



## 9<sup>th</sup> WPSA Planning Meeting

Budapest, 5-9 September 2022

### WPSA Overview

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- 2014 - Milano
- 2015 - Padova
- 2016 - Napoli
- 2017 - Madrid
- 2018 - Barcelona
- 2019 - Sevilla
- 2020 - remote
- 2021 - remote



2022, May - General Meeting, remote

- **Main Building of the Hungarian Academy of Sciences (Széchenyi István sqr. 9)**
- Local Organizer: Plasma Physics Department, Centre for Energy Research
- **65 registered participants**
- **More than 40 in person**

- *First opportunity for an extended face-to-face discussion after a long time*
- *Great help for a team work*
- *Thanks to the local committee members for their availability and a lot of preparation work*

Superconducting coils -> **Long pulse operation**

High current and triangularity shape at large scale  
-> **Large-scale tokamak (>JET) & High confinement**

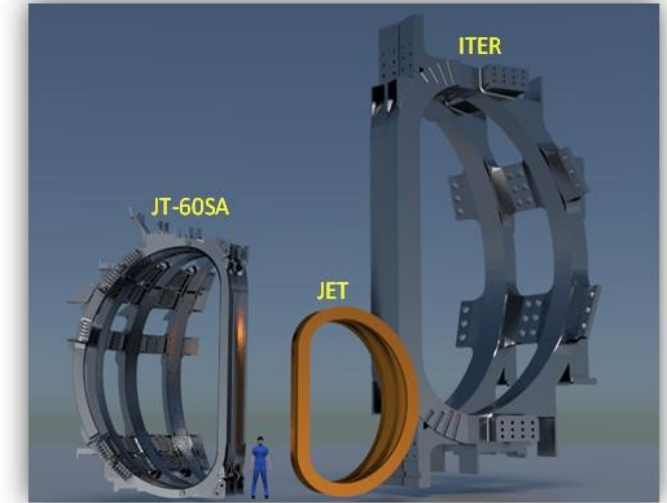
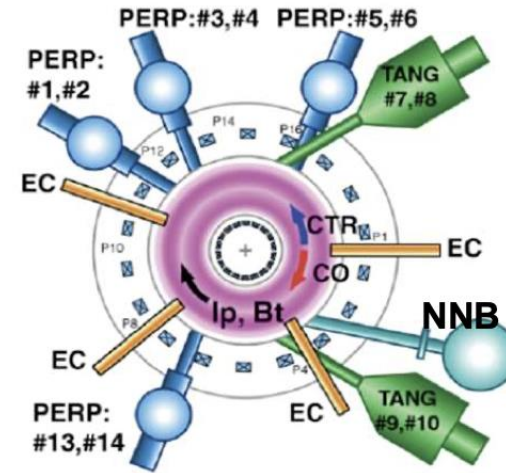
High electron and flexible heating:

- Positive NBI (85 keV, 24 MW) system
  - Negative NBI (500 keV, 10 MW) system
  - ECRH (7MW 100s @ 110/138GHz, 1s @82GHz)
- > **Energetic particles, ITER & DEMO scenarios, control**

Pellet and MGI system, (SPI under discussion=>high impact on the machine planning and scientific programme, decision in the next 6 months)

Error field correction coils & resistive wall mode control coils, stabilizing plates -> **Control capabilities**

