AWP 2022
Title: Global model and independent verification
IMS task ID: DIV-IDTT.P.1-T014, DIV-IDTT.S.02b-T002 – T004

DIV-IDTT.P.1-T014 Del. Owners: G. Ramogida, A. Marin

DIV-IDTT.S.02b-T002 – T004

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Deliverables and allocated resources:

DIV-IDTT.P.01-T002

ID	Deliverable Title	Start Date	Due date	Beneficiary	Del. Owner	Standard ppm	Industry ppm
D001	Report on 2022 activities on disruption definition and simulations	01/01/2022	31/12/2022	ENEA (DTT)	G. Ramogida	2.0	
D002	Report on 2022 activities on global model and analyses	01/01/2022	31/12/2022	ENEA (LTC)	A. Marin		4.0

Global model and independent verification - Tasks 2022

Tasks and allocated resources:

DIV-IDTT.S.02b

ID	Deliverable Title	STATUS	Due date	Beneficiary	Del. Owner	Standard ppm	Industry ppm
T001	Update and final set-up of EM global model – 2022 (see S. Turetta presentation)	On-going	31/12/2022	ENEA (LTC)	A. Marin		~~4.0~~ 5.0
T002	Database of disruptive events from 3D model and comparison with 2D simulations – 2022 (see R. Lombroni / G. Ramogida presentation)	On-going	31/12/2022	ENEA (Create, UniTus, LTC)	F. Villone, G. Calabrò, A. Marin	6.0	~~3.0~~ 2.0
T003	Database of magnetic and thermal field distribution inside vessel and ports – 2022	Resources identification	31/12/2022	ENEA (ENEA) tbc	O. Tudisco, tbd	6.0	
T004	Non-linear MHD codes disruption modelling for validation of engineering simulations - 2022	Resources identification	31/12/2022	ENEA (RFX) tbc	D. Bonfiglio tbc	3.0	
T005	Global thermo-mechanical analyses - 2022	Started	31/12/2022	ENEA (LTC)	A. Marin	9.0	
T006	Independent verifications by FE analyses – 2022 (see S. Turetta and S. Desiderati presentation)	On-going	31/12/2022	ENEA (LTC)	A. Marin	9.0	

Deliverables and allocated resources:

DIV-IDTT.S.02b-T002

ID	Deliverable Title	STATUS	Due date	Beneficiary	Del. Owner	Standard ppm	Industry ppm
D001	3D 2022 disruption model and database of excitations evolution	Started	31/12/2022	ENEA (CREATE)	F. Villone	4.0	
D002	Disruption definitions and 2D simulations - 2022	Completed	31/12/2022	ENEA (UniTus)	G. Calabrò R. Lombroni	2.0	
D003	Comparison of 3D excitations with 2D simulations - 2022	Expecting 3D	31/12/2022	ENEA (LTC)	A. Marin		~~3.0~~ 2.0

Deliverables of DIV-IDTT.S.02b-T002:

Database of disruptive events from 3D model and comparison with 2D simulations -2022

- Objective: completing the features list of significant plasma disruptions and off-normal terminations to be used in the evaluation of the design EM loads
- Events considered: worst-case events (Fast Major Disruptions, Fast and Slow Vertical Displacement Events, TF coil fast discharge), other significant events (less dangerous but more frequent as events at reduced plasma current or mitigated VDEs quenching before becoming too displaced)
- Tools: 3D model (Carma0NL) for worst case events, including local path of induced and halo current in 3D structures (VV, divertor, FW and supports); 2D model (Maxfea) to benchmark worst case events and simulate other events, including toroidal induced currents and rough evaluation of poloidal and halo currents in VV, divertor, FW and supports → Due to availability of resources in first months of 2022, a different approach has been adopted: 2D model for worst cases analyses, 3D model for benchmark analyses, late in 2022
- Output: plasma evolution (as current filaments), induced currents (including halo currents in divertor, FW and supports), EM loads and field variations in proper locations

Deliverables of DIV-IDTT.S.02b-T002:

