Challenges and Lessons Learned for Designing and Supplying Control Rooms for Nuclear Power Plants

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Nuclear Control Rooms Challenges

Source: NS Energy

TECNATOM BACKGROUND

grupo tecnatom

1957 — COMPANY FOUNDATION

1962 — ZORITA NPP PROGRAM STARTS

70's — DEVELOPMENT OF SPANISH NPP PROGRAM

80's — TECHNOLOGICAL INDEPENDENCE ACHIEVED

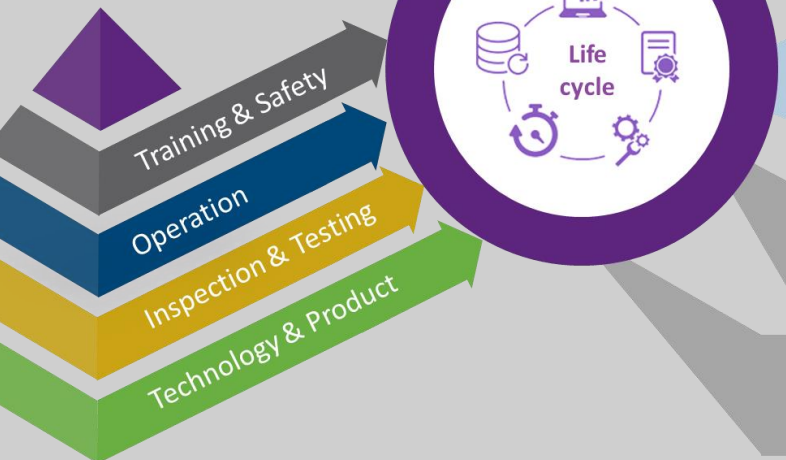
2010's — TECNATOM AS INTERNATIONAL GROUP

1975-1979
- Automated Inspection Systems
- Full Scope Simulators

90's
- Internationalization in Nuclear Markets
- Consolidation of Strategic Alliances

