

# Subsea Well Intervention Systems

# API Specification 17D

May 8, 2015  
BSEE HPHT Forum

# Current Scope of 17D 2<sup>nd</sup> Edition Document

- Includes 5KSI to 15KSI psi working pressure equipment
- PSL 2,3,& 3G
- All PSL's available for all pressure and temperature ratings
  - PSL 3 recommended for > 10KSI psi service
- Sour and non-sour service classes for all pressure ratings
- Charpy V-notch impact requirements 20 joules (15 ft-lbf) for all PSL Levels
- Hydrostatic testing to 1.5 times working pressure for 5KSI thru 15KSI equipment
- Design requirements – self contained: Per ASME BPVC Section VIII Div 2:2004 with some modifications
- External loading (bending/axial) must be considered when designing wellhead, tubing heads, flowline connections, OEC's, tools for running/ retrieving/ intervention
- Current high temperature derating requirements contained as informative by pointing to API 6A, Annex G
- Use of QTC's and perlongations for material properties for production components per API 6HT
- Design validation by means of product testing is a requirement (table 3), but pointing to API 6A, Annex F for informational guidance
  - Scaling rule allowed to validate other sizes than the one tested, but only if “parametric” stresses and geometry are the same

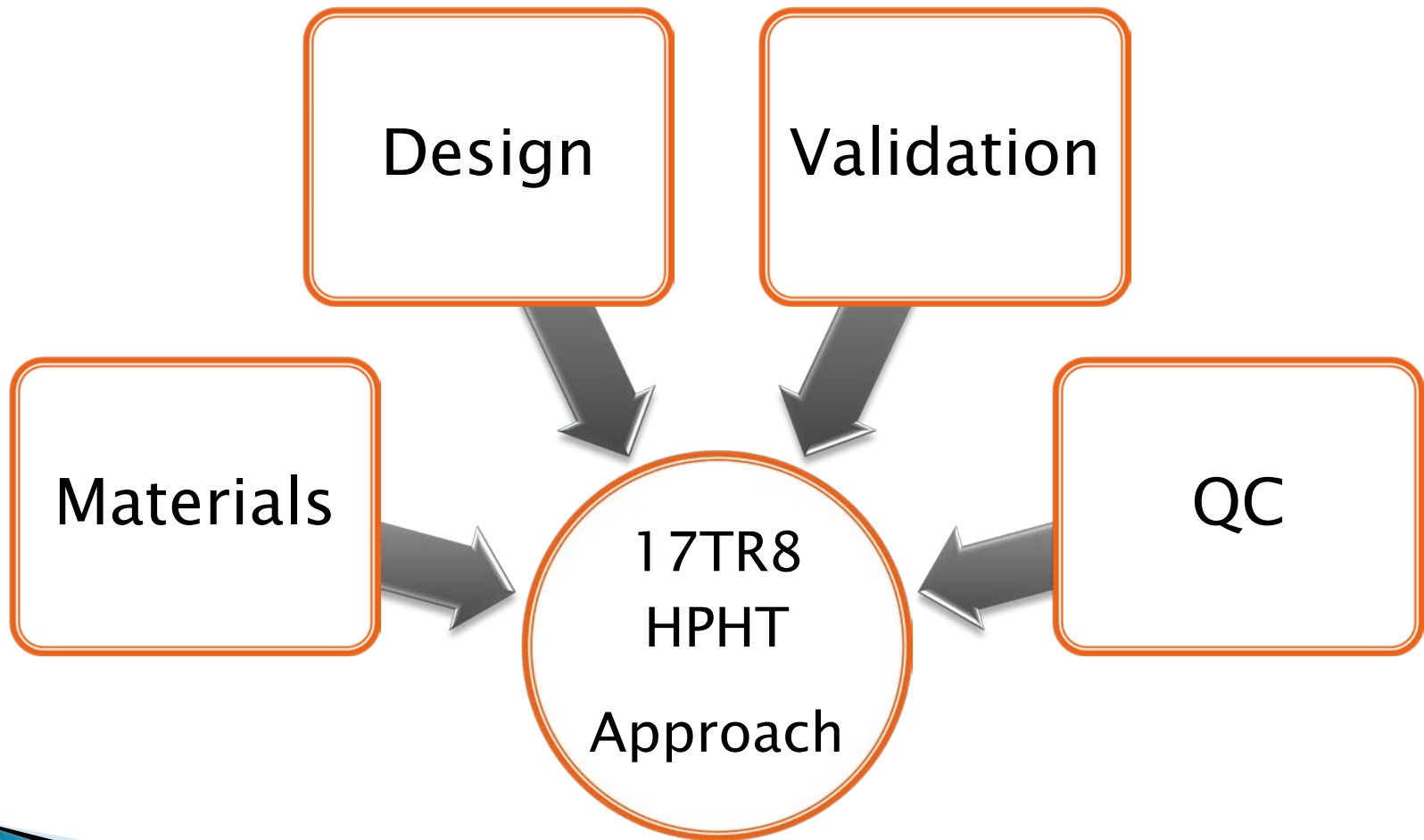
# Errata and Addendum to 17D 2<sup>nd</sup> Edition Document

