WPSA Operations – Overview
Discussions to define 2023 activities

WPSA General Meeting, 6-9 September 2022

Eva Belonohy

WPSA Operations Area Coordinator

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WPSA Operations Area Goals

SA.OP will support the execution of the experimental campaigns by providing expertize in system and integrated commissioning, operation, maintenance including plasma operations, vacuum conditioning, diagnostics, heating and fuelling systems.

Primary goals in 2023:

1 - Ensure successful execution of the first **integrated commissioning** activities in 2023.
Capture and share the commissioning and operations experience.

2 - Start the preparation of the **commissioning of EU enhancement projects** reviewing their needs, and connection to protection systems.

3 - Start building a team of EUROfusion experts to **support the operational activities of future campaigns**.

Relevant EUROfusion wiki pages:

- FP9 WPSA Operations Area
- FP9 Integrated commissioning information (2022-23)
- FP8 Integrated commissioning information (2019-21)

Integrated commissioning activities in 2020-21

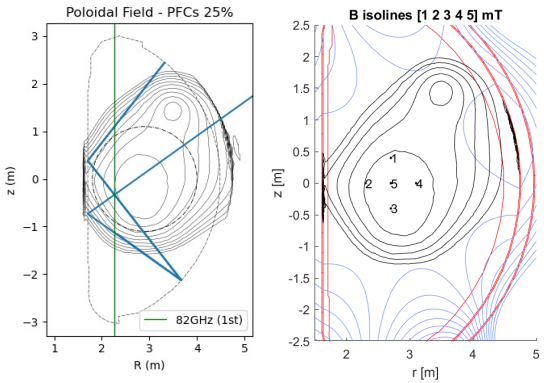
Integrated commissioning - IC (December 2020 – March 2021)

Close collaboration with QST and F4E on 7 IC topics

1. *Cryo and magnet system:* supported coil cool down, energization and repair plan.
2. *EDICAM:* commissioned the camera remotely. Ready for first plasma.
3. *Scenario development:* shared first IC experience of MAST-U and WEST. Discussed plasma operation plan.
4. *Equilibrium control:* prepared CREATE tools for JT-60SA. First steps to learn MECS.
5. *Plasma Breakdown:* simulated JT-60SA plasma breakdown incl. at various coil currents.
6. *Magnetics, MHD, disruptions:* Supported calibration of magnetics. Prepared tools for a disruption database.
7. *Wall conditioning:* direct input into GDC commissioning, ECWC simulation parameter scans.

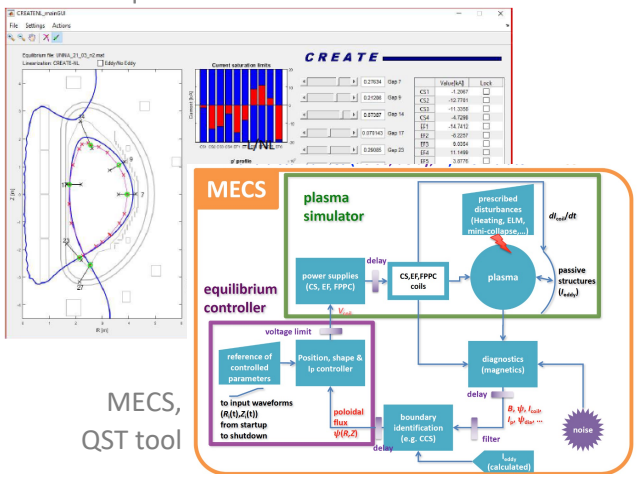
Magnets: A. Louizguiti with the QST team and S. Davis

