Installation, commissioning and operation of the Pellet Launching System (PLS)

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Questionnaire

- **Onsite support: Installation**
- **Need for EU personnel to work in labs or the torus hall**
- **EU expert support in Japan (control room work etc.)?**
- **Software needs beyond Procurement Arrangement**
- **Knowledge management and transfer**
- **Training of EU and Japanese personnel in English/Japanese.**
- **Remote operation/maintenance/commissioning or Remote support**

System requirements

Main research needs (from Research Plan)

Physics:

- High density operation in ITER and DEMO relevant plasmas

- Explore accessibility to densities in vicinity of the Greenwald density

- Investigate power exhaust, develop radiation layers in scenarios

- ELM control

- Pellet applied in particle balance studies (SOL, divertor)

Engineering:

Functions of **actuator "pellet injection"** on electron **density and ELMs**

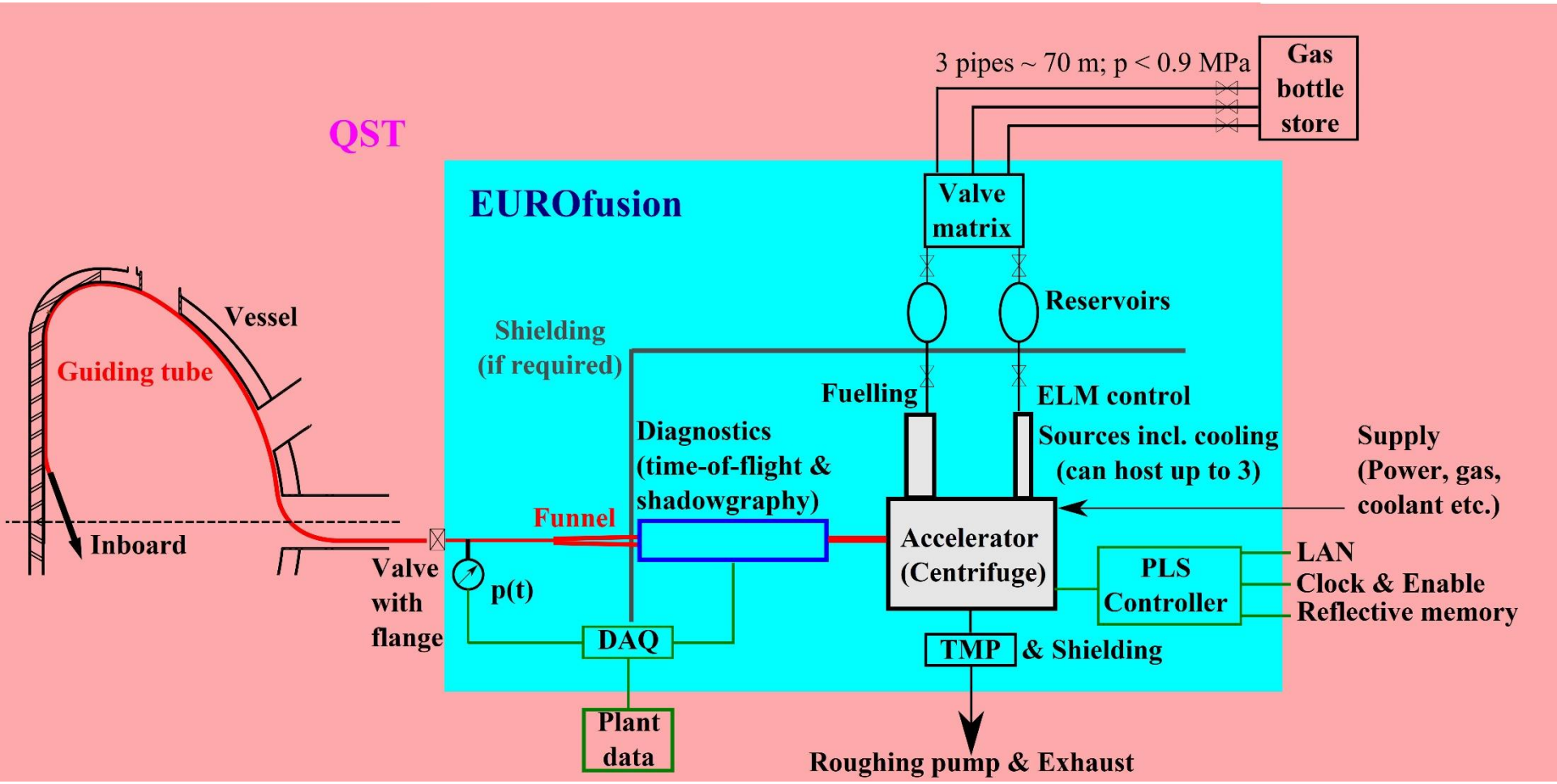
Quantify actuation (in open loop) during the initial research phase I

Prepare closed-loop control experiments in the initial research phase II

➔ Pellet actuation for fuelling (density gradient) **control within the advanced real-time control scheme**

Installation (1)

PLS scheme with projected responsibility as shared between QST and EUROfusion



Installation (2)

Need for EU personnel to work in labs or the torus hall?

