WPSA Operations – Summary of discussions from the WPSA PPM

WPSA General Meeting, 6-9 September 2022

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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)

WPSA Operations relevant sessions

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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

Tuesday, 6th September 2022 - Session 4

(Remote) data access and IC tools including current status, python tools, discussion on tools to develop and REC

Thursday, 8th September 2022 session 3

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

Thursday, 8th September 2022 - Session 1

Real-time controller and protection systems

Thursday, 8th September 2022 - Session 5

Disruption prediction

2023 plans for Integrated Commissioning

Pump down – start of the integrated commissioning — Early 2023

~ 4 months

Cryo & Magnet modelling – active protection crucial to detect LOVA/LOCA causing Paschen conditions

- Superconducting coils will not be Paschen tight in IC -> active protection being developed by F4E

=> Meeting with F4E (M. Verrechia, V. Tomarchio, S. Davis) to discuss the CEA modelling activities and its use as an operational tools with particular focus on IC and as a protection tool

EON

Wall conditioning – clean conditions essential to support breakdown and avoid runaway generation

- We will support the (baking), further GDC commissioning and ECWC optimisation
- ECWC modelling validated on multiple EUROfusion devices + parametric scans on JT-60SA

=> Check the ECWC shape against current coil limits, consider use of the REC Cadarache site

EON

Magnetics

- Supporting calibrations, disruption database prepared
- Discussion on the availability of 1MHz signals, locked mode signal
- What analysis tools to use to study MHD
  => check with QST, consider using EU tool also to be used on ITER
- What modes are expected and what can we detect?
  => model the integrated commissioning scenario with the JT-60SA modelling suite?

Connection point with the MHD topical group

<- first plasma

2023 plans for Integrated Commissioning

First plasma attempt

Summer 2023?

<- Increase plasma current

Plasma breakdown – F4E breakdown attempt with booster filter only?, accessible Ip with current coil limits?

- ENEA modelling support with reduced currents and w/o booster
- F4E/EUROfusion working group - Include impurities in the breakdown modelling
- Plasma operations support from UKAEA, CEA, ENEA
- [Suggestion to apply/benchmark codes at AUG to understand modelling vs. AUG experience]

EUROfusion

Runaway generation at start-up – worry by EUROfusion experts, share with F4E & QST

1. Collect and share EUROfusion operational experience with QST to evaluate risk and stra
2. Detection: synchrotron radiation and snow-like effect of hard X-rays visible on EDICAM camera

=> Evaluate providing "runaway" signal from processed EDICAM images

3. Strategy: move with basic positional control, use of gas valves? -> difficulty to breakdown in next pulse in C
4. Modelling: to map operational space, guidance, support code development

- Available codes: DREAM, SOFT, STREAM (extension with kinetic calculation needed
- Run codes on the IC scenario for feasibility study?
- Check QST cameras for additional view to complement EDICAM

EON

=> Dedicated runaway meeting within EU and with F4E/QST

Connection point with the MHD topical group

2023 plans for Integrated Commissioning

<- Increase plasma current

Plasma current > 500 kA

Equilibrium control – CREATE tools available but not planned to be used by QST

- QST provided only compiled version of the QST code = “black box”
- ENEA experts in Naka during IC can demonstrate the ues/advantage of the CREATE tools (vs. parametric scans planned)
- Use of CREATE tools with future 3D perturbations

Plasma operations

- Team of UKAEA/CEA/ENEA experts supporting vacuum conditioning, breakdown, runaway avoidance strategies, plasma ramp-up, flattop as required by the QST/joint plasma team
- Share experience again on the first start-up of the EUROfusion devices through EON
- Offer discharge simulator training to the team (many Session Leaders, 1 Engineer-in-Charge)
  - Use discharge simulator with the IC scenarios to support IC
- Importance of developing session leader competence on JT-60SA to support EU team

EON

Discuss and agree integrated commissioning priorities and targets vs. start of the maintenance phase

- **Target plasma current (0.5, 1 or 2MA?)**
- **Magnet commissioning (TF at 100%, PF at ?%)**

End of 2023

2023 Plans - (Remote) data access and IT tools during IC

Wall conditioning – GDC, ECWC

2022 **(2023)** **Closer to start of IC** → **Integrated Commissioning**

EU IC team needs

G. de Tommasi to organise a meeting with H. Urano to review outstanding IT requests for the IC team

Follow up on the REC recommendations

English documentation/logs, live remote experimentation process,. Collective development of analysis tools, test computing resources (or use Gateway?), …