Carbon wall with water-cooled W-divertor at later stage

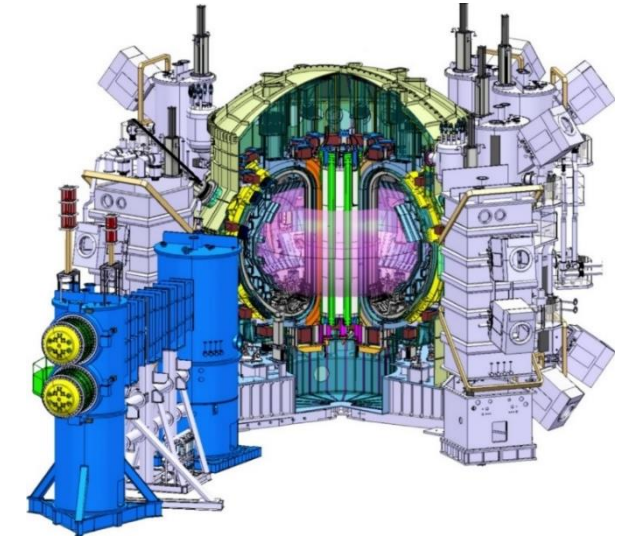


Parameters	JET	JT-60SA	ITER
Major radius [m]	2.96	~3.0	~6.2
Minor radius [m]	1.25	<1.18	<2
Plasma current [MA]	(<4.8)	<5.5	<15
Toroidal field [T]	4	<2.3/NbTi	<5.3/Nb3Sn
Plasma volume [m3]	~100	~140	~840
Pulse length [s]	~20	~100	>400



# WPSA: Exploitation of JT-60SA – project objectives

- EU Strategic priorities in the JT-60SA research program
  - 1. Development and investigation of **high performance scenarios** compatible with future **W-PFCs**.
  - 2. Avoidance and mitigation of **disruptions and runaways**
  - 3. **Fast ion** physics
  - 4. Development and validation of high level **real-time control** strategies
- support the exploitation of JT-60SA through a high quality EU participation, fully integrated in the EU fusion programme within the Broader Approach frame
- Maintaining/developing control room experience in a large superconducting machine in view of EU participation in ITER operation
  - play an **active role in scientific exploitation** and **campaigns management**
  - participation to the **machine operations**
  - contributing to an efficient **access to data and analysis** tools
  - contributing with the scientific support to the **machine enhancements**
- Contribution to **specific items of the ITER Research Plan**
  - Start-up, Wall conditioning (w and w/o EC)
  - Disruption loads, mitigation, detection, triggering, avoidance...
  - H-mode, L-H transition, ELM control, plasma magnetic control, NBI shine-through
  - Topics in diagnostics R&D (high neutron flux resilience, very high temperature, in-situ calibration...)





- Integrated Commissioning (plasma phase in particular) definitely in 2023
- Enhancement projects started in FP8 going towards the installation phase (with different amounts of delay)
- Experiment team: After the selection of the ET Leaders (2021), the topical group leaders have been nominated (2022) and have started to work
- Within EUROfusion, 2 (out of 3) contact persons have been selected: the aim of this role is
  - Facilitate the interaction of the Japanese TGLs
  - Help in promoting the scientific contribution of the EU experts in the related topic