Scenario development: M. Iafrati in the Naka control room

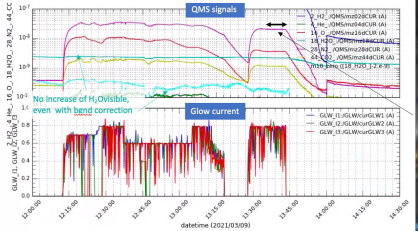


Plasma breakdown with 25% PF coils

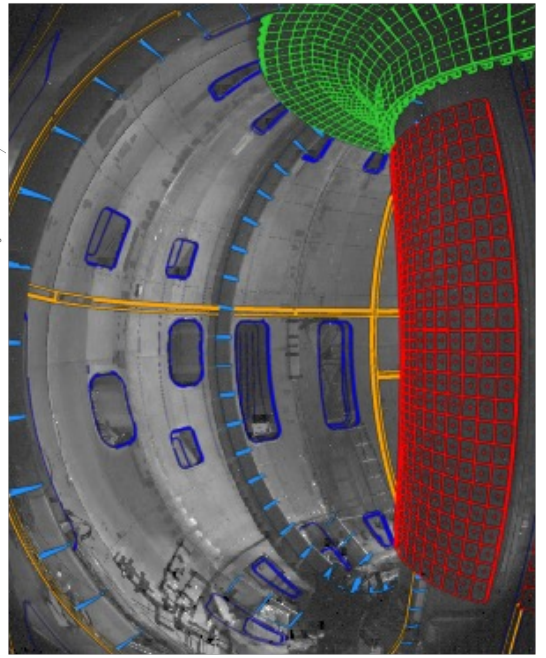
CREATE equilibrium control tools



MECS, QST tool



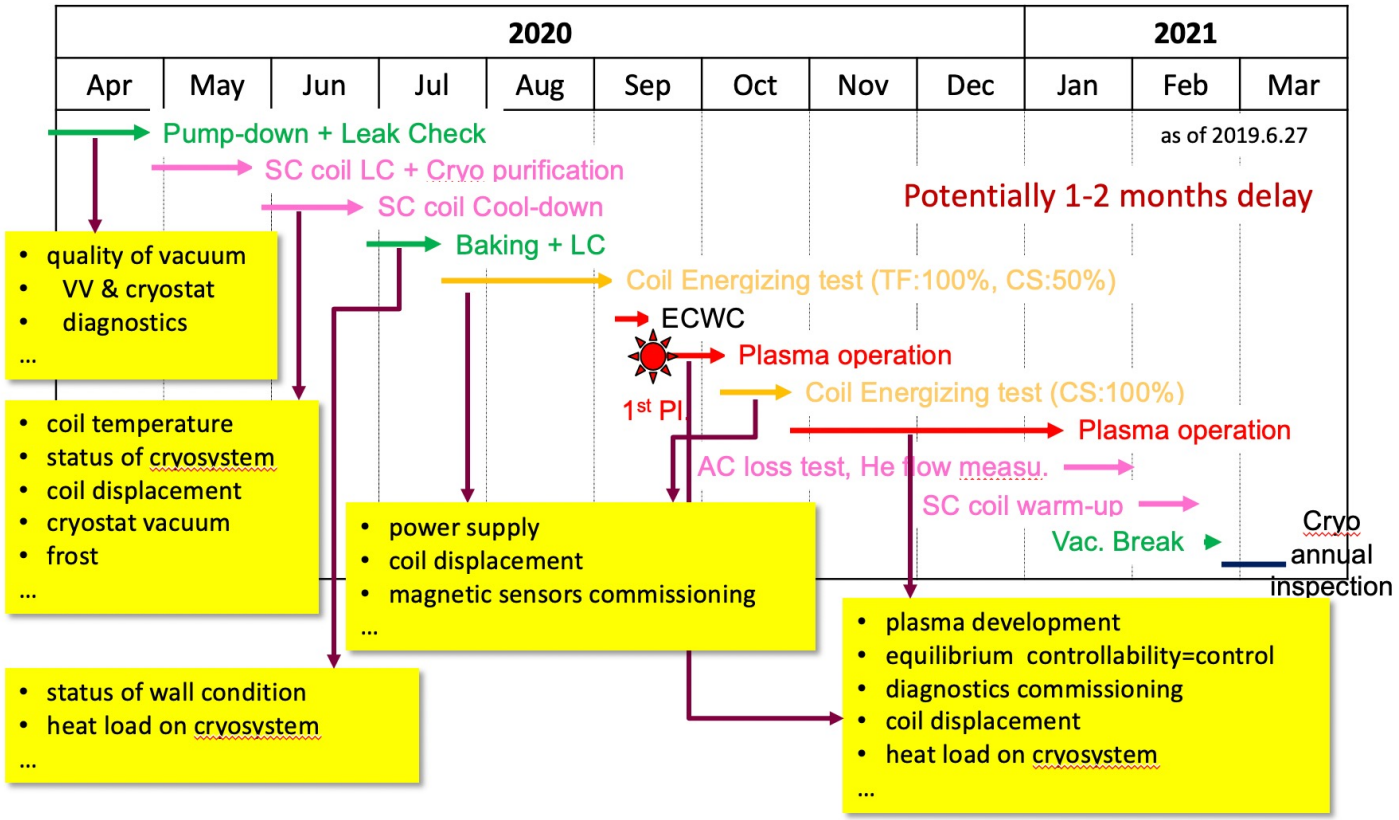
Glow Discharge Cleaning (GDC) commissioning and ECWC preparations with simulations



