GTD SIR – Instrumentation & Control

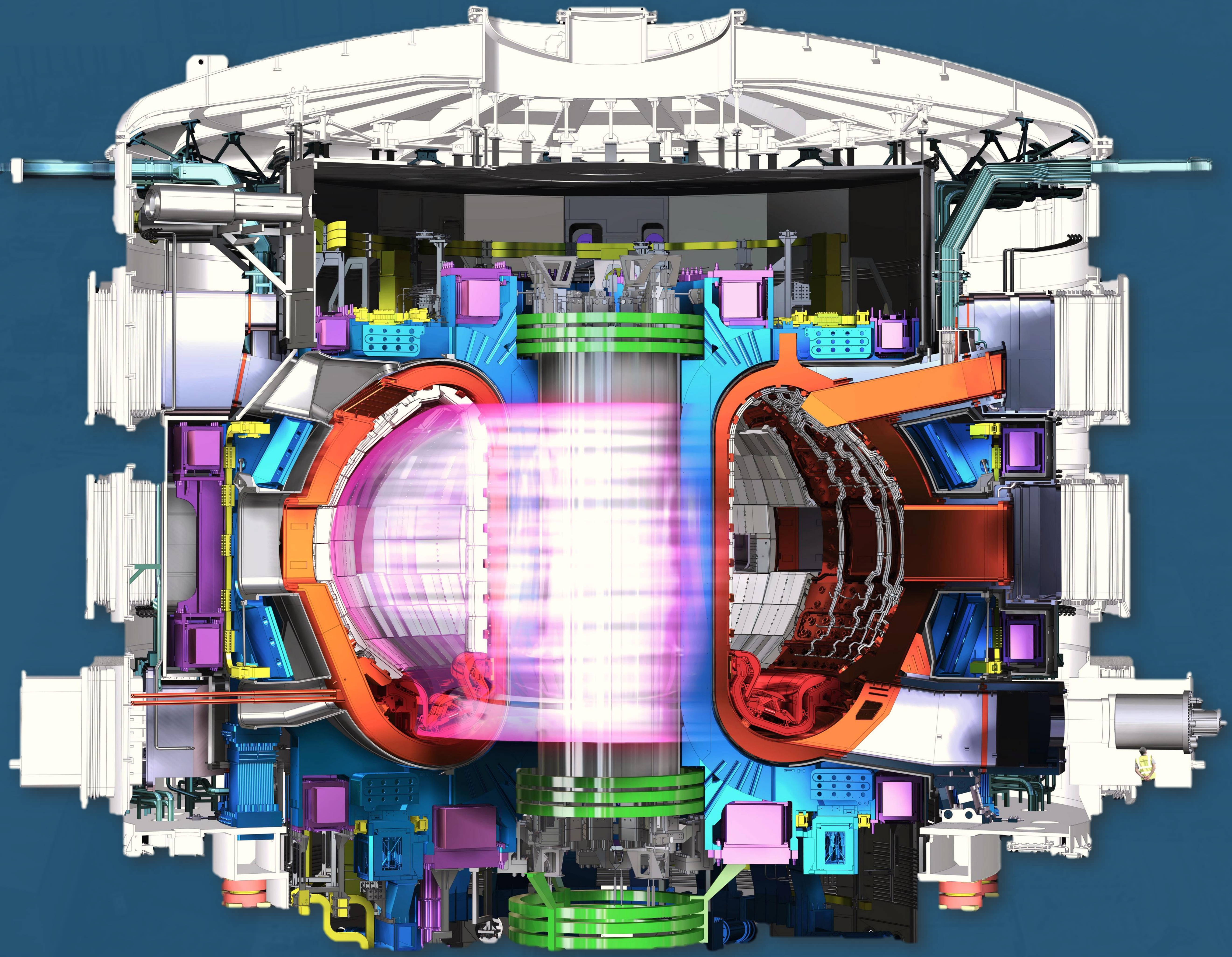
Slow Controllers (ms)

I&C Conventional

Machine Protection

Occupational Safety

Nuclear Safety

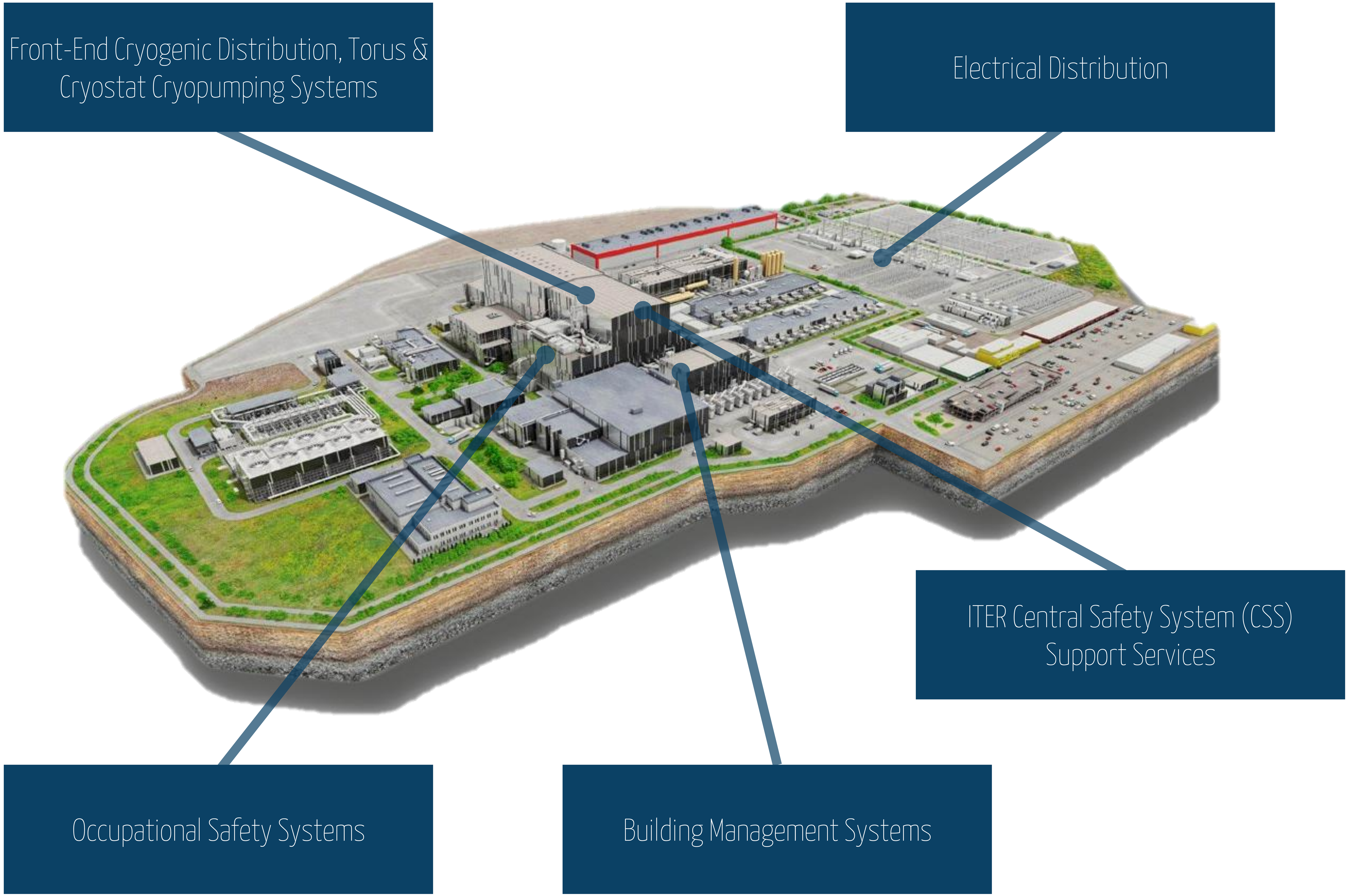


I&C PROJECTS in ITER

OVERVIEW

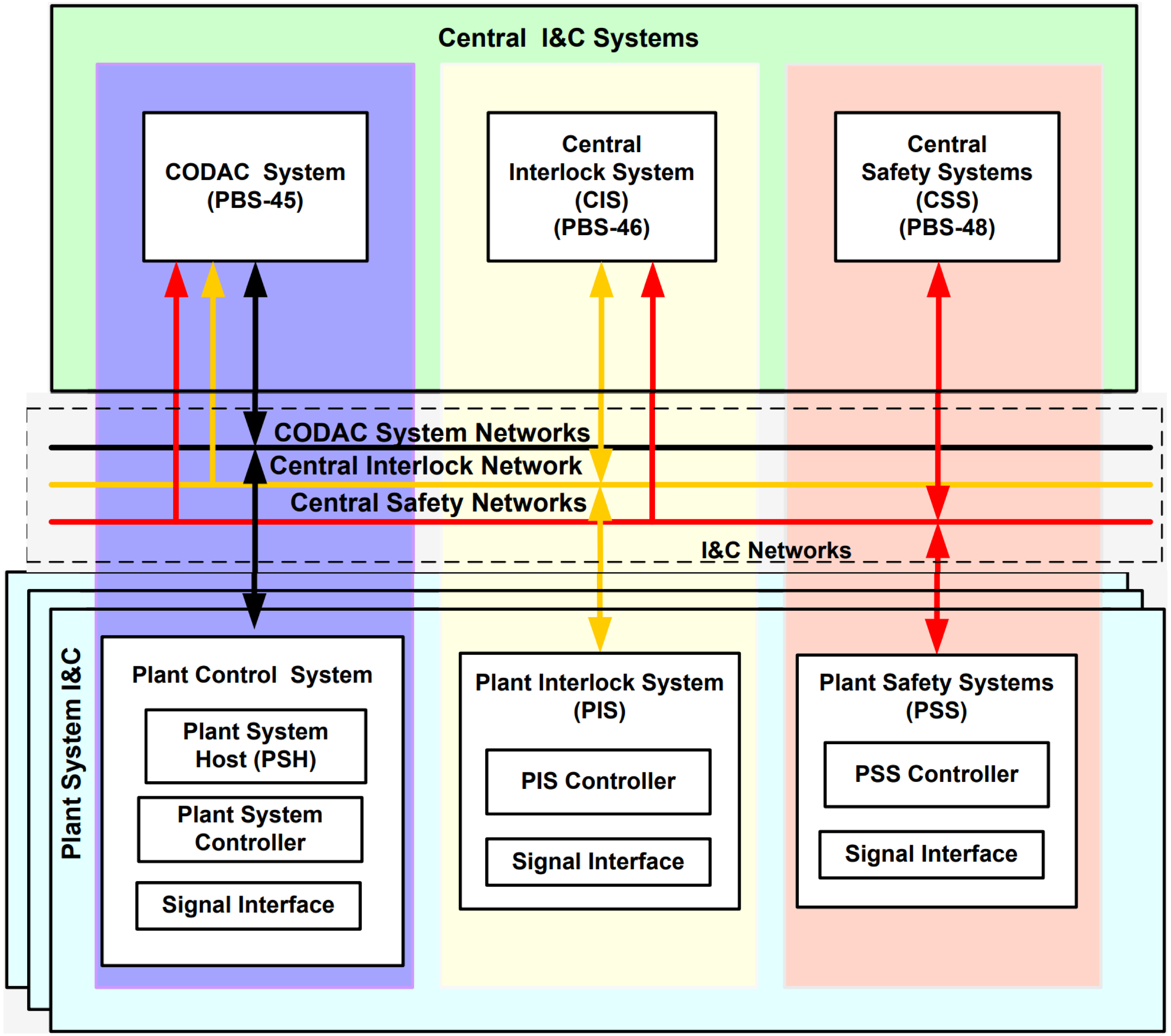
Projects involve:

- Quality Documentation;
- I&C Design Documentation;
- Control software development;
- SCADA development;
- Proof of concept tests;
- Environmental qualification;
- Control cubicle design & manufacturing;
- FAT, SAT & Commissioning.



Each ITER Plant System could have 3 levels of control:
- Control (PCS);
- Interlock (PIS);
- Safety (PSS).

All Plant System Control layers are connected to the Central Systems:
- CODAC for Control;
- CIS for Interlock;
- CSS for Safety.




OVERALL SYSTEMS LIFECYCLE
SYSTEM LIFECYCLE
ITER I&C LIFECYCLE
Overall I&C integration
Overall I&C commissioning
Overall operation and maintenance
System requirements specification
System specification
System detailed design and implementation
System Integration
System Validation
System Installation
REQUIREMENTS MANAGEMENT PLAN
PRELIMINARY BOM
SYSTEM ARCHITECTURE
SOFTWARE SPECIFICATION
DETAILED BOM
DESIGN AND DEVELOPMENT PLAN
INTEGRATION PLAN
VALIDATION PLAN
INTEGRATION PLAN
VALIDATION PLAN
INSTALLATION PLAN
CONCEPTUAL DESIGN
PRELIMINARY DESIGN
FINAL DESIGN
SUBSYSTEMS INTEGRATION
VALIDATION (FAT)
INSTALLATION
VALIDATION (SAT)
INTEGRATED COMMISSIONING
DESIGN PHASE
MANUFACTURING PHASE
INTEGRATION PHASE
OPERATION AND MAINTENANCE PHASE

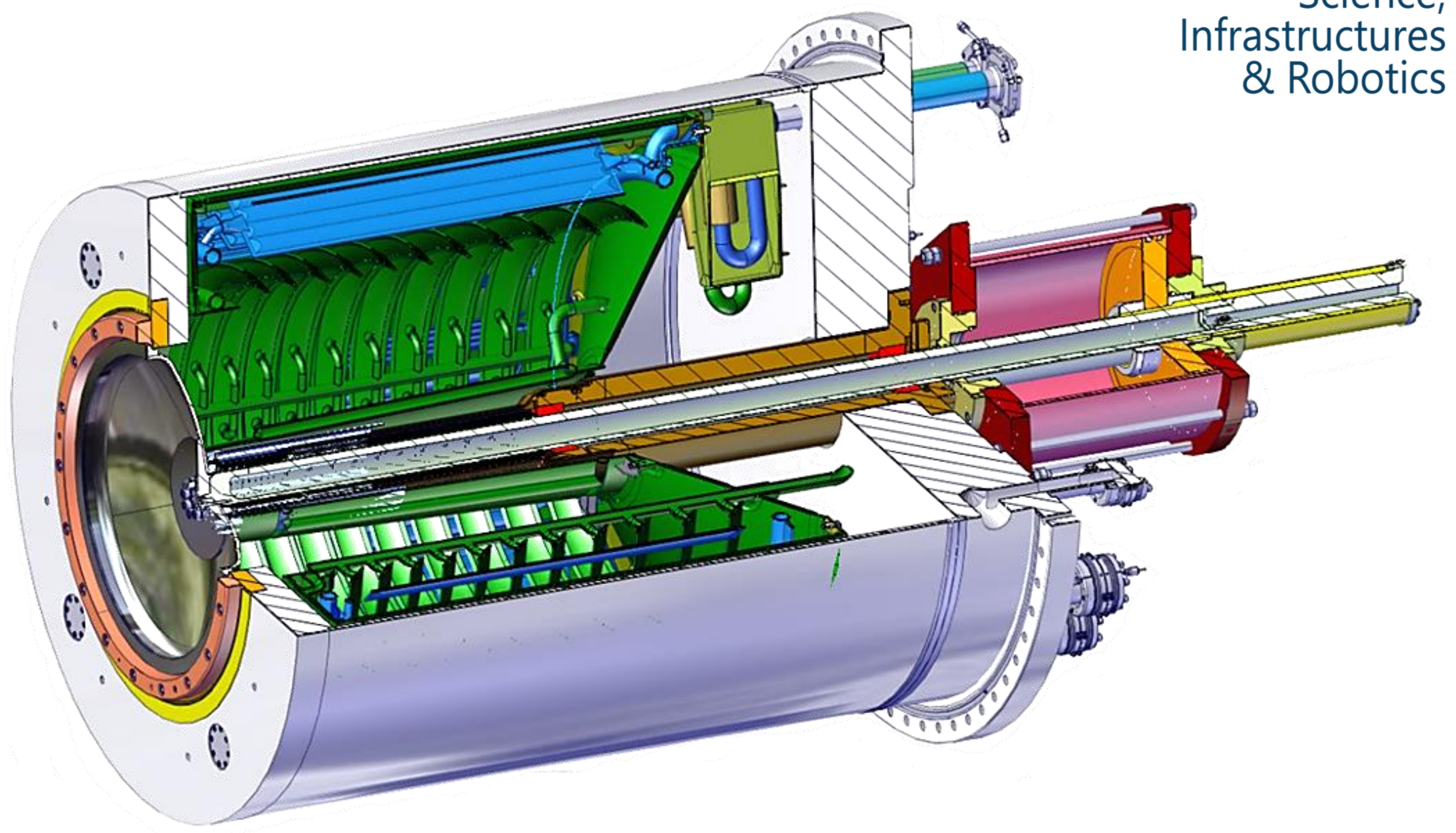
Science, Infrastructures & Robotics
gtd sir

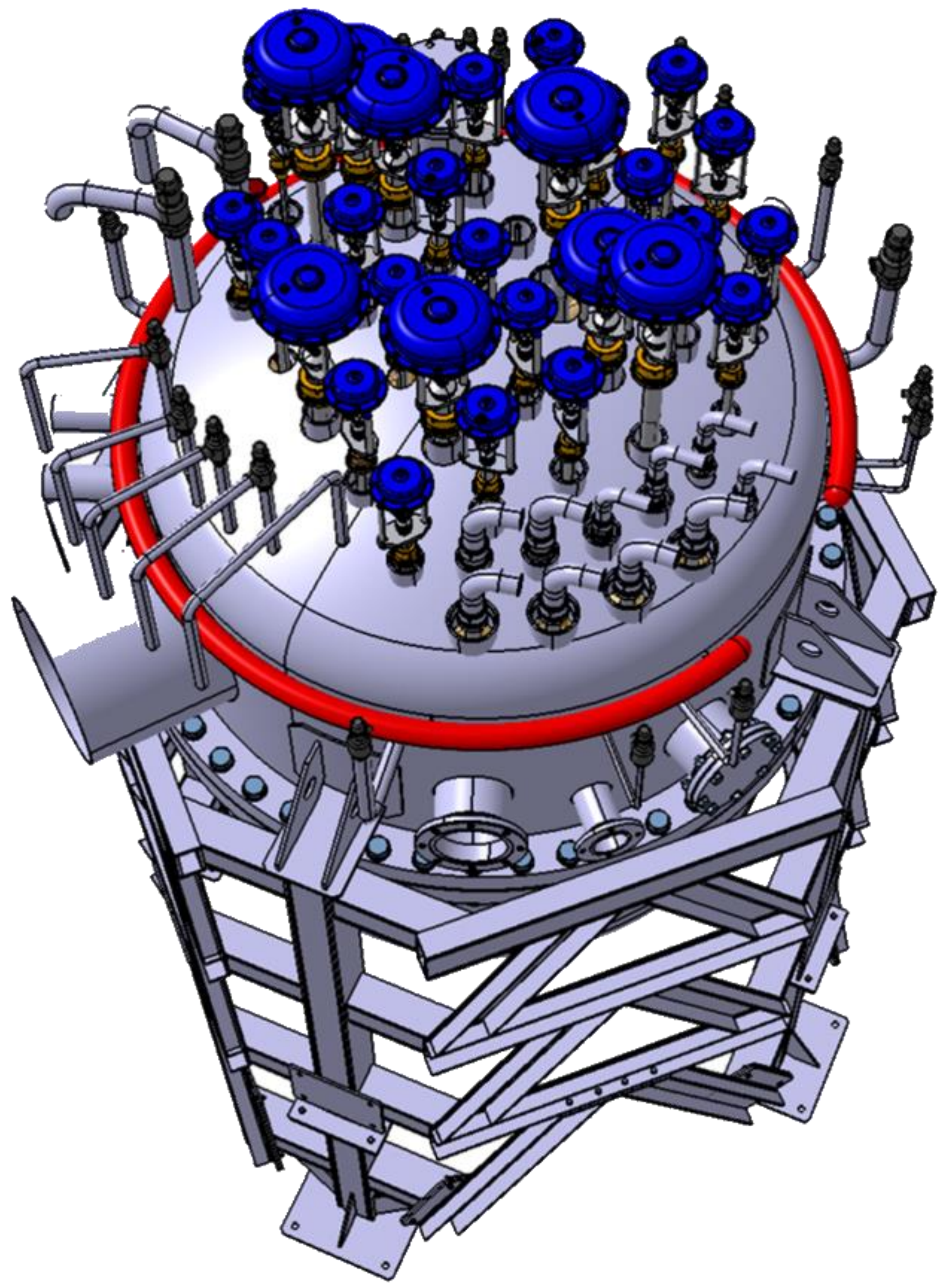
PLC PLATFORM	TIA V17
HMI PLATFORM	WinCC OA SIEMENS; CSS control system studio
PROGRAMMING LANGUAGES	IEC 61131-3 PLC Programming Languages; Microsoft® Visual Basic® for Applications
PROTOCOLS	PROFI NET®; PROFI BUS®; Modbus; OPC UA; PROFIsafe
SCHEMATIC APPLICATION	see E
HARDWARE	SIEMENS; S7-1500, S7-400; ET200M, ET200S
OTHER	Jira Software; Confluence; SUBVERSION

The systems under the scope of the project are:
Warm Regeneration Box
6 Torus Cold Valve Boxes
2 Cryostat Cold Valve Boxes
6 Torus Cryopump
2 Cryostat Cryopump

Cryopumps will be installed in the port cells at level B1 of the Tokamak complex building.

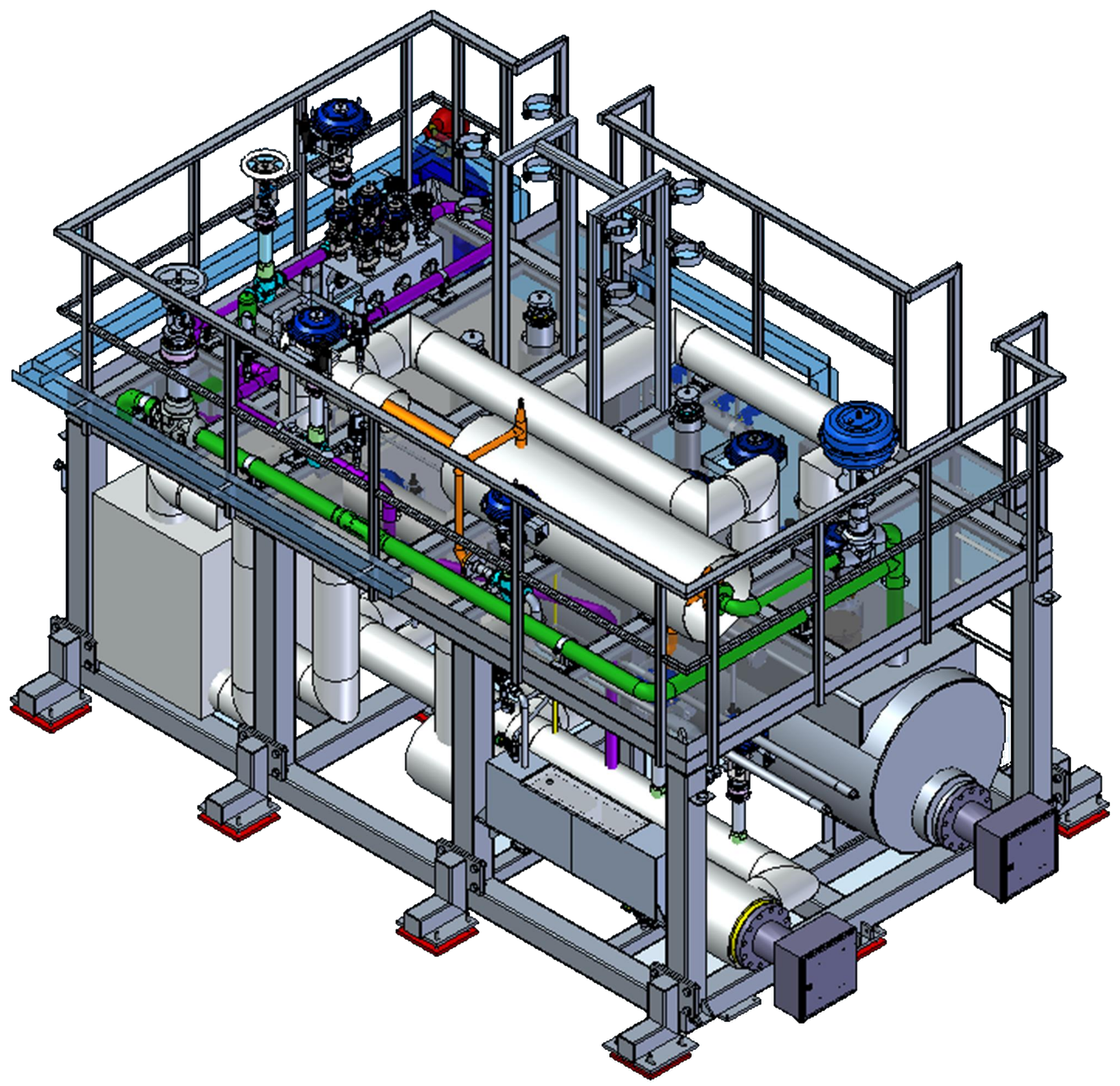
The Cryopumps are cryogenic adsorption pumps which will maintain the pressure required in the ITER Vacuum Vessels and remove residual gas during operation. The working principle of the pumps is based on the adsorption of exhaust gases by charcoal coated cryo-panels cooled to around 4.5 K.