# Present time schedule

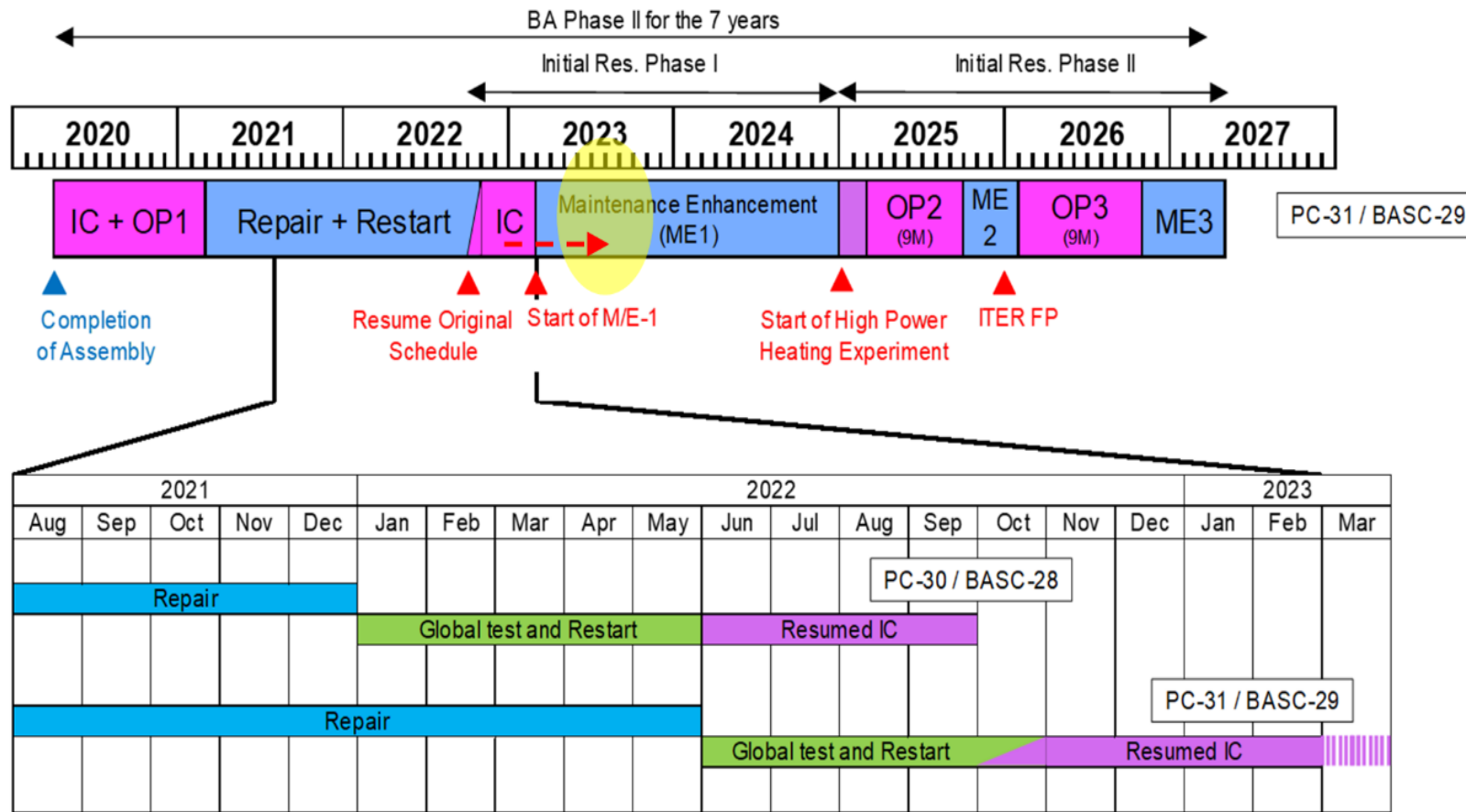


Fig.1 JT-60SA time plan after the 31st Meeting of the Satellite Tokamak Programme Project Committee (March 2022). A further (indicative) delay of several months should be accounted for, due to the weaknesses discovered in the pancake joints of the EF coils.

- The hypothetical period of the next IC phase after the discovery of this last issue is indicated in Figure 1 with the yellow area.
- Integrated commissioning may restart in early 2023, including HV tests in air, Paschen conditions and under 4K operating vacuum **(decision point after global Paschen test)**
- The possible impact of this on the start date and duration of the Machine Enhancement 1 period is not evaluated yet. Consequently, the start date of the scientific campaign OP.2 might fall outside or **just inside** the Grant Agreement period 2021-2025
- This last assumption is taken in the following

Main objective for the Operations area and the IC team

## Superconducting coils

Manufacturing, **testing**, installation, **commissioning** and operation of the superconducting coils, its cryo and protection systems

-> Paschen testing procedures

## Limited initial configuration, plasma breakdown, runaways:

Metallic wall with limited carbon first wall elements

No divertor, upper single null configuration

1.5MW ECRH to support plasma breakdown and burnthrough

Limited set of diagnostic (e.g. 1 interferometer line)