First EDICAM photo with the camera tomography calibration

Integrated Commissioning Timelines

To be updated!



1st integrated commissioning phase reference

- 1st pump down: Early December 2020
- 1st plasma was planned in March 2021

FP9 WPSA Operations (E. Belonohy)
FP8 Integrated Commissioning page
Plasma team folder on the JT-60SA DMS (restricted access to Plasma Team members)
Integrated Commissioning Procedure and IC summary on the JT-60SA DMS (restricted to IPT members)

We expect about 4 months between pumpdown and first plasma attempt.

Plan to be updated based on current availabilities and priorities.

Regular EU IC team meetings and QST/EU Plasma Team meetings to keep you up to date.

2022 Activities – Contribute to Integrated Commissioning

Start of the next IC phase:

- Waiting for the next start of the integrated commissioning activities
- Next decision expected at the end of September 2022
  - Even if IC started in 2022, plasma operation would fall to 2023

Preparation activities:

- F4E-EUROfusion working group to review possibility of **plasma breakdown** without the booster power supplies
- Discussion continued on generation of **runaway electrons** at the first plasma operation including how to detect runaways using IC diagnostics.
- Progress with the MECS simulations

Preparation of future scientific exploitation

- Involve the Experiment Team Leaders and Topical Group Leaders in the IC discussions and activities as observers. They will lead the scientific exploitation/analysis of the IC results post-IC.

Wednesday, 7th September 2022 - Session 1
2023 IC: cryo & magnets, vacuum conditioning, equilibrium, magnetics, MECS,

Wednesday, 7th September 2022 - Session 2
2023 IC – Preparation for first plasma (modelling, runaway generation, detection of runaways) and Plasma Operations

FP9 WPSA Operations (E. Belonohy)
Plasma Operations (incl. vacuum conditioning and breakdown)
Equilibrium control
Magnetics and the disruptions database
Cryo and Magnets
EDICAM operation
Camera tomography implementation

FP9 WPSA Code Management (G. Falchetto)
ECWC simulations
EDICAM software tools
Camera tomography software tool
Breakdown simulations
Disruption modelling

2022 Activities - IT support

Ongoing F4E-QST working group (EUROfusion representative: G. de Tommasi)

Tools:

- WebAPI development
- Update of the research site and live video feed from the control room

Outstanding IT needs:

- Access for the Czech team to the raw EDICAM data
- Access to outside the pulse data
- Understanding of the full diagnostics cycle – upload camera tomography analysis as official data

Access to the Naka-server: new accounts for the management, new IC team members and the experiment team.

