



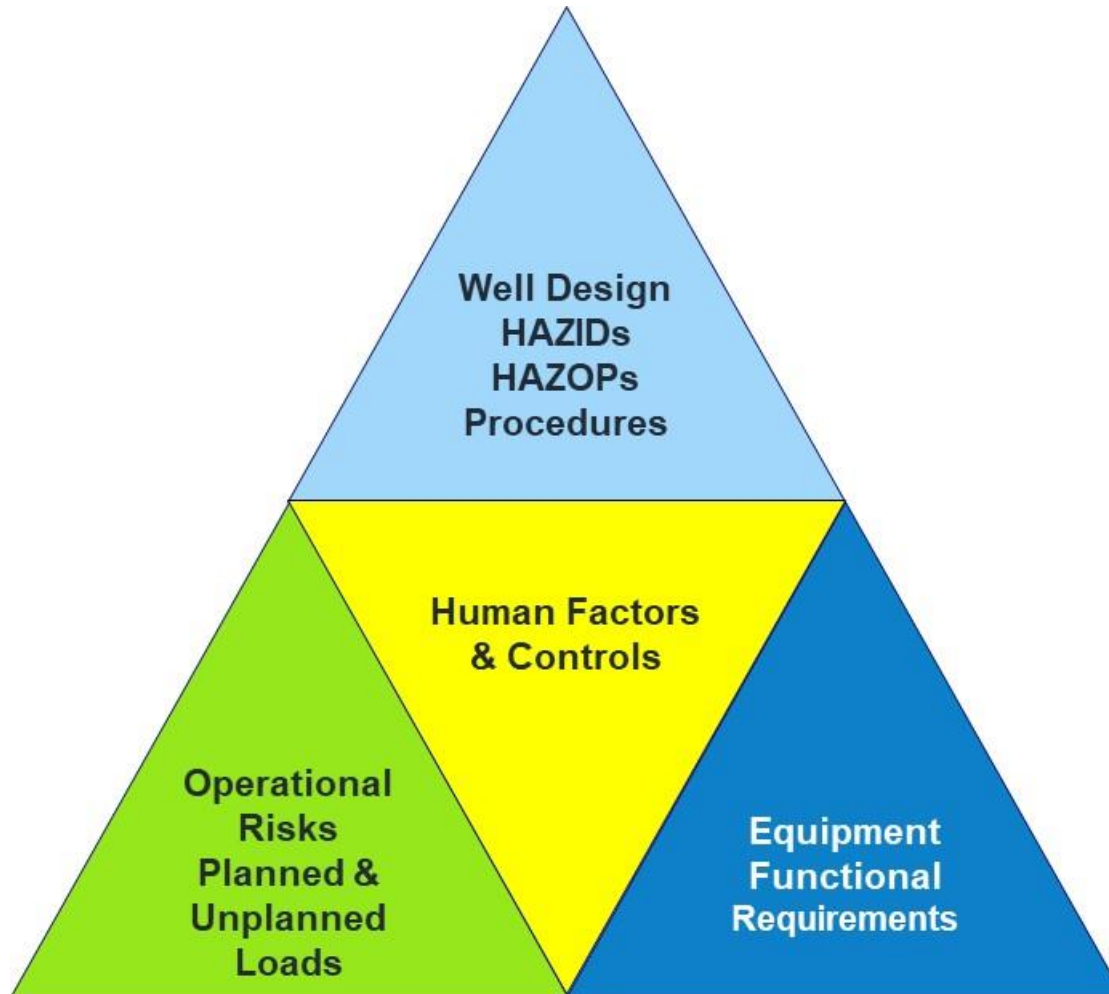
NYSE: APC
WWW.ANADARKO.COM

20A – Managing Subsea HPHT Equipment Risks

Gregory Walz

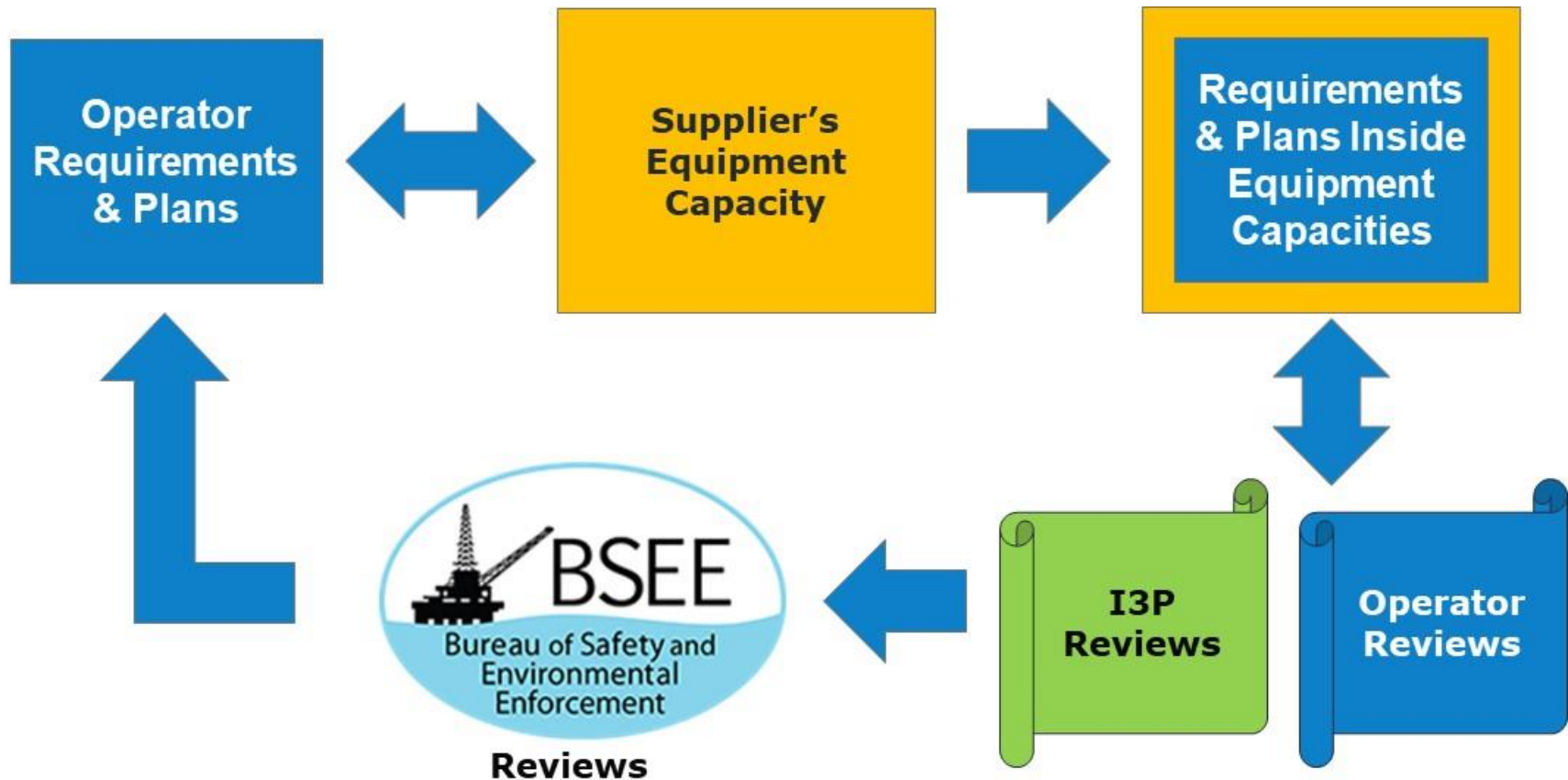
Anadarko's Unique Opportunity

- Anadarko's 20A Project kicked off in 2014
- Design, verification, and validation 20ksi subsea equipment