Work plan:

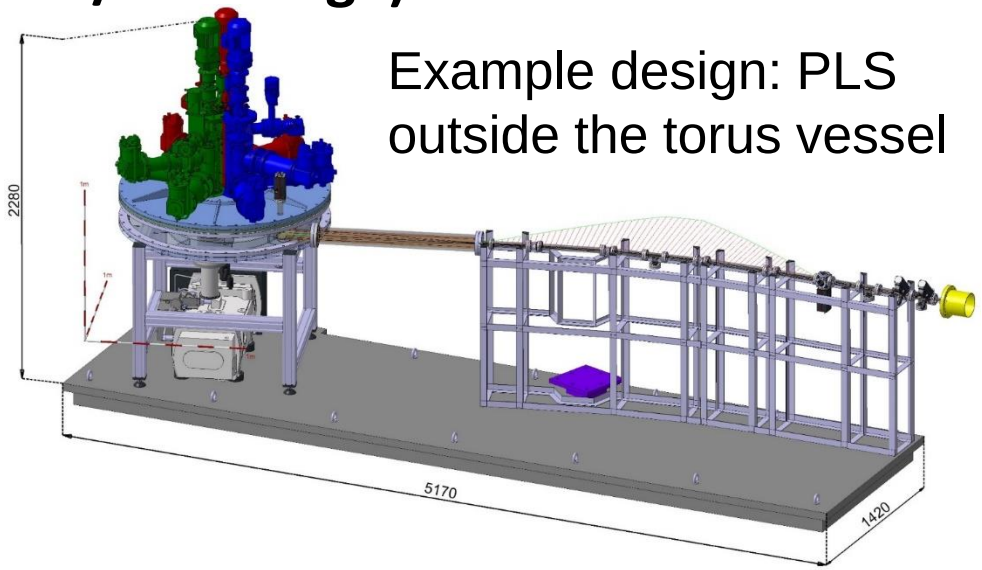
- **Dismantling of PLS after acceptance in EU**
- **Packaging and shipment to QST**
- **Reassembly at dedicated space (tbd.) near torus hall (crane required)**
- **Transport to P9 and installation (connection to gas and vacuum)**
- **Installation of cubicles**
- **Installation of PLC in pellet control room**
- **Establish all interfaces (data, control, power…)**
- **Commissioning of full system**
- **Training of QST engineers**

Installation (3)

Need for EU personnel to work in labs or the torus hall?

Yes!

- **Same people to reassemble than dismantling**
- **Complicated system requires expert knowledge from design phase for the commissioning of the system**
- **Repair/adjustments may be needed by third party (manufacturer of pellet sources/centrifuge)**
- **Training for QST operator/ engineers on-site only**



Example design: PLS outside the torus vessel

System start up on plasma

EU expert support in Japan (control room work etc.)

Commissioning on plasma:

Offered significant contribution of

- **Plasma operation expert “Fuelling control by pellets”**
- **Experienced pellet operator**

for period 2023 - 2025 within FP9

within the

CONSORTIUM WORK PLAN 2021-2025

CALL RESPONSE FORM for the work package

SA –JT-60SA Exploitation

System start up on plasma

EU expert support in Japan (control room work etc.)

Commissioning on plasma:

Offered significant contribution of

- **Plasma operation expert “Fuelling control by pellets”**
- **Experience pellet operator**

This way also best coverage of the tasks (learning by doing)

Knowledge management and transfer

(reports, publication, training)

Training of EU and Japanese personnel

Questionnaire

Software needs beyond the ones listed in the Procurement Arrangement (e.g. for post-processing, calibration or analysis). Licensed or free software

Regarded too early for an qualified answer now

But keeping an eye on this

Main topic this is very likely to get relevant:

