

## **Concept of ITER Tritium Plant Instrumentation and Control (I&C)**

O. Kazachenko, D. Babineau

ITER Organization, Route de Vinon, CS 90 046, 13067 Saint-Paul-Lez-Durance Cedex, France

The Tritium Plant (TP) will provide recirculation of hydrogen isotopes within the ITER fuel cycle. TP systems shall be built for hydrogen isotopes storage, delivery, extraction from different gaseous mixtures and liquid water, and isotope separation.

The systems complexity is defined by the torus fuelling rate and pulsed mode of tokamak operation. The number of instruments (digital and analog inputs/outputs), sensors, actuators and heaters in the TP will be above 10,000. Integration of such a complex plant requires a reliable process control system. This paper presents the concept of the TP Instrumentation and Control (I&C), comprising three functionally and physically separated tiers: control and data acquisition (TPCDA), interlock system (TPIS) and safety system (TPSS) have to support the safe automatic operation of the TP systems.

Each TP system shall be designed with I&C providing its standalone operation and protection of system equipment. TPCDA will integrate TP systems addressing interfaces between systems and to the ITER central control (CODAC) on the basis of predefined TP operational scenarios and control algorithms. TPCDA has to e.g. synchronise the process set-points of TP systems according to operational scenarios, redirect, if necessary, streams between TP systems, collect process data of interfacing TP systems, send reports and receive commands from CODAC. TP data base management and data visualisation to assure proper human-machine interface will also be the tasks for TPCDA.

The operation of complex systems is unavoidably accompanied by malfunction of elements which can have operational, maintenance, cost or even safety impacts. In most cases the redundancy of TP systems shall allow the TPCDA to keep the system inside operation limits (OL). The logic controller based TPIS using its own instruments shall prevent the system operational parameters like pressures, temperatures and flow rates from deviating outside of OL. The system, totally or partially, can continue operation servicing interfacing systems or can be put into a predefined safe state. Return of the system to normal operation will be possible automatically or under a TP operator's decision after deficiency corrections.

If TPCDA and TPIS will not be able to maintain the system or entire TP inside OL the TPSS shall trip the system or the entire TP into predefined safe states to prevent an incident or accident. Depending on probable event characterization, the local safety tiers of TP systems can be arranged as hardwired or on the basis of PLC. The intelligent TPSS will integrate these tiers providing TP protection and activation the safety systems when necessary.