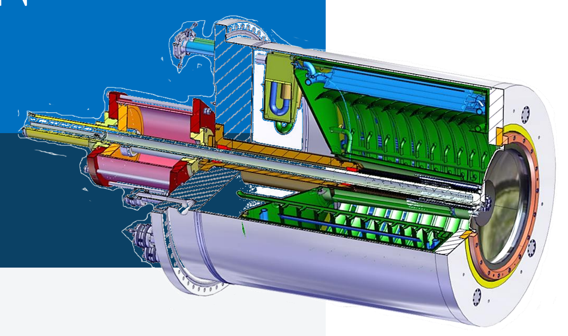




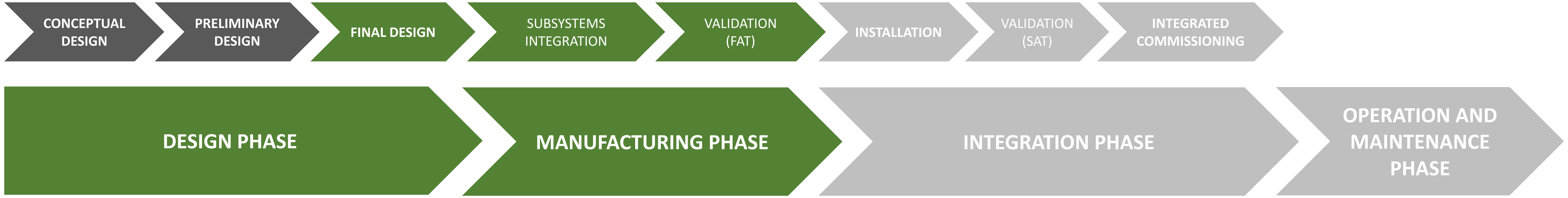
The Cold Valve Boxes control the flow of cryogens (and elevated temperature gases) to the cryopumps in the correct sequence to allow their operation in the nominal pumping and regeneration modes.

The Warm Regeneration Box provides the warm gases for cryopumps regeneration and
thermalizes the returns flows which would be too hot to send them back directly to the cryoplant.





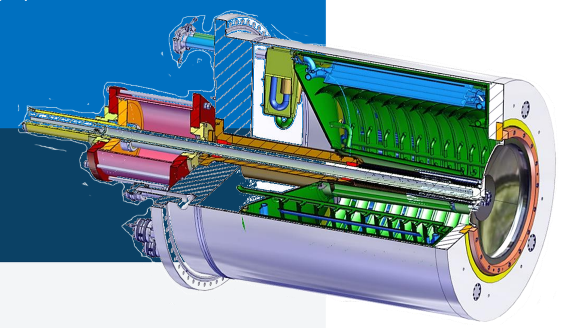
- Final Design for the FECDS & TCCS conventional control, interlocks, and nuclear safety I&C components
- Environmental qualification of FECDS I&C components (EMC, SMF, Radiation)
- Manufacturing Design for the FECDS & TCCS I&C cubicles
- System Software Design & Implementation
- First of Kind Manufacturing



Four contracts with F4E:
F4E -OFC-0811-09, 2019
F4E -OFC-0811-13, 2019
F4E -OFC-0811-14, 2019
F4E -OFC-0989-01, 2021

FRONT-END CRYODISTRIBUTION & CRYOPUMPING SYSTEM

SERVICES & SCOPE



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DESIGN

- System Plans
- Physical Design Documentation
- Functional Design Documentation

QUALIFICATION

- Test Set-up Specification
- Test Procedures
- Test activities
- Test Reports

MANUFACTURING

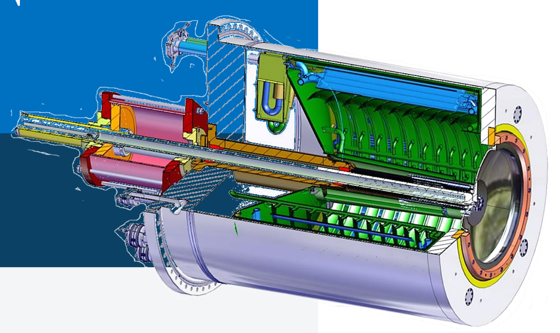
- 5 Control Cubicles for Conventional & Interlock Layers as First of a Kind manufacturing
- 1 Pneumatic Cubicle for process valve control
- 1 Pneumatic Cubicle for safety valve control

SOFTWARE

- 1 Process Control Software for Warm Regeneration Box System
- 1 Process Control Software for Torus Cold Valve Box & Cryopump System (+7 additional software instances)
- 1 Interlock Control Software for the Machine Protection

VALIDATION

- Software;
- Hardware (LCC & WMEE)
- Integrated (All cubicle interconnected, Software deployment



System Plans for the whole lifecycle with the proper level of details according to the design phase.

VERIFICATION

How to comply with the system requirements. Verification Control Document to trace the justifications and proofs (design, qualification, development) of proper requirements compliance.

INSTALLATION

Installation details for Control Cubicles and Pneumatic Cubicles (mechanical anchoring, power and signals cable interfaces, tubing interfaces), Software Integration.

VALIDATION

How to prove that the delivered system behaves as specified by the requirements.
High level definition of expected tests during FAT & SAT.

MAINTENANCE

Maintenance activity description for inspection, calibration, re-validation, replacement of I&C equipment of Conventional, Interlock & Nuclear Layers.

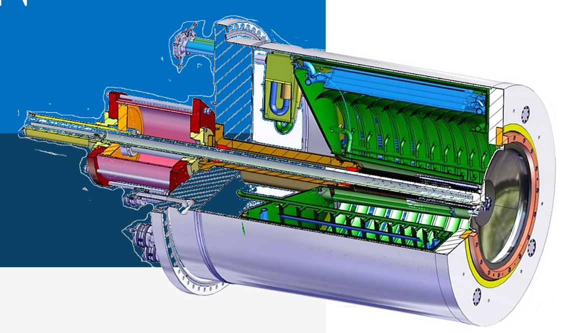
QUALITY ASSURANCE

CONFIGURATION MANAGEMENT

SECURITY

OPERATION

QUALIFICATION

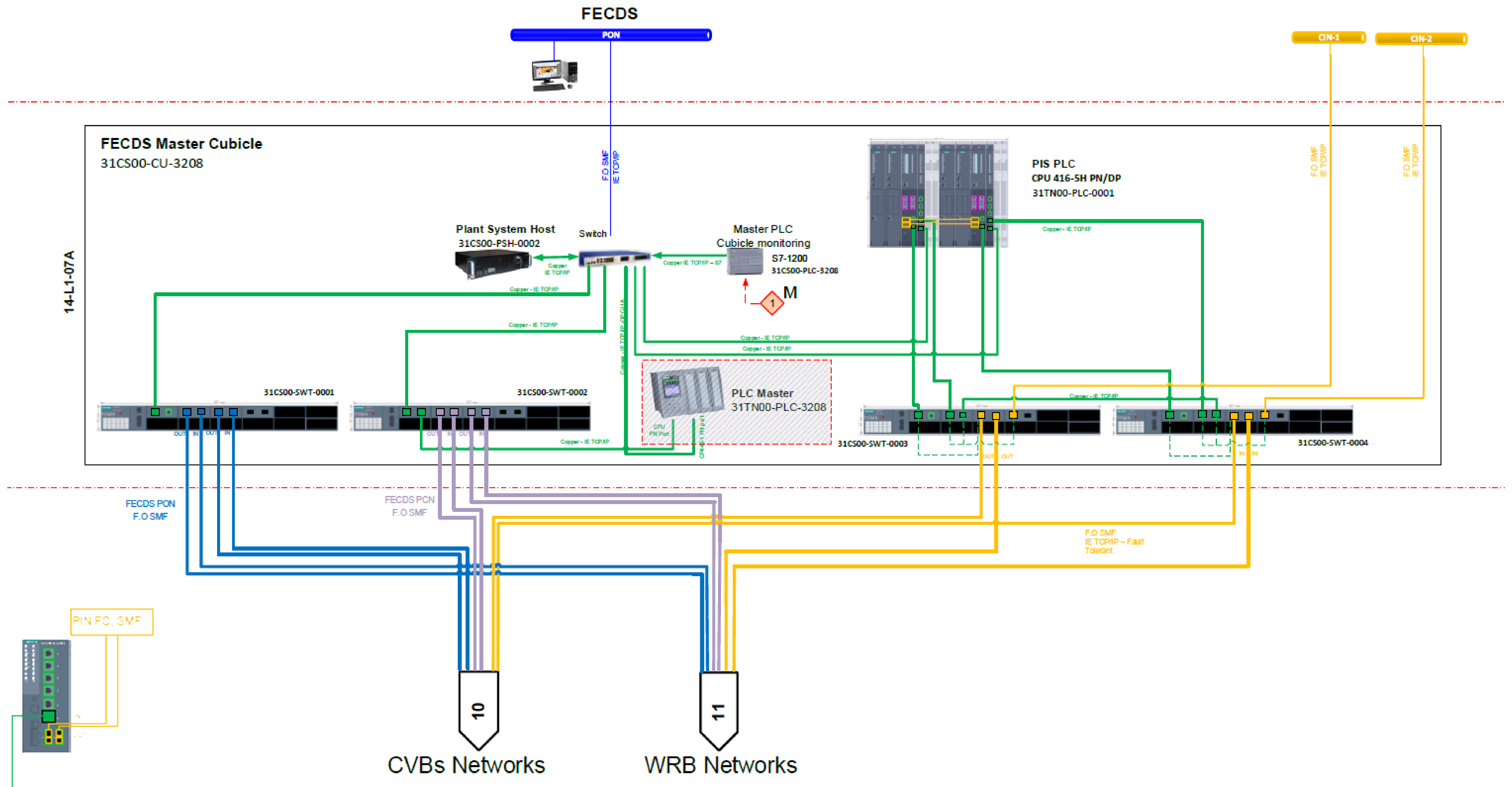


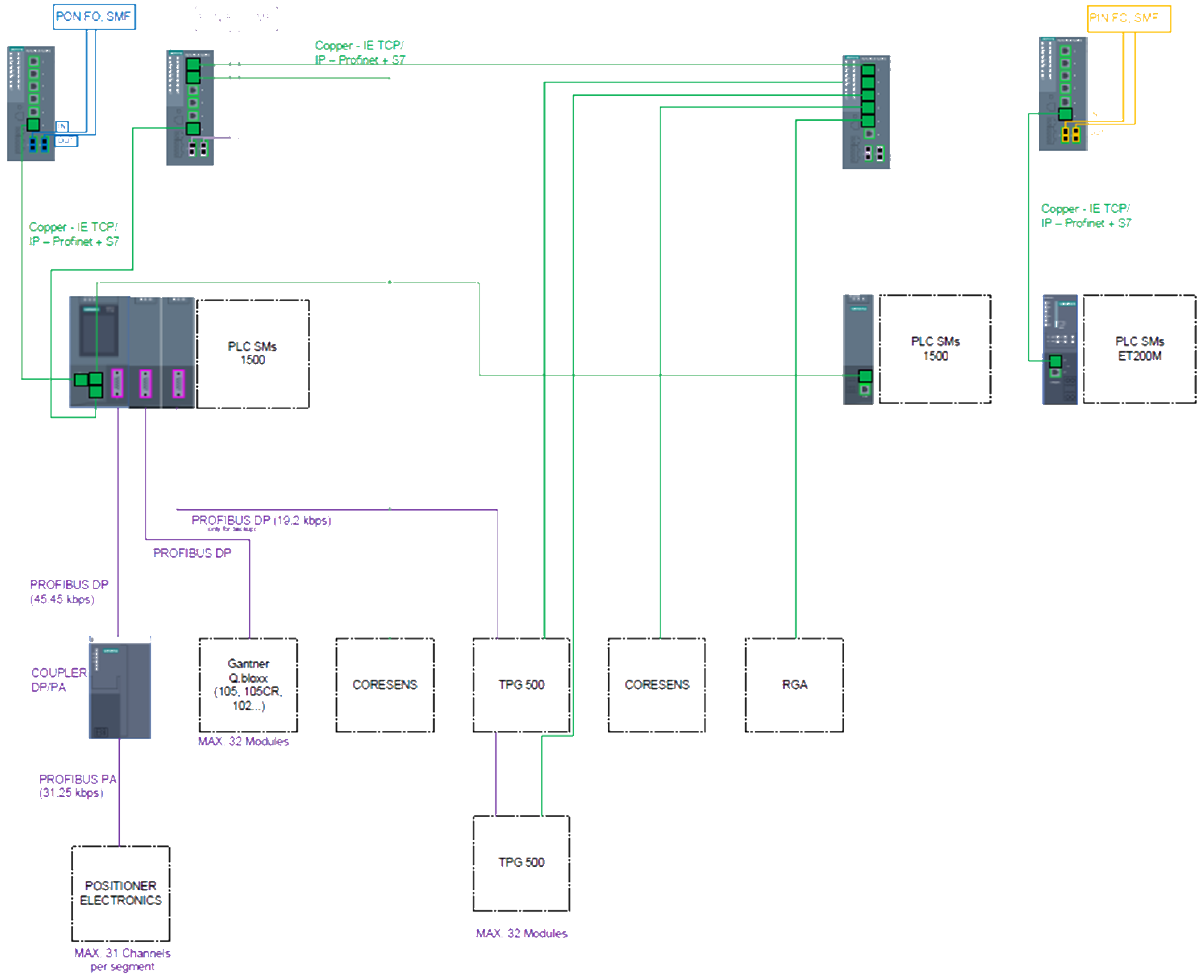
Physical Design includes:

- Physical Architecture;
- Bill of Material;
- I/O list;
- Control Cubicle Wiring Diagram & Layouts;
- Pneumatic Diagrams;

Bill of Material with more than 300 different references among electronics devices, pneumatic components, cables and connectors, up to the tiny detail to ease the procurement and manufacturing stage.

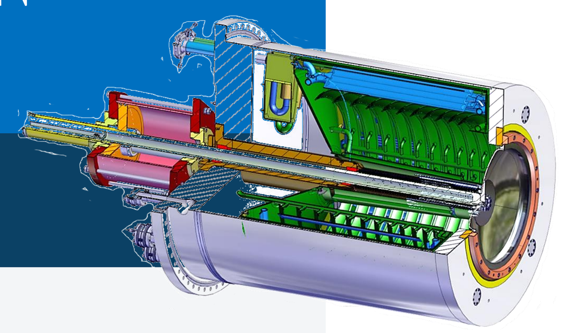
I/O list with more than 600 hardwired signals cabled to the conventional control layer, 100 to the plant interlock layer and 250 to the nuclear safety one, distributed among 9 sub-systems.





Conventional control layer with 9x Siemens S7-1516-3PN/DP PLCs.
PROFINET, PROFIBUS-DP & PROFIBUS-PA subnets.

Interlock control layer with Siemens S7-416-5FH PLC & 9 Peripheric Interface Modules.



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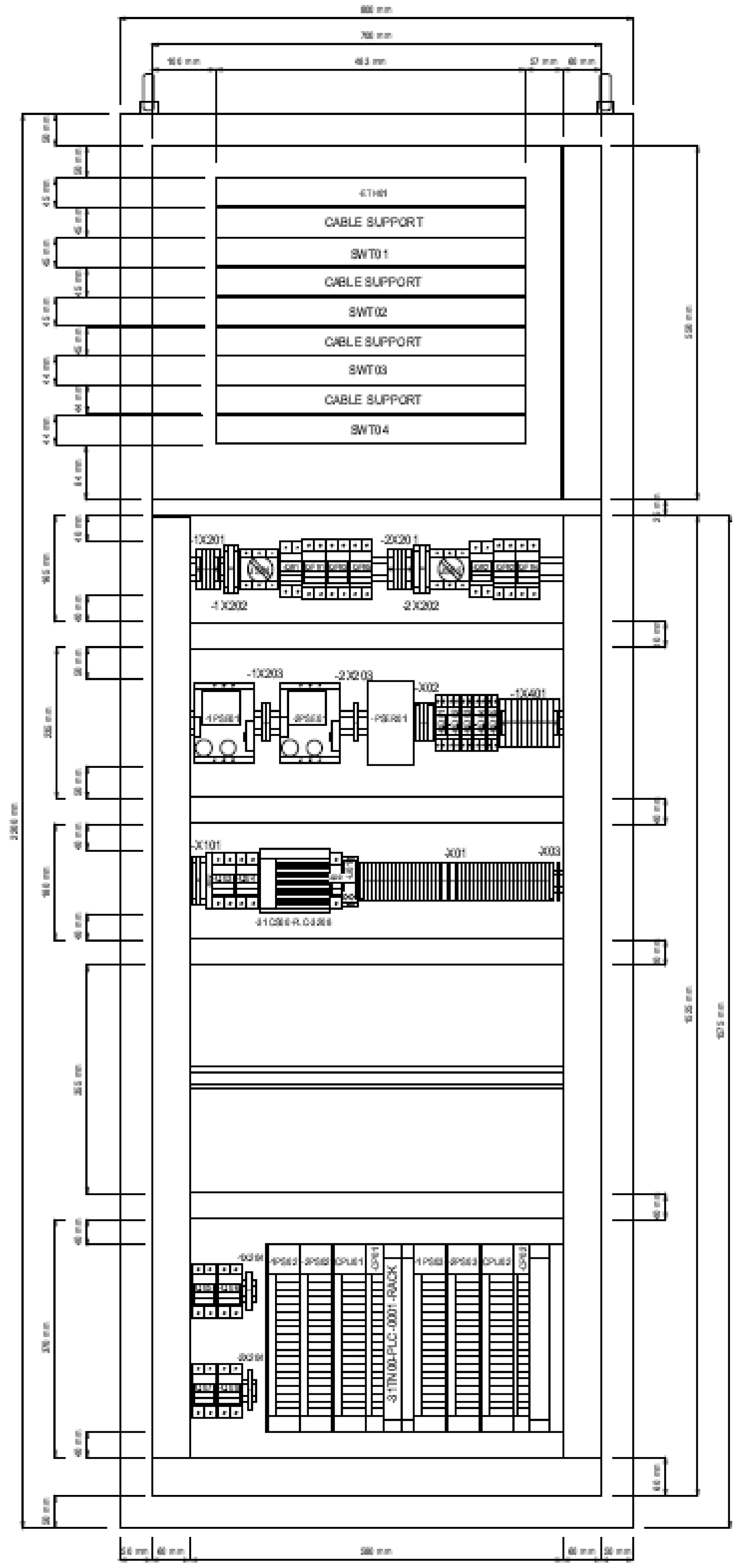
Physical Design includes:

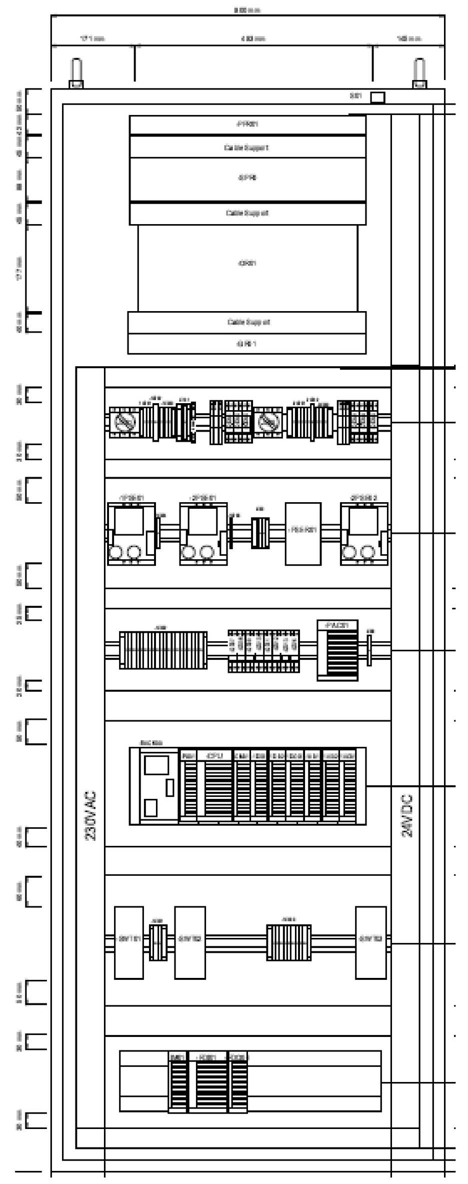
- Physical Architecture;
- Bill of Material;
- I/O list;
- Control Cubicle Wiring Diagram & Layouts;
- Pneumatic Diagrams;

Highlights:

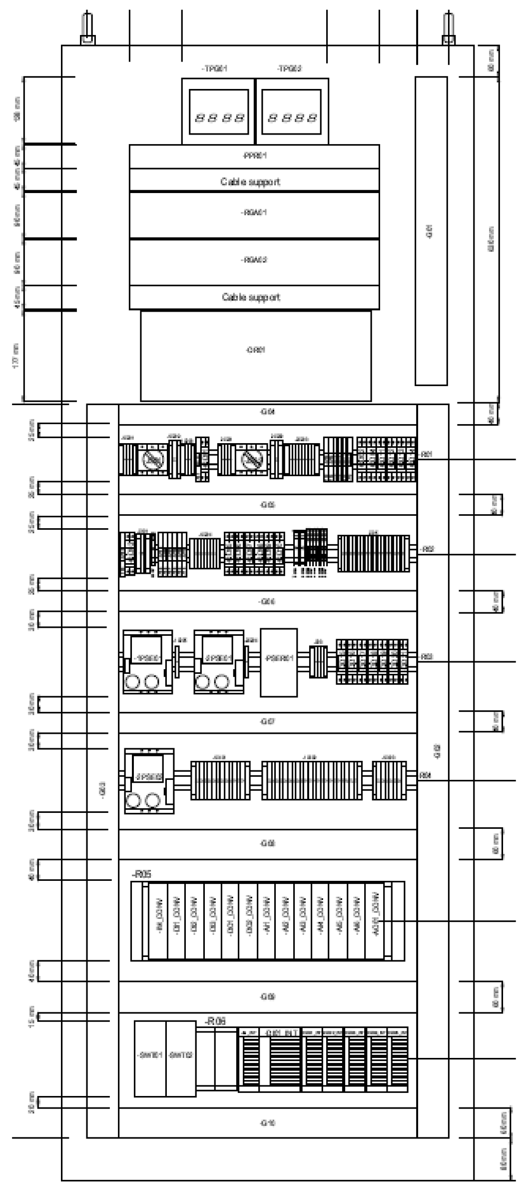
- Acquisition electronics for temperature sensors (Pt100, Cernox, TVO), pressure sensors (Membrane, Optical, Pirani, Cold Cathode);
- Controllers for proportional process valves;
- Process PLC & Interlock PLC with peripheric interface modules;
- Redundant power supplies;
- Three networks.



