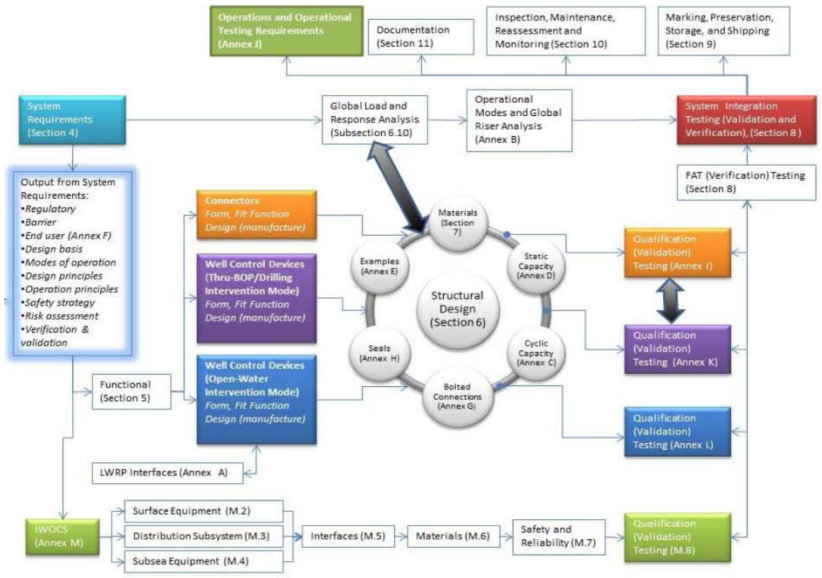
Subsea Well Intervention Systems

Working Draft 6 API Standard17G



May 8, 2015

BSEE HPHT Forum

Introduction

- API RP 17G 1st edition: released 1995 for Completion/workover risers
- API RP 17G 2nd edition: 2006/ISO 13628-7 released 2005
  - 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

