

# 2026 Development of a runaway electron monitor

**Task-specification: SA-EN.FE.14-T004**



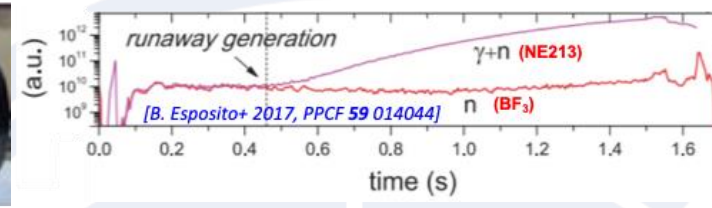
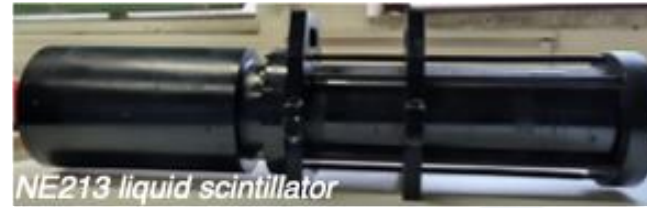
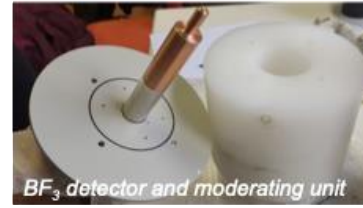
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**Beneficiary: ENEA**  
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# Project status

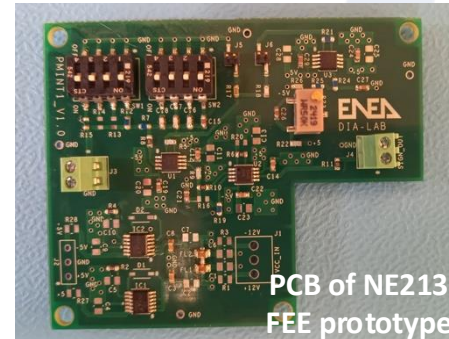
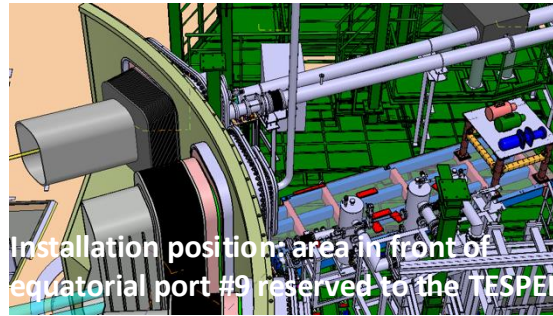
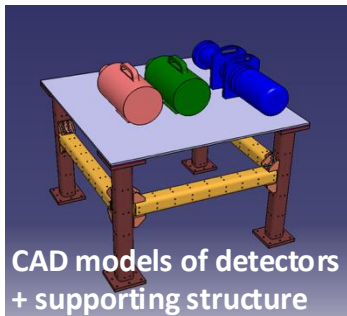
- Aim: installation in JT-60SA of a **RE monitor based on former FTU detectors** available at ENEA (two BF<sub>3</sub>, one NE213).



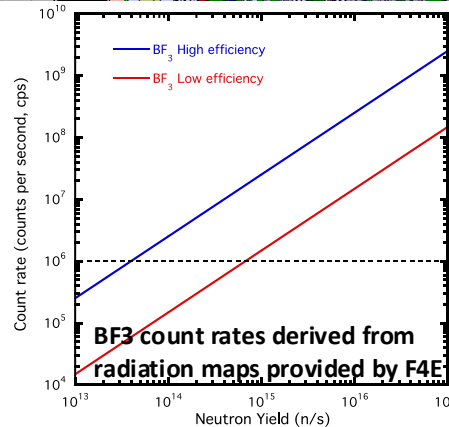
- Design activities carried out in 2025 as part of EDGE and SOL diagnostics feasibility studies (final report: EFDA\_D\_2T3V9T v1.0):

- **Diagnostic components** defined, including: front-end electronics (FEE), back-end electronics (BEE), cables and connectors.
- Preliminary **spatial allocation** analysis based on JT-60SA CAD drawings provided by F4E → *diagnostic fits in front of a JT-60SA equatorial port*

- **Magnetic field compatibility** of NE213 addressed based on magnetic field maps included in JT-60SA PID. → *No issue for detector operation.*
- **Prototypes** of NE213 and BF<sub>3</sub> front end electronics (**FEE**) designed and components procured.



