FUSION FOR ENERGY

TECHNOLOGY OFFER

Advanced I&C Architectures for Cryogenic and Vacuum Systems in Fusion Environments

Through its collaboration with Fusion for Energy (F4E) in the ITER project, GTD Science, Infrastructures & Robotics has developed specialised capabilities in the design, integration, and validation of instrumentation and control (I&C) architectures for cryogenic and vacuum systems operating in nuclear and fusion environments. Within the ITER Front End Cryogenic Distribution System (FECDS) and the Torus and Cryostat Cryopumping System (TCCS), GTD performed the final design of complex control infrastructures integrating hardware, software, safety interlocks, and nuclear safety functions. The work also included the manufacturing and validation of a First-of-a-Kind (FOAK) control system, demonstrating the capability to deliver complete I&C solutions from design to deployment.

Capabilities and technologies

As part of the development of the FECDS and TCCS control systems, GTD has developed specialised capabilities in the design and validation of complex control infrastructures, including:

- Design of **integrated I&C architectures** for cryogenic and vacuum infrastructures, combining control cabinets, acquisition electronics, and PLC-based control systems.
- Development of **process control software and system state machines** aligned with ITER's CODAC environment and Plant Control Design Handbook (PCDH).
- Implementation of **interlock and safety architectures**, including risk analysis (FMECA) and integration with plant-wide safety systems.
- Manufacturing and validation of **First-of-a-Kind control systems,** including **Factory Acceptance Tests and full system integration tests.**
- Design and qualification of instrumentation and **pneumatic control systems for process and nuclear valve actuation**.
- **Qualification of control hardware** for EMC, radiation, seismic conditions, and nuclear safety standards.

Advantages and Potential Applications

- Experience gained in delivering **complete I&C systems** for complex cryogenic and vacuum infrastructures.
- Capability to **design control architectures combining conventional control, interlock systems, and nuclear safety functions.**
- Proven expertise in **full lifecycle development**, from system design to manufacturing and validation of FOAK systems.
- Applicable to fusion reactors, **particle accelerators, cryogenic plants, hydrogen infrastructures, and advanced energy facilities.**

Collaboration opportunities

GTD offers these capabilities to organisations developing complex cryogenic, vacuum, or safety-critical infrastructures. The company can support the design, integration, manufacturing, and validation of advanced control architectures for large-scale scientific facilities and demanding industrial systems.

Fusion for Energy Technology Transfer Programme
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