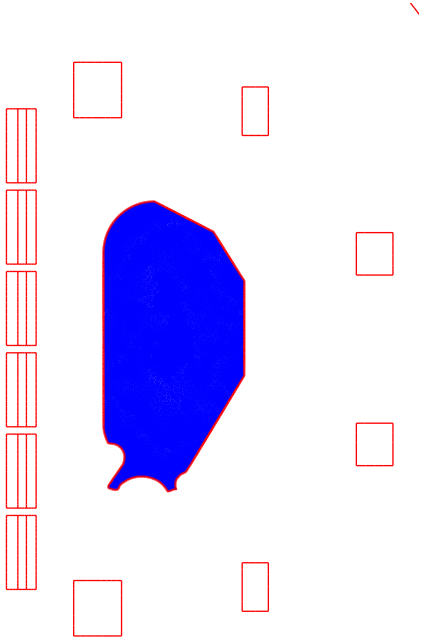
Database of disruptive events from 3D model and comparison with 2D simulations -2022

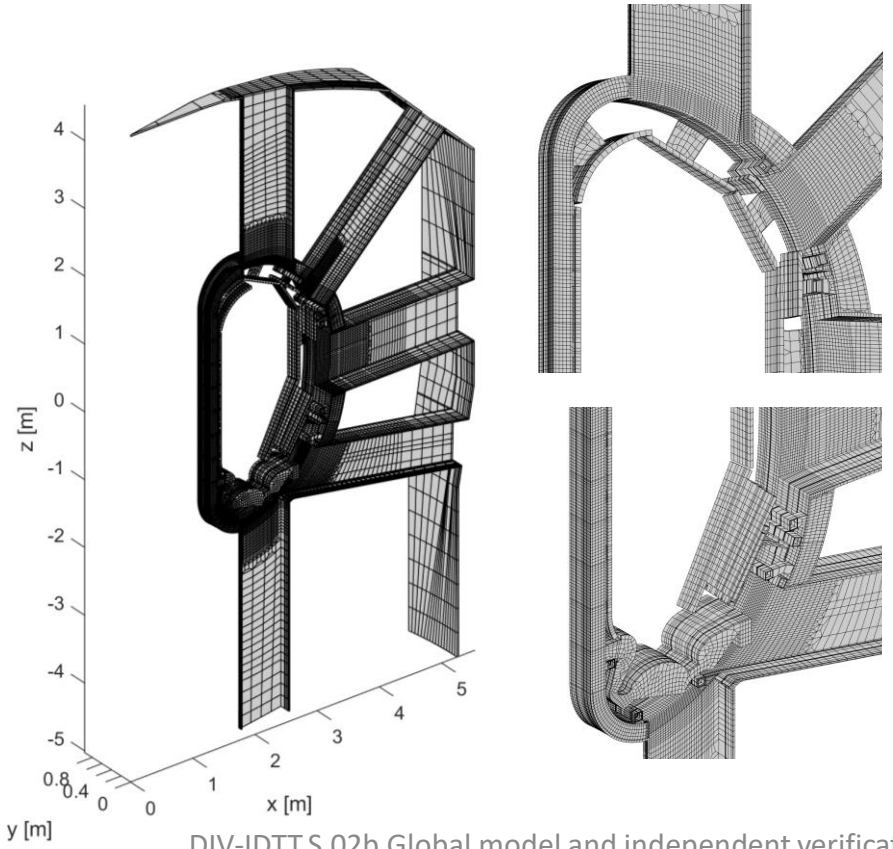
The deliverables of this task are:

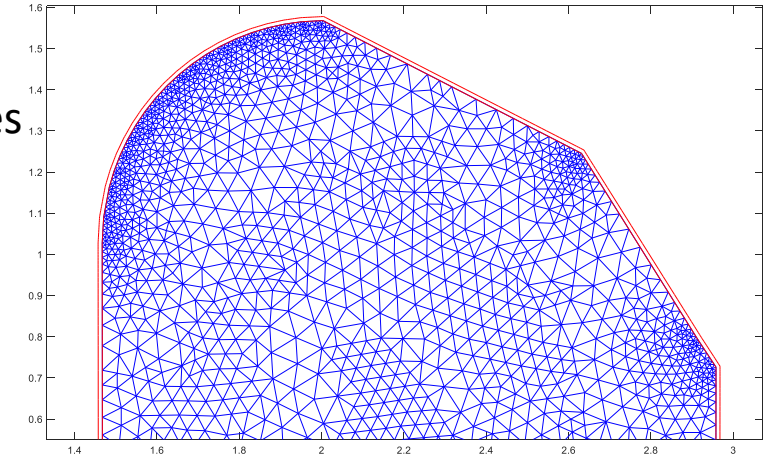
- D001: 3D 2022 disruption model and database of excitations evolution → see next slides
  - Update of the DTT 3D model by Carma0NL and simulation of worst-case events, providing input by plasma filaments evolution, field variations and induced currents on 3D structures to the subsequent EM analyses with global model
- D002: Disruption definitions and 2D simulations – 2022 → see R.Lombroni /G. Ramogida presentation
  - Update of the list of features identifying the worst-case and other significant disruptions
  - Update of the DTT 2D model by Carma0NL and simulation of worst-case and other significant events, providing input by plasma filaments evolution, field variations and induced toroidal currents on axisymmetric structures to the subsequent EM analyses with global model
- D003: Comparison of 3D excitations with 2D simulations – 2022 → on hold, waiting for 3D excitations
  - The Deliverable shall provide a check of the most significant input coming both from 2D and 3D disruption models comparing them and performing additional verification based on proper check lists.