- Preliminary evaluation of **measurement performance** carried out based on MCNP neutron/gamma-ray data provided by F4E → *No issues for NE213, use of additional shielding might be needed for BF<sub>3</sub> for RE discharges at neutron yields above ~10<sup>15</sup> n/s*



- **Implementation plan** developed and structured in a draft timeline assuming installation of the diagnostic for OP3 (September 2027)
- Draft **estimate of total effort** provided, including: hardware & shipment costs; costs for use of facilities; staff effort; weeks of mission.

- Communication received on March 27 that the **proposal has been preliminarily discussed as one of the potential candidates for installation in OP3**. 2025 final report now shared with QST and F4E.



# Plan of 2026 WPSA activities

- **RE monitor development** activities **supported** for 2026 and 2027 with **1 PM/Year through WPSA**.
- **Diagnostic implementation plan according to 2025 report**, including: design finalization; procurements; testing; shipment; installation; functionality tests without plasma; commissioning with plasma pulses; CODAS integration.

Activities	Diagnostic preparation at ENEA												ME2				OP3							
	Dec-25	Jan-26	Feb-26	Mar-26	Apr-26	May-26	Jun-26	Jul-26	Aug-26	Sep-26	Oct-26	Nov-26	Dec-26	Jan-27	Feb-27	Mar-27	Apr-27	May-27	Jun-27	Jul-27	Aug-27	Sep-27	Oct-27	
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| <ol style="list-style-type: none"> <li>Finalization of interfaces/responsibilities for installation/commissioning</li> <li>Development of a BF3 FEE (preamplifier) prototype</li> <li>Set-up of BF<sub>3</sub> commissioning BEE</li> <li>Test of BF3 assembled systems (detector, prototype FEE and commissioning BEE) using radiation sources/FNG</li> <li>Development of a NE213 FEE (integrating circuit) prototype</li> <li>Set-up of NE213 standalone BEE</li> <li>Tests of NE213 and BF3 assembled system (detector, prototype FEE and BEE) using radiation sources/FNG</li> <li>Development of final BF3 / NE213 FEE based on the tests performed with prototype units</li> <li>Design/procurement of BF3 standalone BEE</li> </ol> | <ol style="list-style-type: none"> <li>Final tests of NE213 and BF3 assembled systems (detectors, final FEE and standalone BEE)</li> <li>Update of detector performance analysis based on updated MCNP data and flux efficiency data</li> <li>Finalization of the design of the detector supporting structure</li> <li>Procurement of detector supporting structure</li> <li>Shipment of the complete system to JT-60SA</li> <li>System installation at JT-60SA</li> <li>Functionality tests without plasma</li> <li>Integration with JT-60SA CODAS</li> <li>System commissioning with plasma pulses</li> <li>Integration of the diagnostic in the JT-60SA real-time system</li> </ol> |
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- **Progress** on the following subset of activities is planned **for 2026**, in **accordance with the foreseen level of support**:
  - **Definition of physical interfaces** in the torus hall and the diagnostic room (*point 1*)
  - **Finalization** of the assembly of **BF3 and NE213 front-end electronics** and **tests** (*points 2, 4, 7*)
  - Update of detector **performance analysis** (*point 11*)
  - **Evaluation of the static ferromagnetic forces** acting **on NE213** detector (*point 12*)



# Needed inputs & other points of discussion

- Definition of physical interfaces in the torus hall and the diagnostic room (back-end electronics location) is essential to finalize design, plan procurement and diagnostic installation:
  - Need of confirmation that area in front of equatorial port #9 reserved to the TESPEL can be assigned to RE monitor in case of its installation for OP3.
  - Investigate the possibility that QST provides the supporting structure for the detectors
  - Define exact location for RE BEE electronics and any requirement on BEE layout

→ *Need support from EUROfusion to identify reference people in QST and organize dedicated meetings.*
- 2025 performance analysis for detectors located @ 12 m from tokamak axis carried out based on F4E MCNP simulations @ 8.5 m from axis with water instead of nitrogen in vacuum vessel cooling circuits.

→ *Updated radiation maps extended up to 15 m and scaling factors for presence of nitrogen shared by F4E on March 31. Request made for neutron/gamma-ray spectra at representative location.*
- EM calculations planned to estimate the static ferromagnetic forces acting on NE213 magnetic shielding to define the detector mechanical supports.

→ *Static magnetic field maps from JT-60SA PID will be used in first instance. Further data will be requested in case of need.*
- Feedback needed from EUROfusion on next steps that will be followed for projects identified as candidates for installation in OP3.