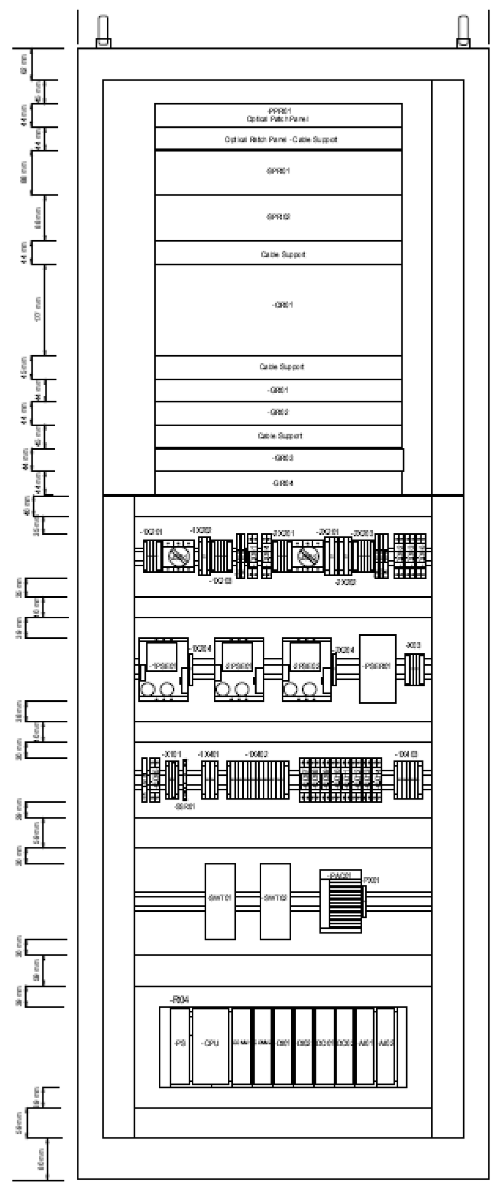
1x MASTER



1x WRB



8x CP



8x CVB

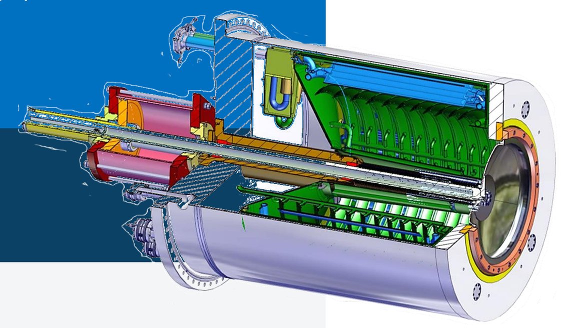
CHALLENGES

Space Limitation

Weight restriction due to Seismic

Qualification

Environmental Conditions



Physical Design includes:
- Physical Architecture;
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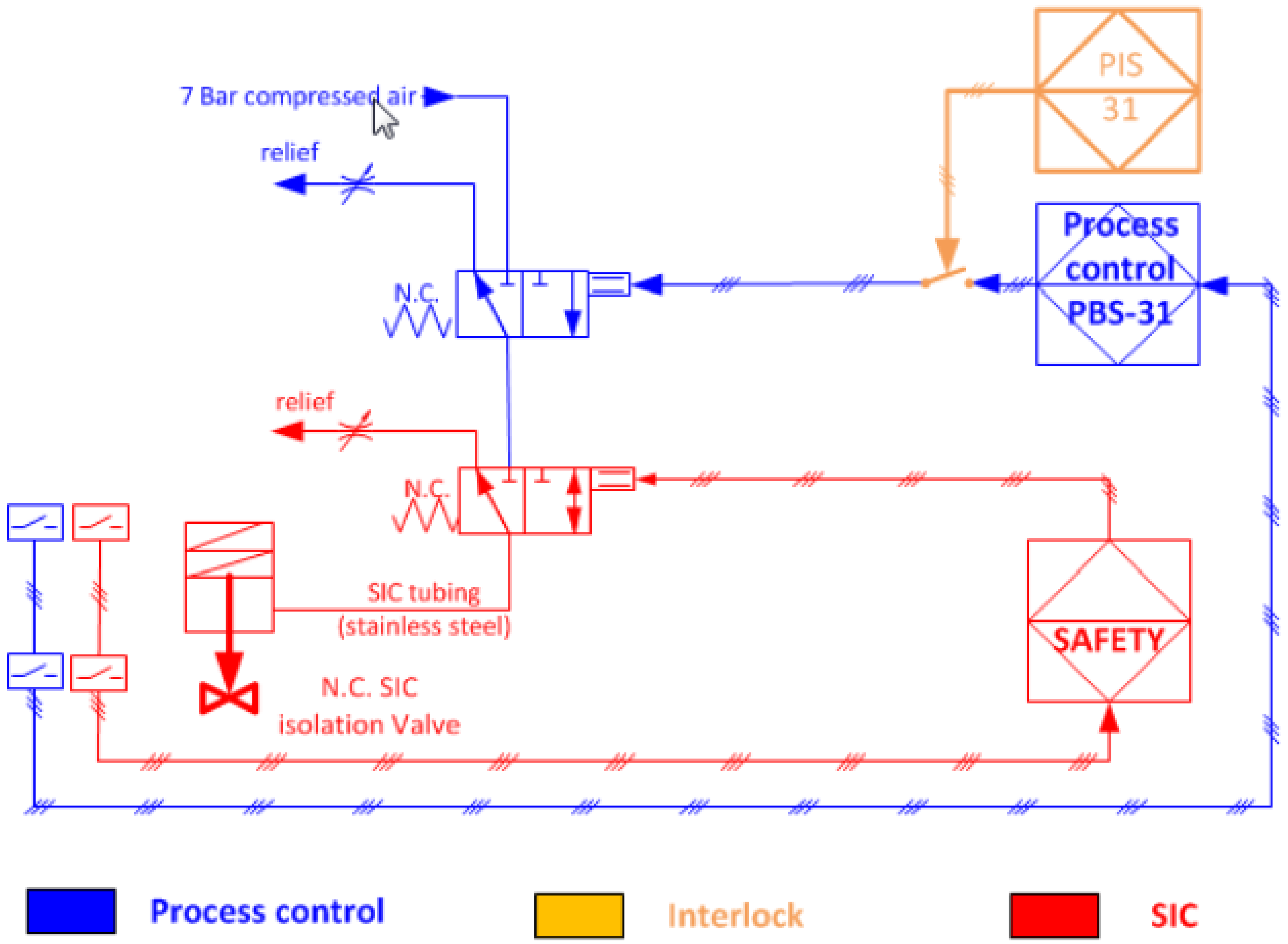
- Control Cubicle Wiring Diagram & Layouts;
- Pneumatic Diagrams & Layout;



Pilot valve to control the process.
Switch to disable process action for investment protection action.
Pilot valve to actuate safety valves and perform safety functions.

Up to 368 conventional pilot valve.
Up to 122 nuclear safety pilot valve.

36 Pneumatic Enclosures
standardized in 5 Configurations:
18x Conventional Function
18x Nuclear Safety Function

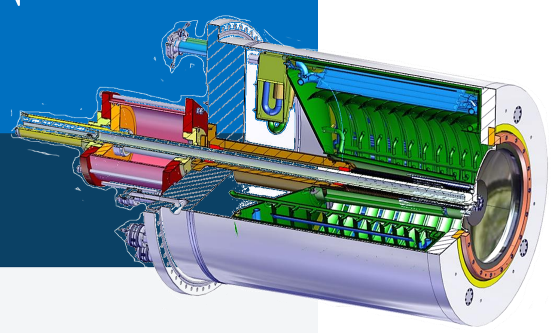
CHALLENGES

Space Limitation

Weight restriction due to Seismic Qualification

Environmental Conditions

Distribution based on nuclear safety trains



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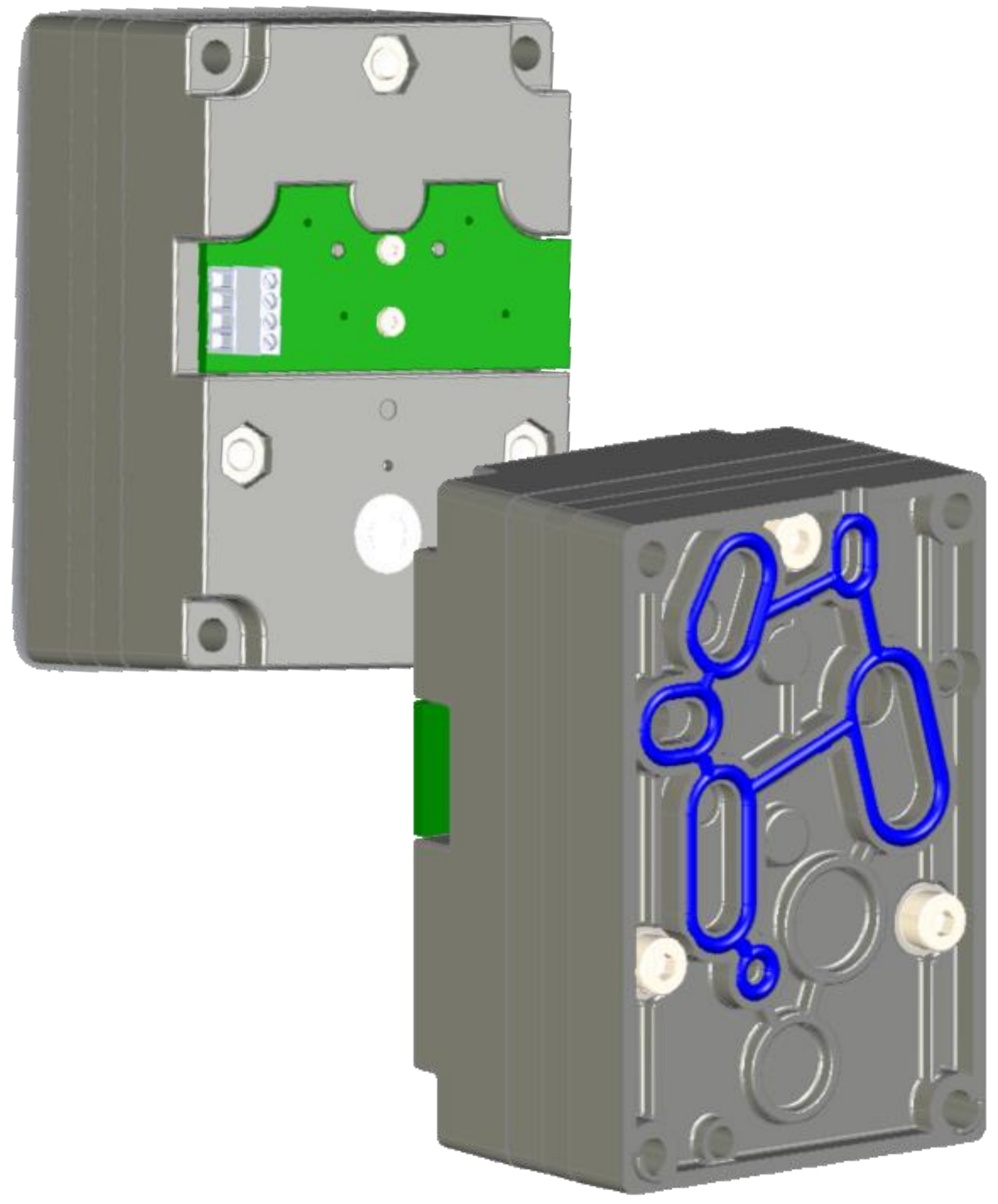
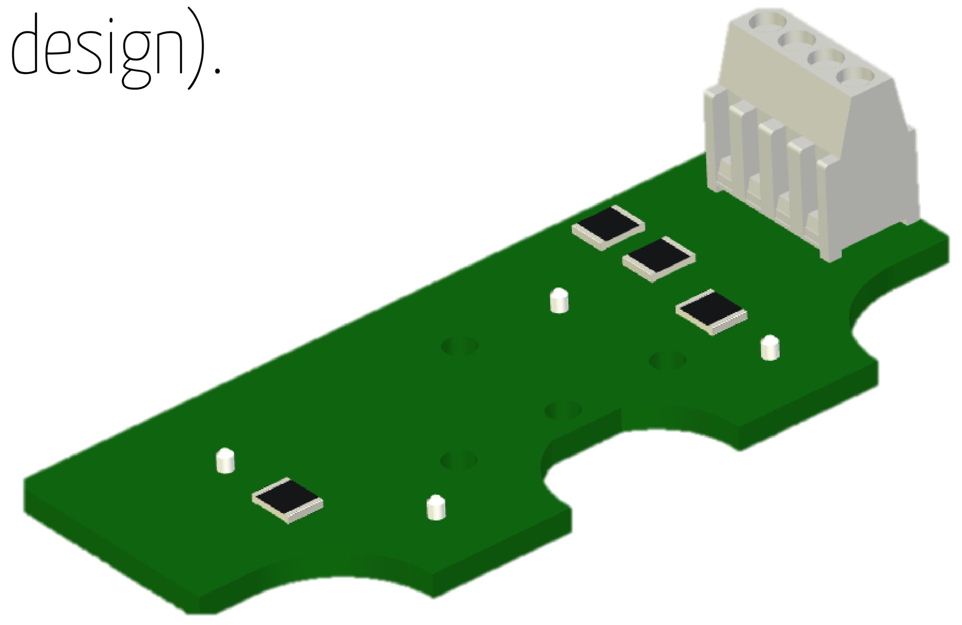
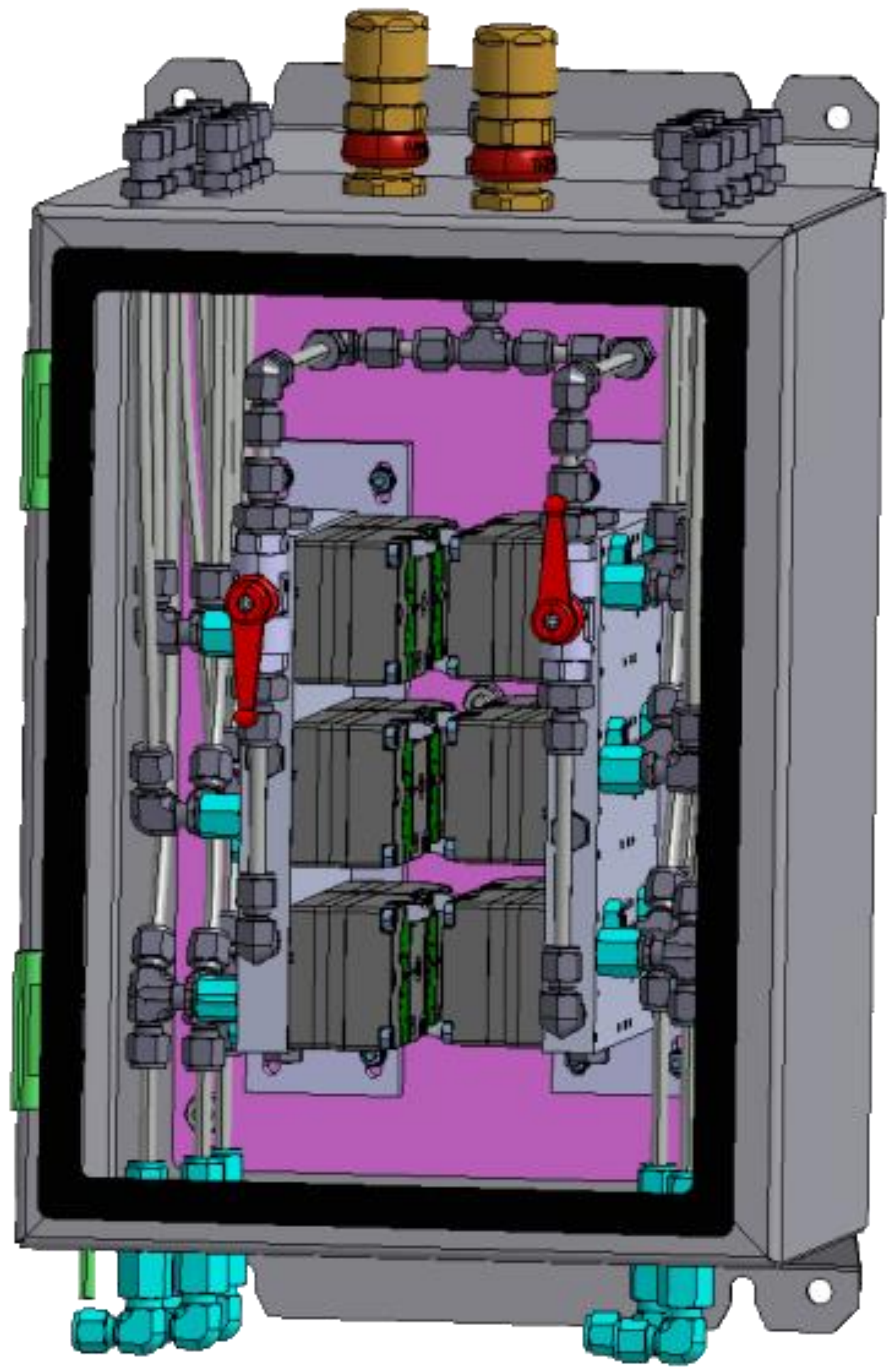
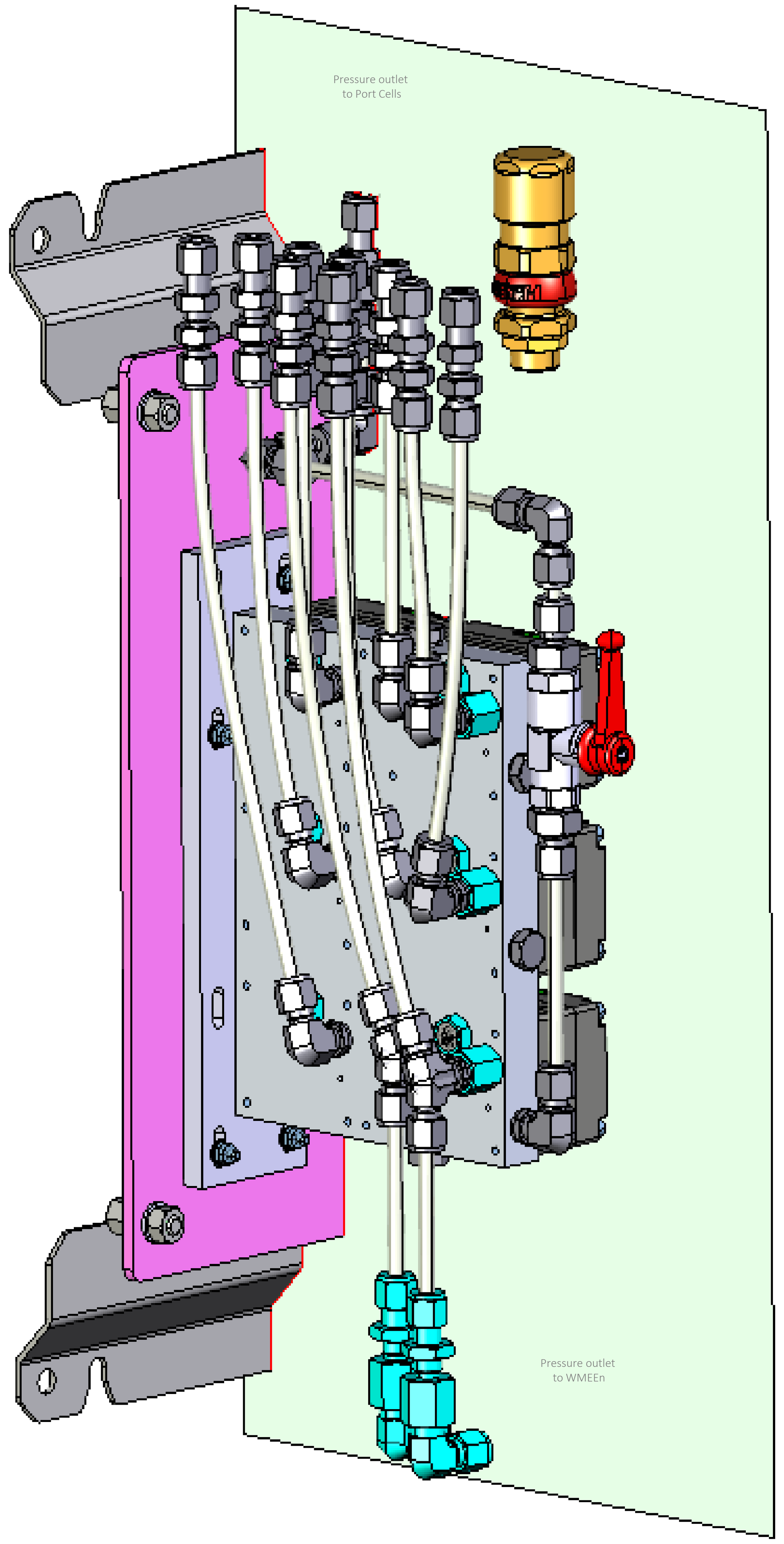
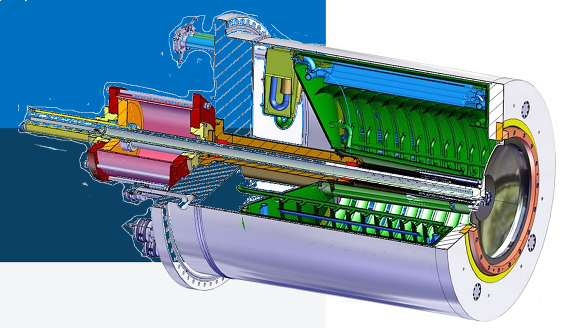


Piezo-electric pilot valve with customized PCB to include discharge resistors able to move the pilot valve and the process valve to safe state in case of cable damage (fail-safe design).









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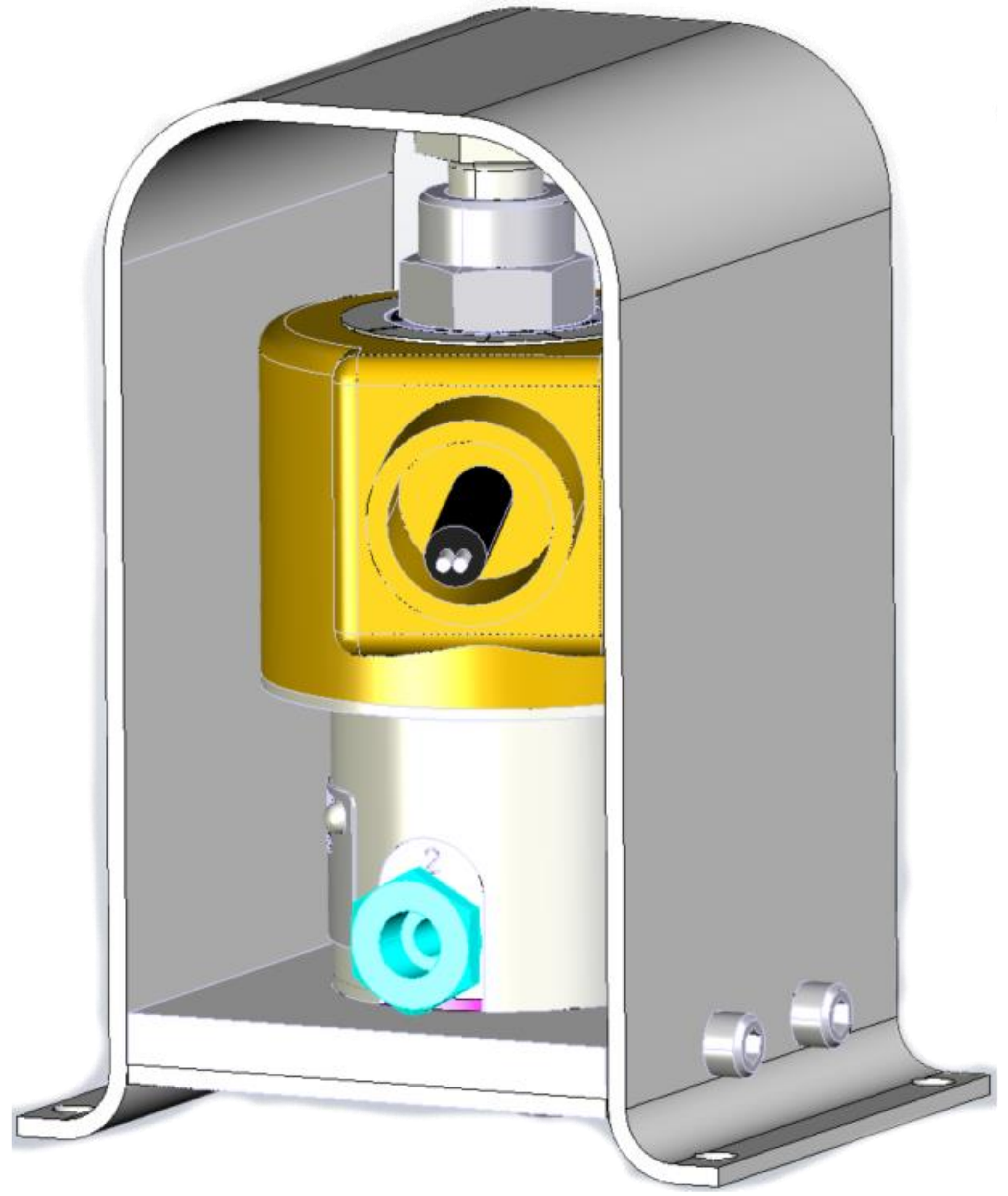
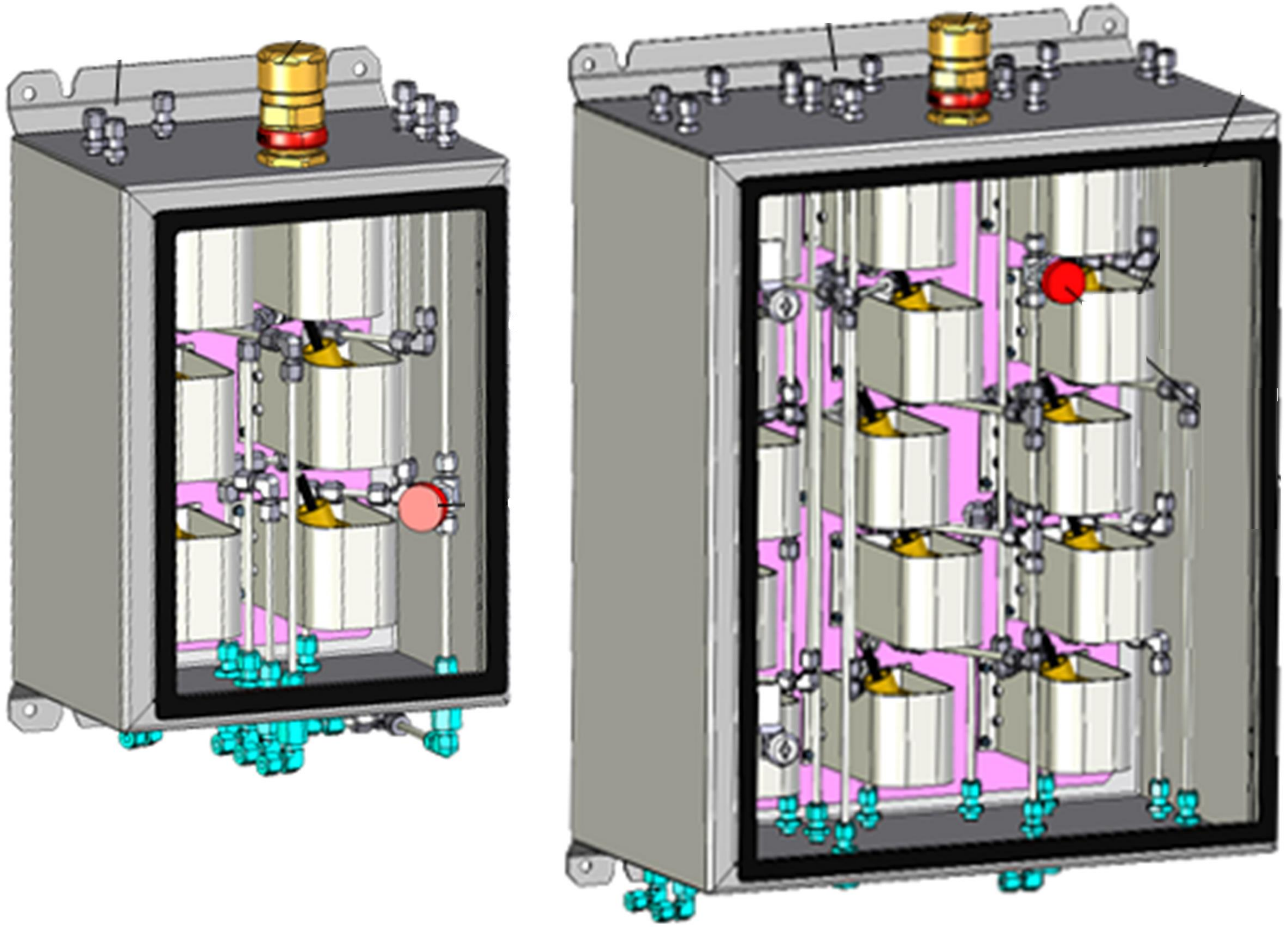


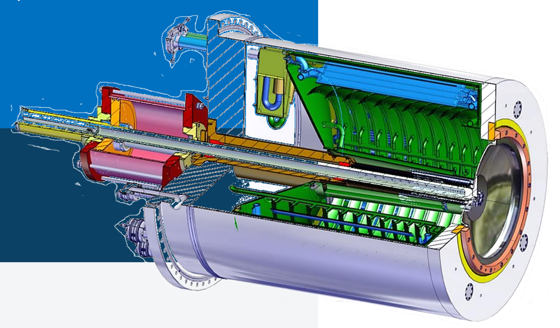
Solenoid valve qualified for Nuclear application, with external shield to withstand Static Magnetic Field.