BSEE Review Process

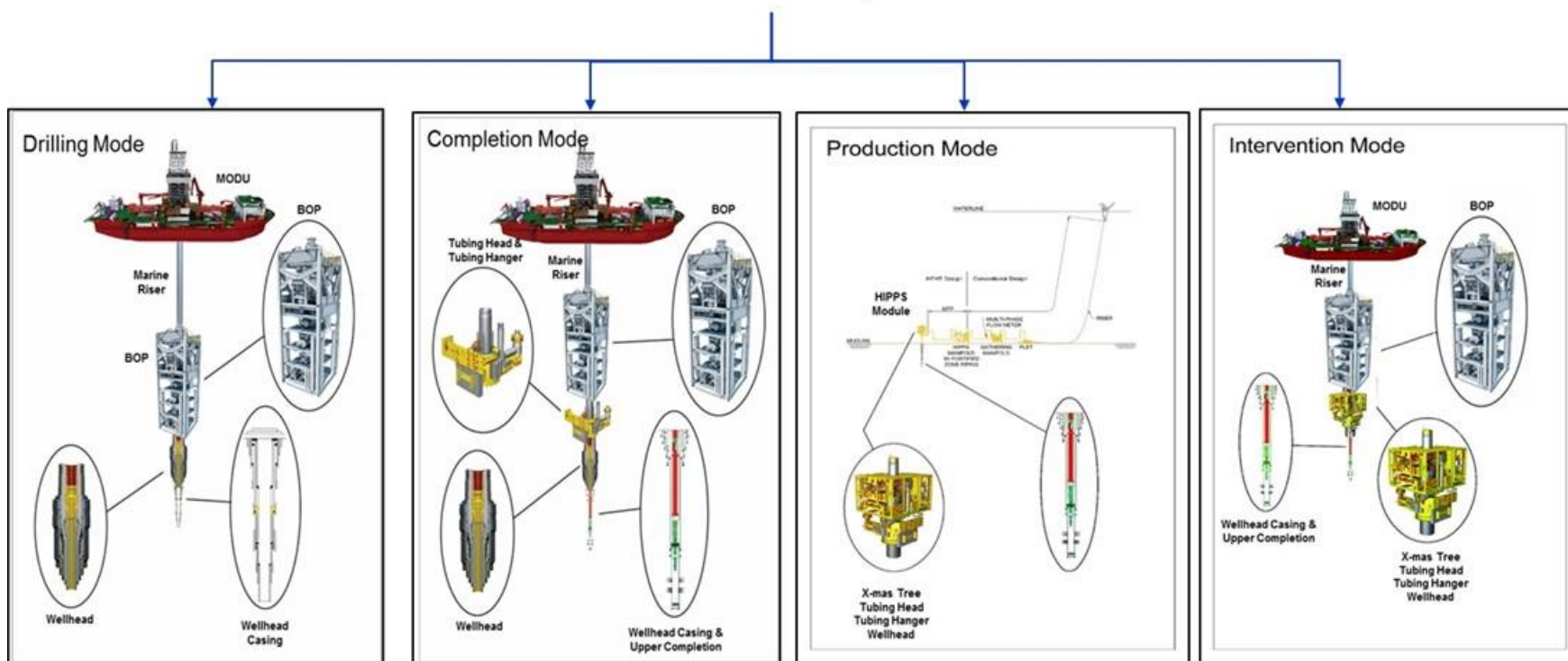
- Pressure controlling & containing equipment review process