- Fix wording related to PSL 2,3,& 3G; specifically wellheads should be PSL 3 only (modified Figure M.1)
- Fix dimension value errors in tables
- Address tight “band” of flange bolt make-up torque
- Address issue of testing cycles for valves in Table 3
  - Pressure cycles vs. Temp. cycles vs. Endurance cycles ← and how Hyperbaric cycle test figure into total number of cycles recommended to qualify a prototype or new size/pressure rating...

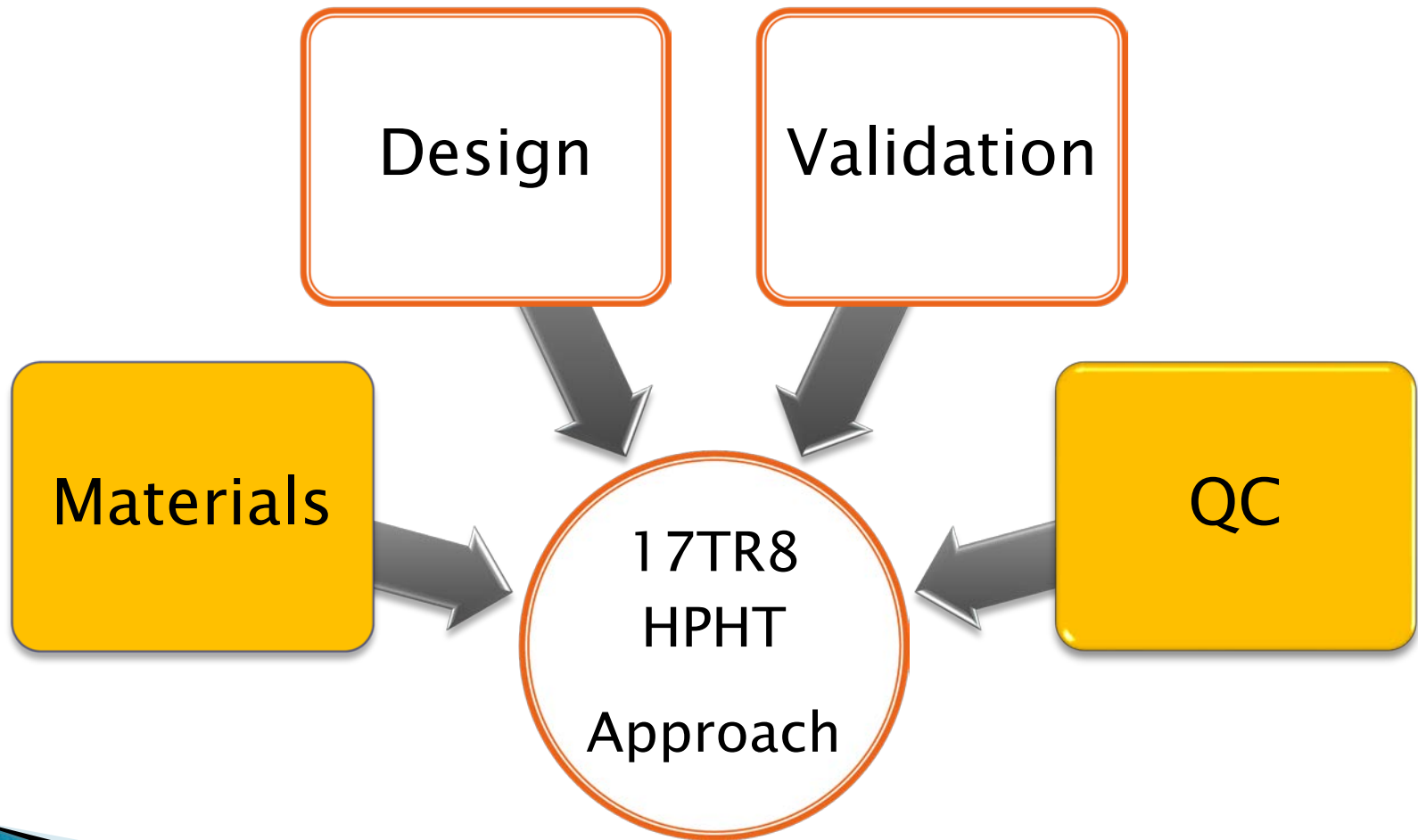
# API 17D 3<sup>rd</sup> Edition Revision Proposal

