RT17 priorities in 2027

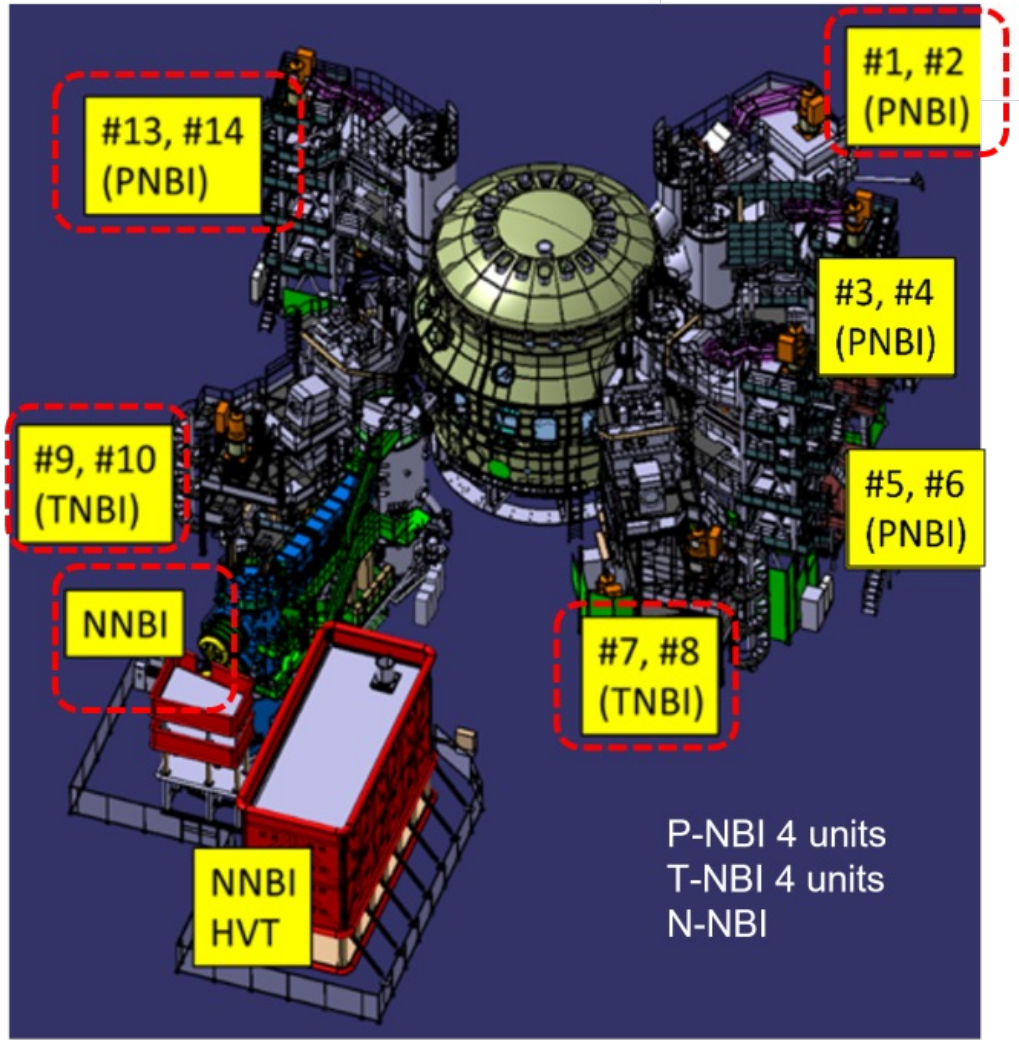
JT-60SA TG 'Divertor, Scrape-Off Layer and Plasma-Material Interaction'

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WPTE General Planning Meeting, 9 November 2026



Selected TG-DSOL experiments for OP2

OP2 experiment	EC	Co-EC
M12: Wall conditioning and isotope exchange monitoring	M. Fukumoto (QST)	L. Laguardia (CNR-Milan)
M19: Heat flux decay length parametrisation in high-current H-mode	G. Rubino (ISTP-CNR)	R. Matoike (QST)
M20: Impact of divertor geometry on SOL plasma parameters	M. Groth (Aalto University)	R. Sano (QST)
M21: Divertor heat flux control with impurity seeding	T. Nakano (QST)	A. Stagni (RFX)