SIC- NUCLEAR SAFETY

FRONT-END CRYODISTRIBUTION & CRYOPUMPING SYSTEM

DESIGN - FUNCTIONAL



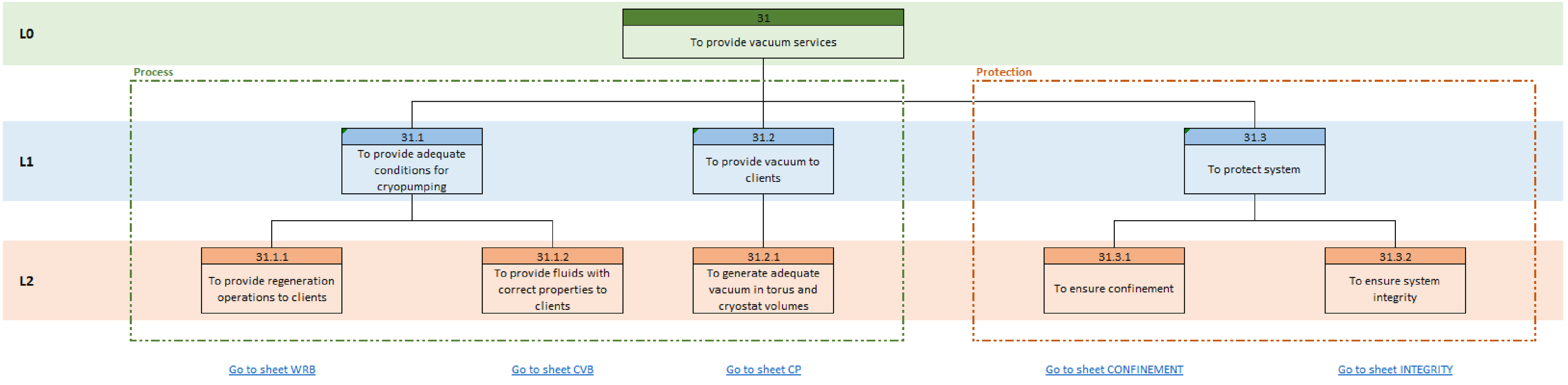
DESIGN | QUALIFICATION | MANUFACTURING | SOFTWARE | VALIDATION

Science, Infrastructures & Robotics

Functional Design includes:

- Functional Architecture with the list of process functions;
- Risk assessments & Definition of Investment Protection Functions;
- State Machine definition;
- Software Requirements Specification for Process Control Software & Interlock Control Software;
- Functional Design Specification for Process Control Software & Interlock Control Software;
- HMI Proposal for Process Control Software.

FUNCTIONAL ARCHITECTURE



RISK ASSESSMENT

Category	Criteria
Catastrophic (Ca)	Disastrous threat to ITER's mission, abandonment of the project and goals
Major (Ma)	Loss of a full operational campaign, moderate threat to ITER's mission
Severe (Se)	Significant reduction of an operational campaign program
Minor (Mi)	No significant impact on the operational campaign program

Category	Description
Frequent	Event occurs very likely
Probable	Event is likely to occur
Occasional	Event possible and expected
Remote	Event possible but not expected
Improbable	Event unlikely to occur
Negligible	Event extremely unlikely

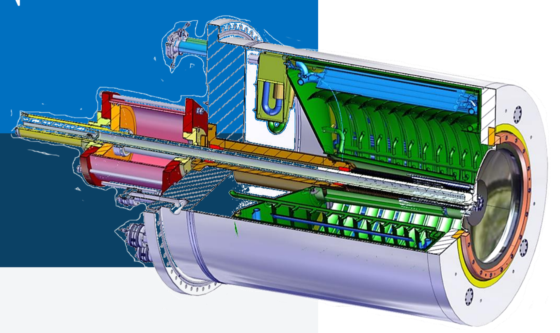
Event Likelihood	Consequence			
	Catastrophic	Major	Severe	Minor
Frequent	3IL-4	3IL-3	3IL-3	3IL-1 (no interlock)
Probable	3IL-4	3IL-3	3IL-3	3IL-1 (no interlock)
Occasional	3IL-3	3IL-3	3IL-2	3IL-1 (no interlock)
Remote	3IL-3	3IL-2	3IL-2	3IL-1 (no interlock)
Improbable	3IL-3	3IL-2	3IL-1 (no interlock)	3IL-1 (no interlock)
Negligible	3IL-2	3IL-1 (no interlock)	3IL-1 (no interlock)	3IL-1 (no interlock)

Minimum Interlock Integrity Level	Equivalent SIL
3IL-4	SIL-3
3IL-3	SIL-3
3IL-2	SIL-2
3IL-1 (no interlock)	SIL-1

PROTECTION FUNCTIONS

21x Conventional Functions (3IL-1)
8x Interlock Functions (3IL-2)

	Sever.	Occurr.	Mode	Req 3IL	Functional Comments
WRB_ILK1	Major	Remote	Low Demand	3IL-2	Valves VC-0143 and VC-0144 cannot be opened together to avoid routing high temperature fluid to the cryoplant (Cold fluid flowing through the heat exchanger HT-0140 with consequent risk of water freezing)
WRB_ILK2	Major	Improbable	Low Demand	3IL-2	If valve VC-0144 is not closed and valve VC-0401 is closed, valve VC-0401 is opened to avoid freezing risk of the cooling water.
CVB_ILK1	Major	Improbable	Continuous	3IL-2	CP cryo panel: If any Helium supercritical supply or return line is opened (4K supply and return, cooldown supply and helium recovery), CP cryo panel WRB supply and return valves must remain closed. To assure these critical processes, CP thermal shield WRB supply and return must remain closed too.
CVB_ILK2	Major	Improbable	Continuous	3IL-2	CP thermal shield: If 80K supply is opened, WRB supply must remain closed.
CVB_ILK3	Major	Improbable	Continuous	3IL-2	If the WRB supply line to CP cryo panel is opened, all cryolines supply and return valves must remain closed.
CVB_ILK4	Major	Improbable	Continuous	3IL-2	If the WRB supply to CP thermal shield is opened, all cryolines supply and return valves must remain closed.
CVB_ILK5	Major	Improbable	Continuous	3IL-2	If any WRB return line is opened, 4K supply, 4K return, cool down supply or helium recovery must remain closed.
CP_ILK1	-	-	Low Demand	3IL-2	A double failure is not considered in the risk assessment, hence the residual severity for such scenario is low and no protection function derives from the analysis. However, it is suggested to include an interlock between the inlet valve and the regeneration line valves as implemented in the safety system for the Torus CPs to avoid loss of vacuum in the Cryostat volume.



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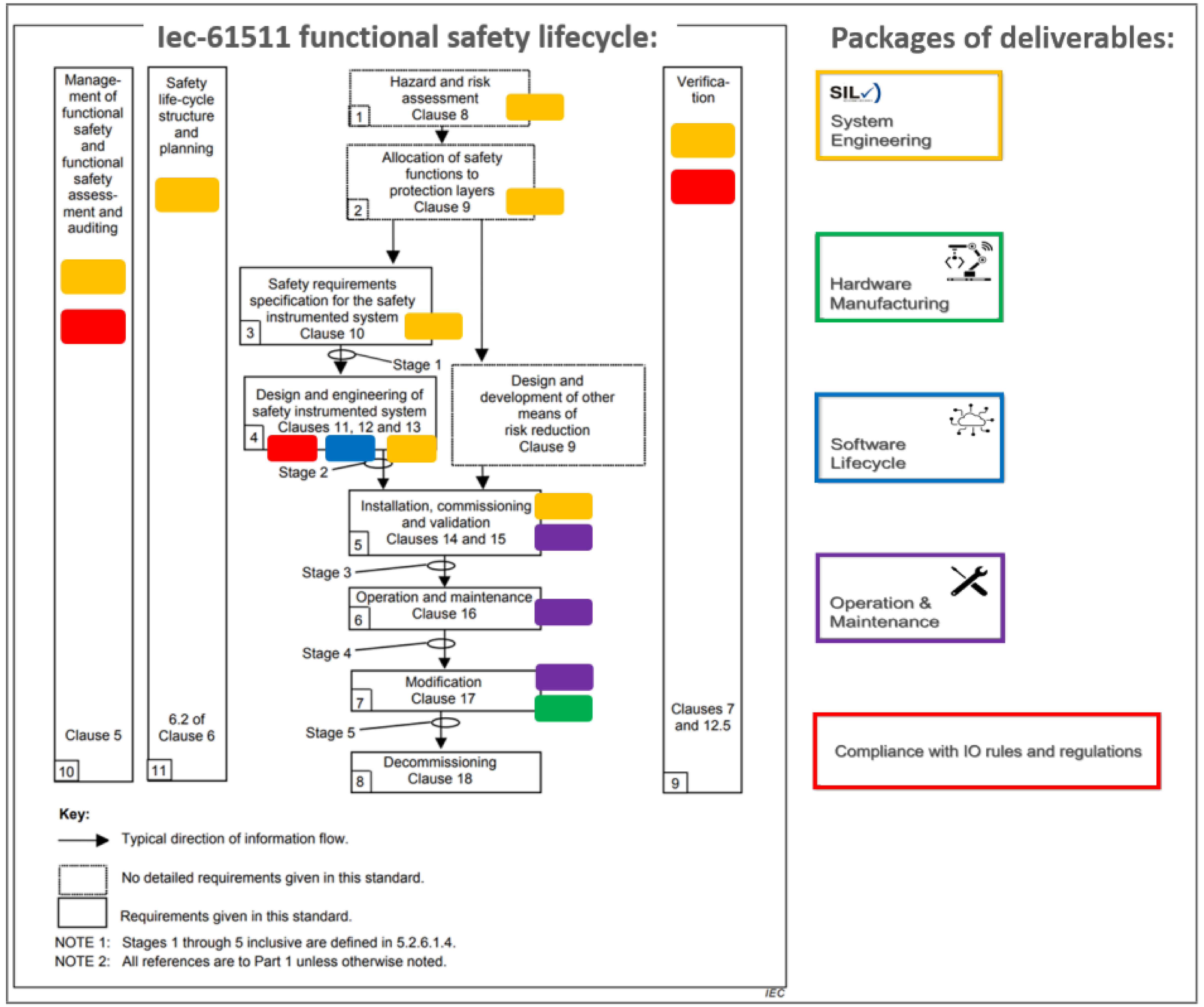
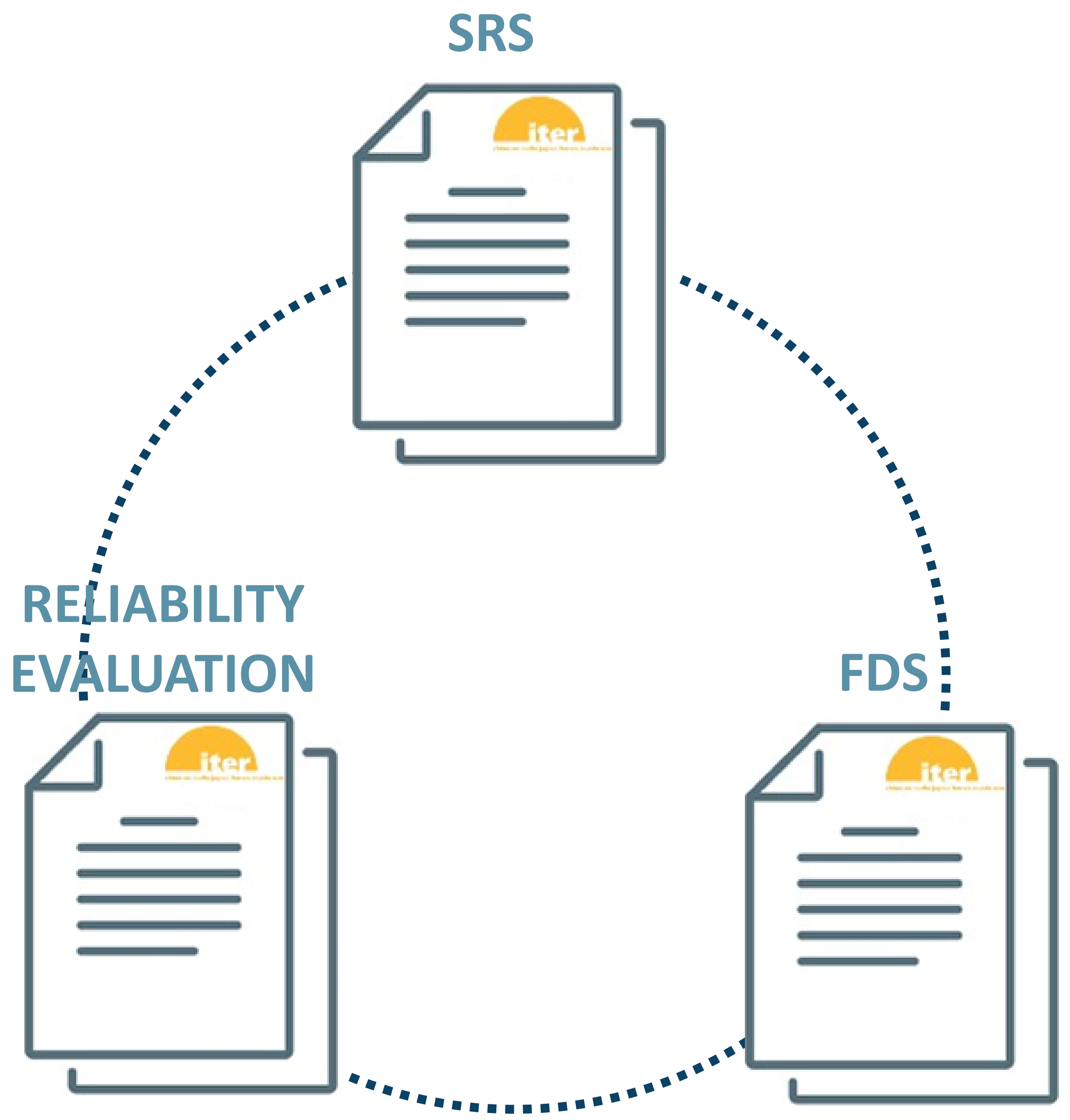
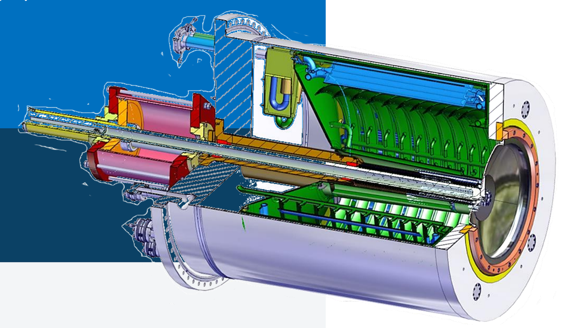
Design of Safety Systems according to IEC61511 following the safety life-cycle.



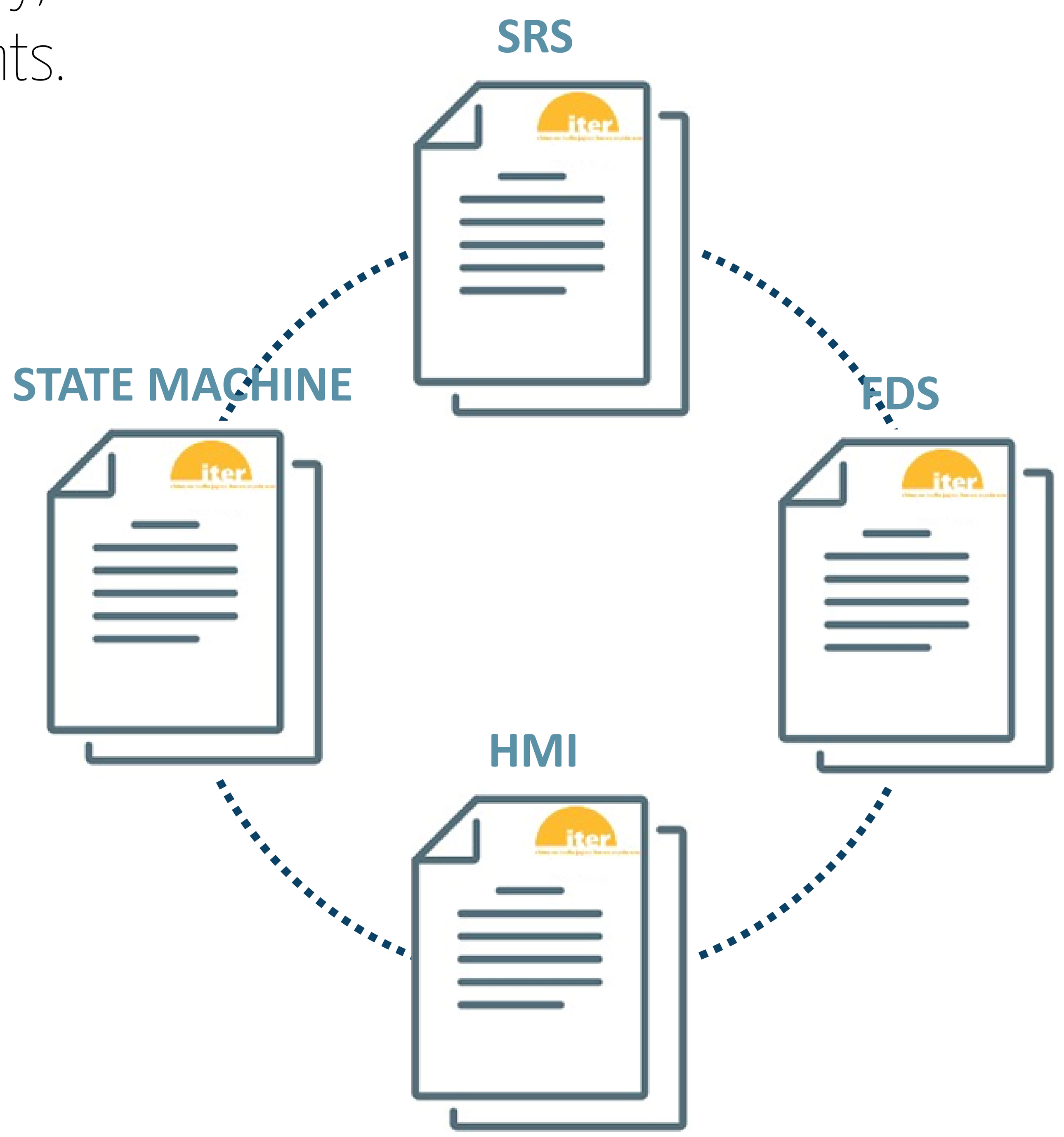


The reliability evaluation of each function was performed to guarantee the required SIL level is reached with the elements involved in the whole chain (from sensor to actuator).

In some cases, diagnostic proof test and maintenance activities are considered to achieve the required SIL level with margin.



Functional, HW & SW Interfaces, User Interface, Tools & Libraries, Security, Performance requirements.



Functional description from whole system to sub-components (sensors, actuators) with specific control logic definition.
Reference to the used control library objects for each sub-system and component.

Functional Design includes:

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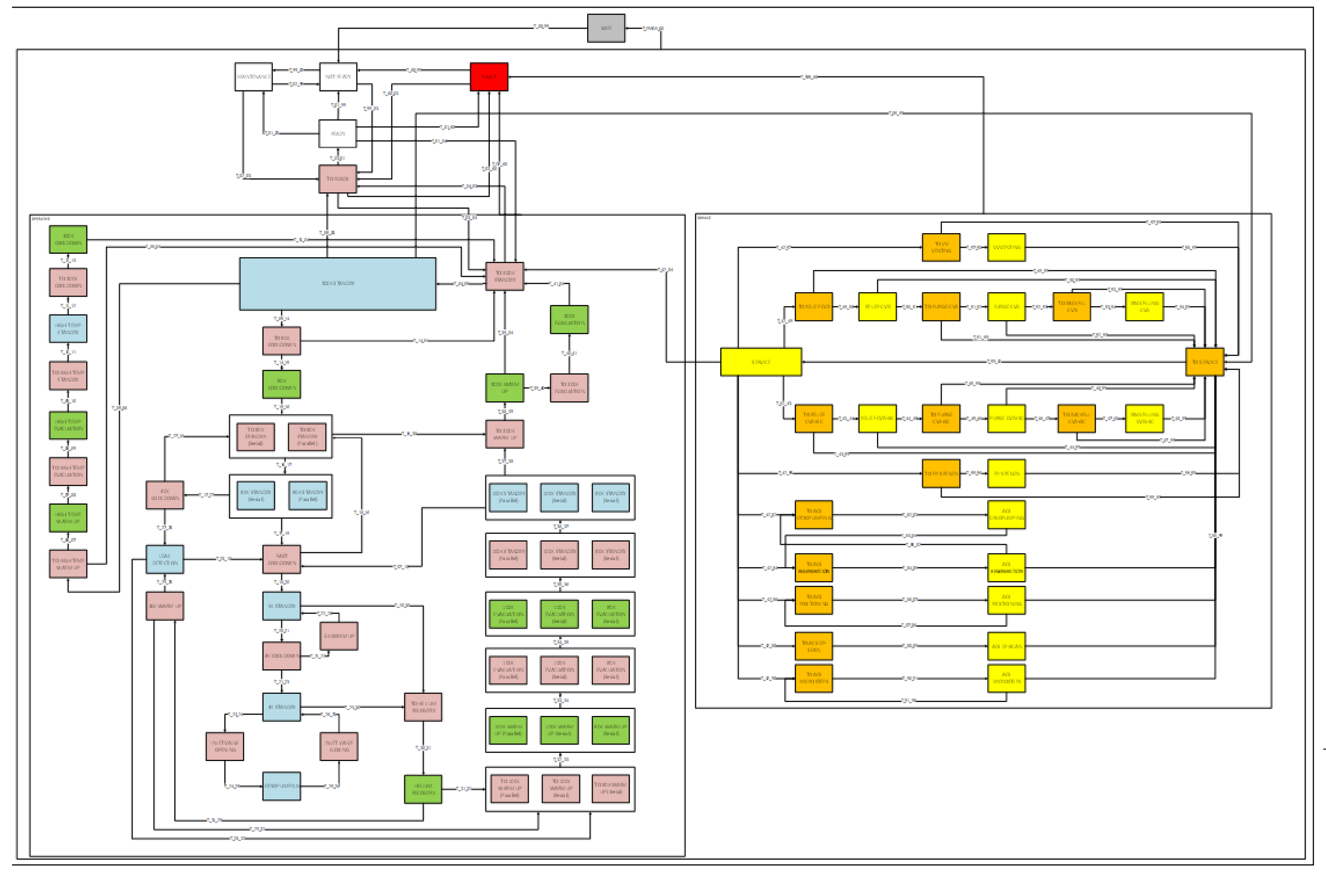
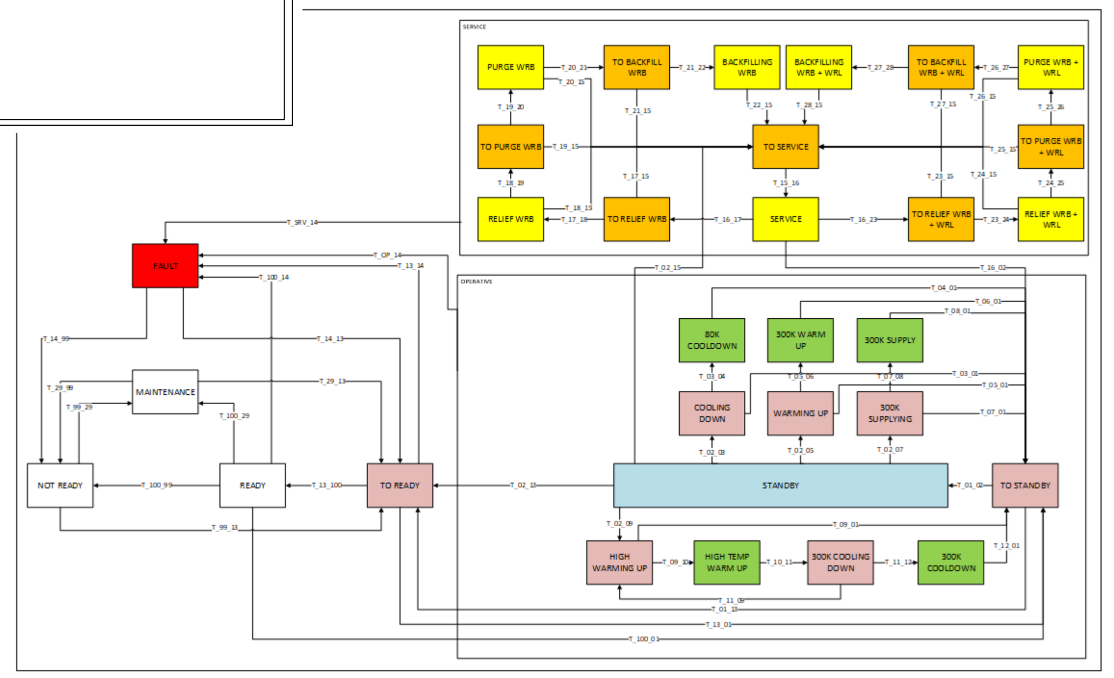
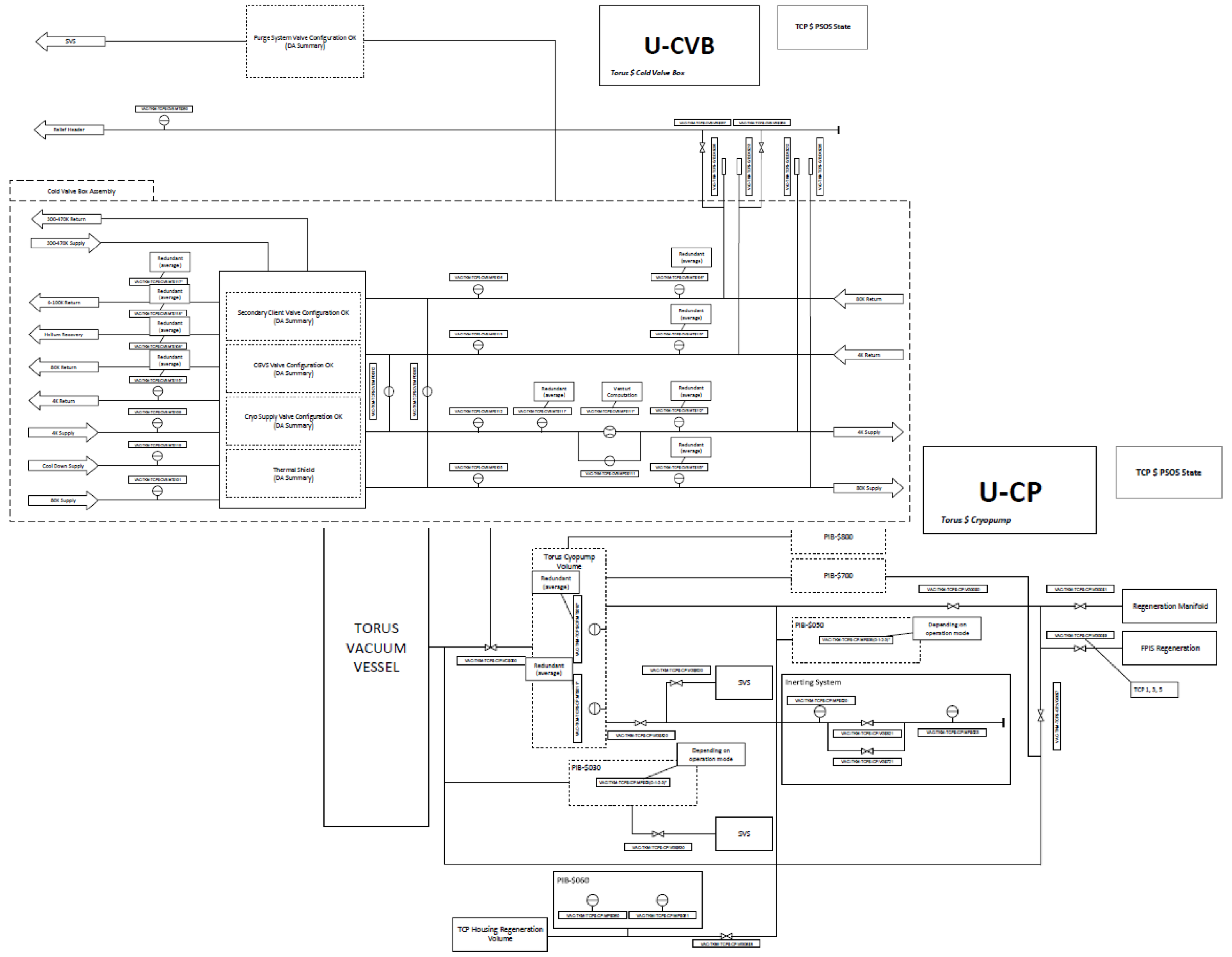