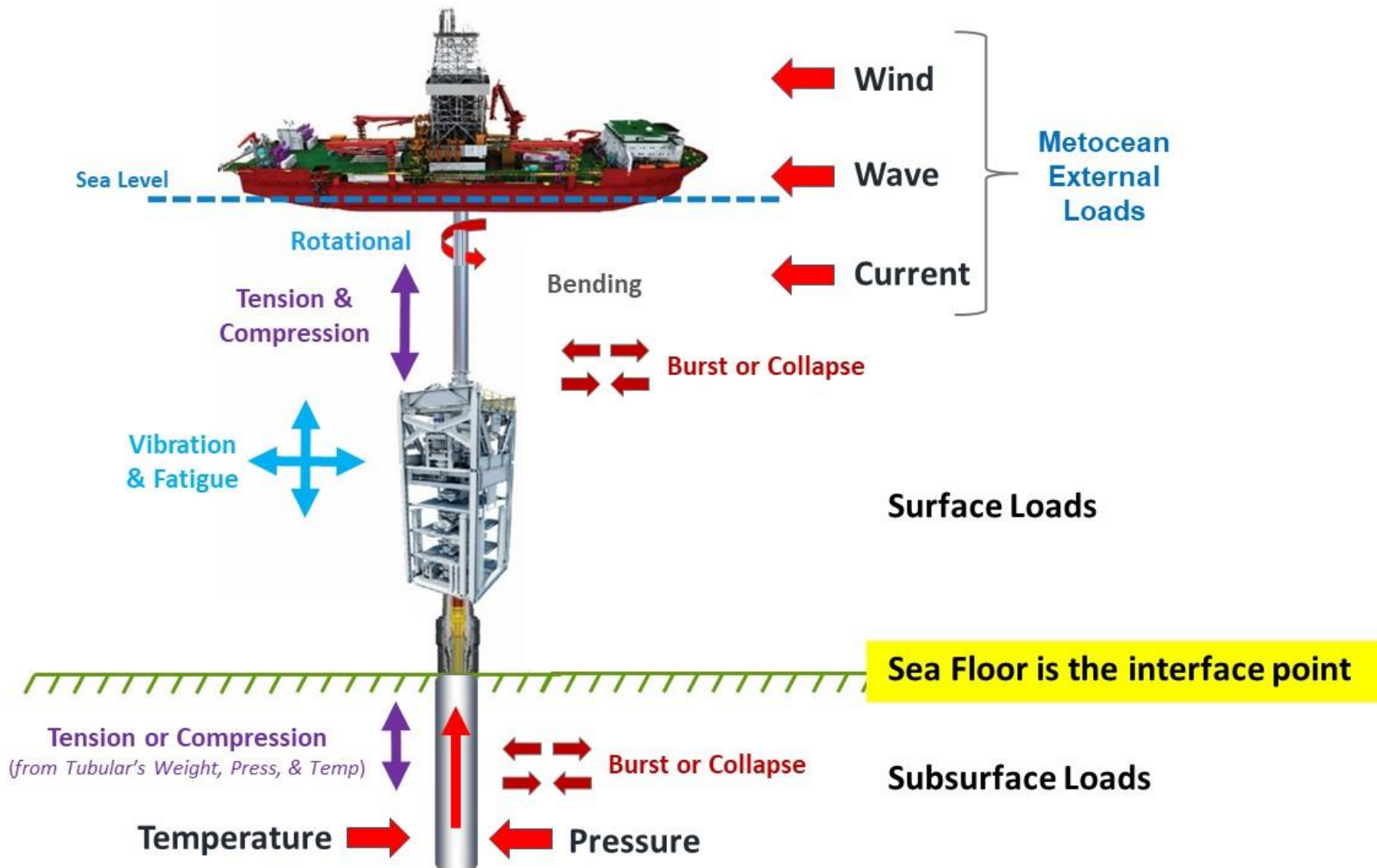
Whole Life Cycle Modes

► Systems engineering approach

"Whole Life Cycle"



