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Inertia load analysis of ITER equatorial and upper port plug EPP9 and UPP14

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Inertia load analysis of ITER equatorial and upper port plug EPP9 and UPP14

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The work presented in this paper mainly focuses on the response spectrum analysis of ITER diagnostic equatorial port plug (EPP) and upper port plug (UPP) structure assemblies to extract dynamic behavior of PPs and the in-port diagnostic systems due to transient vacuum vessel (VV) movements during plasma vertical displacement events (VDEs) and seismic loading. The generic port plug structural models were provided by ITER Organization (IO). Based on the generic EPP models, the US ITER equatorial port #9 Diagnostic Shielding Module (DSM) with in-port systems such as the Electron Cyclon Emission (ECE) was integrated in and the latest design of closure plate was used to replace the simple plate in the generic model too to ensure structural integrity. For the UPP14 model, diagnostic first wall (DFW), Glow Discharge Cleaning (GDC) system, wide-angle viewing system (WAV) and DSM shielding blocks etc. are updated to latest design based on the generic UPP model.
Two types of response spectrum analysis (RSA) were performed: The floor response spectra (FRS) analysis based on random vibration (power spectrum density (PSD)) is to provide the input response spectra for the RSA of next level components in their system integration design and inertial load calculation. The RSA based on deterministic method (Multi-Point Response Spectrum (MPRS)) is to compute the steady state inertial loads of the components currently in our design. Four load cases were simulated and results are provided in this paper: plasma vertical displacement events (VDE-II, VDE-III, VDE-IV) and seismic event (SL-2).
However, RSA gives only steady state result. For VDEs which last only for a very short time, less than half second, the system may not reach steady state so that the energy may not accumulate to reach maximal response as RSA calculated. Thus a transient run would be better to determine the dynamic behavior of the system. There are infinite numbers of time histories that are compatible to a given spectrum. Currently many commercial softwares exist to generate time histories for seismic qualification but almost nothing available for plasma VDEs. This paper provides the typical process to generate artificial time history for VDEs. For our model, two time histories are created and used to run the UPP14 model. Although the two results have relatively big difference at this time, when we have more information on the real disruption behavior of the VV, i.e. how the magnitude gradually increases, holds and decreases etc., this method can be improved.

Eligible for student paper award?

No

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