2000's
- Diversification to Synergic Markets

Complex technological industries with the highest quality and safety standards



Power Generation

- Current Nuclear Fleet
  New Reactors
  Advanced Reactors
  Research Reactors

- Gas Combined
  Coal
  Cogeneration

- Renewable

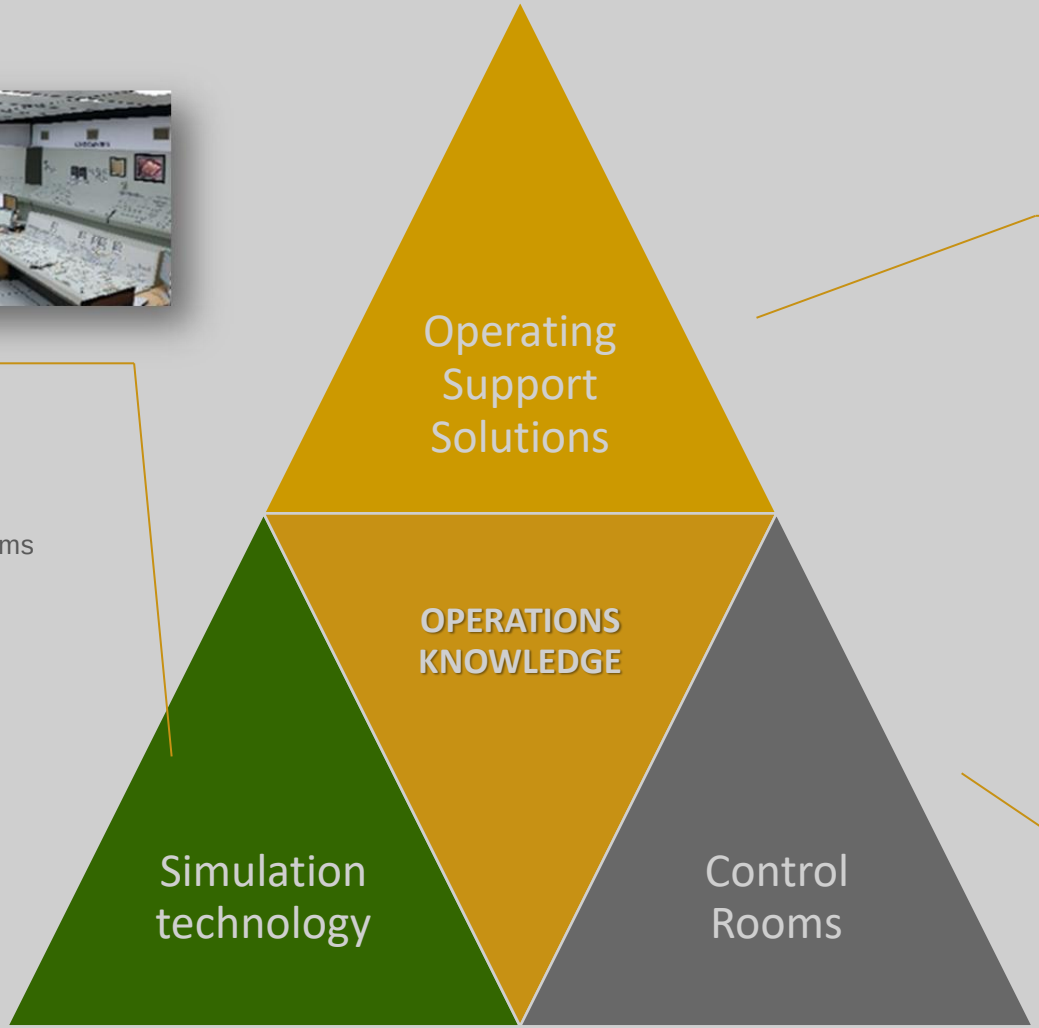
Industrial

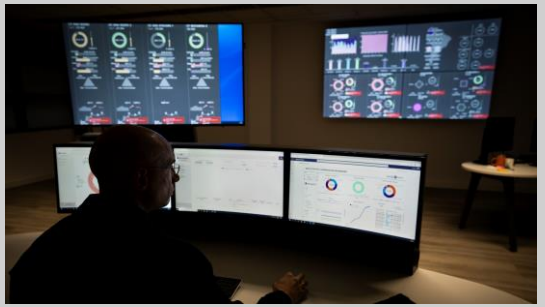
- Oil & Gas
  Manufacturing
  Process Industry

- Aerospace
  Railway
  Automotive

OUR APPROACH

- Full Scope Simulators: Engineering & Training
- Own Simulation tools-suit
- Digital Twin
- Simulation, Emulation and stimulation of I&C systems

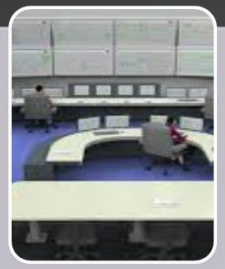




- Monitoring Center
- Predictive Monitoring
- Efficiency Monitoring
- Computerized Operation Support Systems

- Human Factor Engineering analysis & design
- Independent verification and Validation
- Instrumentation and Control system Integrator
- Mechanical & Electrical design
- Commercial Grade Dedication and Qualification
- Control Rooms manufacturing and Commissioning
- Cybersecurity