Load Identification & Bracketing



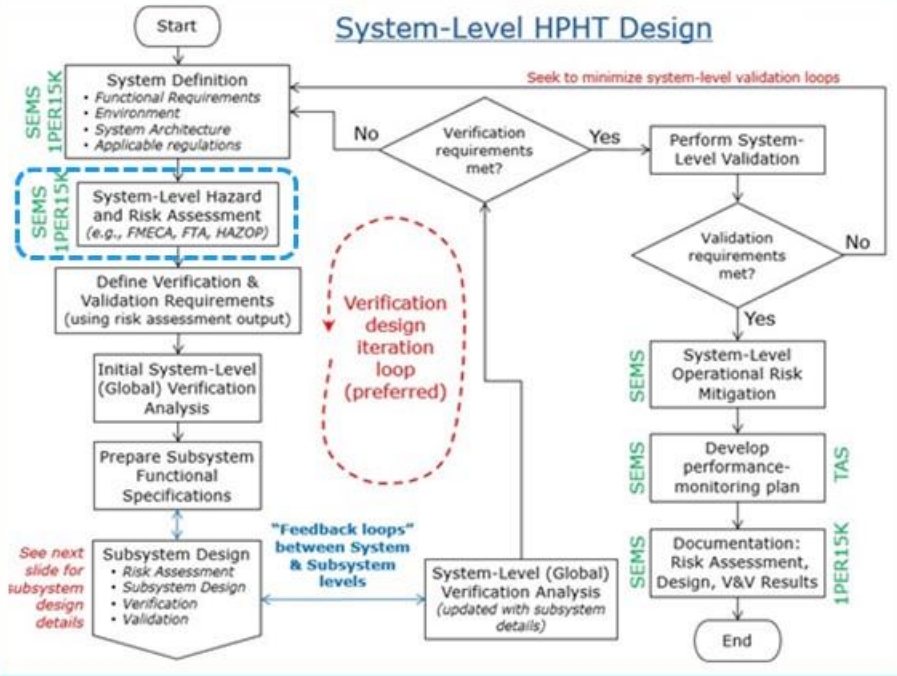
System Design Flow

Operator

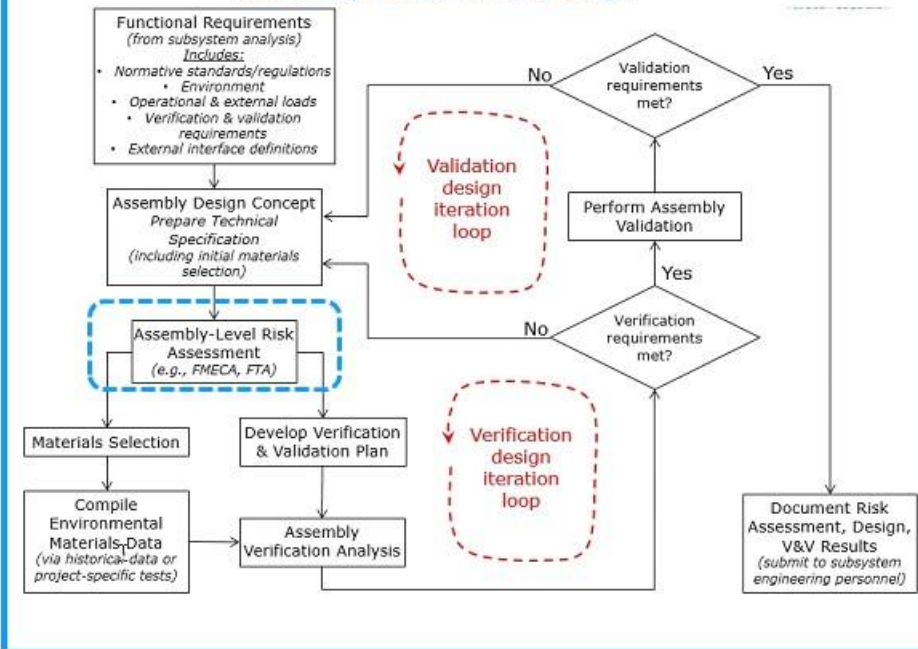
Supplier



System-Level HPHT Design



Assembly-Level HPHT Design



Verification = Calculations & Computer Modelling

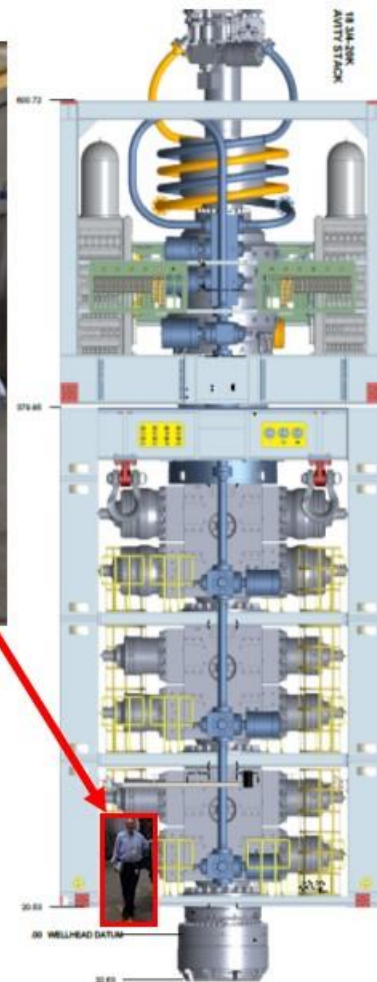
Validation = Instrumented Testing (Subscale or Full Scale)



Validation Testing Examples



Tubing
Connection
Testing



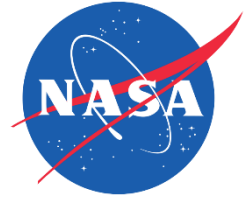
Control Line
Connector Testing



