

CONSORTIUM WORK PLAN 2021-2025

CALL for the work package SA – JT-60SA Exploitation: Implementation of New Enhancements for JT-60SA

1 INTRODUCTION

JT-60SA is a large fully superconducting tokamak device with high plasma current, high auxiliary power and long pulse operation capability. The JT-60SA tokamak was fully assembled in March 2020 and successfully produced the first plasma in 2023 as part of the Operation Phase 1(OP1).

The main characteristics and scientific goals of JT-60SA can be found in the JT-60SA research plan [1], which was developed in the period 2010-2020.

The EUROfusion work package SA [\[wiki page\]](#) provides support and resources to the European scientists to contribute to the scientific programme of JT-60SA in the next years, including participation in plasma and systems operations (SA Operation Area), development of sub-systems and diagnostics (SA Enhancements Area), preparation and application of analysis tools (SA Code Management Area).

To timely meet its scientific objectives [1][2], the JT-60SA Tokamak will be sequentially upgraded with different components, including operational and diagnostic systems. Part of these enhancements are being developed by Europe (EUROfusion WPSA Workpackage in collaboration with the EU implementing agency F4E), to be installed during the upcoming years, in close contact with the hosting entity QST.

The joint EU-JA JT-60SA Experiment Team (ET) has prioritized the machine enhancements (including both operational and diagnostic systems) for the upcoming years in coherence with the scientific objectives.

2 DESCRIPTION OF THE CALL

The present call concerns the selection of the team for the detailed design and the subsequent procurement of the set of high priority diagnostic systems for the JT-60SA tokamak, listed in Table 1.

The activity will be conducted within the Enhancements Area of the WPSA workpackage and in collaboration with the F4E implementing agency. The work is expected to be developed in the timeframe (2024-2028). This call is focussed on the work programme for the period 2024-2025.

| Enhancement | Objectives/Requirements |
|----------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tangential phase contrast imaging system (TPCI) | <ul style="list-style-type: none"> Provide a map of turbulent (as well as non-turbulent) density fluctuations across the entire cross-section of JT-60SA plasmas. Resolve fluctuations with high spatial resolution in selected locations (near the magnetic axis and the high-field-side edge in the proposed tangential configuration) and adequate resolution everywhere else. Have no access or parameter-range restrictions, being able to study fluctuations in each plasma discharge. |
| Doppler reflectometry system (DR) | <ul style="list-style-type: none"> Systematic characterization of turbulence detailed enough for meaningful comparison with simulations from gyrokinetic models. Measurement of radial profiles of perpendicular plasma flows for numerical models validation. |
| Gamma-ray spectrometer (GRS) | <ul style="list-style-type: none"> Determination of energies of runaway electrons and their evolution. Characterization of distribution function of confined fast ions (NBI and fusion products). |
| Electron cyclotron stray radiation detection system (EC Stray) | <ul style="list-style-type: none"> Detect residual radiation (from Electron Cyclotron RF heating) in case of low plasma absorption. Provide information to prevent risk of damage for in-vessel components and diagnostics and useful to develop a protection system |

Table 1 - Systems proposed for implementation during the period 2024-2028

2.1 Expected timeline for implementation

The expected dates for the commissioning of the proposed systems are illustrated in Figure 1, together with the current JT-60SA timeline. The target dates have been defined by the ET according to the scientific objectives of the foreseen operation phases of the machine (OP1 to OP4), during the initial research phase.

