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P3.146 Rescue and recovery studies for the DEMO blanket transporter

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RACE has been developing a concept design for the remote maintenance system for the EUROfusion DEMO powerplant. Within the DEMO tokamak, tritium breeding blankets will require periodic replacement which is currently designed to utilize the upper vertical ports at the top of the vacuum vessel. This operation will be challenging due to the scale of the blankets (~10m tall, up to 80 tonnes). The blanket transporter has previously been presented as a key high technical risk system for the blanket replacement process. The concept has subsequently been reviewed by several independent industrial experts who highlighted break-down rescue and recovery as significant unaddressed risk. Rescue and recovery is often overlooked in the early stages of concept development, resulting in expensive, compromised solutions having to be incorporated later to comply with regulatory requirements. Addressing this issue early provides more scope for design solutions, but inevitably increases the complexity of the concept design.

This paper outlines the process used to identify the key hazards resulting from failure scenarios and the improvements made to the concept design to mitigate them to enable successful recovery and/or rescue. Possible failure modes were identified via input from industrial experts, completion of a Design Failure Mode, Effects and Criticality Analysis (DFMECA) and a Hazard and Operability studies (HAZOP). An Analytic Hierarchal Process was used to create a prioritised list of key failure scenarios, comparing the likelihood and severity of each. Key design changes for each scenario were identified, reviewed and, where possible, consolidated into a single solution to produce an efficient solution. Mitigation of the failure scenarios were achieved by providing secondary load paths in the main structure, redundancy in key components (such as motors) and the inclusion of additional features that allowed secondary recovery equipment to engage to assist recovery.

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