Connector Testing
Combined Loading: Pressure, Tension,
and Bending



Integrated PRA Model



Risk - “Loss of Containment” during a rig operation

Mobile Offshore Drilling Unit



Riser

LMRP

BOP Stack

Subsea Wellhead



Rig Floor



Bridge / Quarters



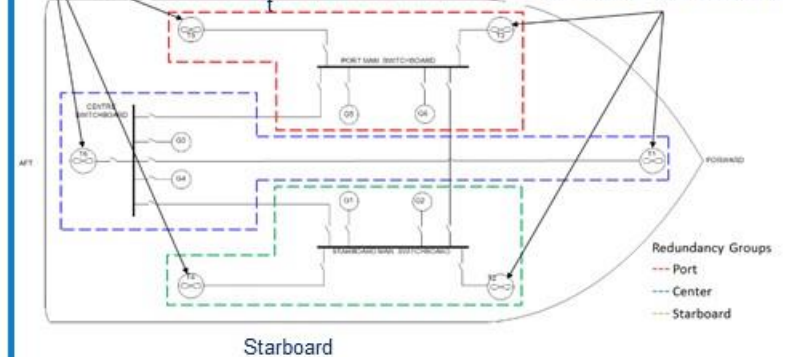
Kick Detection

- Flow sensors
- Pit level sensors
- Pressure sensors
- Temperature sensors
- Gas sensors
- Hook load sensors
- Rig floor
- Mudlogging Unit
- LWD Unit
- Onshore monitoring