- ▶ TG Committee consists of approximately 30–35 members per meeting up through 2011 publication
- ▶ Met on various occasions in 2012–14 to deal with errata and addendums
- ▶ Comes up for 5–year review in 2016 for entire document review
- ▶ TG approach
  - Compiling worklist (based on Industry usage inquiries through API)
  - Monitoring progress of 17TR8, in order to address requests for pressure ratings and temperature classes above 15KSI, and 350F
  - Monitoring progress of 17TR7, in order to address requests wellhead connector validation/qualification test protocol and requirements

# API 3<sup>rd</sup> Edition / HPHT Alignment



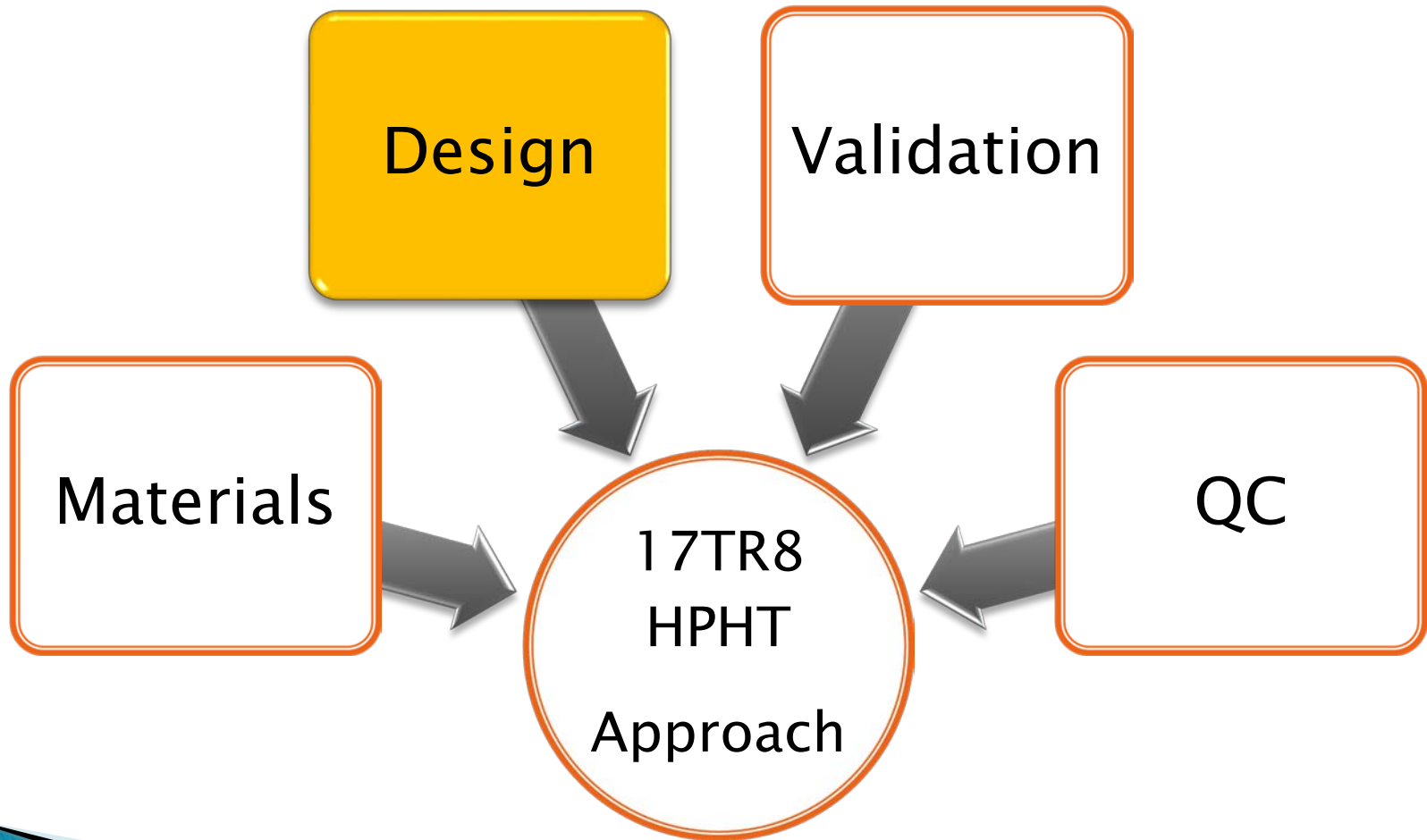
# API 3<sup>rd</sup> Edition / HPHT Alignment