Name	Role
Gloria Falchetto	WPSA Code Management Area Coordinator
Juan Ayllon	WPSA Enhancement Area Coordinator

Name	Role
Gianluca Pucella	Topical Group Leader for MHD stability and control
Luca Garzotti	Topical Group Leader for Transport and Confinement
Yevgen Kazakov	Topical Group Leader for High Energy Particle Behaviour

Name	IC topic
Alberto Gallo	Plasma Operations
Cedric Reux	Plasma Operations

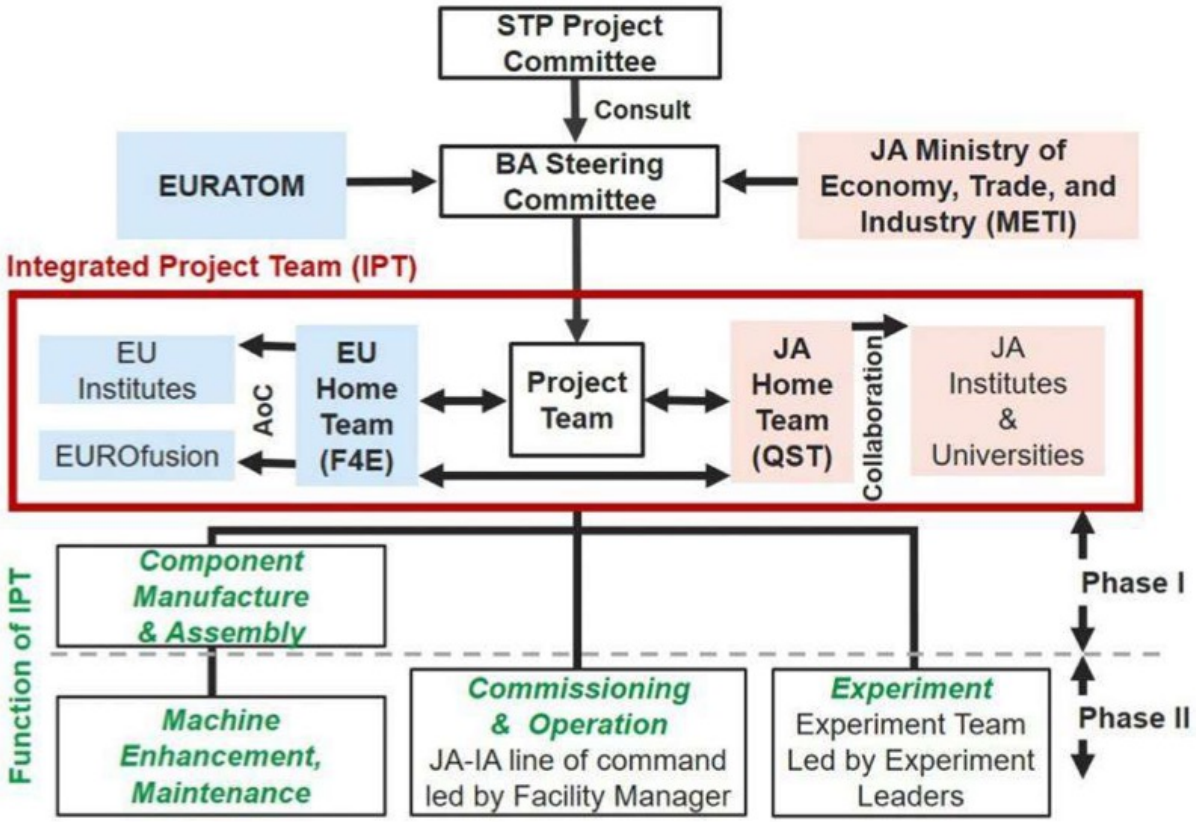
Name	Affiliation
Frederic Imbeaux	CEA, France
Herve Ancher	CEA, France
Gabriele Manduchi	CNR, Italy
Axel Winter	IPP, Germany
Christoph Fuchs	IPP, Germany