Aft Thrusters

Port

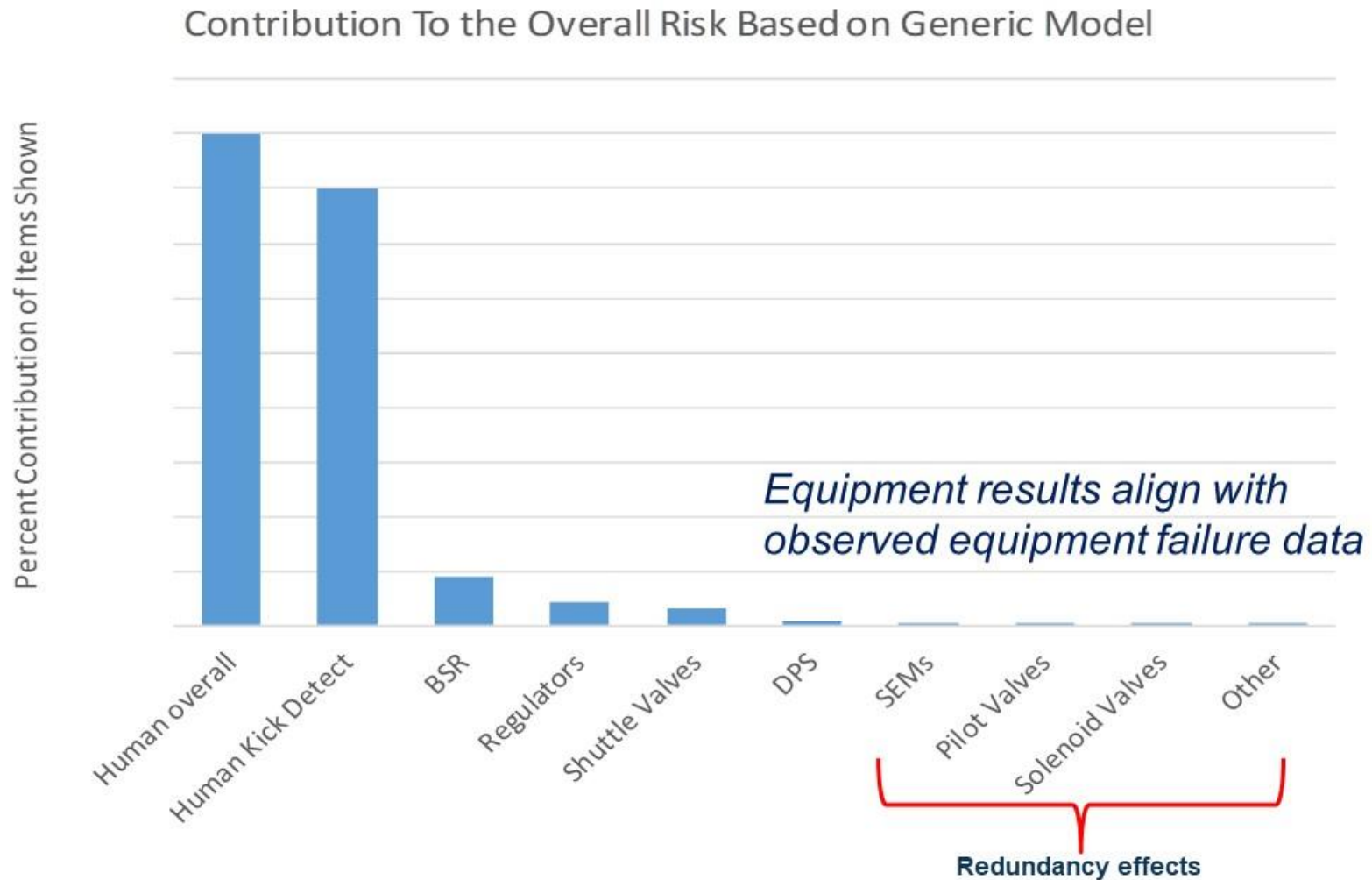
Forward Thrusters



- Blowout Preventer
- Dynamic Positioning System
- Human Factors / Response
- Kick Detection System