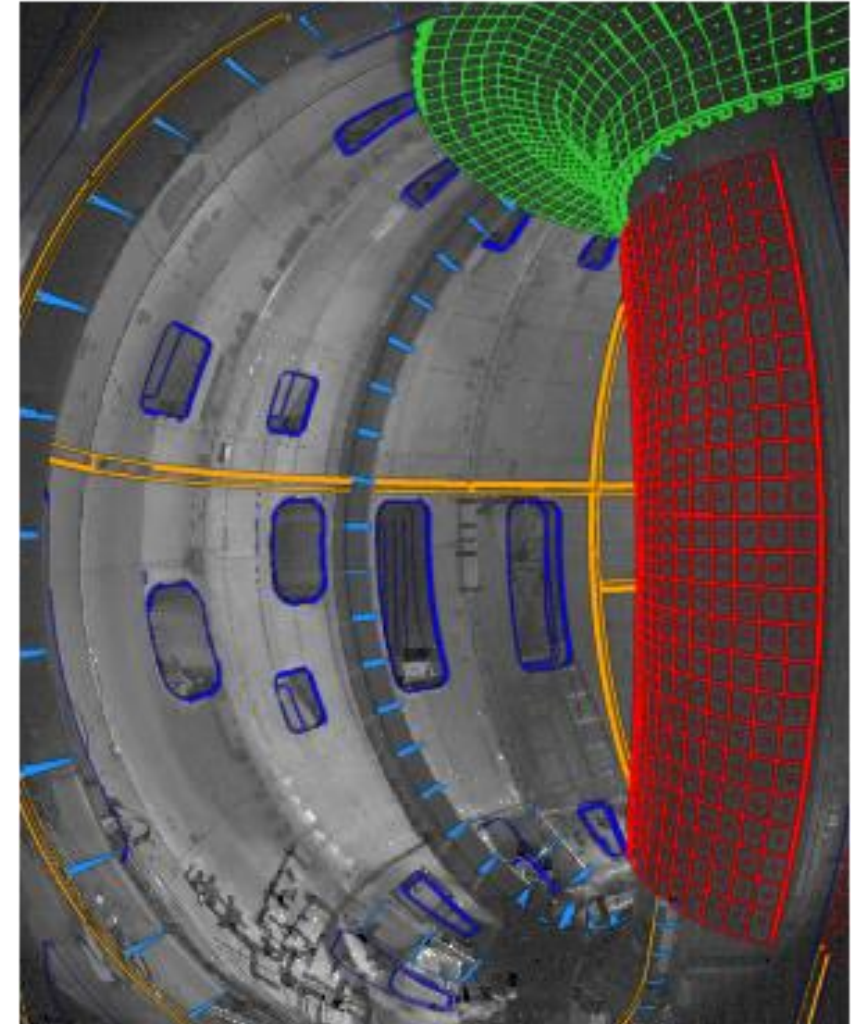
-> camera tomography (under EU lead) to provide profile measurement

## Vacuum conditioning:

Baking, Glow-Discharge-Cleaning (GDC, no TF), Electron-Cyclotron-Wall-Conditioning (ECWC, with TF)

@ Large-size (JET < JT-60SA < ITER)

Elements relevant to ITER, DEMO, DTT, STEP, ...



First EDICAM photo with the camera tomography calibration



## Code Management

- Continuation in the development of tools for scientific analysis and in simulation activities in preparation of the experimental campaign, taking into account the information (possible constraints) coming from the IC
- Whereas, the activities related to IC moved from 2022 should be added to the 2023 planning. The CM area will also contribute to the analysis of the IC data in liaison with the ET
- A training on the Discharge Simulator as well as trainings on the released modelling tools in support to the scientific exploitation shall be planned respectively ahead of the IC and experimental campaigns.
- Support for Diagnostics R&D

## Enhancements

- Completion of the assembly and testing of the systems before shipping
- preparation for installation and commissioning in JT-60SA of the procured subsystems (FP8), starting after the IC (second half 2023) (with the OP area)
- The presently ongoing tasks (scoping studies for enhancements after 2025) will come to the end in 2022
- Main objective is advancing the design of new subsystems (mainly diagnostics), following the scientific priorities being at this time discussed within the ET, and the subsequent selection/ordering taking into account the funding sources and capabilities. This process is related to the Grant Milestones SA.M.03, SA.M.04, SA.M.05 and to the Grant Deliverable SA.D.04.