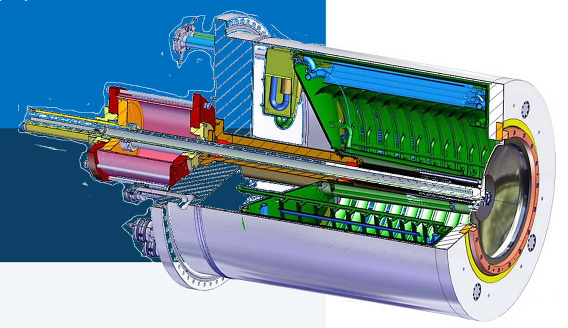
States & Transition definition
Command Requests from Master Controller



HMI mock-up

FRONT-END CRYODISTRIBUTION & CRYOPUMPING SYSTEM

QUALIFICATION



DESIGN | **QUALIFICATION** | MANUFACTURING | SOFTWARE | VALIDATION

Science, Infrastructures & Robotics

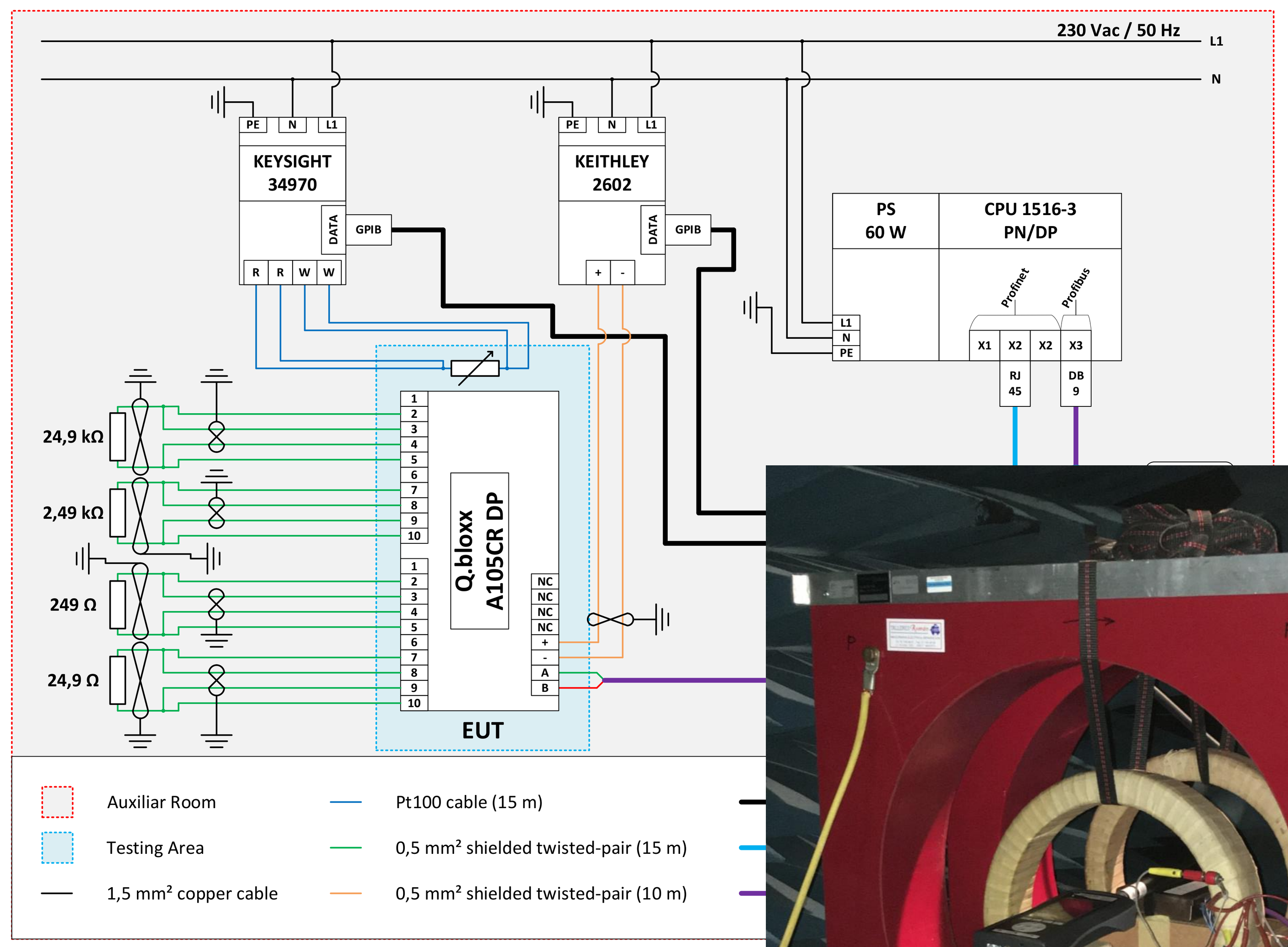
Qualification of FECDS I&C components

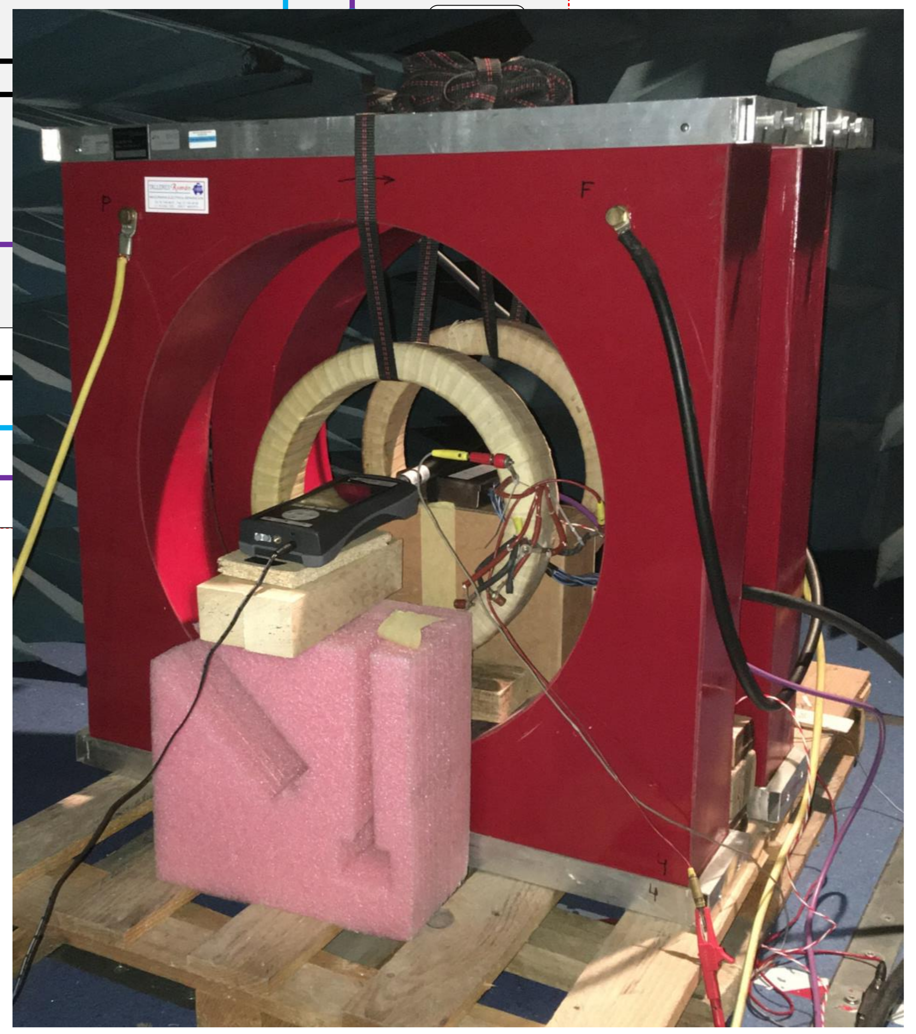
- Fire and Seismic
- Static Magnetic Fields up to 18 mT for I&C control cubicle and 61mT for pneumatic cubicles
- Electromagnetic compatibility according to IEC 61000-6-2 (Immunity Tests) and 61000-6-4 (Emissions Tests)
- Radiation resistance up to 175 kGy for pneumatic cubicles
- Halogen-free elements
- Nuclear Safety compliance (IEC61513)

Qualification by test performed for the following devices:

- Electrical Protections;
- Solid State Relays;
- Temperature Sensor Acquisition Modules;
- Process Valve Positioner Electronics;
- Power Electronics Cubicle for WRB Heaters;
- Piezo-electric Pilot Valve;
- Solenoid Pilot Valve.

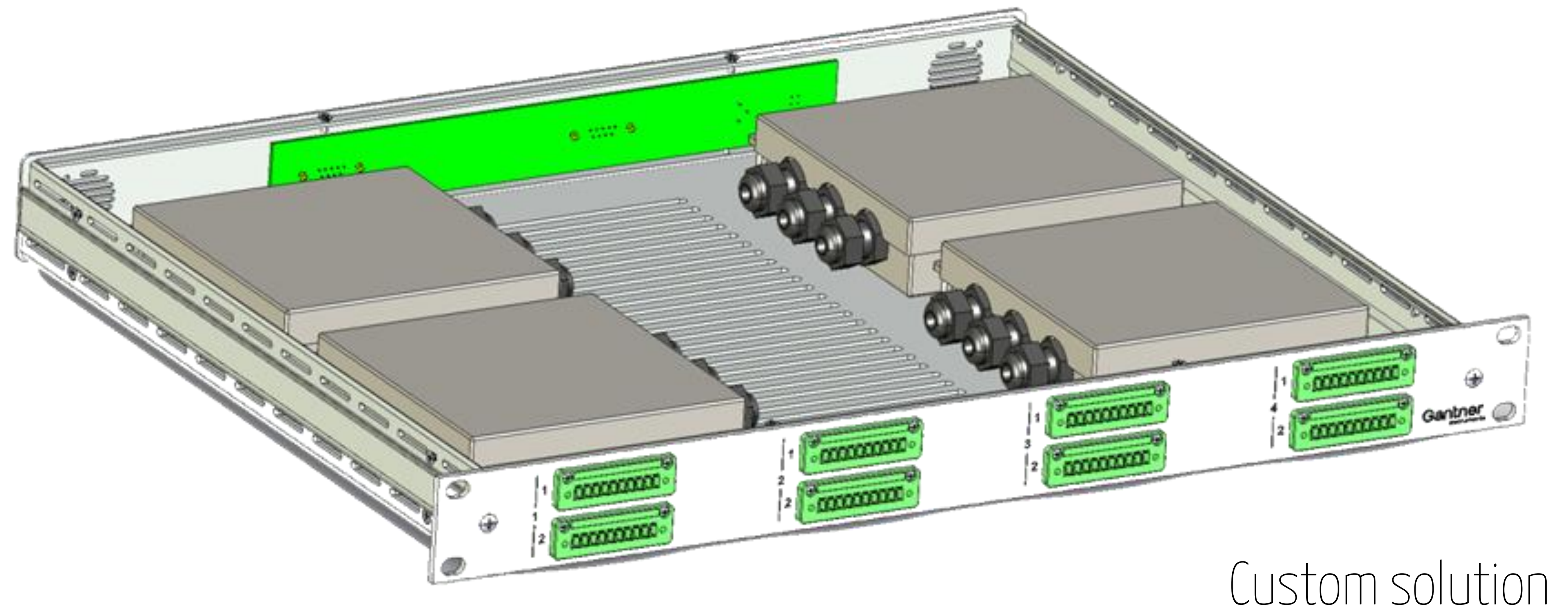
EUT





Static Magnetic Field Tests

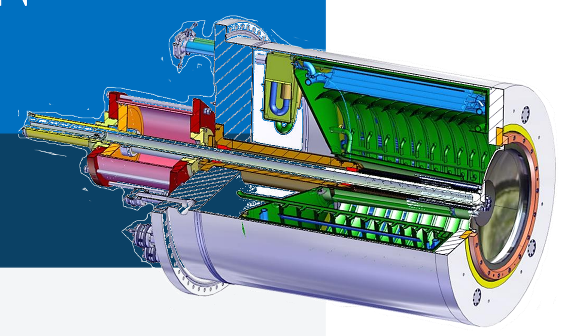
EUT with NETIC shielding



Custom solution

FRONT-END CRYODISTRIBUTION & CRYOPUMPING SYSTEM

QUALIFICATION



DESIGN | **QUALIFICATION** | MANUFACTURING | SOFTWARE | VALIDATION

gtd Science, Infrastructures & Robotics sir

Qualification of FECDS I&C components

- Fire and Seismic
- Static Magnetic Fields up to 18 mT for I&C control cubicle and 61mT for pneumatic cubicles
- Electromagnetic compatibility according to IEC 61000-6-2 (Immunity Tests) and 61000-6-4 (Emissions Tests)
- Radiation resistance up to 175 kGy for pneumatic cubicles
- Halogen-free elements
- Nuclear Safety compliance (IEC61513)

Qualification by test performed for the following devices:

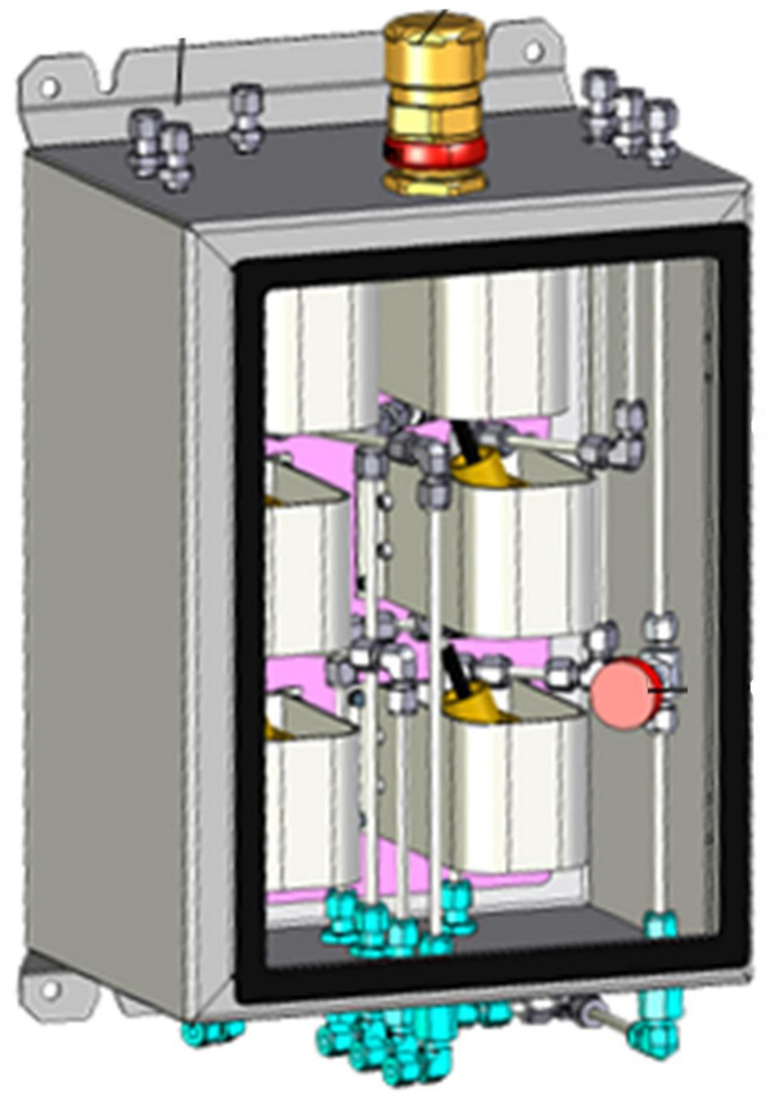
- Electrical Protections;
- Solid State Relays;
- Temperature Sensor Acquisition Modules;
- Process Valve Positioner Electronics;
- Power Electronics Cubicle for WRB Heaters;
- Piezo-electric Pilot Valve;
- Solenoid Pilot Valve.

The design of all ITER systems shall include provisions to minimize the potential for other hazards that could challenge confinement systems.
ITER provides a reference document which contains all the safety requirements that apply to any component according to the room installation location (Safety Requirements Roombook).

IEC-61513 Nuclear power plants - Instrumentation and control systems important to safety

The pneumatic enclosure is PIC (Protection Important Component) and its design and manufacturing are PIAs (Protection Important Activity).
IEC-61513 follows a lifecycle analogue to IEC-61511.

Structure System Component (ITER)	Function safety level IEC 61226 - category	System safety level IEC 61513 - class
PIC/SIC-1	A(2)	1
PIC/SIC-2	B	2(1)
PIC/SIC-2	C	3
SR	C	3
SR	*Non Safety*	*Conventional I&C*



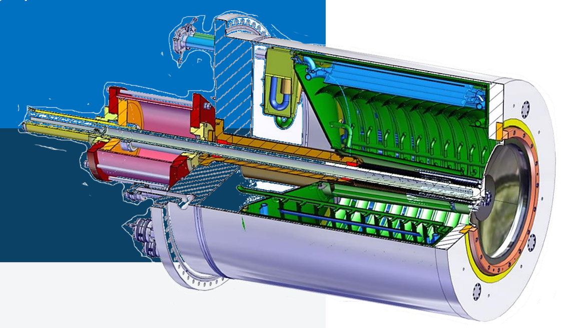
Nuclear Qualuification

Product qualification: the individual component part of the safety system comply with the safety requirements (pre-qualification).
Environmental qualification: effect of the environmental conditions upon the components (by test, by analysis, etc). To be considered operation and accidental conditions.

CHALLENGES

Fire requirement

Nuclear qualification (enormous amount of documentation and inspection reports)



Related activities:

- Material Procurement
- Manufacturing Support
- Manufacturing Inspection
- Conformity to design
- Certification of Conformity

Cold Valve Box Control Cubicle

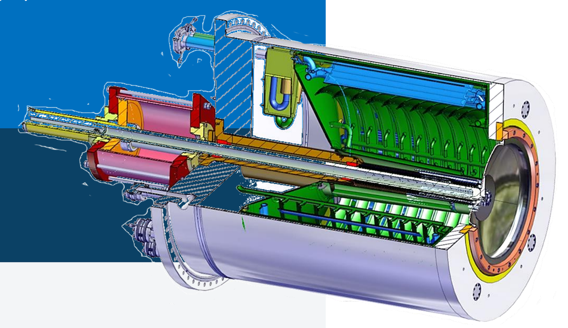
Master Control Cubicle

Warm Regeneration Box Control Cubicle

Cryopump Control Cubicle

FRONT-END CRYODISTRIBUTION & CRYOPUMPING SYSTEM

MANUFACTURING - WMEE



DESIGN → QUALIFICATION → **MANUFACTURING** → SOFTWARE → VALIDATION

Related activities:

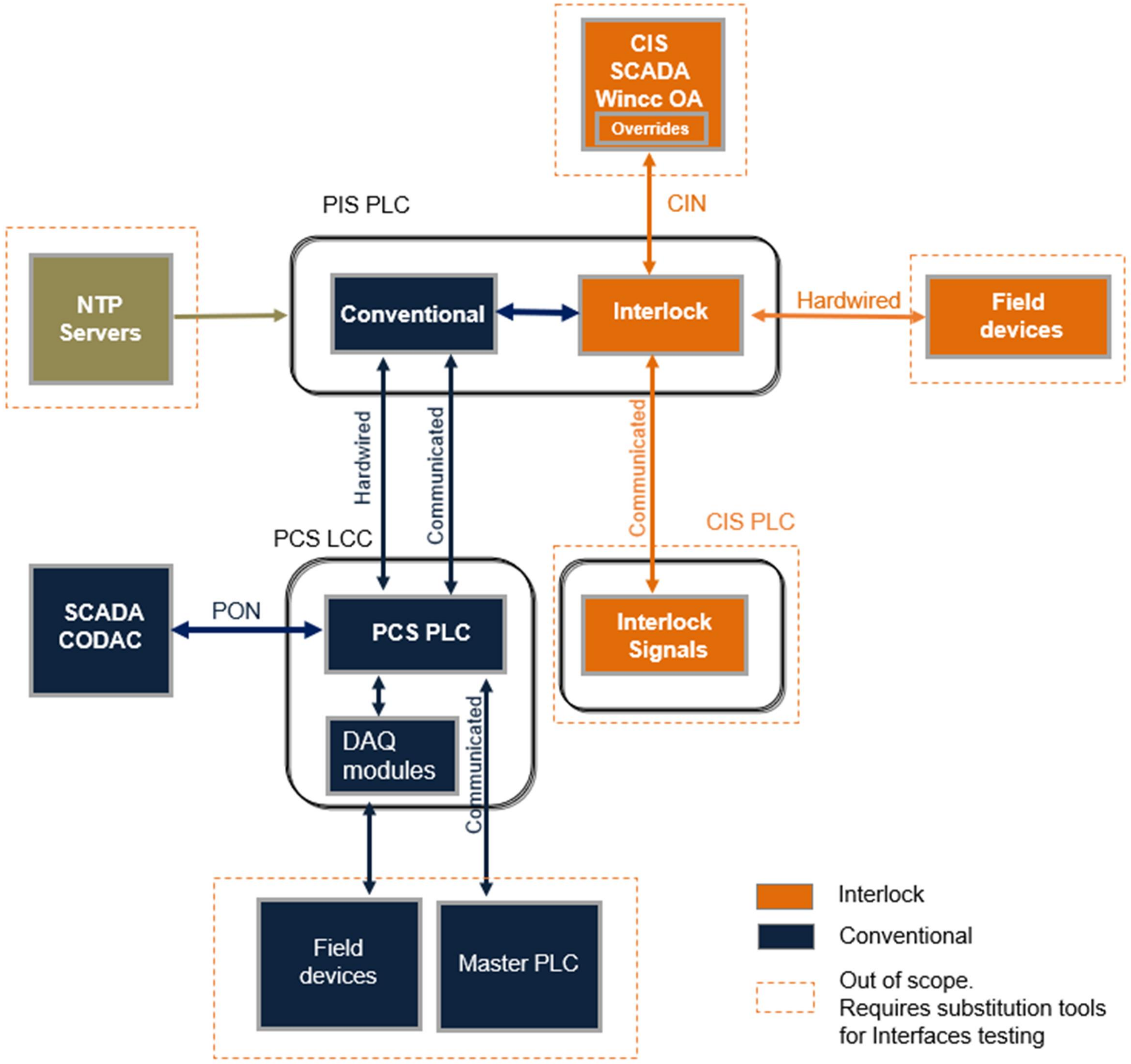
- Material Procurement
- Manufacturing Support
- Manufacturing Inspection
- Conformity to design
- Certification of Conformity

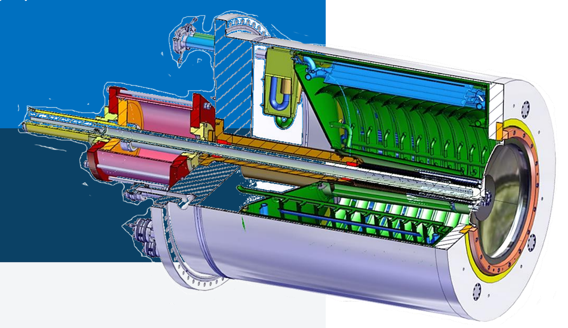
Conventional Pneumatic Enclosure

Nuclear Safety Pneumatic Enclosure & Fire Protection Jacket

Implementation:

- 1 Process Control Software for Warm Regeneration Box System covering PLC & SCADA
- 1 Process Control Software for Torus Cold Valve Box & Cryopump System (+7 additional software instances) covering PLC & SCADA
- 1 Interlock Control Software for the Machine Protection covering PLC & interface with SCADA





DESIGN | QUALIFICATION | MANUFACTURING | SOFTWARE | VALIDATION

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EPICS is a set of software tools and applications used to develop and implement distributed control systems to operate devices and large scientific facilities. The tools are designed to deliver control and feedback. They also provide SCADA capabilities.

