- The JIP is managed by NZTC in Aberdeen and aims to commence in **2Q 2022** with the majority of testing complete within a 12-month period enabling projects to procure **qualified SCSSSV during 4Q 2023**.
- Continued positive and open collaboration among members.
- Continually engaged supply chain.

“CCS is a necessity, not an option.”

Committee on Climate Change, May 2019