Probabilistic Risk Assessment (PRA) Overall Results

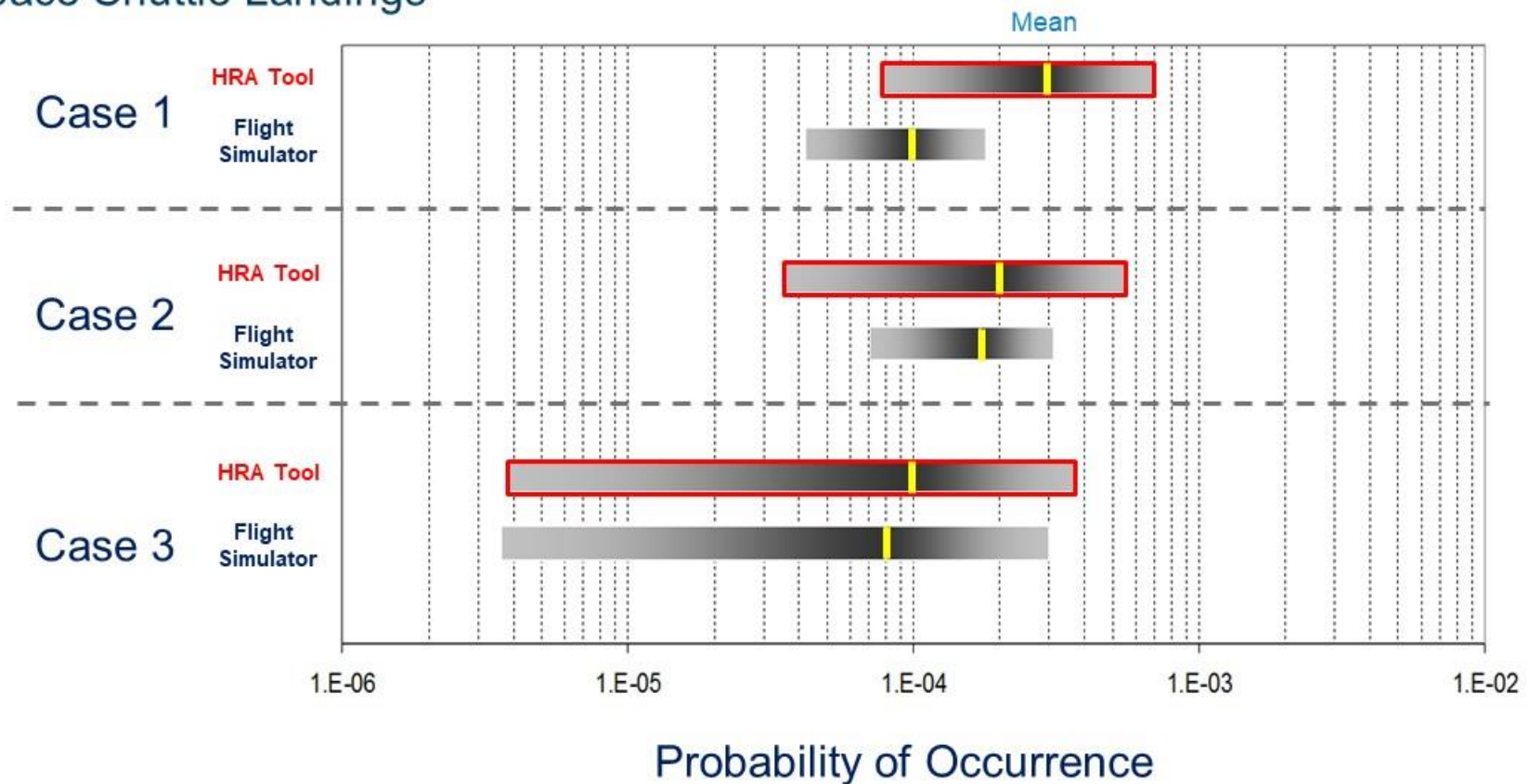
- ▶ Human contribution to the overall risk for the generic configuration



Next Steps – Human Factors

Human Reliability Analysis Tool Predictions Versus Simulator Results

Space Shuttle Landings



Summary

- **Anadarko and our suppliers have been performing an extensive development program for 20K subsea equipment since 2014**
 - Currently finishing all testing, 4Q18 / 1Q19
 - Developing and submitting the I3P reports to BSEE 4Q18 / 2Q19
- **Extensive technical rigor, documentation, and review is being performed to mitigate “Serial #1” risks**
- **Anadarko sees value in PRAs, working on how best to use the methodology**
 - Will continue to collaborate with BSEE and NASA on PRA modeling

Thank you