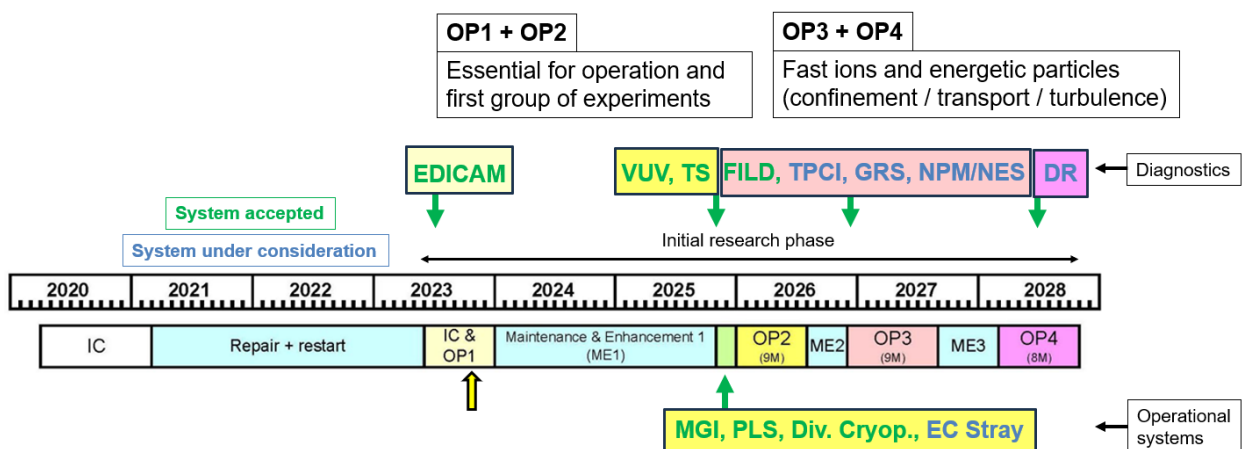


Figure 1 - JT-60SA Timeline and EUROfusion Enhancements (accepted or under consideration) commissioning tentative dates.

Required competencies for the proposed systems: The competences required for the development of the proposed systems are presented in Table 2.

| Enhancement | Required competencies |
|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tangential phase contrast imaging system (TPCI) | A lead physicist and chief mechanical engineer. Postdoc and/or a Ph.D. student for final implementation, commissioning and exploitation. |
| Doppler reflectometry system (DR) | Lead physicist and chief engineers with experience on design of microwave components. Engineering works on mechanical (CAD and simulations) and DAQ design. |
| Gamma-ray spectrometer (GRS) | Physicists with experience in development of gamma-ray systems. Engineers (development of CAD models, simulations, DAQ etc.). |
| Electron cyclotron stray radiation detection system (EC Stray) | Microwave expert. Microwave diagnostics design expert, for sensor commissioning and operation. Mechanical engineer for system integration and simulations. Signal processing and data acquisition expert. |

Table 2 - Required competencies for the development of the proposed systems

2.2 Financial support

Conditions of appointment: The manpower costs will be reimbursed by EUROfusion to the sending Beneficiary according to the Internal funding rates within the new Consortium Agreement for the period 2021-2025 (Personnel costs 50% plus beneficiary overhead 25%).

The reference available manpower budget for the development of the proposed systems for 2024 and 2025 is included in Table 3.

| Enhancement | Manpower (ppm) | |
|----------------------------------------------------------------|----------------|------|
| | 2024 | 2025 |
| Tangential phase contrast imaging system (TPCI) | 12 | 12 |
| Doppler reflectometry system (DR) | 12 | 12 |
| Gamma-ray spectrometer (GRS) | 6 | 12 |
| Electron cyclotron stray radiation detection system (EC Stray) | 6 | 12 |

Table 3 -Reference available manpower for the proposed systems for the period 2024-2025

Hardware expenses: The hardware expenses will be fully supported by F4E. Conditions for reimbursement will be managed separately between F4E and the leading beneficiary for each one of the systems.

3 ELEGIBILITY AND PARTICIPATION

Candidates should be staff of one of the EUROfusion Consortium members or its Affiliated Entities. The application should be submitted through the EUROfusion IMS system by the relevant Beneficiary sending:

- the Responsible Officer candidate's CV, with particular reference to the competence as for Table 2
- the Team description with short CVs. a short motivation letter including the expression of interest for the development of one of the proposed enhancements.

by 31st March 2023. Shortlisted candidates might be interviewed in the final phase of the selection.

4 REFERENCES

[1] JT-60SA Research Unit, 'JT-60SA Research Plan: Research Objectives and Strategy', v4.0 (2018)

[2] G. Giruzzi et al, Plasma Phys. Control. Fusion 62 014009 (2020)

Other useful information can be found at the following links:

- EUROfusion WPSA wiki page:
[https://wiki.euro-fusion.org/wiki/WPSA_wikipages: JT-60SA Work Package](https://wiki.euro-fusion.org/wiki/WPSA_wikipages:JT-60SA_Work_Package)
- JT-60SA public web page
<https://www.jt60sa.org/wp/>
- Visitors' handbook for EUROfusion staff on mission at the Naka site:
https://users.euro-fusion.org/iterphysicswiki/index.php/WPSA_Visitors_Handbook

5 FURTHER INFORMATION

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