

UNICORN

Non-Computerized Safety Class 1 I&C Platform

Non-Computerized Safety Class 1 (acc. IEC 61513) I&C platform for customer specific application including digital interface to supervisory information systems, modern design tools and state-of-the art testing and maintenance features.

Challenge

The design criteria for Nuclear Power Plant's (NPP) safety systems include principles such as quality, qualification, reliability, separation. In addition, a defense-in-depth principle with independence of safety functions and systems in the plant I&C architecture is followed to address potential vulnerabilities related to failures of equipment and the propagation of their effects.

Diversity is an additional measure against potential common cause failure (CCF) applied to ensure that independence targets are met.

A Diverse Actuation System (DAS) is required to be diverse from the I&C systems of the main line of defense, in particular the Reactor Protection system (RPS).

Such system belongs to the back-up line of defense in the I&C architecture of the EPR for Hinkley Point C, which aims at managing sequences based on frequent postulated initiating events combined with the loss of the main line of defense.

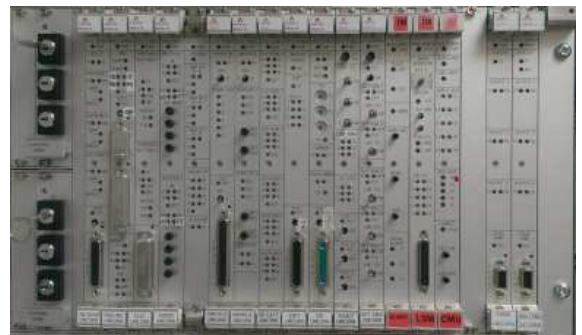
Solution

Considering that some regulatory bodies expect or highly encourage the use of non-computerized systems to implement the DAS, Framatome has decided to develop a non-computerized safety I&C platform diverse from the TELEPERM XS safety I&C platform.

The usage of the UNICORN platform provides the necessary means for a diverse backup solution for any digital system solution to meet the most stringent requirements enforced by safety bodies.

UNICORN is a modular Safety Class 1 platform for realization of customer specific applications in all types of Nuclear Power Plants (PWR, BWR, SMR, etc.) starting by small scale solutions (self-standing-systems) up to main automation systems to reach Controlled State after DEC-A.

It therefore allows implementing permissive signals, automatic functions as well as manual controls operated locally or from the Main Control Room (MCR).



UNICORN Sub-Rack with 6U modules © Framatome

Customer benefits

- Full consideration of UK Office of Nuclear Regulations (ONR) requirements for a non-computerized DAS.
- Safety Class 1 (IEC 61513) technology applicable for safety I&C functions for all types of plant.
- Suitable for small scale solutions as well as comprehensive safety I&C systems for NPP.
- De-risking of licensing process thanks to comprehensive equipment qualification.

References

Hinkley Point C EPR Non-Computerised Safety System (NCSS)

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is our everyday commitment**

Platform Capabilities



The platform has been designed to enable the design of small scale solutions. It includes all processing features needed for non-complex functions:

- **Analog Processing :** Linear/Quadratic acquisition, Thresholds, 2nd MIN, 2nd MAX, Proportional-Integral-Derivative Controller
- **Binary Processing:** Permissive, Voting Logic, Temporization and Pulse generator, Lockout management, Actuator driver
- **Monitoring functions**

The platform provides all necessary tools to design and validate a UNICORN based I&C system:

- **Unicorn Design Tool** allows to fully design an I&C system from its functional architecture description to detailed hardware design (rack and cabinet assembly as well as internal and external wirings).
- **Unicorn Validation Tool** allows to simulate the designed I&C system and validate the functional behavior of the system. Testing scenario can be then re-used for test-bay and on-site testing.
- **On-Site Validation Tool** allows physical stimulation of the system for validation purpose.
- **Periodic Test Bench** facilitates the execution of periodic tests.



UNICORN Cabinets © Framatome

CABINET DESIGN

Dimensions (HxWxD): 2200 x 900 x 400 mm

	Weight	Typical weight value is 360 kg Maximum is 410 kg
	Module:	6U-1T, 160mm depth
Power	Voltage:	18 – 32 VDC nominal: 24 VDC
	Current:	32 A maximum

System Data

Safety Classification:

- ✓ IEC 61513 – Class 1 (Design)
- ✓ IEC 60987 – Class 1 (V&V)
- ✓ RCC-E 2012

IP Classification:

(according to IEC 60529)

- ✓ Cabinet - IP30
- ✓ Components - IP00
- ✓ Components in subracks - IP20

Environmental conditions

(according to IEC60721-3-2)

- ✓ **Climatic Conditions** - 2K2
- ✓ **Biological** - 2B1
- ✓ **Function-endangering gases** - 2C2
- ✓ **Function-endangering dust** - 2S2

Qualification:

- ✓ **Overall:** RCC-E 2012 - IEC 60780
- ✓ **Seismic:** SC1 - IEC 60980
DBE : 63 m/s² - APC: 44 m/s²

Environmental Tests:

- ✓ IEC 60721-3-3,
- ✓ IEC 60068-2 Series
- ✓ **EMC: Class A** (Class B accepted for specific cases)
 - IEC 61000-4,
 - IEC 61000-6-2,
 - IEC 61000-6-4

Qualification & Reliability

The **Reliability, Availability and Maintainability Studies (RAMS)** have demonstrated that the following reliability target are achieved:

- **Failure rate of platform modules** below 1000 (Failure In Time) FIT and portion of non-detected dangerous failures below 50 FIT per module.
- **Failure on demand** : $1,5 \cdot 10^{-3} / d < Pfd < 2,9 \cdot 10^{-2} / d$
- **Spurious actuation:** $\lambda < 10^{-6} / h$

The UNICORN platform is qualified to meet **Class 1 equipment** requirements stipulated by RCC-E and IEC standards. The platform ensures high reliability according to the following operation profile (IEC 62380) :

		Day/Night Cycle		ON/OFF Cycle	
	Tac	N1 (cycle/year)	ΔT1 (°C)	N2 (cycle/year)	ΔT2 (°C)
Profile	40°C	365	10	1	15

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