TECNATOM EXPERIENCES

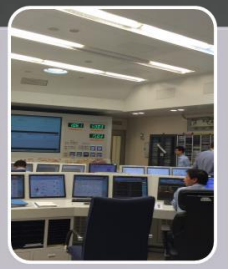


AP600
Westinghouse
FOAKE
AP600

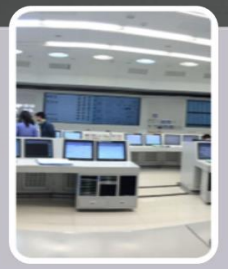
1992

South Texas Project 3&4
Westinghouse
ABWR

2009



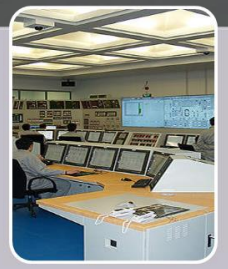
Fangjiashan 1&2
CNNC
CPR1000



Fuqing 3&4
CNNC
CPR1000

Krsko 1
ENEC
PWR-632

2015



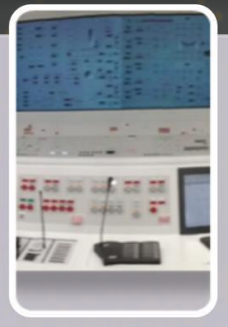
Hongjianghe 5&6
CGN
ACPR1000

Fangchengang 3&4
CGN
Hualong

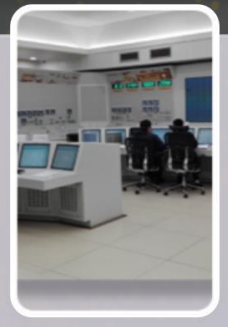
Xe-100
X-Energy

2020

Lungmen 1&2
General Electric
ABWR



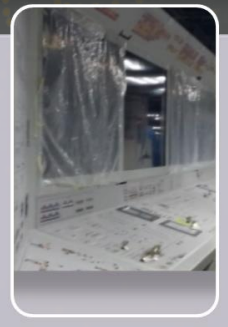
Fuqing 1&2
CNNC
CPR1000



Hainan 1&2
CNNC
CPR650

Yangjiang 5&6
CGN
ACPR100

Hualong No.1 FOAKE
CGN
Hualong



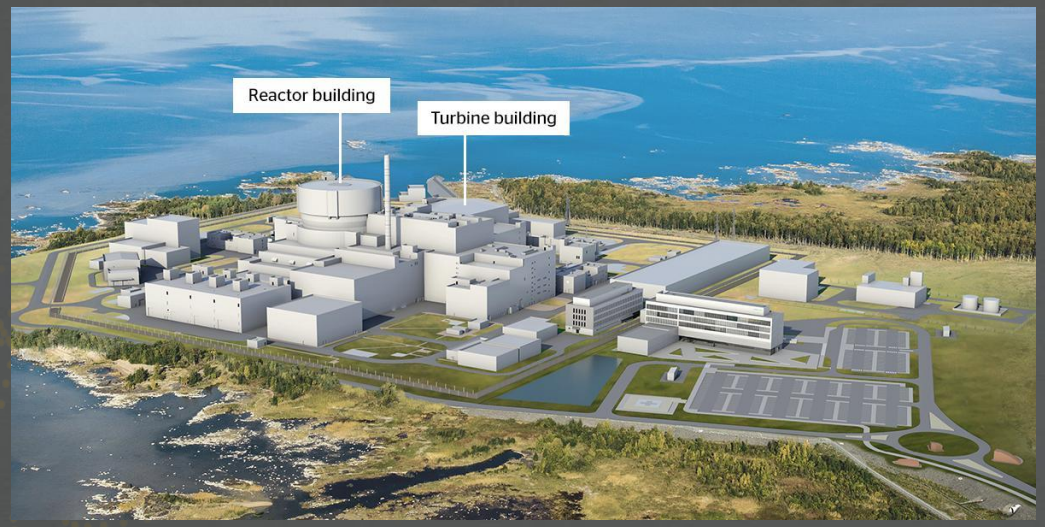
Tianwan 5&6
CNNC-CGN
APR1000

Wilfa
Horizon
ABWR

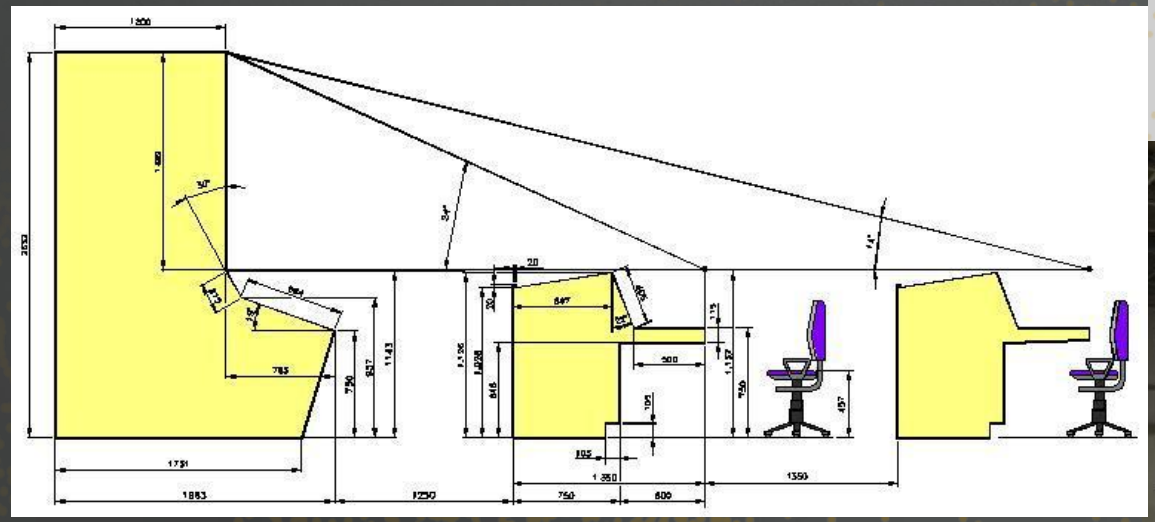
Labgene
CTMSP
SMR100

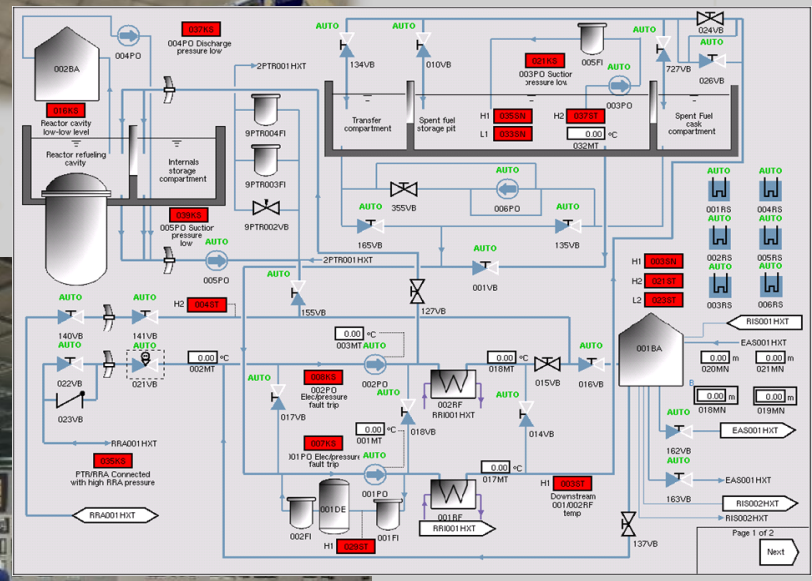
TECNATOM EXPERIENCES

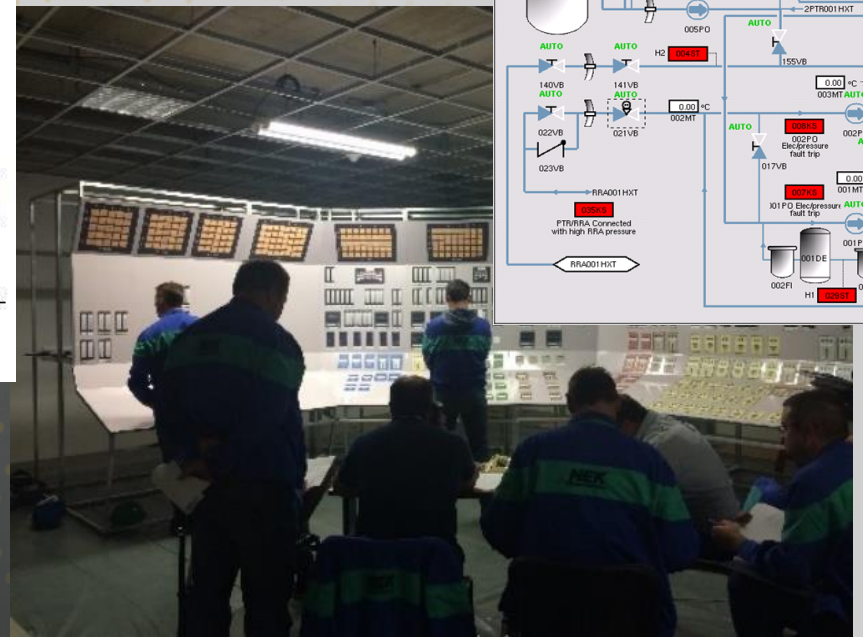
- Control Room modernizations & HFE for NPPs: Krško, Turkey Point, Atucha, Angra, Embalse, Asco, Vandellos, Kalinin, Almaraz, Cofrentes, Zorita, Garoña, Beznau, …