Cycle #4: Deuterium plasma, high-current I_p > 3MA

Two options: decision to be taken at the end of week #3 in Cycle #3

JT-60SA Advanced Superconducting Tokamak BA-Satellite Tokamak Program

Note: Weekly neutron budget = 3.1×10^{18}

Option #1 (preferred): **change of N-NBI to deuterium** (Y_n ~ 5×10^{16} s^{-1})	
Week #1: no NBI [08/06 – 11/06]	* 20kA CS test (4 days) * N-NBI: change gas from H to D
Week #2: IC act. [15/06 – 18/06]	* Pulse extenstion for N-NBI (D), Δt ~ 5s * High-power gyrotron test (> 1MW/unit inj.)
Week #3 [22/06 – 25/06]	* M01: H-mode at I_p ~ 4MA [+ W-TESPEL test] * M02 & M08: Shinethrough and fast ions (L-mode) * M04: High-current L-mode, I_p ~ 5MA (evenings)
Week #4 [29/06 – 02/07]	* **DSOL studies: M19-M21 (2 days)** * EL contingency (M22 & M23 – tbc) (2 days)

Option #2 (backup plan): **keep N-NBI in H until the end of the campaign** (Y_n ~ 1×10^{16} s^{-1})	
Week #1: no NBI [08/06 – 11/06]	* 20kA CS test (4 days) * No change of N-NBI gas
Week #2 [15/06 – 18/06]	* M01: H-mode at I_p ~ 4MA [+ W-TESPEL test] * M04: High-current L-mode, I_p ~ 5MA (evenings) [Bonus: dedicated H-mode T&C studies; start DSOL activities]
Week #3 [22/06 – 25/06]	**DSOL studies: 4 days** * M19: Heat flux decay length characterisation * M20: Impact of divertor geometry on SOL * M21: Impurity seeding (Ne/Ar)
Week #4 [29/06 – 02/07]	EL contingency: 4 days [Candidates: high-beta plasmas, M22 & M23; high-power gyrotron test > 1MW/unit inj., M11]

IC: Machine inspection after the first disruption at I_p ~ 4MA and I_p ~ 5MA

Weekly neutron budget constraint:
H-mode & L-mode pulses mixed during the day;
H-mode scenario development distributed throughout the week

Note: all OP2 experiments, B_t ~ 2.25T (except [M22] and [M23])

RT17 – M12 ‘Wall conditioning and isotope exchange monitoring’

M12: Wall conditioning and isotope exchange monitoring

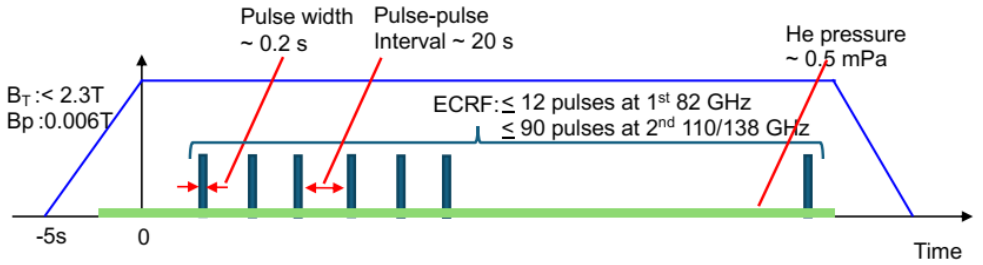
Experiment Coordinator: M. Fukumoto (QST, Japan)
Co-EC: L. Laguardia (CNR-Milan, EU)

Deliverables	
M12-D1	Characterize and optimize ECWC for hydrogen removal
M12-D2	Develop reference ECWC for inter-shot wall conditioning in OP2
M12-D3	Document H/(H+D) evolution during the H → D changeover
M12-D4	Characterize GDC for impurity removal
Extended goals	
M12-E1	Compare modelling for ECWC
M12-E2	Develop ECWC with the 2nd harmonic ECRH for ITER
M12-E3	Monitor wall status during ECWC plasmas in support of ITER
M12-E4	Develop a cleaning sequence (e.g., post-disruption)
M12-E5	Study He-GDC effect on wall conditioning and comparison with ECWC

Session distribution in OP2

Cycle #1	Cycle #2	Cycle #3	Cycle #4
2	1	0	0

RT17 – M12 ‘Wall conditioning and isotope exchange monitoring’



Priorities for 2027:

- M12 experiment preparation: strategy for optimizing ECWC for hydrogen removal (Optimise He pressure; input ECRH power waveforms; sequential and/or simultaneous injection of X1 (or O1) & X2 mode ECRH; modelling support)
- Validation and modelling comparison for ECWC during IC with plasma and Cycle #1 (in particular for Cycle #2)
- Analysis of H/(H+D) with QMS and visible spectrometer (comparison)
- Analysis of $p(H_2)$ and p(He) optimization for GDC characterisation (impurity and H_2 removal)
- Demonstrate wall monitoring capabilities during ECWC plasmas

RT17 – M19 ‘Heat flux decay length characterisation in high-current H-mode’