Meet with some EU IC team members as users

JT-60SA seminar

a) Update on the QST tools (Research Management Site, …)

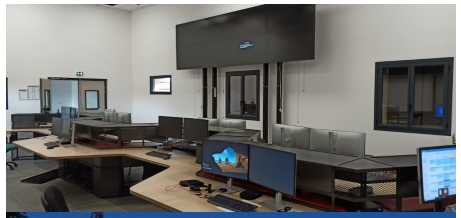
b) How to set up access for new account holders, and use w/o internet explorer

c) current python tools and the use of the WebAPI

⇒ WebAPI to be available for the whole EU team with account

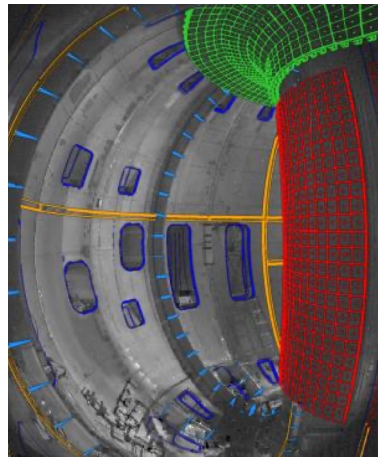
Demonstration of REC capabilities

Use of the REC facilities in Cadarache during vacuum conditioning (GDC, ECWC experiments)
Try IMAS format on MHD?



Develop/test procedure for data processing/validation using the camera tomography

1. Get access to raw data
2. Analyse on the Naka server
3. Upload processed data to the processed data server.



Disruptions

Joint QST/EU Disruption Working Group led by G. Pucella

Connection point with the MHD topical group

WPSA-OP IC activity: Development of a disruption database (L. Pigatto)

- Parameters and tools defined
- Reached out to A. Pau, the European disruption database RO under WPPrIO => meeting soon
- New JET disruption database RO
- Looking for additional support for the disruption database task

Use of MGI as standard disruption protection

- Not planned by QST. JET experience of high current operation, required the use of the MGI in all pulses > 2MA.
- Would be useful to set up the MGI system to have the capability to be set up as automatic protection system.

Disruption predictors

- Offer a simple GUI interface to check disruption trigger on reference pulses when it was not used in order to increase the trust of the operation staff / QST in the predictor.
- Tool to categorize disruption post-pulse (improve speed and quality of analysis and choice of approprioate modification of the next pulse) and/or real-time (allow suitable dedicated response)

Thu Session 1 - Real-time controller session feedback

2022

Step 1. Review and summarise currently available scientific real-time networks used on EUROfusion facilities as input for consideration by the JT-60SA Experimental Team.

+ Understand current and planned real-time platform on JT-60SA

Agreed with QST

Focus first on scientific (high-level) controllers. Collect and share European experience with JT-60SA.
Collaboration with the EUROfusion Operations Networks (EON).
-> Developing EON Real-Time workshop proposal for 2023.

Considered to be a good step-wise approach

2023
2024

Step 2A. Focus on **few dedicated real-time controllers** selected with the Experiment Team.
Review feasibility, potential design/implementation considerations, requirements.

Step 2B. Interest to understand current and planned JT-60SA **protection system**.
Share and collect European experience.

OP2
OP3

Step 3. Contribute to the development of real-time controllers for JT-60SA
Step 4. Control room support to commissioning, optimise and run real-time controllers.

Thu Session 1 - Real-time controller session feedback

Step 1. Review and summarise currently available scientific real-time networks used on EUROfusion facilities as input for consideration by the JT-60SA Experimental Team.

+ Understand current and planned real-time platform on JT-60SA

Reviewed the real-time controller database structure -> avoid jargon and investigate addition of information

- Easier to implement (in 2022?): development level
- Need time (in 2023?): frequency of use, associated experiments, [one page example on a example pulse]
- Discussion on how much detail to include on requirements for the controllers -> for dedicated controllers

Connection point mainly with the MHD and scenario development topical group

Share with the Experiment Team and QST – Joint Real-Time Working Group

- Experiment team is compiling a list of real-time controllers for scientific exploitation
- Would be useful to review high-level controllers beneficial for operations and machine protection too

⇒ Select a few (1-3) to analyse more in detail in 2023 as a pilot

EUROfusion Operations Network (EON) workshop(s) in 2023 [removes focus on JT-60SA]