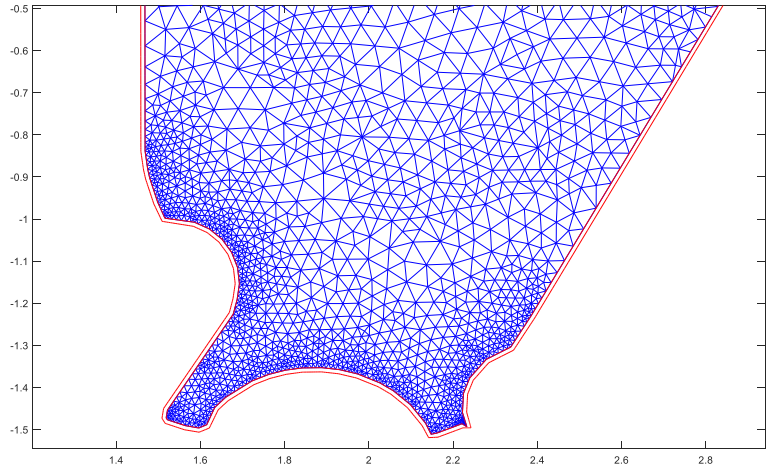
3D 2022 disruption model and database of excitations evolution
DIV-IDTT.S.02b-T002-D001: Activities carried out in 2022

- Creation of a mesh of the plasma region
- Adaptation of an existing volumetric 3D mesh of the conducting structures
- Simulation of some disruptive events
- Production of inputs required for subsequent EM analysis

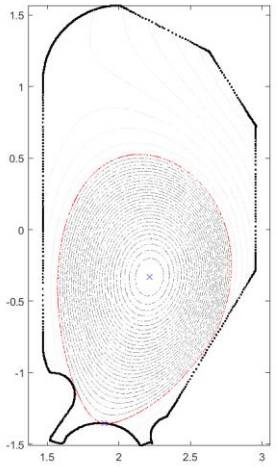
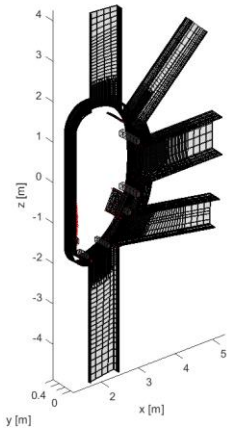
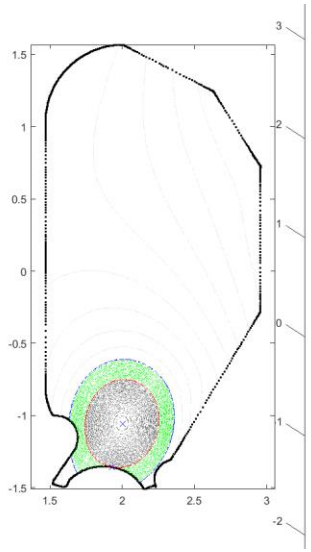
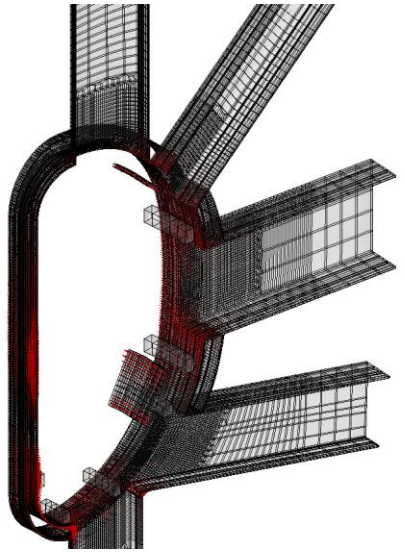
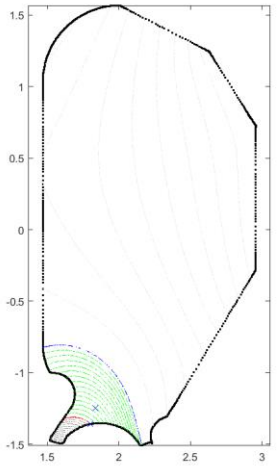
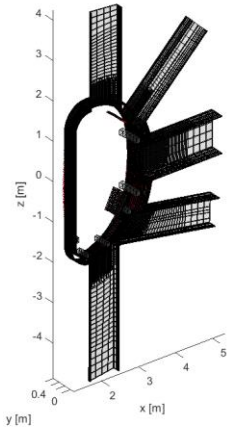
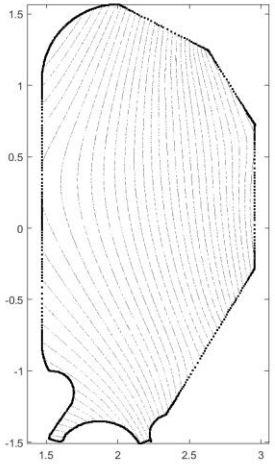
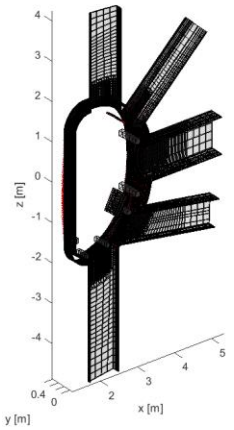