# Materials & QC Changes

- ▶ Target “Higher PSL” for HPHT
  - Require prolongation or sacrificial part for material property tests
  - Test location should address issues of differential heat zones be at T/4 of prolongation or thickest section of sacrificial part
  - Testing per heat treat batch
  - Separate quench loads not allowed with just single prolongation
- ▶ Tighter range of material properties than at lower PSLs?
- ▶ Want to follow 17TR8 for testing data of material properties
- ▶ High strength nickel requirements in conformance with API 6A-CRA
- ▶ BSL 3 per API 20E bolting requirement
- ▶ Stud/nut hardness matching
- ▶ Sour service compliance per NACE MR0175 mandatory... but have to resolve strain limit criteria for loading situations go beyond NACE limits
- ▶ Follow higher ductility requirements per ASME BPVC, Section VIII, Div. 3
  - Resolve “normal” API material list with ASME approved list for Div. 3

# API 3<sup>rd</sup> Edition / HPHT Alignment

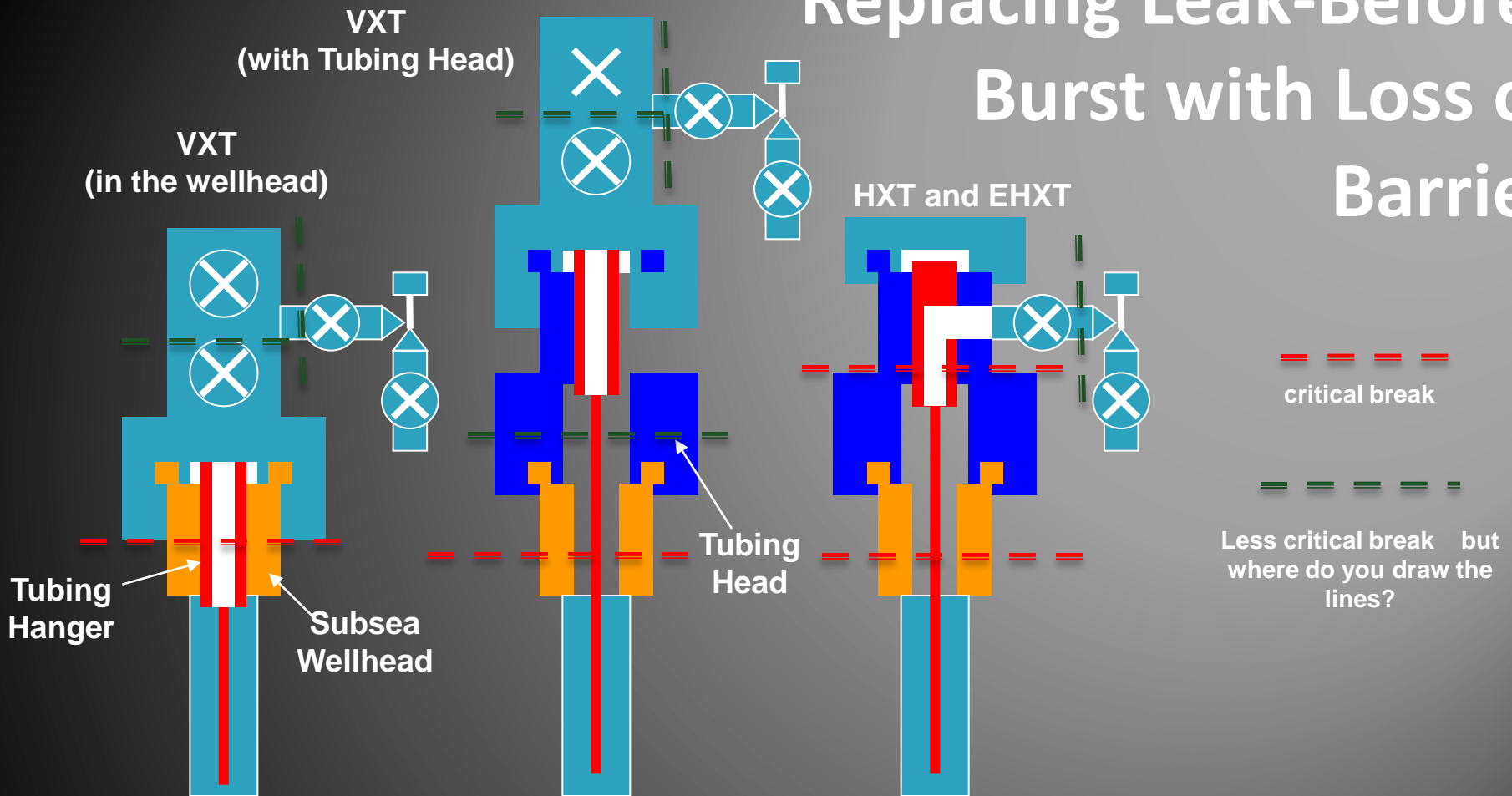




# Fatigue screening requirements per 17TR8?

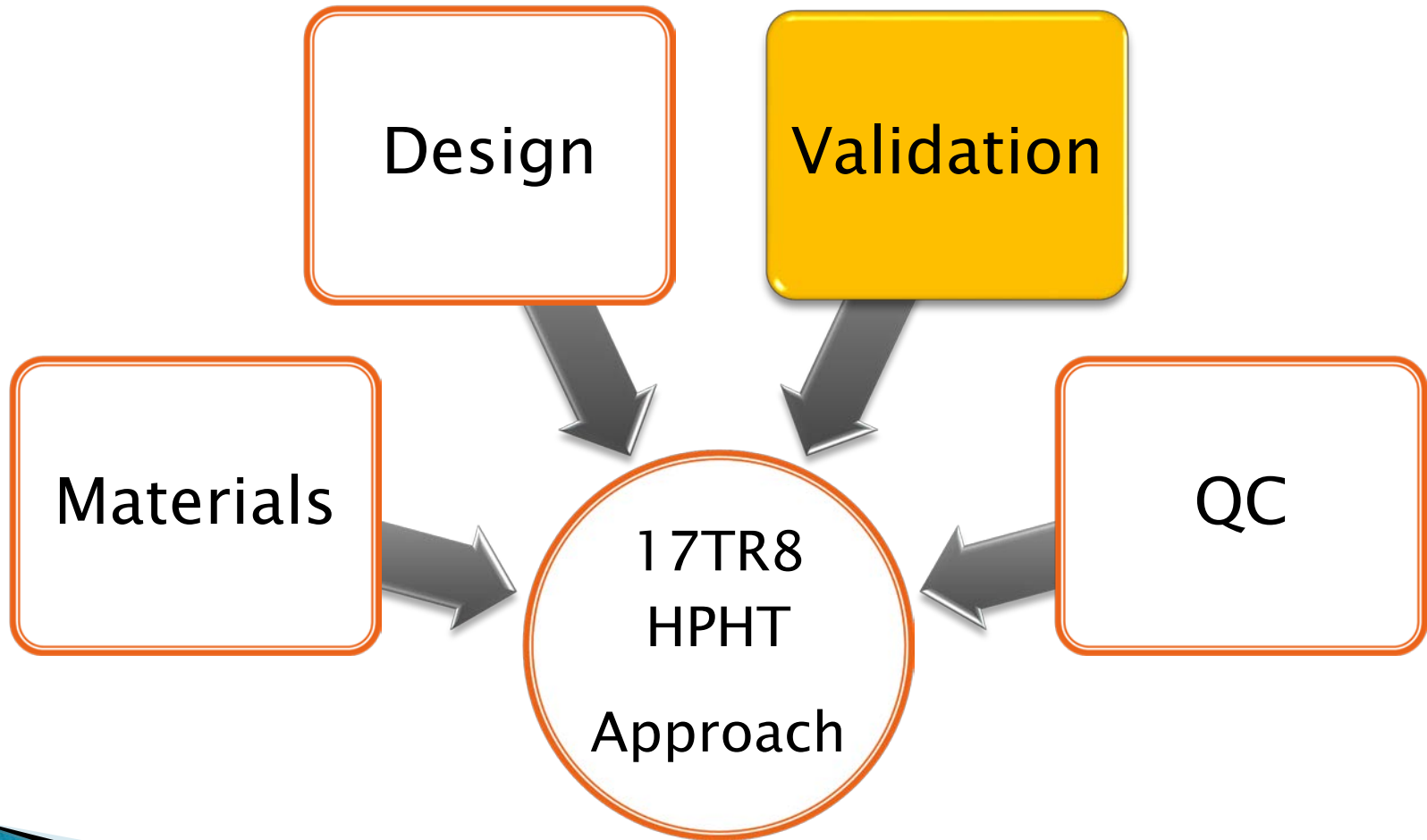
- For fatigue screening, we have legacy designs that are justified based on documented field history and successful performance. This is permitted under ASME BPVC Section 8, Div. 2 Paragraph 5.5.2.
  - “Provisions of paragraph 5.5.2.2, Experience with comparable equipment operating under similar conditions.”
- For designs where equivalency to a legacy design cannot be established, a fatigue screening analysis would have to be performed for each application to determine the necessity as well as the method to be used for fatigue analysis. Using the SN method, a screening can be conducted on high stress concentration areas to assess fatigue life and necessity to do a more exhaustive fatigue analysis.
- Realize that 17TR8 is doing more work in this area for 2<sup>nd</sup> Edition – will follow progress