Control system

Control system requirements

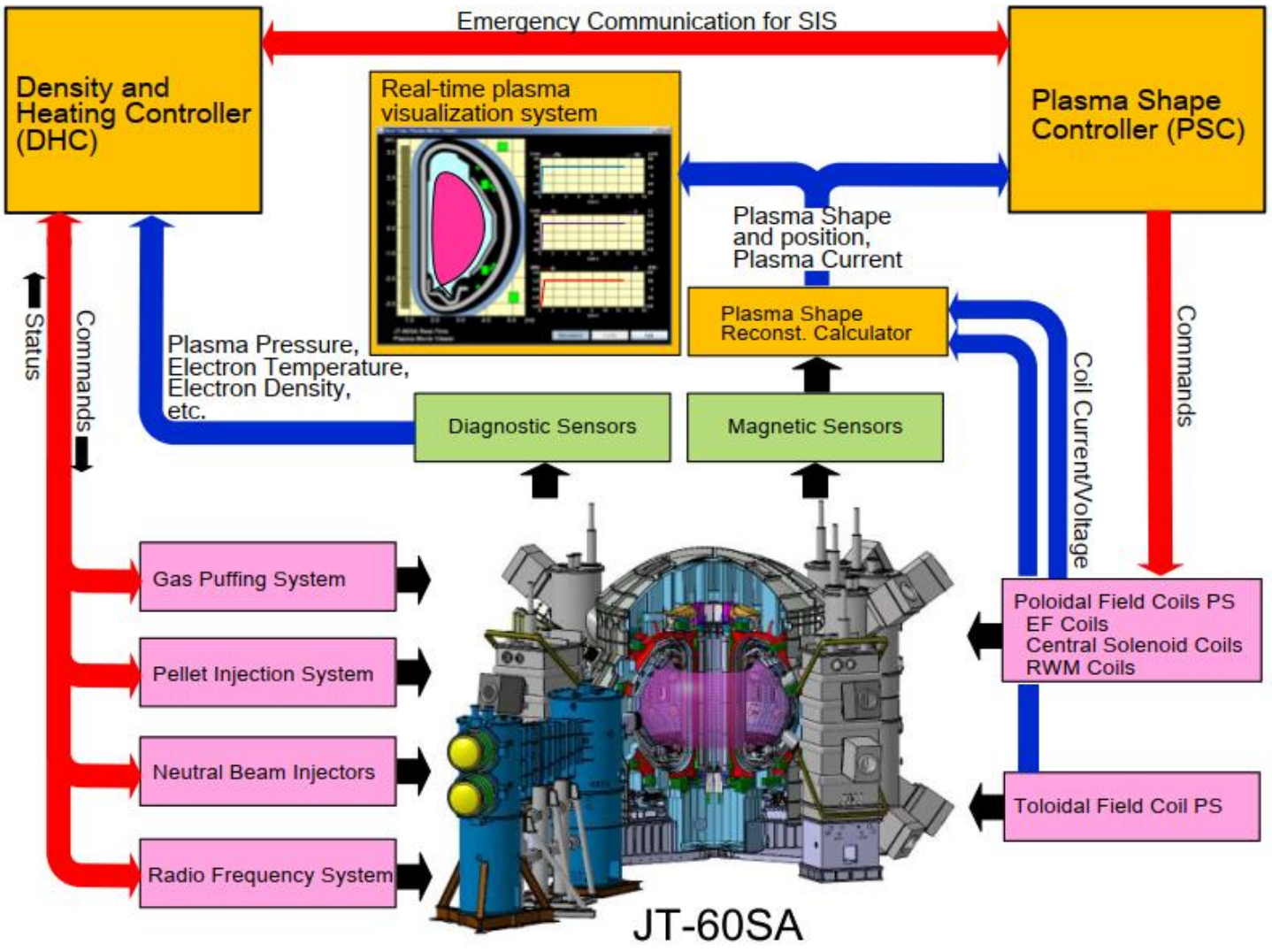


Figure 2.17-6 Configuration of the JT-60SA real-time plasma control system

Control strategy

The control algorithm is not part of the FP8 project – but a sophisticated approach is needed to make use of the full system capability

Controller implementation will happen in a staged approach

1) Feed forward on f_P
Pre-programmed sequences $f_P(t)$ (x Enable) for
Fuelling (f_P x m_P = Γ)
Pacing (f_P determines requested ELM rate)
Independent Fuelling & Pacing with extruder priority communicated to PLS controller

2) Feed back on f_P
JT-60SA controller requests according $f_P(t)$ for either
Fuelling (f_P x m_P = Γ)
Pacing (f_P determines requested ELM rate)
Independent Fuelling & Pacing with extruder priority communicated to PLS controller

3) “Prioritised launch slot selection”
JT-60SA controller requests simultaneously fuelling flux and ELM pacing rate
Simultaneous control of both parameters with (flexible) task priority

