Subsea Well Intervention Systems

Working Draft 6 API Standard 17G

May 8, 2015

BSEE HPHT Forum
API RP 17G 1st edition: released 1995 for Completion/workover risers

- Introduced the limit state design approach
- Major updates on design requirements for pipe, connectors, material and connector qualification
- Advanced riser design and connector qualification in the industry

API 17G 3rd edition: (Working Draft 6)
- Transition from RP to Standard. (Major Revision)– Advances design process for WCP, SSTT & forms the basis for emerging well intervention systems
- Winter 2015 Committee 17 meeting voted to move from a Spec to a Standard and allow industry to apply new guidance.
- Self contained document, ensuring system and component life cycle integrity
- Includes: ( currently 15ksi, 350 deg F )
  - Well Control Package, Subsea Test Trees
  - Landing String / Open Water High Pressure Riser
  - Intervention Work Over Control System
Update May 2015

- Working Draft 6 sent to API April 22 for distribution to committee 17

- Requesting comments for the following sections:
  - Materials,
  - Connector qualification,
  - Controls

- Editorial team continuing to review the above sections line by line
API Standard 17G ENHANCEMENTS

- **Safety Strategy**
  - Aligns the Operational Program requirements with the Design / Performance of the Equipment

- **Material Integrity**
  - Is specified to ensure the manufacturing process, quality control & fabrication and assembly provide a ductile material which prevents brittle fracture

- **Design Process**
  - Design by analysis and validated by test
    - Static / Structural
    - Cyclic Fatigue (SN or Fracture Mechanics methods)
    - Functional Testing to validate analysis results and validate design which can’t be determined by analysis

- **Qualification** (Validate by testing)
  - Annex K, L, ie.. Endurance limits, validate shear & seal requirements
  - Annex I, ie… process for scaling, understanding events causing loss of preload

- **Testing Methods** (Verification of equipment and crew)
  - FAT / EFAT & SIT
  - Crew drills
API Standard 17G ENHANCEMENTS

Std. 17G Analysis process provides component Capacity information which will aid the engineer

Functional capacity could set the limits for the equipment
Material properties, NDT, QC requirements compatible with the static and cyclic design methodologies
  - Rationalization of Material requirements for design method should be consistent and limit use of different material requirements and code

Material section in Std. 17G requires Qualification of the Manufacturer

Std. 17G does not require analysis of low cycle Pressure and Temperature (Considering requirement for equipment above 15ksi)

ASME process is Analysis based, TR8 process may not identify functional limitations of equipment
  - Additional guidance requirements for PR4 testing should be considered
Various connectors within Equipment range

Need industry review and comments to refine

Qualification testing is required to ensure that functional limits are understood

Rationalize large bore high capacity hydraulic connector testing
API Standard 17G Controls

- Varied system requirements
  - Safety system requirements vary
  - Deeper and higher pressure require
  - Bench testing of controls to validate analysis
  - Request industry review
## Comparison of codes

<table>
<thead>
<tr>
<th></th>
<th>API 17D</th>
<th>API STD 17G</th>
<th>ASME VIII 2</th>
<th>ASME VIII 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pressure limit</strong></td>
<td>15K</td>
<td>15K</td>
<td>5K and above</td>
<td>Promoted for 10k and above</td>
</tr>
<tr>
<td><strong>Analysis</strong></td>
<td>Linear Elastic FEA</td>
<td>Elastic and elastic plastic</td>
<td>Elastic or EP + Str Hrd</td>
<td>EP + Str Hrd</td>
</tr>
<tr>
<td><strong>Charpy V(^1)</strong></td>
<td>20 J</td>
<td>50J avg/ 38J sgl</td>
<td>38J (2 in)</td>
<td>41 J(^3)</td>
</tr>
<tr>
<td><strong>Test specimens</strong></td>
<td>QTC or Prolongation</td>
<td>Correlated QTC or Prolongation</td>
<td>Prolongation</td>
<td>Prolongation</td>
</tr>
<tr>
<td><strong>Yield de-rating</strong></td>
<td>120ºC</td>
<td>50ºC</td>
<td>40ºC</td>
<td>40ºC</td>
</tr>
<tr>
<td><strong>Accidental load</strong></td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Cyclic load</strong></td>
<td>No/Yes(^2)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Surface NDE acceptance</strong></td>
<td>3/16” (5 mm)</td>
<td>No relevant linear indication, &gt; 1,6 mm &amp; .8mm for fatigue hot spots</td>
<td>3/16” (5 mm)</td>
<td>1/16” (1,6 mm)</td>
</tr>
</tbody>
</table>

1) 75 ksi steel, 2 in thick  
2) 17D mentions “fatigue considerations” but does not specify requirements and refers to 17G  
3) Figure KM–2342.

Status: Draft
Code Split between API 17G and API 17D

**API 17G**
- Open Water Intervention Riser System including WCP
- Landing String and Subsea Test Tree Assembly

**API 17D**
- XT
- TH, THRT and Wellhead System

Open Water Intervention Mode

Thru-BOP/Drilling Riser Intervention Mode
Summary

- Design method consistent to dovetail with TR8:
  - The static design method gives consistent safety margin against failure
  - Provides consistent results for complex geometries and loads
  - The use of elastic-plastic method provides knowledge of strain in components

- Fatigue failure criteria dovetails with TR8 (below WCP, SSTT where primary barrier resides) so:
  - S–N curves applicable for environmental cyclic loads (>10,000 cycles per day)
  - Use of calibrated fatigue design factors for offshore applications (i.e. high fatigue design factor to limit potential crack size)
  - Inspectable components (i.e. temporary equipment)
API Standard 17G

QUESTIONS?
API Standard 17G Safety Design Strategy

- Physical Protection (loading limiting devices)
- Safety Instrumented System
- Monitoring, Alarms, Operator intervention
- Normal control functions
- Subsea Well Intervention System