# Replacing Leak-Before-Burst with Loss of Barrier

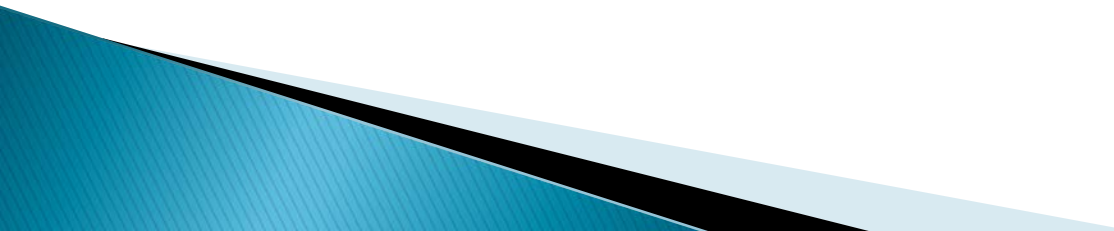


- *ASME Div 3 skeptical, but understands the difficulty in defining this requirement for complex shaped subsea equipment*
  - Oil industry has “two barrier” rule for safe operation.
- Locations where a fatigue failure could compromise primary barrier are critical and more detailed analysis – fracture mechanics

# API 3<sup>rd</sup> Edition / HPHT Alignment



# Validation

- ▶ Currently validation via prototype testing is a normative requirement (table 3), but how its conducted is informative (6A, Annex F – Informative)
  - ▶ 17TR8 dictates that a FMEA (failure modes and effects analysis) be conducted in order to develop an appropriate validation program (“classifications”)
  - ▶ Guidance for PR3 & PR4 should be refined from further work in 17TR8
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As described in API 6A Annex F and API 17D, Table 3

# PR2

The validation testing requirements of PR2 plus the addition of the appropriate tests below:

Elevated Temperature Performance Testing

Mating component validation

Additional thermal cycling

Endurance cycling testing

The validation testing requirements of PR3 plus the additional procedures associated with validating the design verification process of with respect to fatigue sensitive components through one of the following methods:

strain-gauging program of a representative specimen or component comparison (FEA) results

Component fatigue testing

# PR4

# Summary

- ▶ Design method to stay consistent and dovetail with 17TR8, 17G and 6X:
  - The static design method gives consistent safety margin against failure for legacy equipment
  - The use of elastic-plastic method provides knowledge of strain and stress concentrations in components
- ▶ Fatigue failure criteria to dovetail with 17TR8 and 17G so:
  - Follow progress of 17TR8 for continued refinement of fatigue assessment
  - Criteria for operating, extreme and accidental cases
  - Make sure pressure, temperature, and mechanical cycling loads follow same methodology
  - Barriers vs. type of fatigue
  - Monitoring criteria and associated safety factor
- ▶ Following 17TR8 work on 2<sup>nd</sup> Edition updates and timing should coincide in time to be used in 17D 3<sup>rd</sup> Edition update work