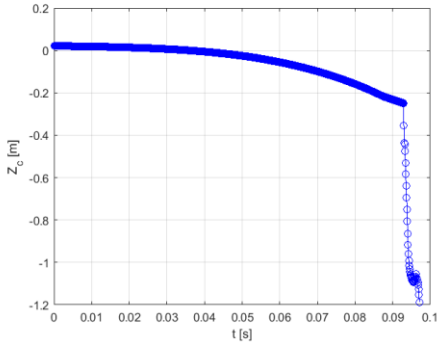


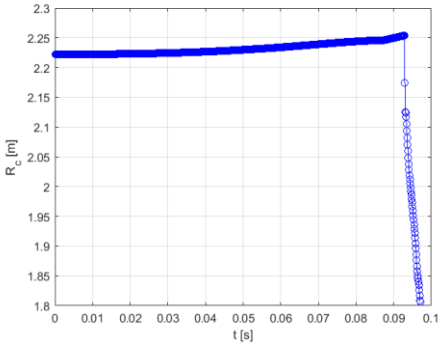
3D 2022 disruption model and database of excitations evolution
DIV-IDTT.S.02b-T002-D001: Fast major disruption simulation

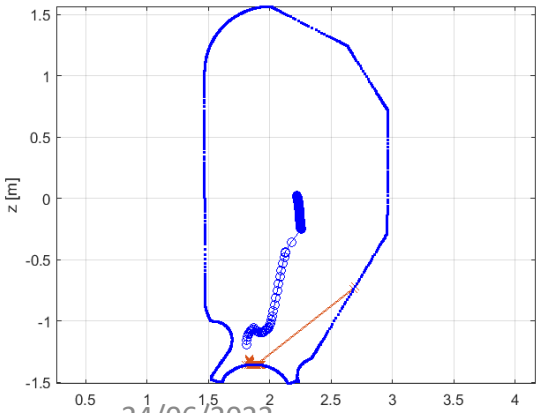









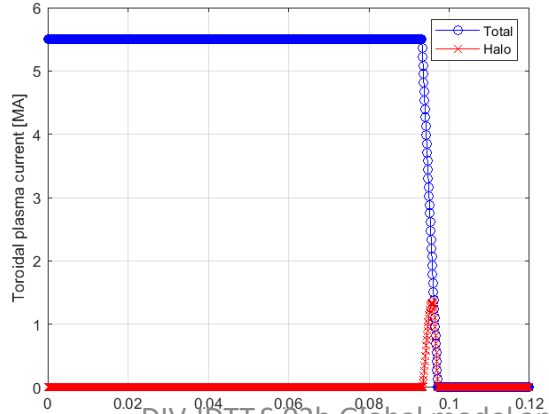
3D 2022 disruption model and database of excitations evolution
DIV-IDTT.S.02b-T002-D001: Workplan