EPICS

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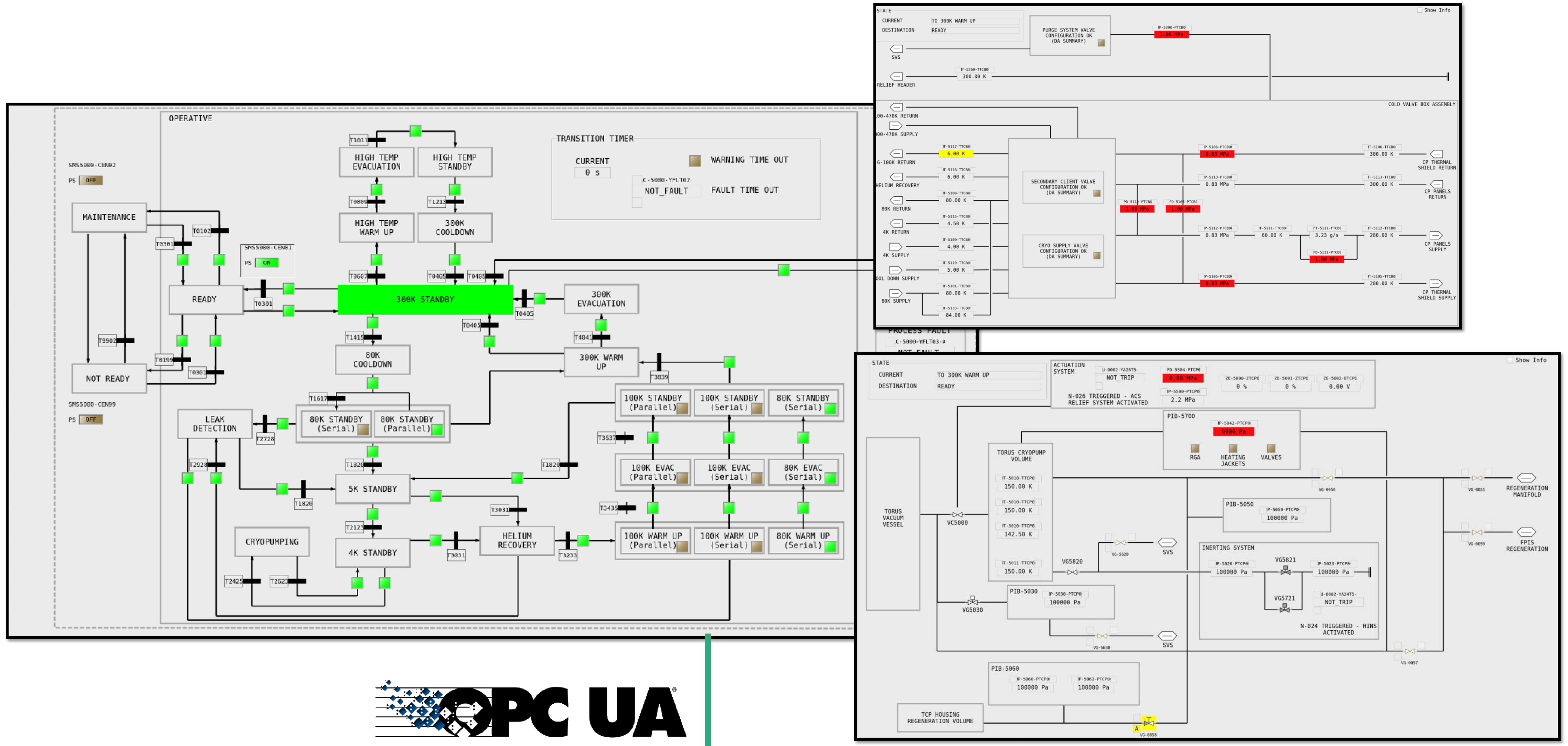
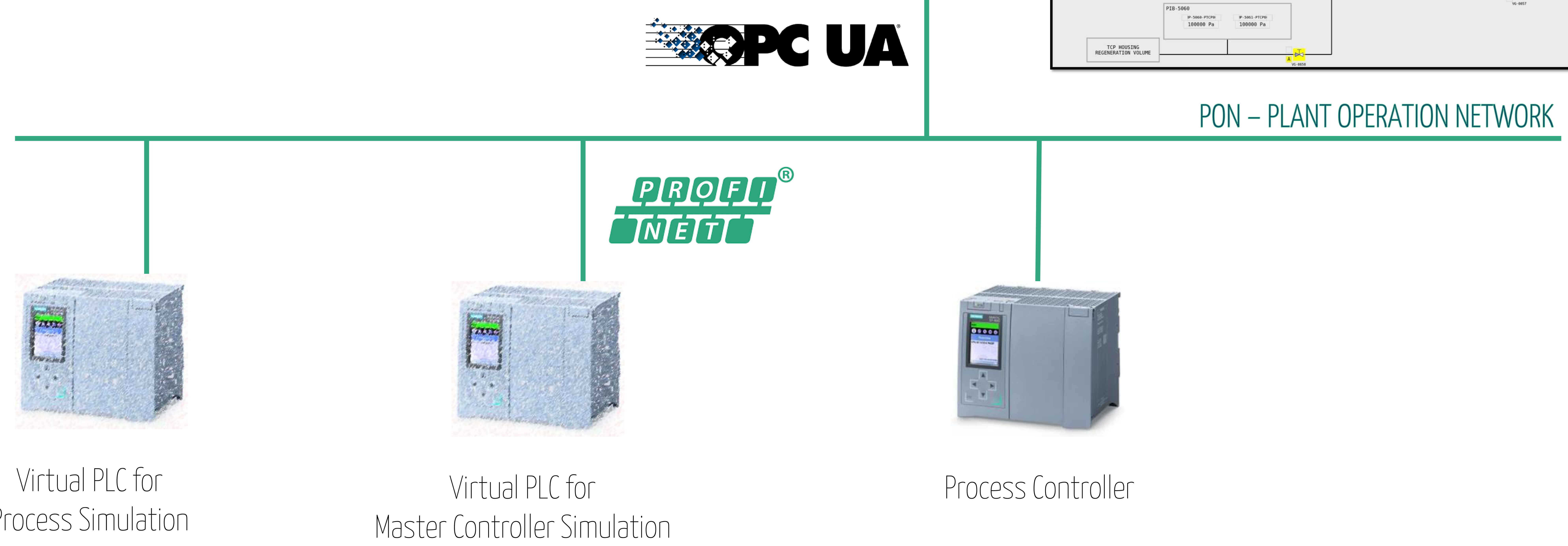
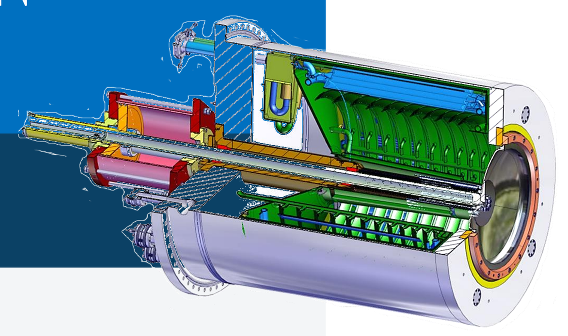




FRONT-END CRYODISTRIBUTION & CRYOPUMPING SYSTEM

SOFTWARE



DESIGN → QUALIFICATION → MANUFACTURING → **SOFTWARE** → VALIDATION

Science, Infrastructures & Robotics

Implementation:

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ITER Unified Control Library (UCL) will provide a defined set of standard element types (objects) covering three layers PLC, EPICS, CODAC HMI.

ITER Code Generation Tool is used to automatically generate:

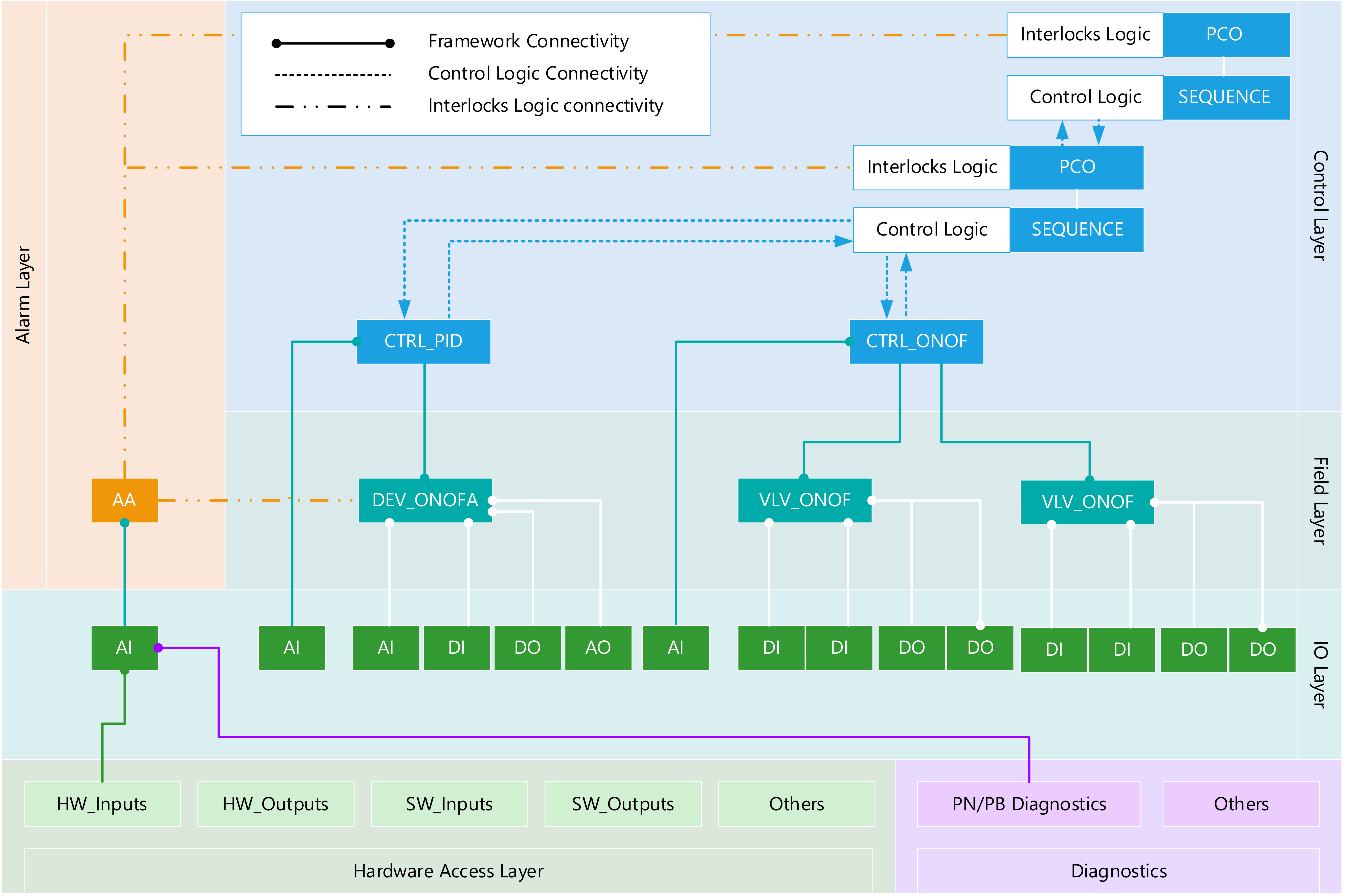
- PLC objects instances with interconnection/dependencies (as source files) to be imported and compiled in Siemens Tia Portal;
- HMI interface DBs based on EPICS;
- Mapping functions between PLC & HMI variables;

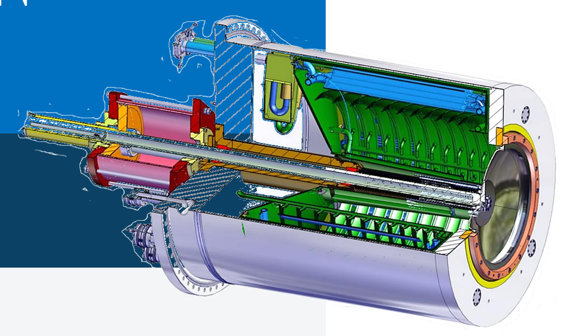
starting from an excel input file.

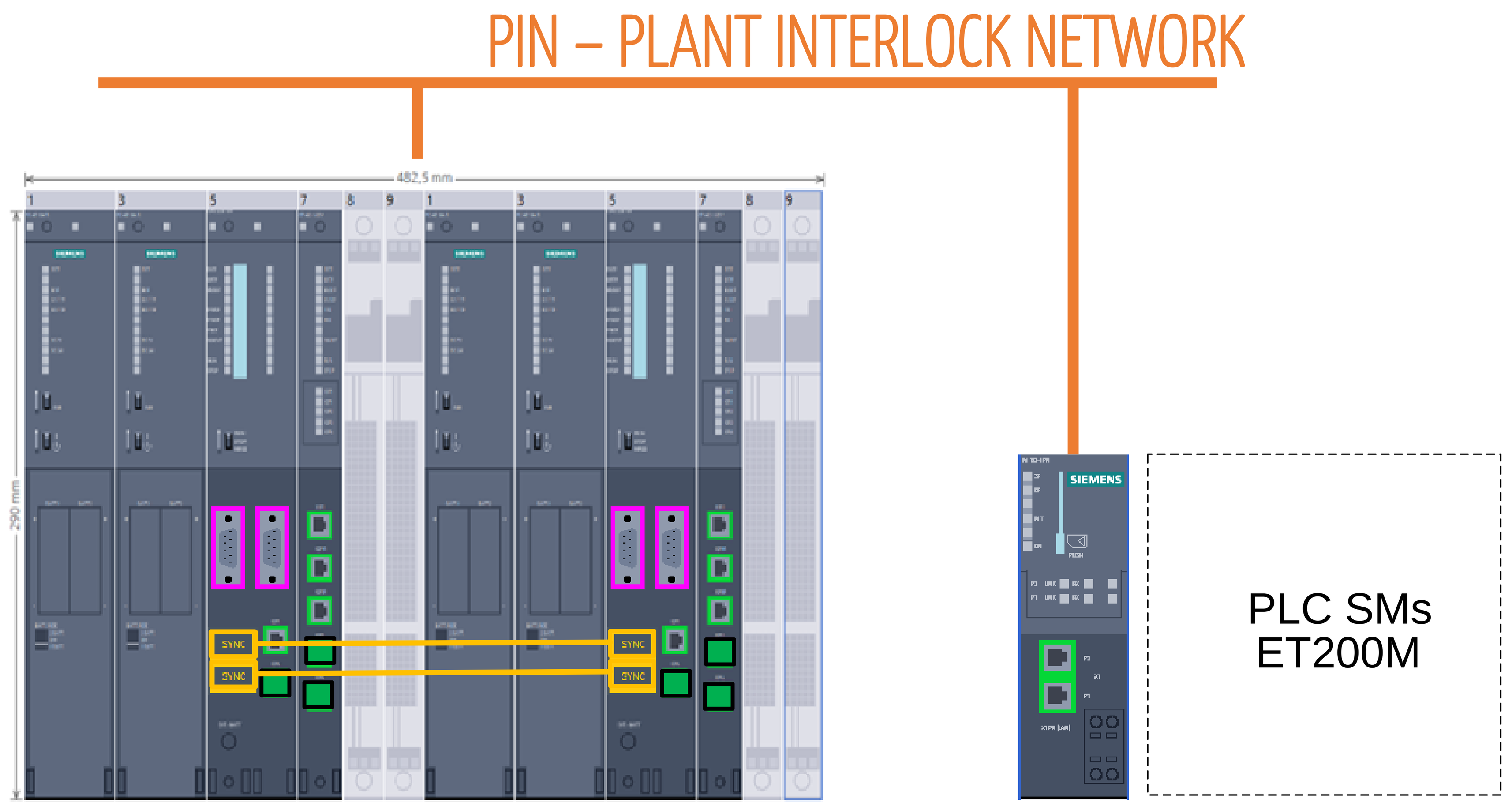
CHALLENGES

UCL Library first Project

Complex State Machine







1x Redundant Fail-Safe PLC

9x IM with Fail-Safe Cards

Programming environment:

Simatic Manager S7

Continuous Function Chart (CFC)

S7 F Systems

Libraries:

F-Library by Siemens

PIS_LIB by ITER

Implementation:

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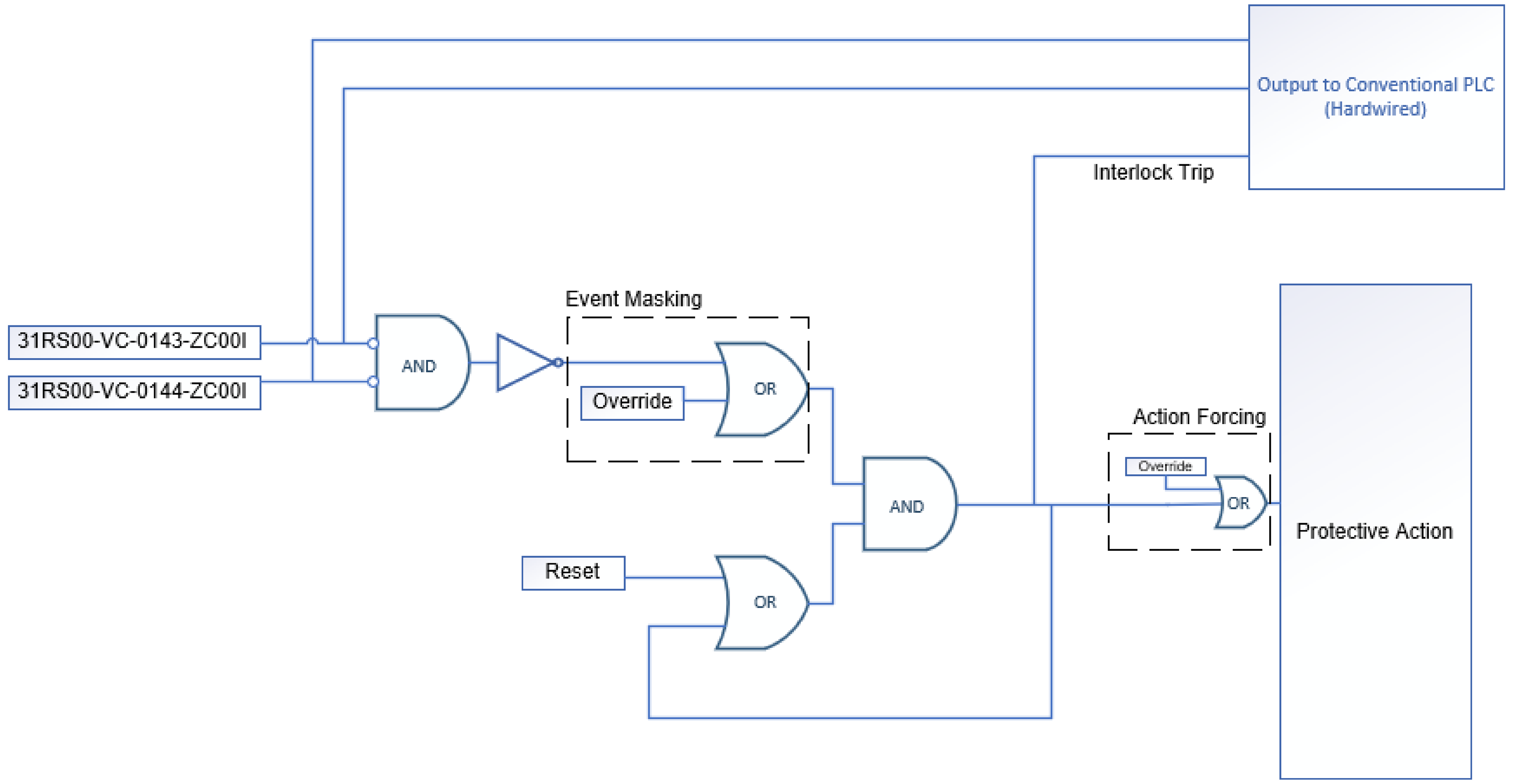
WRB_ILK01: Valves 31RS00-VC-0143 and 31RS00-VC-0144 cannot be opened together to avoid:
- Routing high temperature fluid to the cryoplant.
- Cold fluid flowing through the heat exchanger HT-0140 with consequent risk of water freezing.
Protective Action: If both valves are not closed, the valves VC-$129 and VC-$130 of the CVB will be closed.



Limit switch feedback sent to conventional PLC for process control purpose.

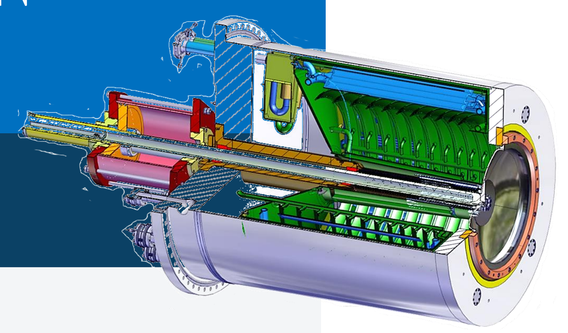
Actuation on the power supply of the valves to move them to safe state. Solid State Relays as interface.

Overrides

Event Masking: it overrides the conditions that generate the interlock (no-interlock).
Action Forcing: it overrides the output channels in order to activate the interlock and move the system to safe-state.

FRONT-END CRYODISTRIBUTION & CRYOPUMPING SYSTEM

VALIDATION



DESIGN | QUALIFICATION | MANUFACTURING | SOFTWARE | VALIDATION

Science, Infrastructures & Robotics

- ✓ 1x WRB Process Control SW
- ⟳ 1x Torus Process Control SW
- ⟳ 1x Interlock Control SW

- ✓ 5x Control Cubicles
- ✓ 1x Conventional Pneumatic Enclosure
- ✓ 1x Nuclear Pneumatic Enclosure

SOFTWARE

Software debugging

Developers test the implemented functionalities.

Internal FAT

Developer, Technical responsable and QA execute the tests following the procedure.

FAT

Tests are performed with client.

HARDWARE

Set-up Preparation

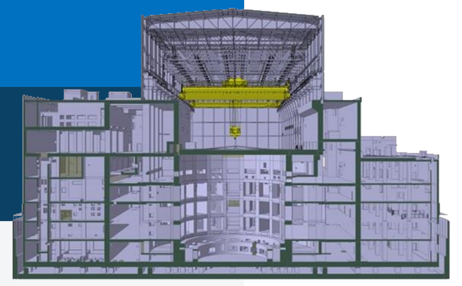
Test Set-up installation according to procedures.

Internal FAT

Execution of the tests following the procedures.

