BSEE Standards Workshop

API 14A, 12th Edition
Subsurface Safety Valves
High Pressure High Temperature Approach

January 2014
New Orleans, LA
API 14A, 12th Edition Overview

- **API 14A – 12th edition**
  - Writing process initiated in May 2010
  - Voting ballot distributed 18 December 2013
    - Comments due 12 February 2014
    - Planned for publishing April 2014
  - Overall comprehensive update which includes major revisions
  - Added new Validation Grades in lieu of Classes of Service
    - V1-H, V1, V2, V3, V4-1 and V4-2 (extensive testing requirements per validation grade)
  - Scope now includes injection valves
  - Debris considerations added to operational parameters
  - Insert valve consideration on SCSSV’s (limits / pressure rating)
  - Design methodology and analysis addition (including FEA/CFD)
  - Validation testing updates (Class 1 and 2)
  - **Addition of new HPHT to define new requirements for HPHT valves**

- Section 5.9 – User/Purchaser Grade Selection
  
  — Validation Grade V1-H defined (5.9.1)
    - Meets requirements of Annex H
    - Meets Annex B
    - Meets all Annex G requirements for V1 validation testing

  — HPHT defined (5.9.2)
    - SSSVs with a working pressure rating greater than 15,000 psi
      - or -
    - SSSVs with a temperature rating greater than 350°F
      - or -
    - When required by the user/purchaser
    - When any of these three requirements are fulfilled, the SSSV shall conform to Annex H

- Sub-task group formed within API 14A TG to address how HPHT will be incorporated
  - Team conducted comprehensive review of API Technical Report 1PER15K-1
  - Critical topics identified that have pertinent effect on subsurface safety valves
  - Annex H was authored by full task group based on comparative review output from sub-task group
Annex H – Verification and validation requirements for high pressure-high temperature environment

- Defines the additional verification and validation requirements that shall be followed in designing and manufacturing SSSV and secondary tools for use in HPHT environment

- H.2 – Functional specification (User/purchaser requirements)
  - Additional requirements are to be specified including max flowing temperature, shut in static temperature, and duration of time that SSSV will operate at temperature

- H.3 – Technical specification (Supplier/manufacturer requirements)
  - **Temperature effects** – use temperature de-rated yield strength and modulus of elasticity with testing on samples at mid-wall or mid radius conducted in accordance with ASTM E21
  - **Environmental effects** – compatibility of metals with well fluids shall be evaluated, limits on castings (API 20A), limits on welding/structural components
Annex H – Verification and validation requirements for high pressure-high temperature environment

- H.3 – Technical specification (Supplier/manufacturer requirements)
  - **Non-metals** – completions and stimulation fluid exposure to be specified, compound evaluation for RGD and ageing along with compound validation
  - **Design verification** – User/purchaser specifies max anticipated shut-in tubing pressure (SITP) at the SSSV and specify RWP > SITP.
  - The component shall conform to the requirements of 6.4 and the following additional requirements:
    - Combined loading analysis, generate rated performance envelope
    - Perform an elastic-plastic FEA using ASME BPVC Section VIII, Div 2 clause 5.2.4 when the stresses exceed yield strength
    - These FEA methods require true stress true strain curves be developed using ASME BPVC Section VIII, Div 2 or Section VIII, Div 3

- Annex H – Verification and validation requirements for high pressure-high temperature environment
  - H.3 – Technical specification (Supplier/manufacturer requirements)

  **KEY FOCUS AREA**

  **Design verification (continued) –**

  - The component shall conform to the requirements of 6.4 and the following additional requirements:
    - Localized stress discontinuities and plastic localized yielding shall be considered in the design and evaluated by a qualified person to determine if the design is acceptable or if additional analysis is required;
    - When FEA has identified plastic strain is evident, ratcheting analysis shall be performed per ASME Boiler and Pressure Vessel Code Section VIII or ASME BPVC Section VIII, Div 2

  **Design validation** – validation grade V1-H is normative, post-test NDE is required on all critically stressed components

  **Scaling of HPHT SSSV’s** – comprehensive material review for scaled designs (metal & non-metal) shall be reviewed and accepted
Annex H – Verification and validation requirements for high pressure-high temperature environment

- H.4 – Additional supplier/manufacturer requirements
  - Metals verification – yield strengths and modulus of elasticity for components integral to the tubing string and the closure mechanism shall be documented at max rated operating temperature
  - Functional test requirements – rated WP used in Annex C, the rated shall be adjusted to account for the temperature de-rating effect on material property. This adjustment shall be done per the equation below:

\[ RWP_A = \frac{RWP}{TDR} \]

Where:
- \( RWP_A \) = adjusted rated working pressure
- \( RWP \) = rated working pressure
- \( TDR \) = temperature de-rating factor

Equipment is evaluated during the functional test at a higher stress level relative to yield strength than is ever experienced in service.
Annex H – Verification and validation requirements for high pressure-high temperature environment

- H.4 – Additional supplier/manufacturer requirements (continued)
  - Quality plan – shall be prepared per ISO 10005 and 7.4 for each order placed and approved in writing by user/purchaser, any changes shall go through the same approval process
  - Final design review – supplier/manufacturer and the user/purchaser shall conduct a final design review to verify that the SSSV and secondary tools are suitable for the applicable HPHT environment
Validation Testing Overview

B.2 Test Agency V3 steps
- B.3 Gas flow test
- B.5 Liquid leakage test
- B.6 Unequalized opening test
- B.7 Operating-pressure test
- B.8 Propane test
- B.9 Nitrogen leakage test
- B.7 Operating-pressure test
- B.10 V3 water flow test
- repeat B.9, B.7, and B.10 four times
- B.5 Liquid leakage test
- B.11 Controlled-temperature test
- B.4 OD/ID Drift per B.4.2/B.4.3

V3 validation completed

B.2.2 Test agency V2 steps
- B.7 Operating-pressure test
- B.12 V2 slurry flow test
- B.9 Nitrogen leakage test
- repeat B.12 and B.9 six times
- B.5 Liquid leakage test
- B.4 OD/ID Drift

New Requirements:
- D.2 Temperature cycle test
- D.3 Differential opening testing
- D.4 Self-Equalizing Test (if applicable)

V2 validation completed
Validation Testing Overview (continued)

From a V2 validated valve, add:

- G.3  Life Cycle testing
- G.4  Differential opening testing
- G.5  Equalization mechanism endurance testing
- G.6  Special feature validation
- G.7  ESSSV Electronics qualification (if applicable)
- Annex M  Rated Performance Envelope

V1 validation completed

- Annex J  Combined Loads Operational Test
- Annex L  Dynamic piston seal test

HPHT validation completed

Optional Validation Testing

- Annex I  Extended Sand Endurance Testing
- Annex K  Gas Slam Closure Testing
- Annex D  Alternative Leak Rate Requirements
Conclusion

- Questions?