## 2024

- Installation of the FP8 enhancements excluding FILD, according to the present planning of the ME1 and ME2 shutdown periods.
- Completion of the REC project
- Planning of the OP.2 campaign, including the commissioning of the EU-led subsystems and scientific objectives
- Training for participation to the JT-60SA operations
- Selection of the ET members in addition to the ETLs and TGLs
- Training on the CM released modelling tools

## 2025

- Commissioning of the FP8 enhancements (excluding FILD which will be commissioned in 2026 - OP3) according to the present planning.
- Detailed planning and execution (start or completion?) of the OP.2 campaign, including the commissioning of the installed EU-led subsystems and connected scientific objectives
- Participation to the JT-60SA operations

# Grant Agreement Milestones



GA Milestone No.	GA Milestone Title	Due Date [mm/yyyy]	Proposed revised due date (at the PB in March 2022)	Proposed revised due date to be discussed at the next PB
SA.M.01	Participation in the Integrated Commissioning before plasma operations	June 2021		
SA.M.02	Start of the EU-REC project	Apr. 2022		
SA.M.03	Decision on plan and resources of EU enhancements for BA Phase II – 2025-2029	Mar. 2023		June 2023
SA.M.04	Call to start EU enhancement programme for 2025-2029	Jun. 2023		Sept. 2023
SA.M.05	Start of the new EU enhancement projects (TBD) Start of the new EU enhancement projects (TBD)	Oct. 2023		Nov. 2023
SA.M.06	Participation to the development of scenario at high plasma current in H-mode	Dec. 2023*	Dec. 2024*	Dec. 2025*

\*Milestones dependent on external conditions to which the workpackage is constrained

# Grant Agreement Deliverables



GA Deliverable No.	GA Deliverable Title	Due Date [mm/yyyy]	Proposed revised due date (at the PB in March 2022)	Proposed revised due date to be discussed at the next PB
SA.D.01	Appointment of Experiment Leader from EU (after call issued end 2020)	Apr. 2021		
SA.D.02	Report on the first phase of the Integrated Commissioning (before plasma operations). Results and return of experience, mainly for DTT	Dec. 2021*		
SA.D.08	Final Report on the Integrated Commissioning (including plasma operations)		Dec. 2022*	Dec.2023
SA.D.03	Report on the initial organisation of the JT-60SA scientific exploitation	Dec. 2021		
SA.D.04	Documented plan of EU enhancement programme for BA Phase II– 2025-2029	May 2022	Dec. 2022	
SA.D.05	Delivery and final tests of EU-REC completed	Jan 2023	Jun. 2023	Jun.2024
SA.D.06	Installation of the EU systems before the OP2 campaign.	Jun. 2023		Dec. 2024
SA.D.07	*Report on participation to the OP.2 campaign. Results and return of experience	Dec. 2024*		Dec. 2025*
SA.D.10	Delivery of EU procurements (TBD) for the OP3 campaign completed.	Dec. 2025*		

\*Deliverable dependent on external conditions to which the workpackage is constrained



- Planning of 2023 activities and tasks
- Review/update of the status of the tasks: progress, difficulties, new facts, constraints, needs, priorities
- Focusing of the objectives
- Evaluate the need of resources
- Evaluate the need of new tasks
  
- Reinforce the interaction with the TGLs
  
- This morning and part of the afternoon: status of the IC activities (F4E) and overview of the work in the three areas, in JIFS, in the Experiment team
- From this afternoon: topical sessions, mostly in a single timeline (parallel sessions only on Thursday afternoon)
- On Friday, review of the actions, discussion and closing