FAT

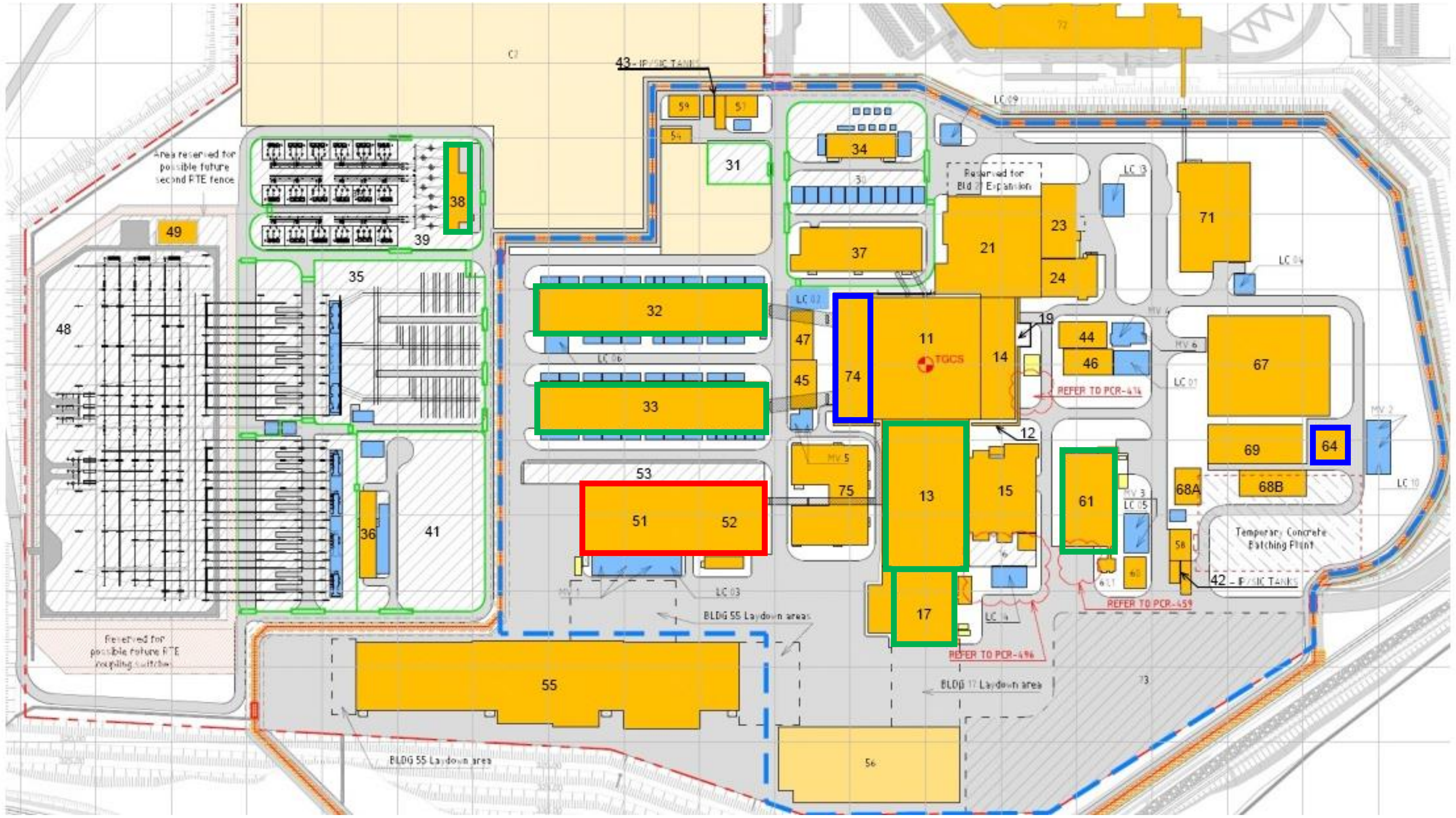
Tests are performed with client.



Science, Infrastructures & Robotics

Services include:
- Review and improve of I&C design;
- Software Development comprising of PLC, local HMI & Remote HMI;
- Control Cubicle manufacturing;
- Commissioning.

Systems under BMS scope:
- HVAC;
- Fluids (He, N, H20, ...);
- Electrical Services;
- Fire Protection.



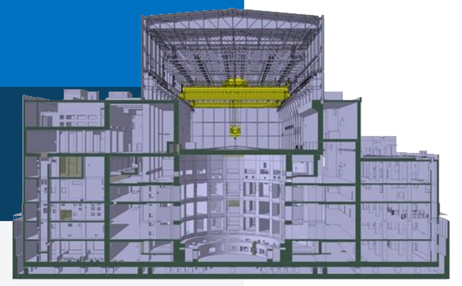
BMS delivered:
- B13, Assembly building;
- B17, Cleaning Facility building;
- B61, Site Services building;
- B32, Magnet Power Conversion building 1;
- B33, Magnet Power Conversion building 1;
- B38, Reactive Power Control building.

BMS under commissioning:
- B51, Cryoplant Compressor building;
- B52, Cryoplant Coldbox building.

BMS under development:
- B64, HRS Water Treatment;
- B74, Diagnostic building.

BUILDING MANAGEMENT SYSTEMS

TECHNICAL ASPECTS



Science, Infrastructures & Robotics

PLC:
- S7-1500 (i.e. CPU 1516-3 PN/DP)
- S7-400 (i.e. S7-416 3PN/DP)
- ET200M (i.e. IM 153-4 PN)
- ET200SP (i.e. IM 155-6DP HF)

HMI:
- WinCC-OA (Local Touch Panel)
- CODAC (Remote Control Room)

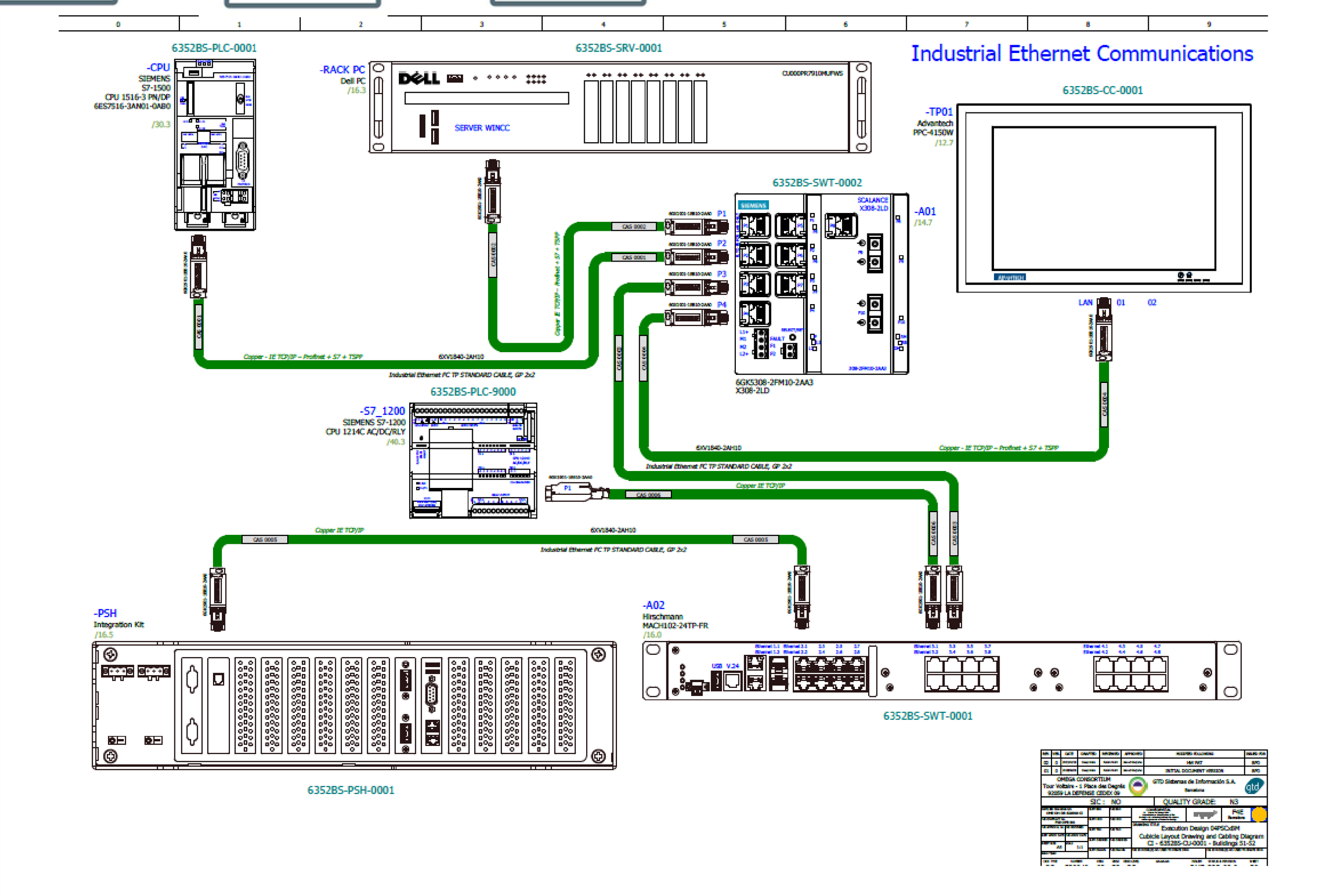
Large systems:
- Up to 6 different CPUs;
- more than 500 I/Os per building;
- More than 30 communicating devices.

Communicating devices:
- VFDs (PROFINET);
- Split Units (Modbus RTU);
- Metering Units (PROFIBUS-DP);
- Fire Protection System (Modbus TCP);
- UPS (Modbus TCP).

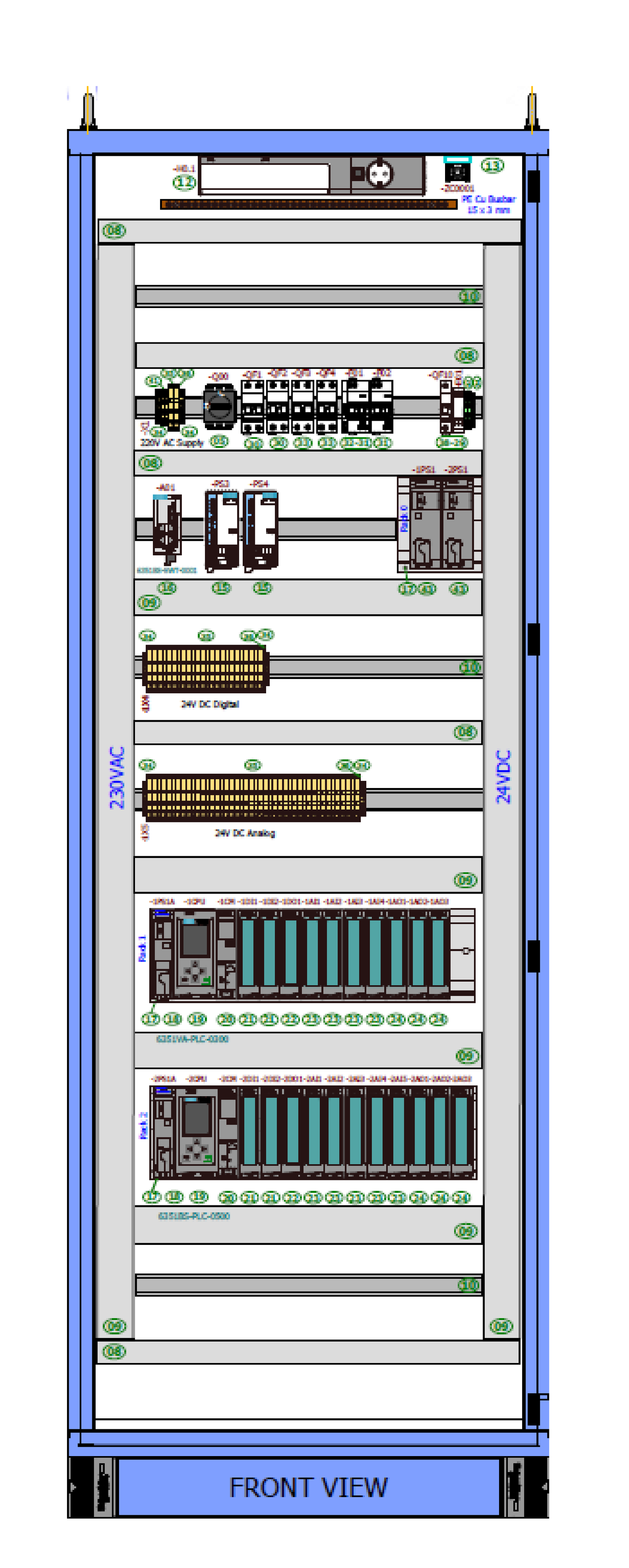
INPUT DOCs

P&ID
IO List
System Architecture
Functional Analysis
Interlock list

WIRING DIAGRAMS **MIP** **HW FAT PROCEDURES**

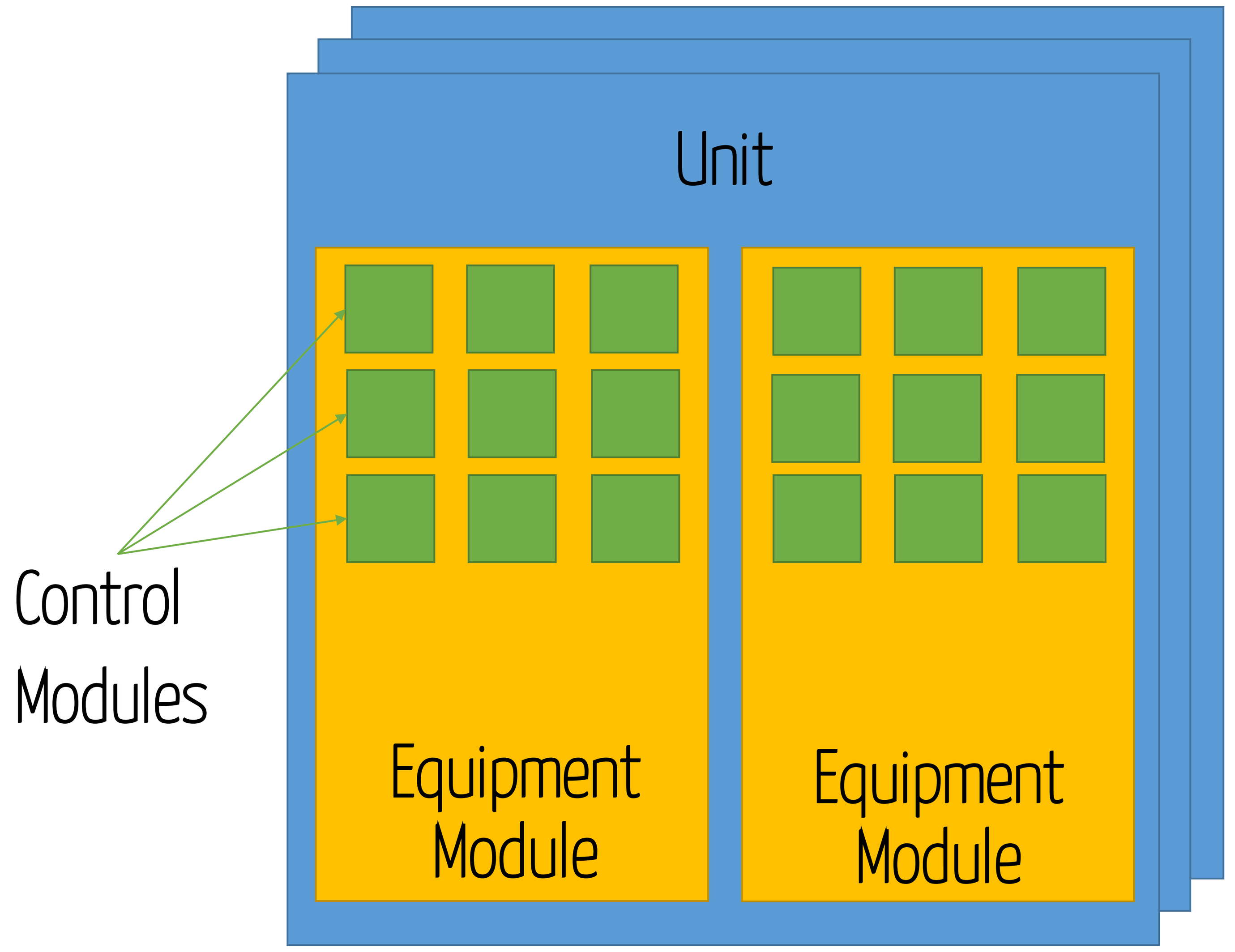


CUBICLE MANUFACTING



FDS **SW FAT PROCEDURES**

System structured based on
ANSI/ISA 88 Standard

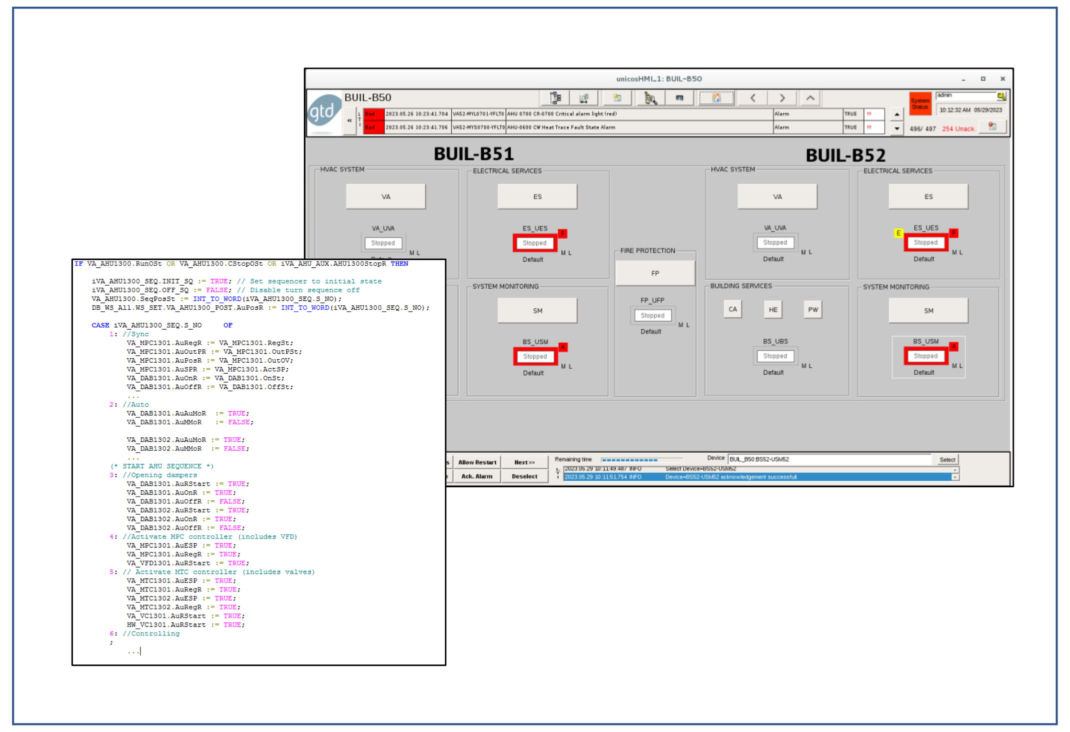


CHALLENGES

Amount of signals.

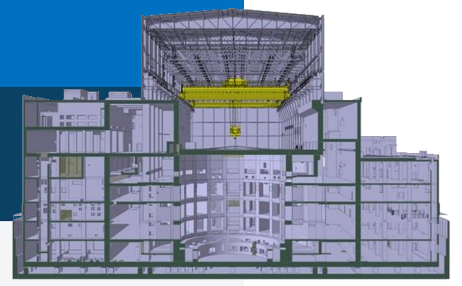
Different comunicating protocols.

SOFTWARE DEVELOPMENT



BUILDING MANAGEMENT SYSTEMS

TECHNICAL ASPECTS



Science, Infrastructures & Robotics

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- Fire Protection System (Modbus TCP);
- UPS (Modbus TCP).

UNICOS FRAMEWORK

UCPC UNICOS-CPC

S7 multi-project
- Hardware Configuration
- Network configuration

TIA V17

- Object definition
- Object instantiation
- Memory mapping
- Communication configuration
- Logic structure
- Generic logic

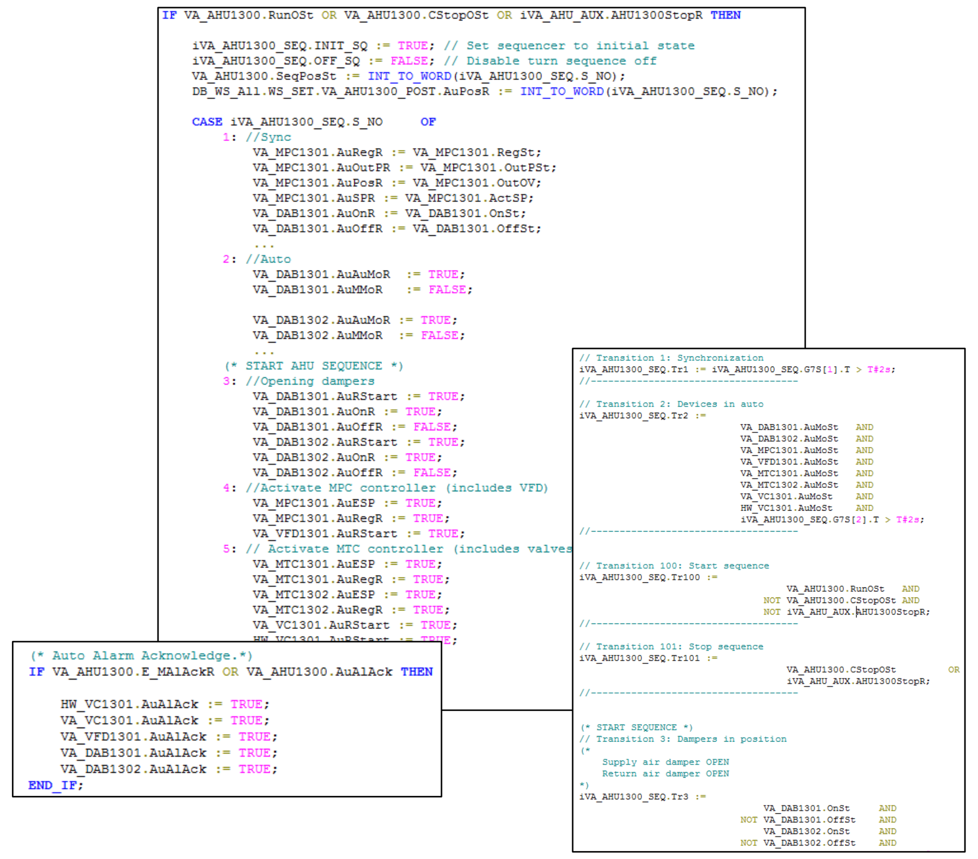
WinCC-OA base-project
- libraries setup
- archiving configuration

WinCC OA SIEMENS

- Data point types
- Widgets, Faceplates
- Data point creation
- Data point configuration
- Communication configuration

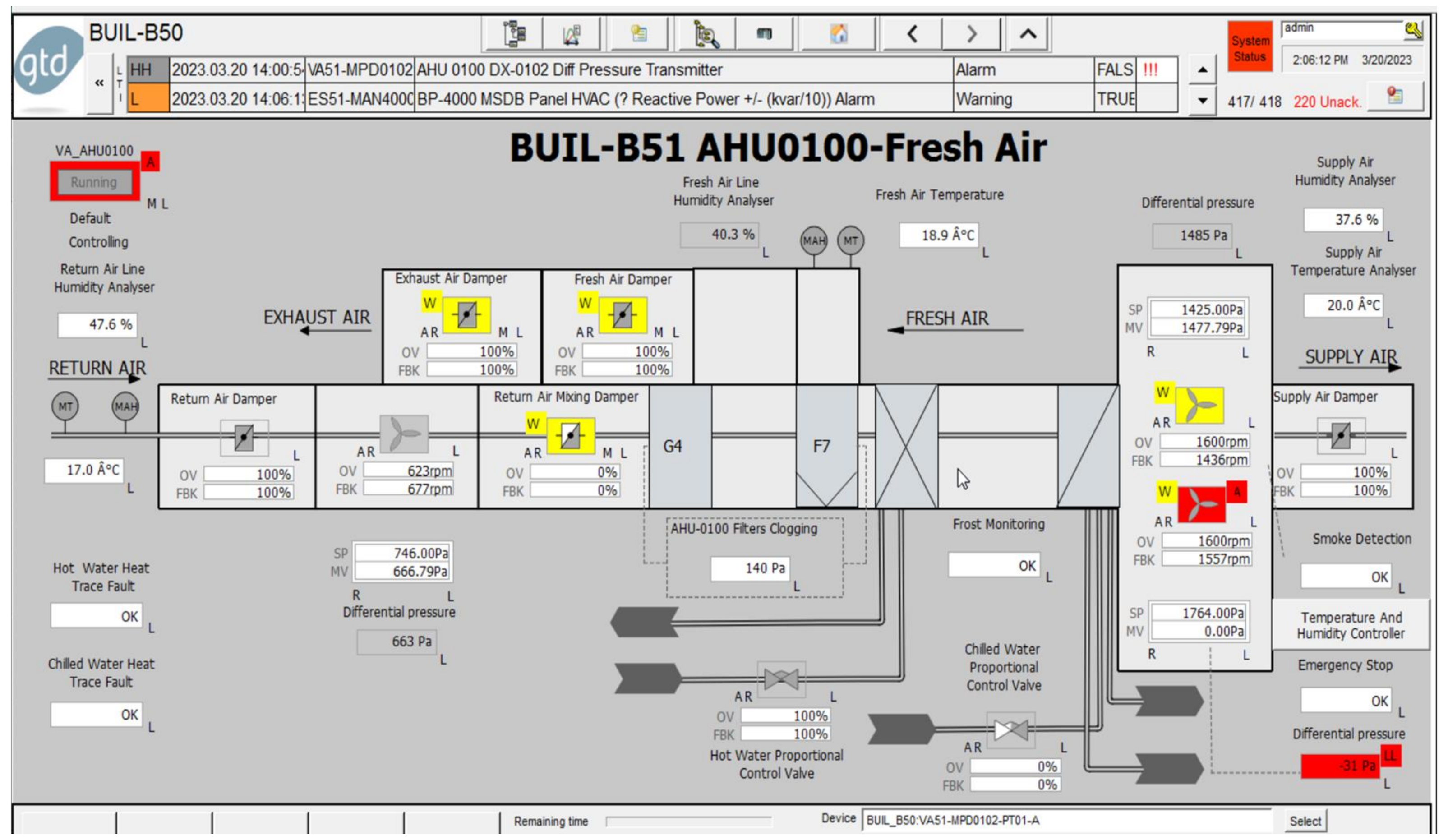
AFIC Tool

Application to extend the UNICOS framework with autogenerated code for:
- CODAC widget instances;
- PLC mapping source between UNICOS object variable and EPICS.



