Recommendations for ARIES Vacuum Vessel Design Loads

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Introduction

- At the last meeting I discussed the ITER Vacuum Vessel design loads
- I will briefly review them and make recommendations for ARIES design loads

References

- Load Specification for the ITER Vacuum Vessel - ITER_D_2F52JY v.2.2
- ITER Vacuum Vessel Dynamic Stress Analysis of a Disruption, B. W. Riemer, D. L. Conner, D. J. Strickler, D. E. Williamson, from osti.gov
- Structural Analysis of the ITER Vacuum Vessel from Disruption Loading with Halo Asymmetry, Bernard W. Riemer, Royce 0. Sayer, from osti.gov
- Design and development of the ITER vacuum vessel, K. Koizumi, et al, Fus Eng Des, 41(1998)299–304

Anticipated Loads

- Weight of Structures (including load paths)
- Pressure Loads
- Thermal Loads
- Baking

Off-Normal Loads

- Seismic
- Disruptions
- Vercial Displacement Effects
- Magnet fast discharge
- In-vessel pipe leakage
- Multiple FW pipe break
- Large VV ex-vessel coolant pipe break
- Loss of flow
- Air ingress in cryostat

Non-Specific Load Cases

- Weight of in-vessel transporter
- Transient effects during heating and cool down before and after baking.
- EM loads during ramp-up of magnetic coil currents
- Thermal shield leak
- Loads during transport and assembly of the sectors
- EM loads due to pulsed operation of central solenoid
- EM loads due to ramp-up of magnet coils.

Combined Loads

- Single load cases must be combined appropriately
- Combined loads are classified as normal, exceptional, hypothetical, and test

Proposed ARIES Philosophy

- Ignore cases where we have insufficient design detail
- Try to focus on items likely to affect design or performance (most critical cases)
- Consult ITER staff regarding our judgment in this regard
- Use ITER Structural Design Criteria unless significant advantage can be gained by more detailed analysis

Outcome

- Skip all "Non-Specific Load Cases"
- Consider all cases listed as "Anticipated Loads"
  - Even bakeout?
  - Do we have all information needed to analyze?
    - Weights and load paths
    - Pressures
    - Heat loads
    - Bakeout conditions

Outcome (continued)

- Off Normal Loads
  - Consider seismic, disruptions, LOCA, LOFA, in-vessel pipe break
  - Can we characterize loads?
    - Seismic requires siting
    - What about disruptions?
- Combined Loads
  - I recommend we address this after single load cases are completed

Summary

- Do all relevant Anticipated Loads
- Do Off-Normal Loads if possible
- Skip Non-Specific Cases
- Consider feasibility of Combined loading once single-event cases are complete