EON

- Expand information collection and discussion to all relevant EUROfusion partners, QST, invited guests
- Focus on 1) hardware and software platform, 2?) discussion of relevant/selected controllers

2023 plans - Real-time controller session

JT-60SA long pulse operation requires steady state with <u>multiple controllers at the same time</u>

- Identify controllers used together, review their efficiency
- MIMO controller experiments at JET.
- To be discussed at the IAEA Technical Meeting for Long Pulse Operation in 2022 (QST participation)

Step 2A. Focus on **few dedicated real-time controllers** selected with the Experiment Team. Review feasibility, potential design/implementation considerations, requirements.

Potential controllers to focus on**: => Experiment Team to identify controllers to focus on in 2023 (pilot studies)**

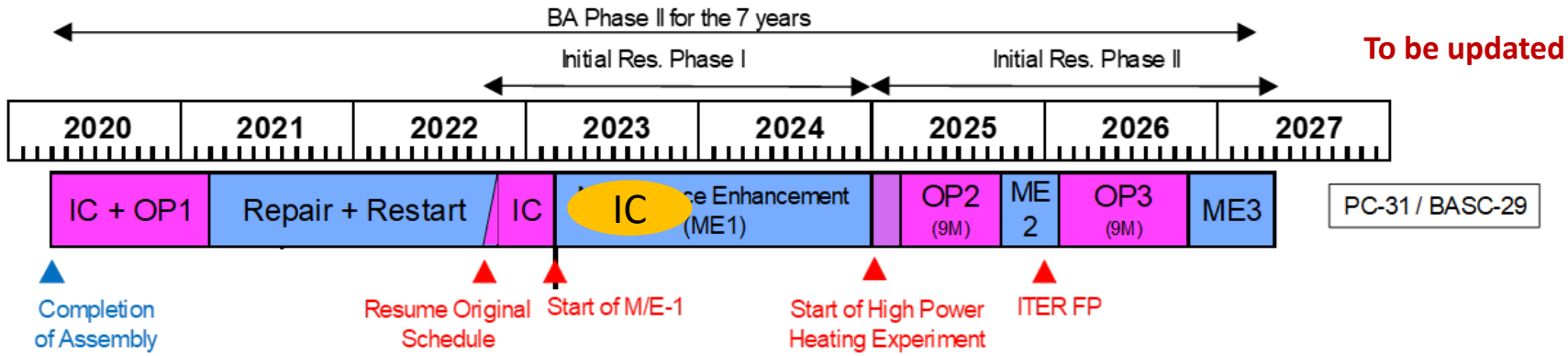
- NTM, RE control, or controller used heavily and expected to be used early like beta control
- Order of controllers for OP2 & 3 based on availability of diagnostics
- Current discussion with QST on RWM, ..

Step 2B. Interest to understand current and planned JT-60SA **protection system**.
Share and collect European experience.

- Discuss potential support of F4E on real-time coil protection using the F4E plant simulator
- Similar activity to 2022 on protection systems and/or EUROfusion Operations Network

FP8 Enhancements

SA.ENH supports the design, assembly and testing of the enhancements before shipping to the Naka site. SA.OP supports the installation, system and integrated commissioning, operation and maintenance of the enhancements following arrival to the Naka site. Includes the preparation of commissioning and operations.



To be updated!

WPSA-ENH Primary goal in 2023: Completion of assembly and testing before shipping to the Naka site

WPSA-OP Primary goals in 2023: Start the preparation of the **commissioning of EU enhancement projects** reviewing their needs, and connection to protection systems.

- Target preparing the draft commissioning procedure by the time the system arrives to Naka (F4E request)
- In 2023, we will start preparing the commissioning plan using/optimising an EU commissioning procedure template
- Start/continue discussion with F4E and QST

FP8 Enhancement Session Focus

European Enhancements

Consider dedicated meeting early October

Clarify remaining question, agree task/deliverable for 2023

QST Enhancements

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

EDICAM – already installed and ready

- Supplement IC team with additional person or QST/camera tomography
- Breakdown equilibrium to position high resolution ROI for first breakdown

FP8 Enhancement arrival to the Naka site end of 2022 and 2023

- Visit to check post-arrival in some cases
- Support installation onsite – mostly in 2024+
- Preparation of the commissioning procedure