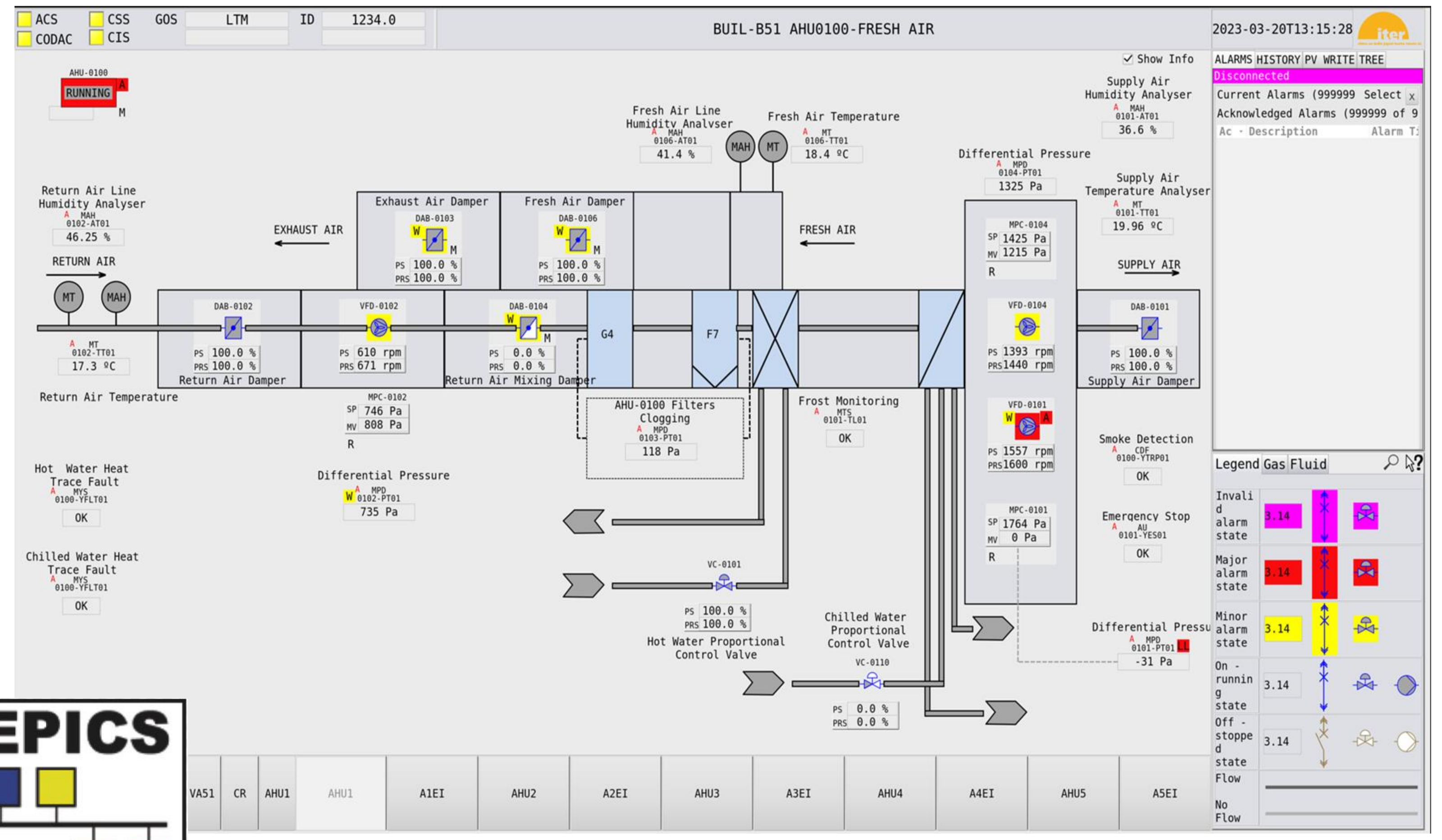
System-specific logic implementation

TXT



Local HMI in WinCC-OA

TXT

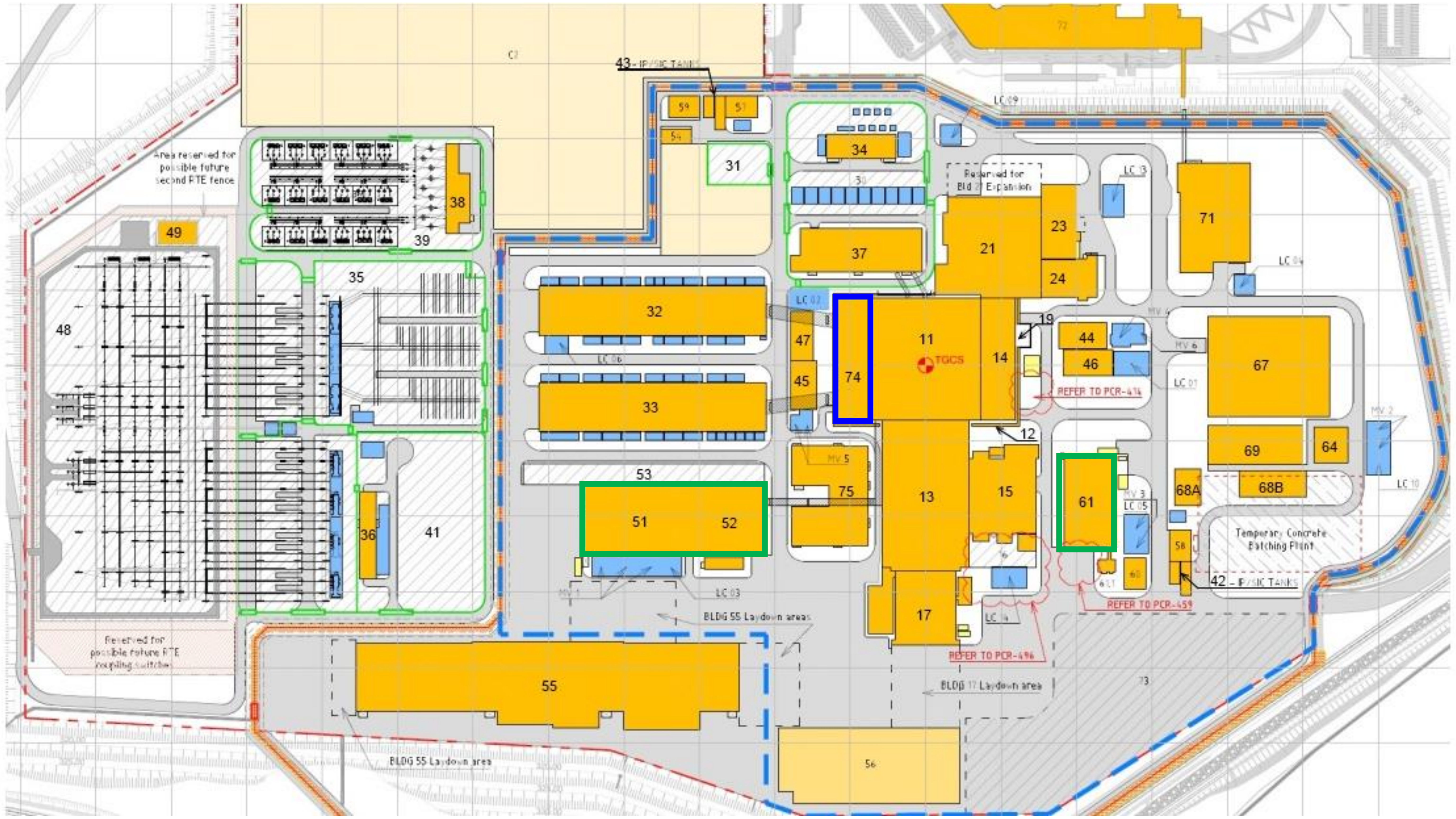


EPICS

Remote HMI in CODAC

Services include:
- Review and improve of I&C design;
- Software architecture design;
- Software Development comprising of PLC & HMI interface;
- Testing environment development;
- Control Cubicle manufacturing;
- Commissioning.

Systems under PSS-OS scope:
- Liquid Monitoring System;
- Leak Detection System.



<u>PSS-OS delivered:</u>

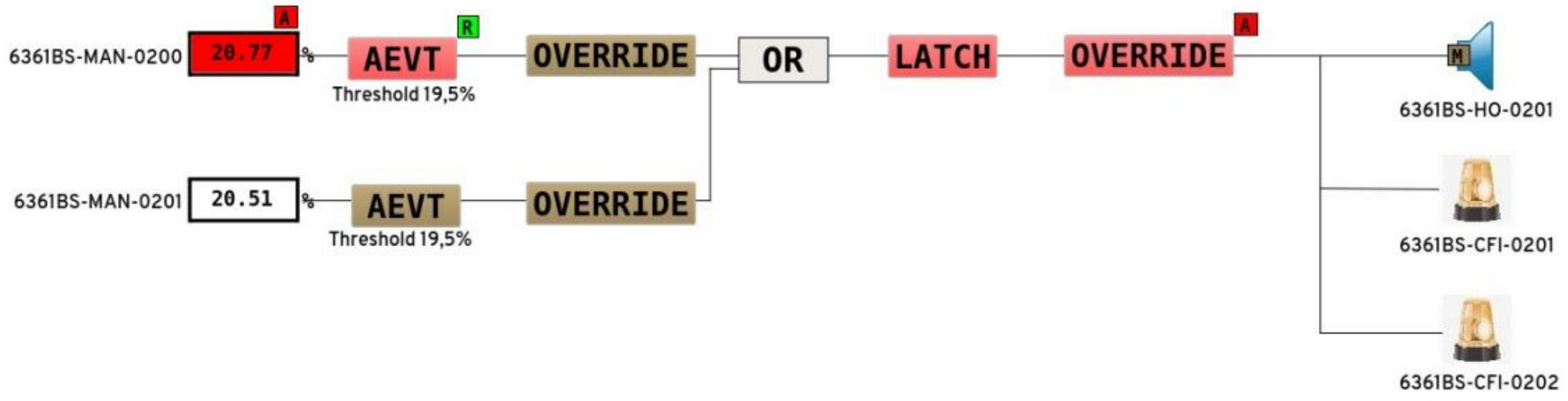
B61, Site Services building;
- B51, Cryoplant Compressor building;
- B52, Cryoplant Coldbox building.

<u>PSS-OS under development:</u>

B74, Diagnostic building.

Functions classified SIL-1.
SIL-2 guaranteed for the whole chain (Sensors + Logic processor + Actuator).

Oxygen sensors detection raises a mitigation action: visual & acoustic alarms.



PLC:
- S7-400 (i.e. S7-414 5H)
- ET200M (i.e. IM 153-2)

SCADA:
- WinCC-OA (Central SCADA under ITER scope)

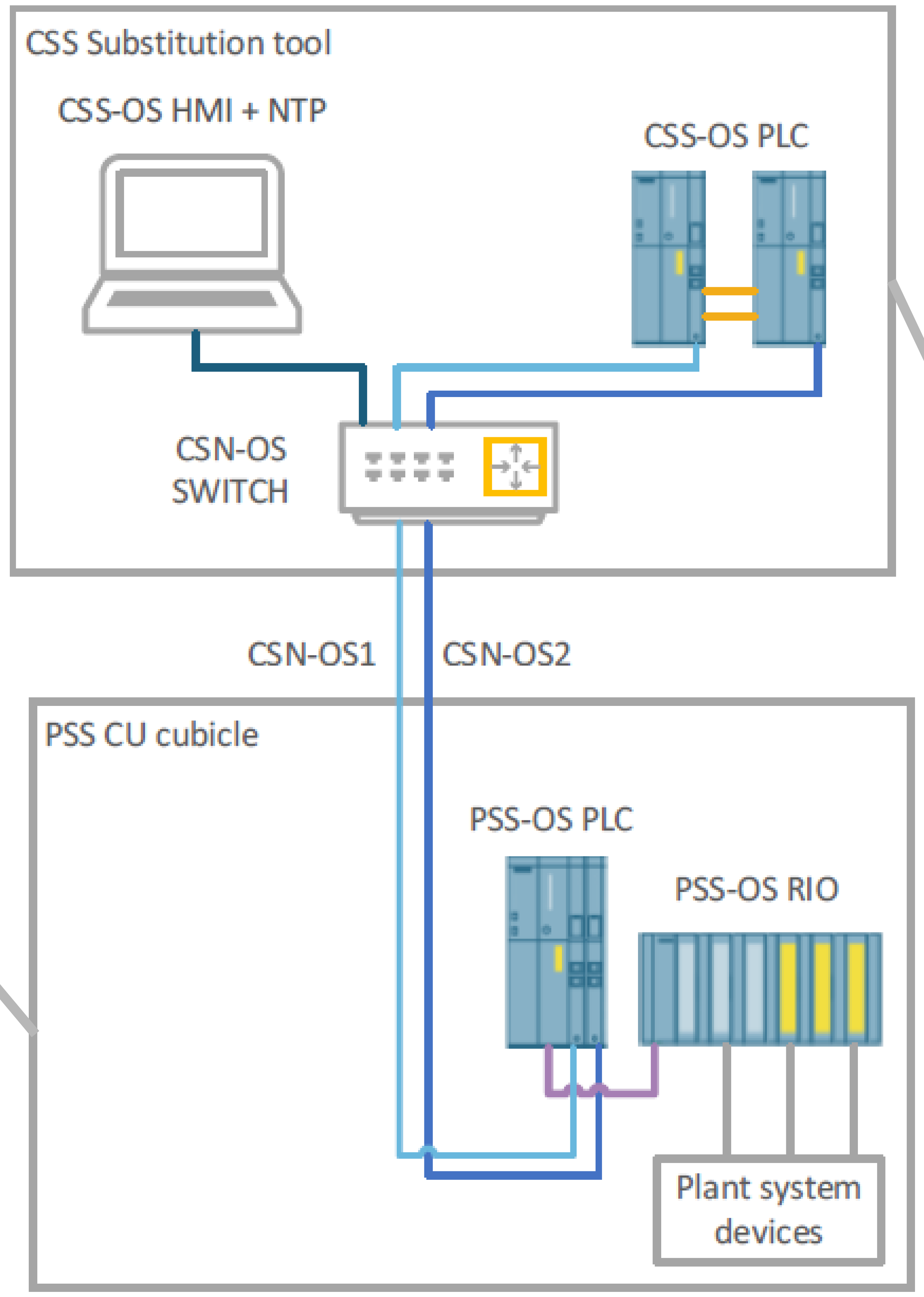
Library:
- Safety Control Library by ITER;

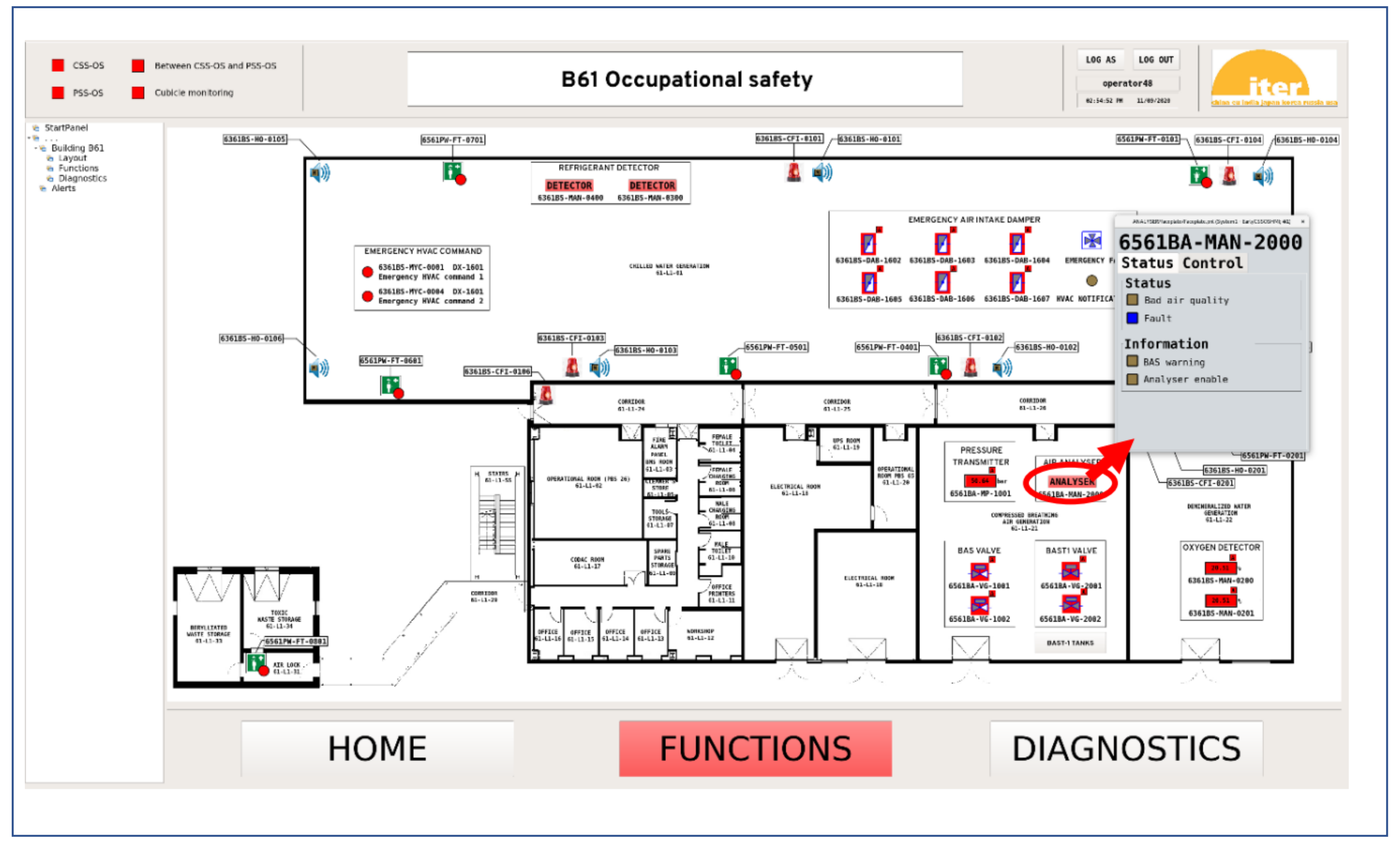
Programming Languages:
- CFC.

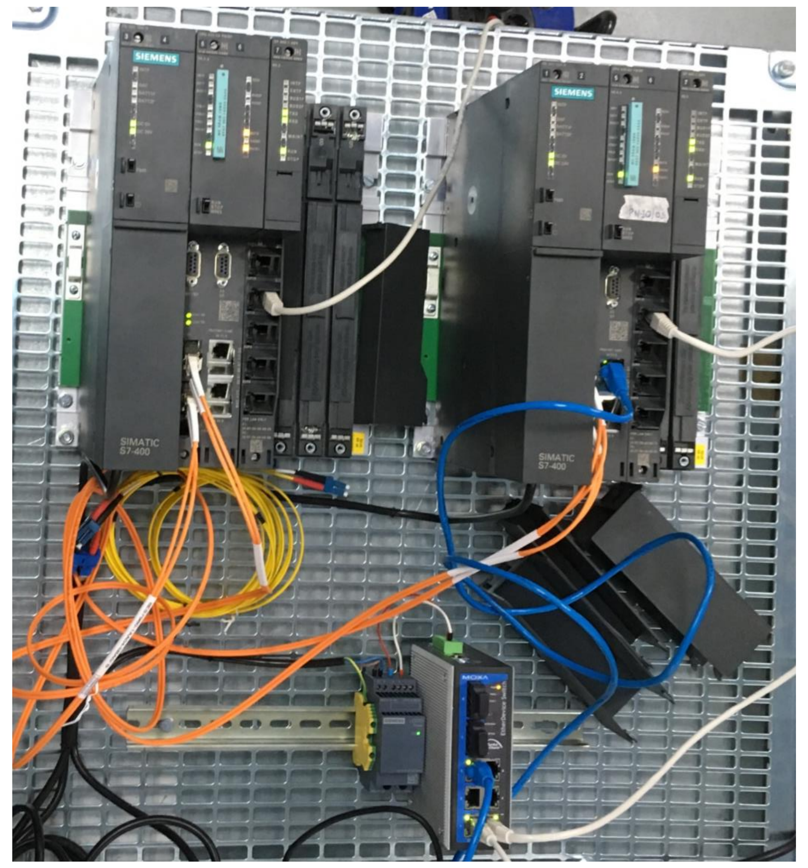
Simulation tool:
- SIMIT unit through Profibus.

PSS Cubicle

Testing Environment for FAT







CSS-OS Substitution Tool

CSS SUPPORT

QUICK VIEW

Two lots.

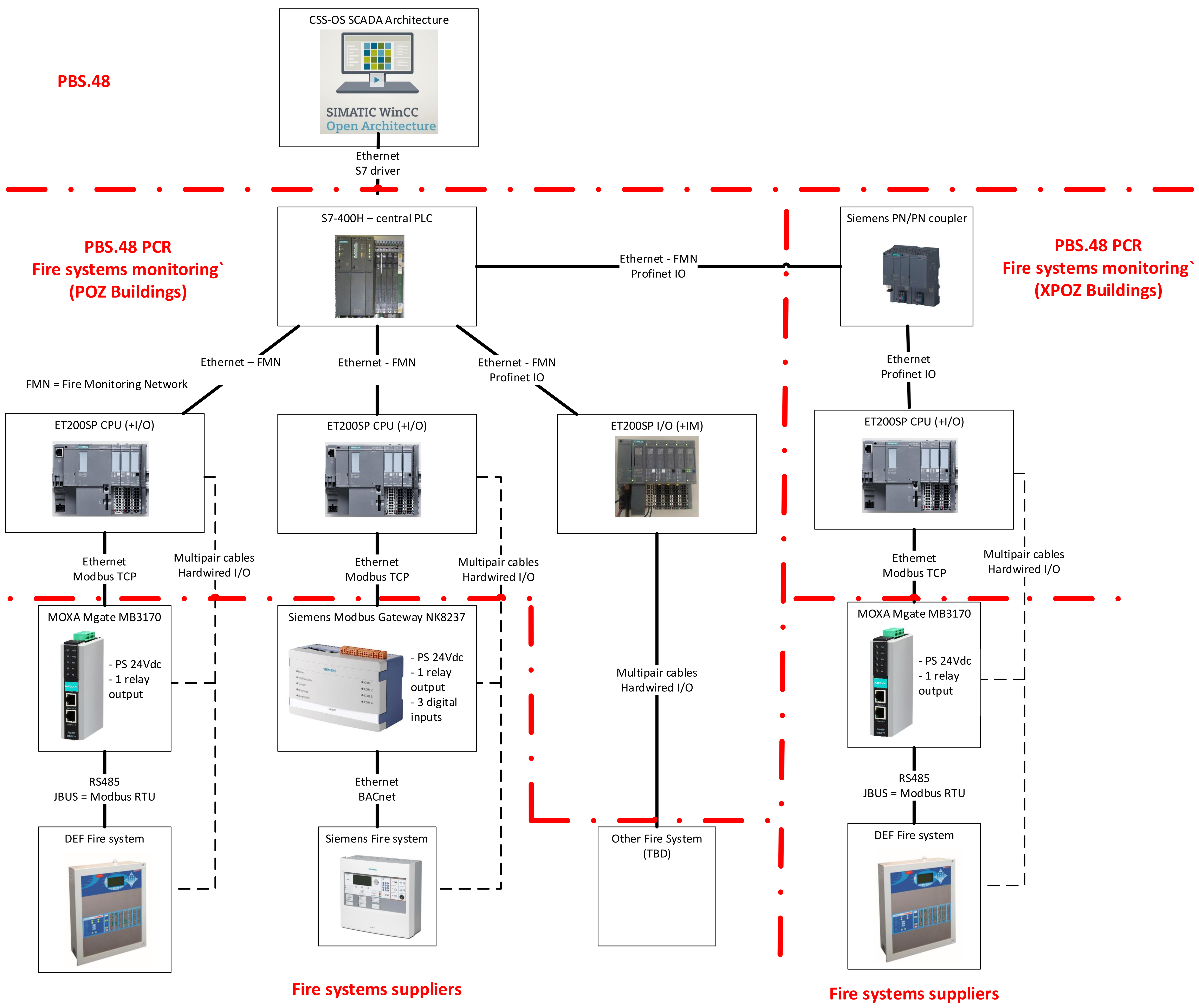
Lot 1 services include:

- Plant System Design and Safety Analyses documentation Assessment
- Functional Specifications preparation
- Control Logic Diagrams production
- Functional Interfaces between systems definition
- HMI diagrams for the CSS-N and/or CSS-OS mimics
- Review of engineering documentation
- Risk analyses

Lot 3 services include:

- Selection of hardware and software components
- Development of testing tools for acceptance and integration tests
- Development of software for safety PLCs and SCADA
- Mounting, integration and testing of prototypes, mock-ups and/or temporary subsystems.
- Acceptance testing
- Participation in the integration and definition of the integration procedures
- Draft Human Machine Interface (HMI) diagrams for the specification of the CSS-N and/or CSS-OS mimics

Science, Infrastructures & Robotics



Objective

Site-wide fire supervision through CSS-OS.

Scope of project

- Design network architecture;
- Selection of components;
- Develop data-model to standardize exchanged communication (up to 21000 signals);
- HMI mock-ups;
- Proof of concept to validate the design with all 3 types of fire protection system;
- Code generation tool development.

Thank You