M19: Heat flux decay length characterisation in high-current H-mode

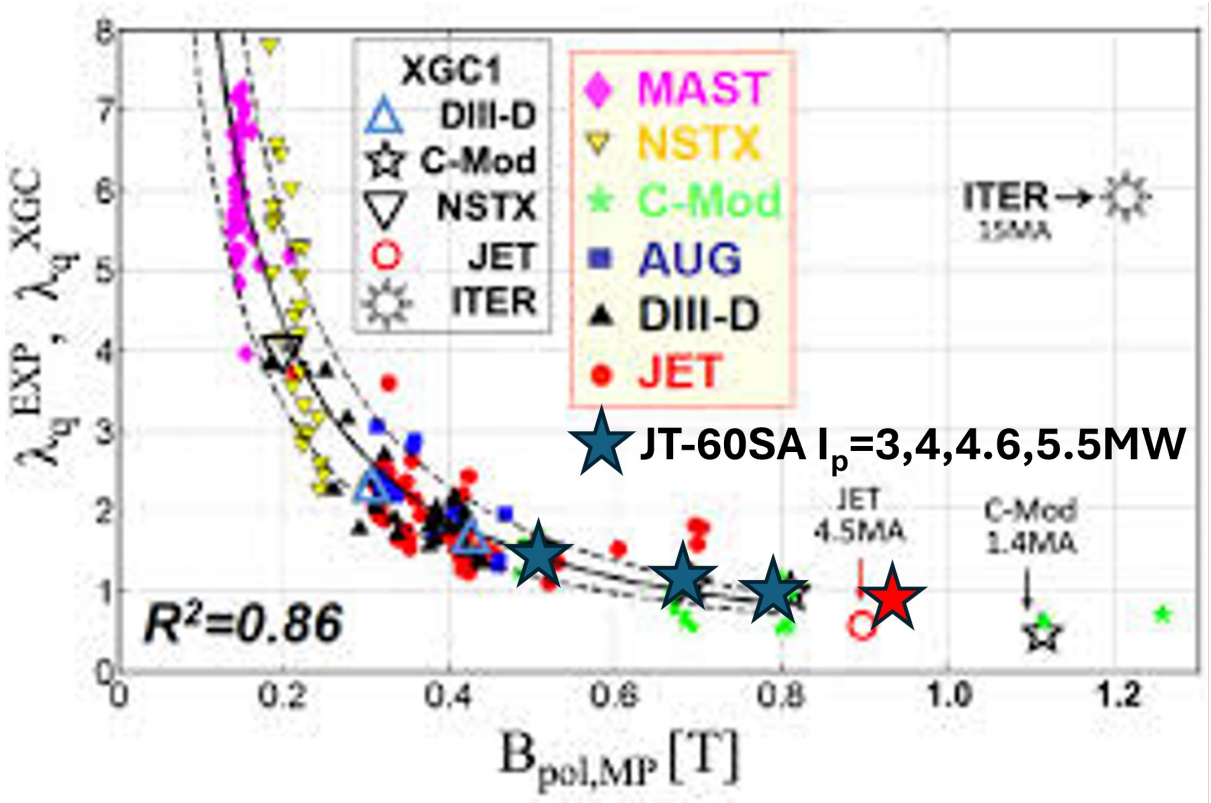
Experiment Coordinator: G. Rubino (ISTP-CNR, EU)
Co-EC: R. Matoike (QST, Japan)

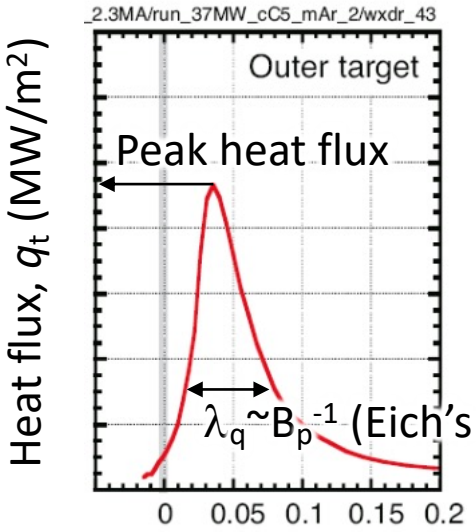
Deliverables	
M19-D1	Characterise divertor heat flux and SOL decay length in H-mode plasmas at different plasma current
M19-D2	Benchmark SOL observations against modelling and empirical scaling laws, with a focus on λ_q-analysis
M19-D3	Assess heat flux broadening at high density
Extended goals	
M19-E1	Edge-plasma cross-field transport
M19-E2	Validation of radiation power density measurements

Session distribution in OP2

Cycle #1	Cycle #2	Cycle #3	Cycle #4
0	0	0	~0.5

RT17 – M19 ‘Heat flux decay length characterisation in high-current H-mode’





- Peak heat flux determines divertor material limit
- λ_q for ITER is based on the Eich’s scaling ($\lambda_q \sim B_p^{-1.2}$)
- Bridging the gap towards ITER is important

