

FEM analyses of the ITER EC H&CD torus diamond window unit towards the prototyping activity

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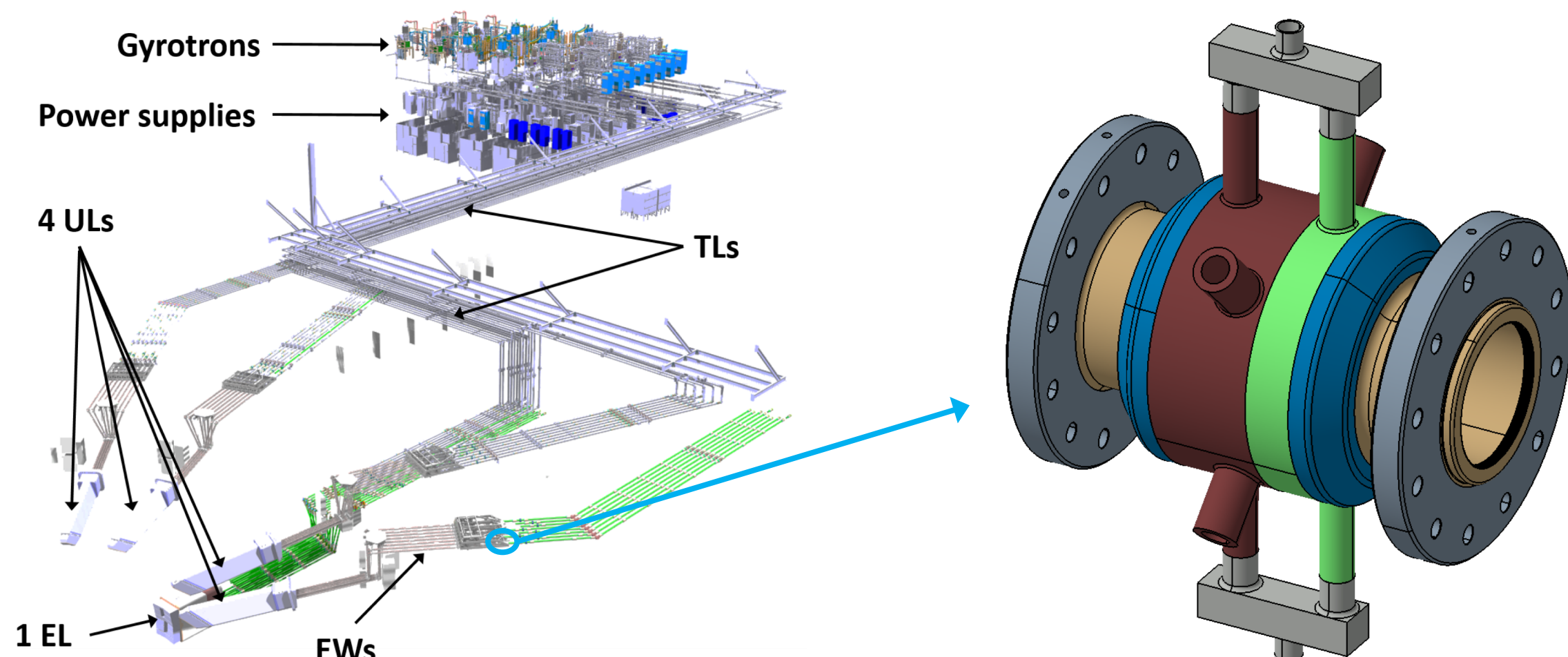
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Motivation

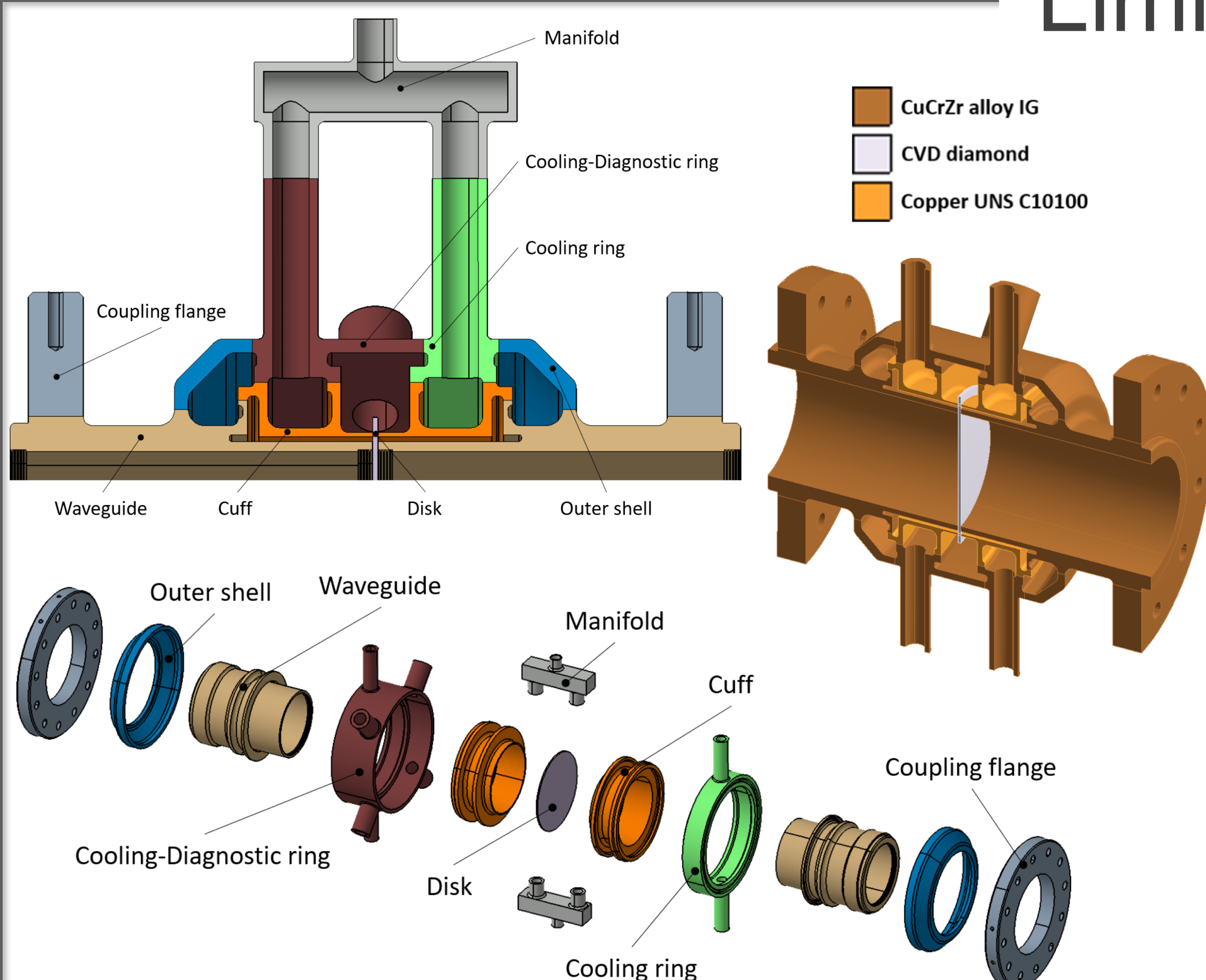
Design of the torus window unit ready to start prototyping and testing activity (upcoming window FDR, but not yet frozen design of the systems surrounding the window)