FP9 WPSA Enhancements (J. Ayllon)
Remote access architecture (incl. data and computer access in IC)

FP9 WPSA Operations (E. Belonohy)
Remote Access
FP8 JT-60SA seminars including how to set up access, HMI and eDAS data viewer
FP9 JT-60SA seminars are available on the FP9 Integrated Commissioning page including diagnostics available in IC

Tuesday, 6th September 2022 - Session 4
(Remote) data access and IC tools including current status, python tools, discussion on tools to develop and REC

Post-Integrated Commissioning



Phase 1: Integrated Commissioning is QST's responsibility

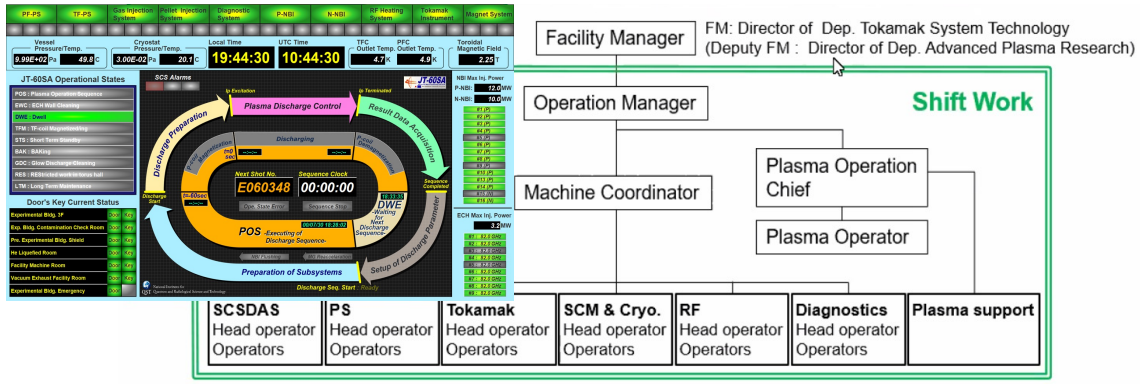
- Strong F4E involvement on some plant systems as well as protection systems, timeline and risks.
- EUROfusion support on the 7 IC topic areas with a QST contact and deputy contact for each.
- Both scientific exploitation and operations under the IC team (including named EUROfusion experts)

Phase 2: Operational Phase

- Scientific exploitation moves to the joint Experiment Team
- How the operational areas will be joint, will only be discussed post-IC with F4E and QST
- We will review the operational experience from IC within WPSA-OP and jointly with F4E and QST.

2022 Activities - Operational support of future campaigns

- Support QST and F4E during IC and test/improve European access to the control room work (tools, intranet, policies).
- Target supporting scientific roles in the control room (diagnostic, session leading and real-time experts)
  -> **Started building a real-time expert group** by reviewing the scientific real-time networks available in European devices as input to the JT-60SA experiment team.