FP9 WPSA Operations (E. Belonohy)
EDICAM camera – OP-CM-ENH
Fast Ion Loss Detector (FILD) - WPPrIO
Thomson Scattering (TS)
VUV Spectrometer (VUV)
Pellet injection
Massive Gas Injection (MGI)
Divertor Cryopump System
Neutral Beam Injection (NBI) (QST, post 2023)

FP8 and FP9 WPSA Enhancements (J. Ayllon)

F4E Enhancements (G. Phillips)

FP8 Enhancement Session Focus

FILD

- PA signed in 2022, manufacturing/testing in 2023/24, delivery end of 2024 -> could be potentially used in OP2
- Ops and data processing manual to be prepared starting 2023
- **Request remote connection option** -> follow up similar to EDICAM
- Has to be operated by a dedicated expert in the control room -> suggestion to clarify this to all diagnostics.

Divertor cryo-pump

- Delivery to Naka at the end of 2022 – March 2023
- After arrival check, installation support (currently Sep-Nov 2023, likely moves to 2024)
- Needs cryo and vacuum to commission expected only after pumpdown (start of OP2) -> **discuss risk mitigation options**
- Preparation of the commissioning procedure task in 2023

MGI

- Lab ready (video at 5bar, can go up to 65 bar), transfer of ownership to F4E at the end of 2022
- Additional baking at 200C for 10 days followed by testing
- QST will observe the final test in Garching -> need to define procedure
- Observe unpacking, quick assembly and test (needs power outlet and pressured air supply) in 2023
- Commissioning can be done after installation in 2024 (uses N2) + QST personnel training

FP8 Enhancement Session Focus

Pellets

- Service contract outstanding
- Arrival to Naka at the end of 2024
- Commissioning procedure in 2023, commissioning with H2 and D2
- Use of pellets in control (e.g. density profile), consider as standard fuelling/pacing, runaway mitigation

=> **Peter to send deposition profile scans done in the design phase to Gianluca for runaway mitigation consideration**

- 100Hz capability aligned to 10ms QST control cycle

VUV system

- Arrival to Naka in 2023, observe arrival
- Installation expected in 2024

TS system

- LOS Russian company, installation in Feb-March 2023 with QST and EUROfusion experts in person, Russian experts remote

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/QST administration: host agreement (per lab) and assignment form (per person and visit) – start at least 2 months before travel.

Collect information for the whole WPSA team travelling in 2023

- 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.

Any questions?

Thank you for all your contributions and patience during 2021-22

Hope to meet next time in person in the JT-60SA control room in Naka

JT-60SA control room

Back up slides

Notes from Tuesday Session 4 – (Remote) data access and IT tools

Update on changes to data access and tools (G. de Tommasi)

- Provide (mini)PCs at Naka for the European team to VPN, then access the Naka-server, Research Management Site and the HMI interface.
- WebAPI access is expected to be available for all current data access holders (IC team).
- Improve logging, preferably in English. Increase number of roles logging control room activities. Improve recording of progress on commissioning forms and procedures.
- -> Organise JT-60SA seminar on reminder how to set up data access + access without Internet Explorer.
- -> Add instructions how to install NoMachine (Tamas)
- -> Use IMAS format (David). This is part of the REC task.

Python tools (M. Iafrati)

- Full data cycle using the camera tomography. Get access to raw data, analyse on the Naka server, upload as official discharge data.
- -> Organise JT-60SA seminar on the use of the use of python and available user-written codes.
- Python and matlab are suitable. No need for IDL or other languages.
- Plant monitor on the WebAPI is restricted in time.

Naka server experience (A. Louzguiti)

- No access to licences under VPN.
- IC will use Microsoft Teams (accessible through VPN)
- TF current was only recorded during pulses. Check if this is still the case.

2023 REC plans (G. de Tommasi, F. Imbeaux) – create IMAS interface (find a good first use case e.g. MHD analysis?)

- Follow up REC recommendations: IT support desk & ticketing, procedure for data processing, collective development of tools
- Active testing of EU REC: potentially with vacuum conditioning <– grant deliverable moved to June 2024
- Arrange meeting between REC experts and EU user group (e.g. IC plasma ops, breakdown and vacuum conditioning)

Notes from Wednesday Session 1 – IC 2023 plans

Cryo & Magnet: evaluate the potential use during integrated commissioning to support coil protection

- CEA support from Europe in case of issues, focus more on plant modelling -> meeting with F4E at the end of September

Wall conditioning: baking + GDC (without TF) + ECWC (with TF) – essential for breakdown and reducing risk of runaways

- Check ECWC shape against planned coil limits
- ECWC experiments could be used to test REC in Cadarache

Equilibrium control: CREATE tool suitable for control room support vs. slower MECS code + parameter scans

- QST code only in compiled version, lack of QST involvement on the topic, CREATE part of the ITER system development
- Plan: ENEA experts in Naka during IC, see how the CREATE tools could support IC.
- Future campaigns: use of CREATE tools in case of 3D perturbations -> advanced controllers eg. with resistive wall modes,
- Post-disruption runaway control?