RT17 – M19 ‘Heat flux decay length characterisation in high-current H-mode’

Priorities for 2027:

- **Preparation of dedicated M19 pulses (at high I_p)**: piggyback data validation using M01, M04, M09 and M10 experiments
- Impact of plasma shape, SP position and main gas fuelling (at lower plasma current)
- Identification of the best scenario in terms diagnostics coverage (in particular, for heat flux by divertor IR camera)
- Characterise divertor heat flux and SOL width at different I_p and modelling comparison
- Study heat flux broadnening at high density
- Validation of radiation power density measurements

RT17 – M20 'Impact of divertor geometry on SOL plasma parameters'

M20: Impact of divertor geometry on SOL plasma parameters

Experiment Coordinator: M. Groth (Aalto University, EU)
Co-EC: R. Sano (QST, Japan)

Deliverables	
M20-D1	Study the impact of edge fuelling, NBI power and X-point configuration on SOL plasma parameters
M20-D2	Measure and validate neutral compression and changes in the pedestal parameters
M20-D3	Validate divertor heat flux for preparing main scenario development
Extended goals	
M20-E1	Compare the impact of D and H plasma at medium plasma current (I_p ~ 2-3MA)
M20-E2	Assess whether detachment conditions are achieved in OP2

Session distribution in OP2

Cycle #1	Cycle #2	Cycle #3	Cycle #4
0	0	0	N-NBI (D): ~0.5 N-NBI (H): ~1

RT17 – M20 ‘Impact of divertor geometry on SOL plasma parameters’

Priorities for 2027:

- Piggyback data validation using M01, M05, M09, M17, M19 and M21 experiments
- Identification of the best settings for diagnostics coverage
- Modelling validation: study impact of edge fuelling, NBI power and X-point configuration
- Preparation of dedicated M20 pulses (at high plasna current): define density steps with strike point sweep for divertor characterisation at verious P_{NBI}; define Ip; variation of X-point height; impact of fuelling location (modelling support)
- Assess if detached plasmas can be achieved in OP2

RT17 – M21 ‘Divertor heat flux control with impurity seeding’

M21: Divertor heat flux control with impurity seeding

Experiment Coordinator: T. Nakano (QST, Japan)
Co-EC: A. Stagni (RFX, EU)

Deliverables	
M21-D1	Characterise divertor heat flux with impurity seeding (Ar, Ne or a mix)
M21-D2	Characterise the impact of impurities at different plasma current
M21-D3	Validate impurity seeding models for high-I_p plasmas
Extended goals	
M21-E1	Assess whether detachment conditions are achieved with impurity seeding during OP2

Session distribution in OP2

Cycle #1	Cycle #2	Cycle #3	Cycle #4
0	0	0	N-NBI (D): ~1 N-NBI (H): ~1.5

RT17 – M21 ‘Divertor heat flux control with impurity seeding’

Priorities for 2027:

- Preparation of dedicated M21 pulses (at high I_p): supportive modelling (e.g., SOLEDGHE3X-EIRENE assessment of the effect of Ne seeding)
- Supportive modelling to select impurity specie for M21 (Ar, Ne or a mix)
- Characterize the impact of impurities at different plasma current (realistically, max. 2 plasma current values)
- Assess if detached plasmas can be achieved in OP2 with impurity seeding

RT17 – WSA ‘Support for future JT-60SA operations and W-PFC transition’

WSA: Support for future JT-60SA operations and W-PFC transition

Deliverables	
WSA-D1	Identify and provide W-PFC-compatible operating conditions (using SOL and PWI simulation codes) for the integrated core-edge scenario modelling
WSA-D2	Investigate ramp-up phases, including the estimate of heat-flux decay lengths, leveraging the validation of OP2 results and refinement of modelling tools to improve predictive capabilities for the W-PFC phase
WSA-D3	Assess the impact of impurity seeding on W erosion under relevant plasma operating conditions
WSA-D4	Explore options to improve wall conditioning for future W-PFC operations in JT-60SA

RT17 – Summary

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M21: Divertor heat flux control with impurity seeding	T. Nakano (QST)	A. Stagni (RFX)

Data analysis and interpretation: Divertor Langmuir probes; divertor infrared camera; TS; bolometry; EDICAM; Quadrupole mass spectrometer (QMS); VUV spectrometer; visible spectroscopy; density interferometer; Pennning gauges; D_α array; impurity analysis, …

Plasma edge modelling: SOLEDGE3X-EIRENE, SOLEDGE-HDG, SOLPS-ITER, ERO 2.0, JINTRAC-SOLPS-NN, nHESEL, JINTRAC-COCONUT + DIVIMP, ECWC modelling, …

More details on RT-17 modeling activities (2026): G. Falchetto et al., WPTE Review Meeting, 06 Nov. 2026