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Exploratory risk analysis of ITER Cask & Plug Remote Handling System

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An exploratory risk analysis of ITER Cask & Plug Remote Handling System (CPRHS) has been performed under a system engineering approach considering the CPRHS in various operational states with the associated loads.

A Functional Breakdown Structure was developed from the 4 main functions fulfilled by the CPRHS: to dock, to handle, to transport and to confine. During Tokamak maintenance operations, various operating states and locations were defined for the CPRHS. In regard to the safety function, to confine, specific configurations were considered to capture all relevant loading cases.

A Failure Mode Effects & Criticality Analysis has been made by identifying potential failures of basic functions to be fulfilled by CPRHS during the maintenance of a Diagnostic Port Plug and quantifying them in terms of Criticality defined as the product of the failure Occurrence and Severity. The Severity rating scale was related to unavailability of the function due to both technical and safety issues.

Specific analyses of docking operations in the different cells and traveling operations in different rooms while taking into account the safety constraints were made leading to recommend actions for mitigating the failures having the highest criticality levels.

In order to perform a sensitivity analysis on maintenance duration by means of statistics approach, the failure modes of CPRHS basic functions were introduced in the schedule Primavera Risk Analysis software which uses a probabilistic Monte Carlo approach. The failure modes were considered as task dependent activities with a duration equal to Mean Time To Repair and an existence likelihood equal to the product λ x DC where λ is the failure rate and DC is the Duty Cycle of the failed basic function.

CPRHS availability and operations time were then addressed while considering the impact of the failure modes on maintenance operations time and the benefit of mitigation actions.

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