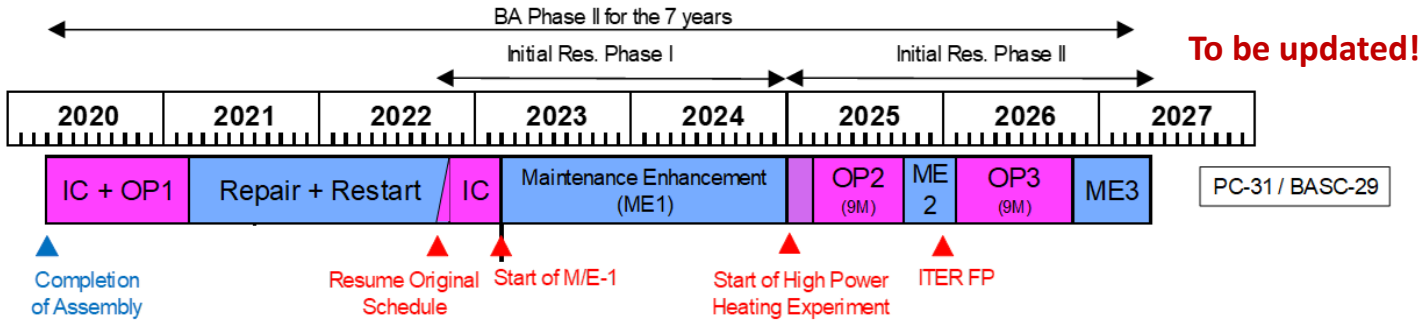


Thursday, 8th September 2022 - Session 1
Real-time controller and protection systems

FP9 WPSA Operations (E. Belonohy)
Real-time networks

JT-60SA control room

2021-22 Activities: Support commissioning of enhancements projects



To be updated!

- Meetings with EU enhancement projects in 2021-22 discussing their commissioning requirements, connection to protection systems, future operation of the enhancements.
- Consider best practices for documentation to support commissioning (develop commissioning procedure, knowledge maps)

European Enhancements

Thursday, 8th September 2022 session 3

Current status and 2023 plans, commissioning plans, interfaces particularly with protection systems, documentation.

QST Enhancements

Sharing commissioning and operational experience with QST through EUROfusion Operations Network – plans to support NBI commissioning with a small EUROfusion team

FP9 WPSA Operations (E. Belonohy)
Fast Ion Loss Detector (FILD)
Thomson Scattering (TS)
VUV Spectrometer (VUV)
Pellet injection
Massive Gas Injection (MGI)
Divertor Cryopump System
Neutral Beam Injection (NBI) (QST enhancement)

FP8 and FP9 WPSA Enhancements (J. Ayllon)

F4E Enhancements (G. Phillips)

Capture and share the operations experience

EUROfusion Operations Network

Established in 2021, EON is a network of 18 experts across 9 associations to:

- facilitate stronger connection between the operational groups of EUROfusion facilities to share operational experience, improve operational reliability and performance,
- support development and training of operators, creation of a joint knowledge base
- contribute to the EUROfusion preparation for the (integrated) commissioning and operation of ITER.

Starting 2022 EON organizes events, training and seminars on dedicated operational topics open to all EUROfusion experts.

EUROfusion Operations Network members

EON NBI members

Positive NBI Teams involved
JET, MAST-U, ASDEX Upgrade, Wendelstein 7-X, TCV, TJ-II, COMPASS-U, JT-60SA
Negative NBI Teams involved
ELISE, BATMAN-Upgrade, SPIDER, MITICA, JT-60SA
Guests
ITER, LHD, (DIII-D)

2022 activities:

- Review of the operational roles and training on EUROfusion devices
- Monthly EON seminars on NBI operations started in May 2022
  - Next NBI seminar is on JT-60SA on 15th September 2022

Potential events in 2023 relevant to JT-60SA:

- Vacuum conditioning, first plasma operation including runaway generation
- Commissioning of superconducting coils
- Real-time controllers, hardware and software platforms
- Foundation course on session leading

▶ Looking for important topics to dedicate EON events relevant for JT-60SA

Capture and share the operations experience

ITER Operations Network (2017 -)

- Biyearly meetings restarting in 2022 to support ITER's integrated commissioning and operation.
- Participants: representatives of the international labs.


1st ITER Operations Network Meeting 2017

ITER-F4E-QST Trilateral Agreement

- Sharing experience in topics of manufacturing/installation, integrated commissioning and scientific exploitation.
- IO expert participation in integrated commissioning.

Publications

- Integrated commissioning is QST responsibility
- Encourage publications in collaboration with QST and F4E on the commissioning and operational experience, strategy and lessons learned during IC
- PPCF Special Issue on Operations (QST special editor: Y. Kamada) (dedicated operations papers, published once accepted)

Travel to Japan

Japan's borders been opening up step by step.

- Quarantine is not required in most cases.
- Strict vaccination history requirements.