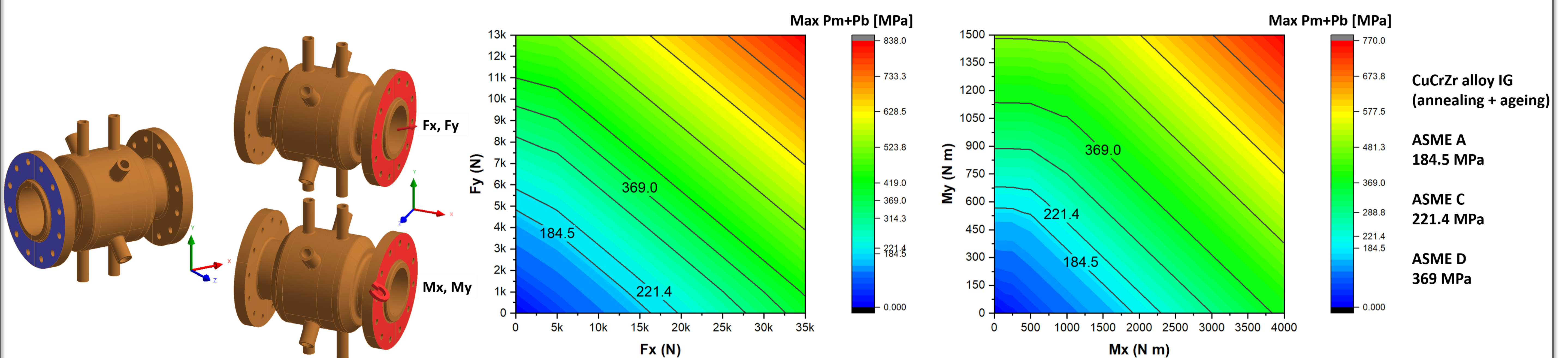
Objectives

- Define requirements for the interface systems of the window in terms of maximum acceptable loads that might be transmitted to the window
- Check the impact of material degradation (due to temperature cycle of brazing process) on the capability of the window outer frame to withstand external loads
- Prove the soundness of the window design before starting the prototyping and testing activity

Limit analysis approach



- A final global analysis of the EWs to provide inputs to the window analysis for the external loads is not currently feasible: not yet frozen design of the EWs
- Limit analysis to find the maximum loads that generate stresses in the window equal to the allowable limits in accordance to: $P_m \leq kS_m$ and $P_m + P_b \leq 1.5kS_m$
- Two separate structural analyses with several combinations of forces and moments
- Linearization of resulting stresses and maximum stress components reported in contour plots for both the forces and the moments
- Limit combination of forces and moments for selected design criterion and ASME service level (limit lines in the plots)
- External loads due to both the EWs and TLs systems shall lay in the area of the plots underneath the limit lines of interest
- Total stress due to both forces and moments shall be lower than the allowable limits (generation of grids with stress values from plots)



Analysis strategy

- Structural analyses with properties of degraded CuCrZr (tensile tests by F4E) to check the impact on window outer frame and optimize design, if required
- Limit analysis to cover all analyses involving the external loads for the window and generate the stress contour plots
- Analyses with load combinations ruled by the limit analysis approach to show that the window design is sound enough for the prototyping: worst case scenarios from limit analyses combined with normal operation (NO), NO plus internal fire, NO plus overpressure
- Analyses for hot spot case and failure of the feeding water system

Outlook

- Prototyping and testing of the window unit
- 2020/2021: window Final Design Review (FDR)
- Qualification of the 56 diamond disks and torus window units for the ITER UL and EL plugs

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