Magnetics:

- Understand what tools QST plans to use for MHD analysis in IC, potentially use the ENEA one to be used on ITER
- Develop locked mode signal and check availability of 1MHz planned signals in IC
- What modes are expected during IC plasmas (tearing modes, ..). Can we map the operational space with modelling tools?
- Machine protection aspects relevant also for disruptions -> deformation of the vessel, F4E gauges too slow? Check with V. Tomarchio
- Drift calculation of magnetics during ramp up -> not to be confused with slow modes early in the pulse

Notes from Wednesday Session 2 – IC 2023 preparation - first plasma

Breakdown modelling:

- Impurities to be included following discussion/agreement with the F4E/EF working group – few reruns
- Tilmann suggested to apply modelling to AUG
- Question on differences between EU modelling without booster and QST modelling with the booster

Runaway detection feasibility using the EDICAM camera:

- Introduced DREAM and SOFT codes. Another code: STREAM (= DREAM + DYON-like equations)
- It should be possible to see synchrotron radiation of stronger runaway electron beams. Could benefit from a second camera view -> check the QST visible cameras
- Could use the IC scenario for the feasibility. Current scenario was a 5.5 MA OP2 plasma disruption with 3 MA RE plateau.
- To use STREAM for synchrotron simulations, extension with kinetic calculation is needed (rough estimate or self consistently).

FTU experience on runaways: experience, useful diagnostics for the future, control to mitigate runaways

- Explore the two options to detect runaways in IC using EDICAM: snow-like effect caused by hard X-rays, synchrotron radiation
- Develop strategy what to do if runaways are detected in IC: equilibrium control, gas valves, ramp down TF?
- Collect multi-machine experience, e.g. JET sustained post-pulse sustained runaway beam
- Difficulty to break down post-runaways and post-disruptions (carbon machine)
- Potential runaway damage

Follow up meeting(s) to gather EUROfusion experience and discuss JT-60SA plans including tasks for 2023.

Notes from Wednesday Session 3 – Discharge simulator & Modelling

Discharge simulator:

- Planning to offer discharge simulator training for the IC plasma ops team
- Can the IC scenario be included in the discharge simulator -> demonstrate its use in the control room during IC.
- Need for EU JT-60SA session leaders to support scenario and experiment design and preparation

- Tool for EU scenario development vs. pre-pulse check and pulse optimisation tool -> high current, long pulse

- Experiment Team looking into phasing of experiments during OP2 and OP3
  - Define scenarios with stepwise heating availability for the phasing
  - Would need to including commissioning considerations of systems, plants and enhancements.

Notes from Thursday Session 1 – Real-time controllers

- What controllers to focus on in 2023? What additional information would be useful?

In general good staged approach. **=> dedicated meeting with Experiment Team and QST.**
Collaboration with EON -> workshop, etc.

Information to add : (avoid jargon)
- Level of development
- Frequency of use
- Associated experiments
- Discussion on how much detail to include on requirements for the controllers

JT-60SA long pulse steady state – limited EU experience **=> IAEA technical meeting on long pulse**
=> Show experience with MIMO controllers (e.g. see JET experience)

Potential controllers to focus on**: => Need to identify controllers to focus on in 2023 (pilot studies)**
- Experiment team is preparing list - need to add operations requirements
- Beta control, control for OP2 & 3 based on availability of diagnostics, NTM, RE control
- Current discussion with QST on RWM, ..

Notes from Thursday Session 3 – FP8 enhancements

EDICAM

- Additional person during integrated commissioning -> 2 people / shift to look at the camera at its first use
- Water damage -> checked by QST, thought to be okay. Enough to travel 2 weeks before first use.
- Provide equilibrium expected for first plasma to align high measurement ROI for first breakdown.

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TS system

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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