Administrative process:

- Discuss with the WPSA management team, who will agree the visit with F4E and QST.
- EUROfusion administration: IMS mission request
- F4E/QSST administration: host agreement (per lab) and assignment form (per person and visit) – start at least 2 months before travel.
- Before travel: visa application, health insurance cover
- Travel arrangements themselves

  -> Dedicated QST team to support travel arrangements in Japan (visa application & accommodation)

FP9 WPSA Operations (E. Belonohy)
Visa Application Process and administrative requirement of the host agreement and arrangement form
Visitors' Handbook providing useful information on the required European preparations, arrangement for Japan and living in Japan.
Updates on travel is included in the EU IC team meetings available at FP9 Integrated Commissioning page.

Reference: 2022 deliverables of the WPSA Operations Area

FP9 Management tasks	Deliverable owner	Beneficiaries
Coordination of the integrated commissioning activities in 2022 in relation to plasma operations (including wall conditioning and breakdown), EDICAM operation and camera tomography, equilibrium control and magnetics, cryogenic systems and superconducting coils).	E. Belonohy	UKAEA
FP9 2022 integrated commissioning activity tasks		
Ensure that the EDICAM camera is ready for wall conditioning and first plasma operation of JT-60SA. Operate and optimise the camera during the integrated commissioning phase.	T. Szepesi	EK-CER
Interface with the EDICAM system and provide timely camera tomography analysis to support ECWC modelling, breakdown studies during the integrated commissioning phase.	J. Cavalier	IPP.CR
Participate in the integrated commissioning of JT-60SA and support the QST team related to plasma operations	M. Iafrati	ENEA
Participate in the integrated commissioning of JT-60SA and support the QST team related to plasma operations	P. Moreau	CEA
Participate in the integrated commissioning of JT-60SA and support the QST team related to plasma operations	E. Belonohy	UKAEA
Support the achievement and optimisation of the plasma breakdown for the first plasma operation of JT-60SA.	D. Ricci	ENEA, MPG
Validate control-oriented plasma linear models against experiment data. This validation will include the implementation of the control algorithms adopted during the Integrated Commissioning within the CREATE tools.	G. de Tommasi	ENEA
Participation of ENEA experts to MECS training provided by QST and/or EU experts.	G. de Tommasi	ENEA
FP8 2022 integrated commissioning tasks		
CREATE personnel to support QST onsite in the commissioning of the plasma equilibrium control system.	G. de Tommasi	ENEA
Support the commissioning of the magnetic diagnostics and perform MHD analysis during the integrated commissioning.	L. Pigatto	ENEA
Support the commissioning activities related to the JT-60SA cryogenic and magnet systems.	F. Michel	CEA

Reference: 2022 deliverables of the WPSA Operations Area

FP9 Management tasks	Deliverable Woner	Beneficiary
Coordination of the activities related to machine and plasma operations. Coordination and training of control room experts Coordination of Remote Access and Participation Coordination of the activities related to the commissioning of the EU-led Enhancements	E. Belonohy	UKAEA
FP9 Preparation of future campaigns tasks		
Review and summarise currently available scientific real-time networks used on EUROfusion facilities as input for consideration by the JT-60SA Experimental Team.	S. Hall	UKAEA
Review and summarise currently available scientific real-time networks used on EUROfusion facilities as input for consideration by the JT-60SA Experimental Team.	O. Ficker	IPP.CR
FP9 Preparation of commissioning of EU enhancement tasks		
Inspection of the Massive Gas Injection system with an onsite visit upon delivery of the system to the Naka site.	M. Dibon	MPG
Preparation activities related to the commissioning and operation of the JT-60SA divertor cryopump system including consideration of experience from European devices.	C. Day	KIT
FP8 Preparation of commissioning of EU enhancement tasks		
Preparation and commissioning of the VUV diagnostic in ENEA prior to delivery to Japan	S. Scully	UKAEA