Karlsruhe Institute of Technology
Institute for Neutron Physics and Reactor Technology
Hermann-von-Helmholtz Platz 1, 76344
Eggenstein-Leopoldshafen, Germany
alessandro.spagnuolo@kit.edu

Development of load specifications for the design of the breeding blanket system

G. A. Spagnuolo[1], L.V. Boccaccini[1], G. Bongiovì[1], F. Cismondi[2], I. A. Maione[1]
[1]Karlsruhe Institute of Technology (KIT), Institute for Neutron Physics and Reactor Technology (INR)
[2]EUROfusion Consortium, Programme Management Unit

Motivation

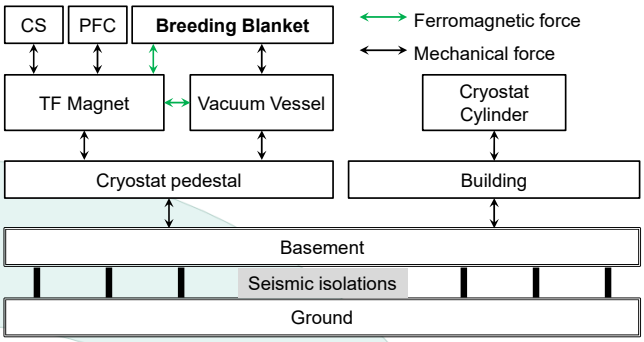
- ❑ List of all relevant single loads and load combinations
- ❑ Categorization of relevant load combinations
- ❑ Identification of the load combinations short list relevant to the Pre-Conceptual Design (PCD) phase

Load categories and damage levels

Loading Category	Damage Limit	Criteria Level
Category I: Operational Loading Conditions	Normal test	Level A
Category II: Likely Loading Conditions ($f > 10^{-2}/a$)	Upset	Level B
Category III: Unlikely Loading Conditions ($10^{-2}/a > f > 10^{-4}/a$)	Emergency	Level C
Category IV: Extremely Unlikely Loading Conditions ($10^{-4}/a > f > 10^{-6}/a$)	Faulted	Level D

- ❑ Criteria levels defined according to RCC-MRx
- ❑ Events, with lower occurrence frequency than the Cat- IV, are not considered within the design basis

Path of the main loads



Breeding Blanket Load Specifications Document

Single loads

Load	Type
Dead Weight	Inertial loads
Seismic	
State	
Test	
In-Vessel LOCA	Pressure loads
In-Box LOCA	
Ex-Vessel LOCA	
Normal operational	
Accidental events	Thermal loads
Off normal transients	
Plasma pulse	EM loads
Off-normal	

Short list of load combinations for the HCPB and WCLL BB for the PCD phase

Cat.	DEMO Operat. State	Plasma state	Press./ Magn./ Seis.	Initiat. event	Concaten. event
I	POS	Normal cycle	-	-	-
I	POS	Fus. Power excursion	-	-	-
II	POS	MD II	-	MD II	-
II	POS	VDE II	-	VDE II	-
II	POS	MD I	SL-1	SL-1	MD I
III	POS	MD III	-	MD III	-
III	POS	VDE III	-	VDE III	-
IV	POS	Normal cycle	SL-2	SL-2	-
IV	POS	Normal cycle	-	-	Ex-Vessel LOCA
IV	POS	Normal cycle	-	In-Box LOCA	-

Pressure and temperature loads in each state

Component		Fluid	Pressure test	Normal Operation	Design value
HCPB BB	FW + BZ	Helium	17.801 MPa 20 °C	8.0 MPa 300 °C	9.2 MPa 550 °C
	PB	Helium	0.445 MPa 20 °C	0.2 MPa 450 °C	0.23 MPa 550 °C
	FW	Water	25.570 MPa 20 °C	15.5 MPa 295 °C	17.825 MPa 344.8 °C
WCLL BB	BZ	Water	25.570 MPa 20 °C	15.5 MPa 295 °C	17.825 MPa 344.8 °C
		PbLi	0.742 MPa 20 °C	0.45 MPa 326 °C	0.5175 MPa 344.8 °C

EUROfusion

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