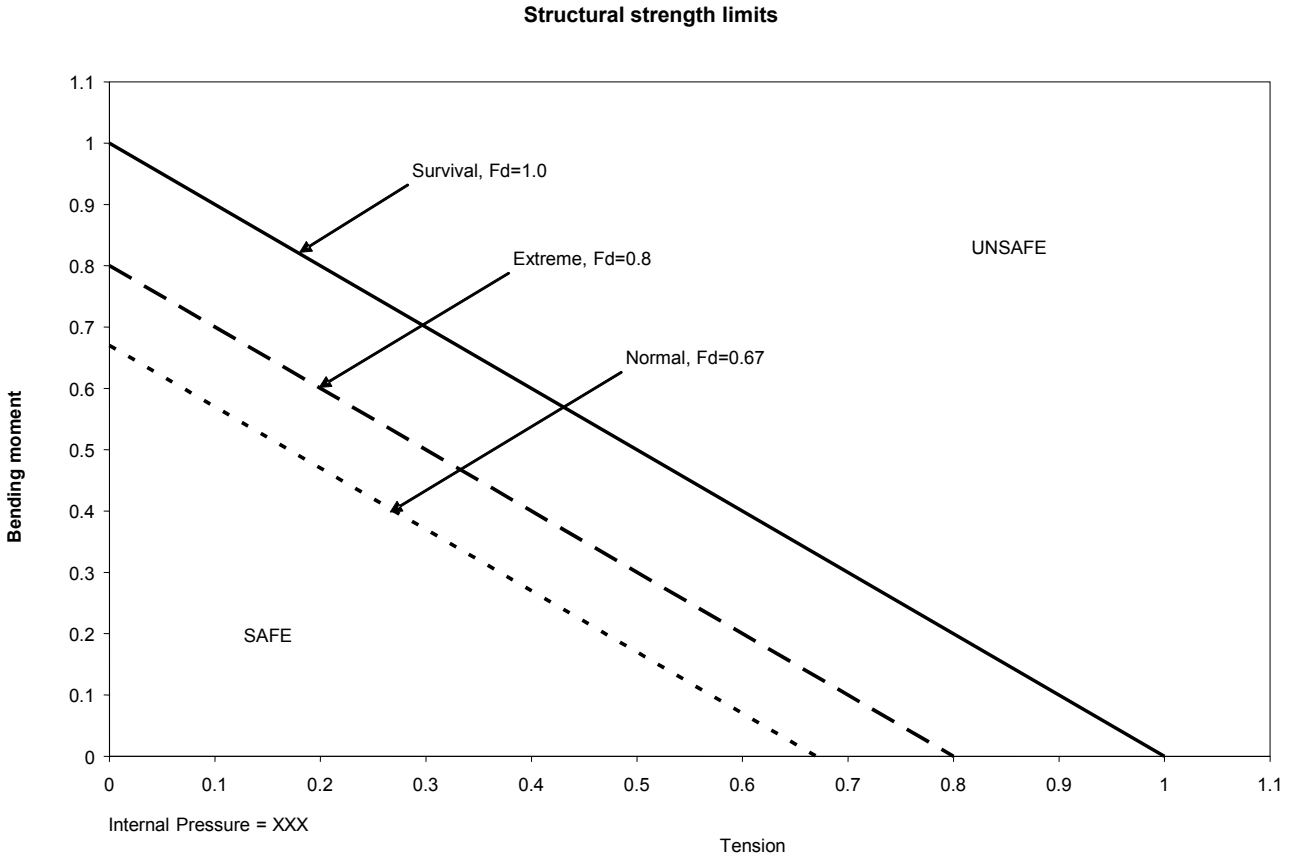
API Standard 17G ENHANCEMENTS

- **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



API Standard17G METALURGY & DESIGN

- 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

API Standard17G Connector Qualification

- 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 Standard17G 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

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

1) 75 ksi steel, 2 in thick

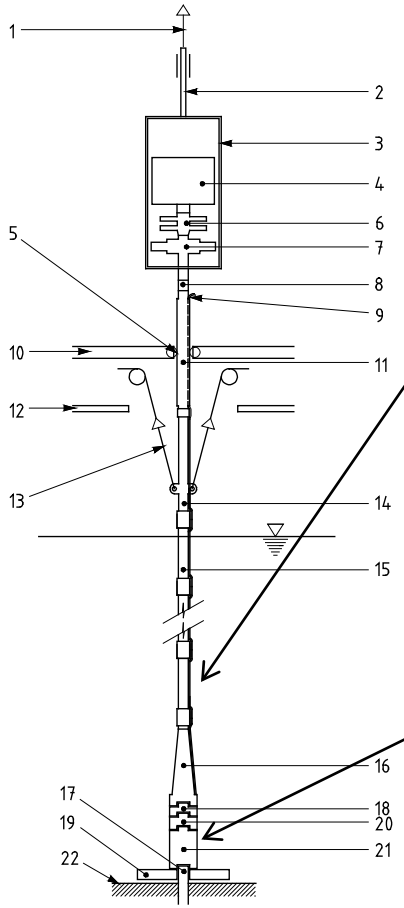
EP = Elastic-Plastic FEA

2) 17D mentions "fatigue considerations" but does not specify requirements and refers to 17G

3) Figure KM-234.2

Status: Draft

Code Split between API 17G and API 17D



API 17G

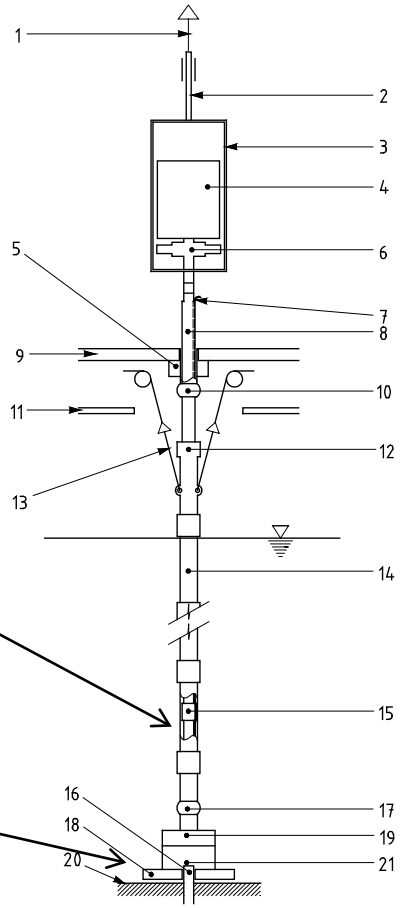
Open Water Intervention Riser System including WCP

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