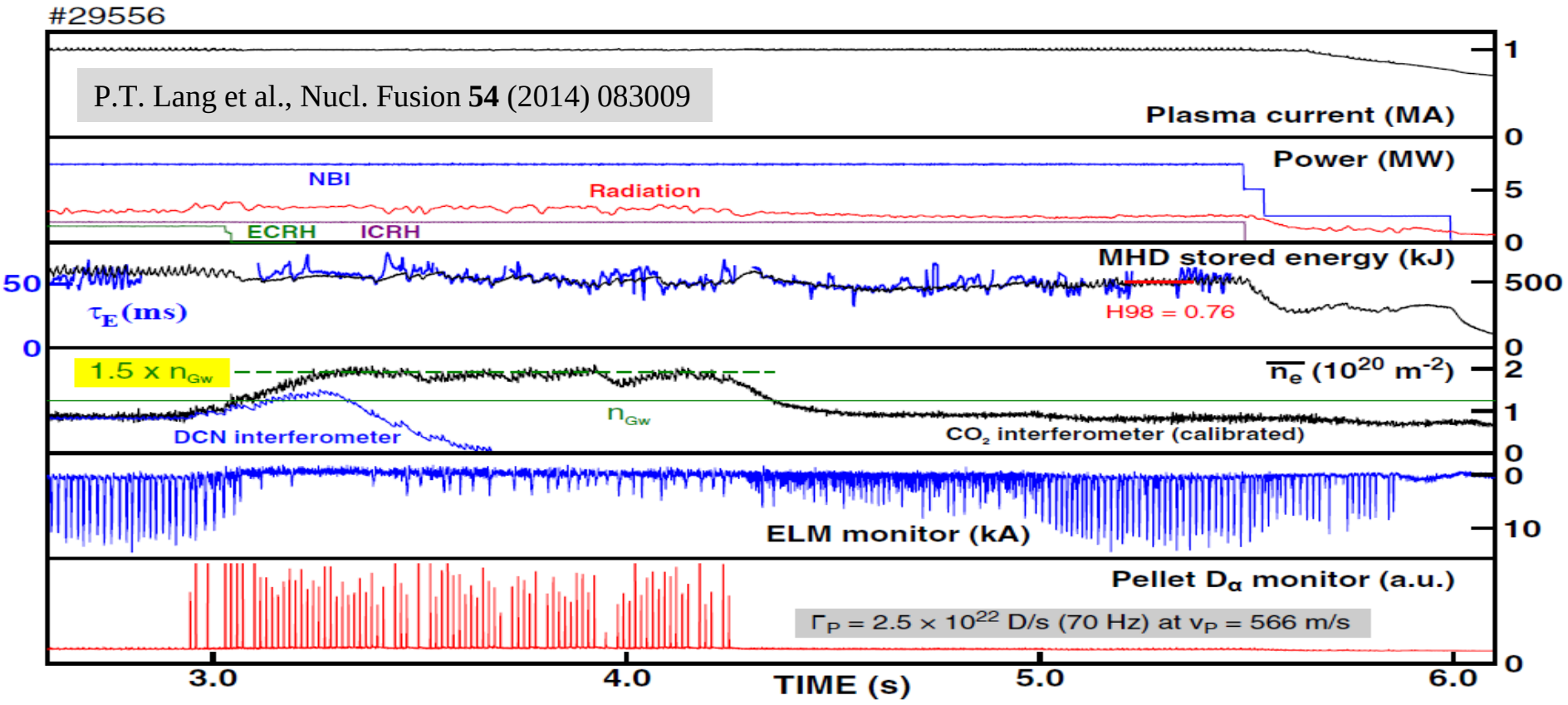
Control strategy – Example for FF

Feed forward on f_P - but taking care for interlock

Pre-programmed sequences $f_P(t)$ (x Enable) for e.g. fuelling

Example from AUG: Pellet fuelling at fixed $\Gamma = f_P \times m_P$

Enables reversible access to high-density regime



Remote participation

Remote operation/maintenance/commissioning or

Remote support

Our personal view:

Not efficient, not pleasant (time difference!)

Requirements for a proper start up

Pellet delivery into the torus is intended – not indicating a leak
PLS not to be handled like a usual system under vacuum

Pellet arrival in plasma well detected?
Ablation radiation monitor close to P09?
Do we have sufficient pellet resilient density measurements?
Taking care for interlock
Suitable as control parameters?

Requirements for a proper start up

Do we have sufficient pellet resilient density measurements?

Taking care for interlock

Suitable as control parameters?