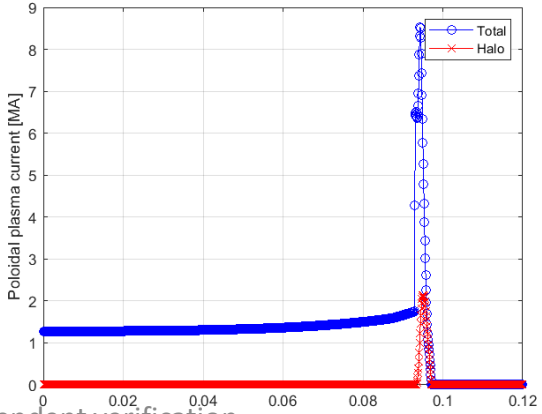
- Selection of events (starting equilibrium, TQ time, CQ time)
- Simulation of chosen events
- Estimate of time evolution of main plasma parameters (current, halo, trajectory)
- Calculation of inputs to be used for EM analyses
  - Position (r,z) of the equivalent filaments on first wall
  - Time base
  - For each time instant, value of equivalent currents on first wall
  - Time evolution of plasma toroidal flux
  - For each instant, the value of the function (f-f0)*2*pi/mi0 over the first wall (related to poloidal halo current)











Database of of magnetic and thermal field distribution inside vessel and ports

Deliverables and allocated resources:

DIV-IDTT.S.02b-T003

ID	Deliverable Title	STATUS	Due date	Beneficiary	Del. Owner	Standard ppm	Industry ppm
D001	Database of fields and plasma profiles in reference scenarios - 2022	Started	31/12/2022	ENEA (ENEA)	O. Tudisco L. Boncagni tbc	3.0 tbc	
D002	Database of fields and plasma profiles during disruption events - 2022	Resources identification	31/12/2022	ENEA (tbd)	tbd	3.0 tbc	

A reorganization of the task is undergoing with the following objectives:

- Create a local depository of Equilibrium runs of DTT, compatible possibly with DTT CODAS architecture.
- Data will be accessible via MDS+
- Integration of the other code outputs in the DB.

The availability of the personal to work on this task is under investigation (proposed PL : O. Tudisco / L. Boncagni)

Deliverables of DIV-IDTT.S.02b-T003:

Database of disruptive events from 3D model and comparison with 2D simulations - 2022

(to be revised)

- Objective: To prepare a full set of input data as required in the diagnostics and other components design to represent the load conditions, which these components will be exposed to, during normal operations and plasma disruption events. The data shall be produced as excel or matlab tables, or according to other tasks requests, and shall be obtained from DTT reference plasma scenarios (available as eqdisk files), reference disruptions (task DIV.IDTT.S.02-T002) and other physics and engineering evaluations
- Output: Time evolution and the poloidal distribution in vessel and ports of the magnetic field and flux surfaces, thermal load on the plasma exposed regions, plasma temperature and density profiles. The aim of the task is mainly providing an interface between existing simulations and requirements from design

Deliverables and allocated resources:

DIV-IDTT.S.02b-T003

ID	Deliverable Title	STATUS	Due date	Beneficiary	Del. Owner	Standard ppm	Industry ppm
D001	Disruptions modelling by non-linear MHD – 2022	Resources identification	31/12/2022	ENEA (RFX) tbc	D. Bonfiglio tbc	3.0 tbc	

Further resources have to be identified (1 pm only assured), to accomplish the minimum 2022 objectives:

- Create a first DTT model with Jorek code, suitable for simulation of shattered pellets deposition during disruptions

Deliverables of DIV-IDTT.S.02b-T003:

Non-linear MHD codes disruption modelling for validation of engineering simulations - 2022

- Objective: To prepare a DTT model to be used to simulate with a proper MHD non-linear code (JOREK, tbc) the evolution of plasma during a reference disruption, unmitigated or mitigated with Shattered Pellet Injection. The obtained evolution of macroscopic plasma features and/or EM loads shall be compared with quantities obtained in 2D and 3D EM disruption simulations (DIV.IDTT.S.02-T002).
- Output: A typical disruption shall be simulated to validate the model.