- I&C consultancy for RASU Hanhikivi NPP, Argentina Regulatory Body, CAREM…
- SMR's: Xe-100, BWRX-300, Carem-25



Applying Human Factors Engineering (HFE) in the whole life cycle







HFE Methodology

Analysis	Design	Test	Implementation
Operating experience review	Human Machine Interface Design	Human Factors Verification and Validation	Design implementation
Functional Requirements Analysis	Procedure Development		Human performance monitoring
Allocation of Functions	Training Program Development		
Task Analysis			
Staffing & Qualification			

- Licensing
- Design
- Testing
- Life cycle

WHY APPLYING HFE IN CR DESIGN?

Mandatory from Nuclear Regulatory Body

i.e. NRC FSAR Chapter 18

Design adapted to the operator needs

Considering design and operation events and system performance
Reducing Human Error

Project Cost Reduction

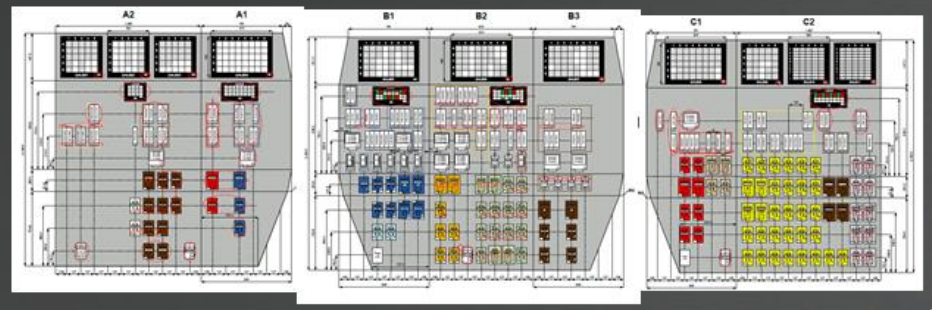
Integrating HFE in design process reduces rework
Input for Operating Procedures and Training Program

O&M costs reduction

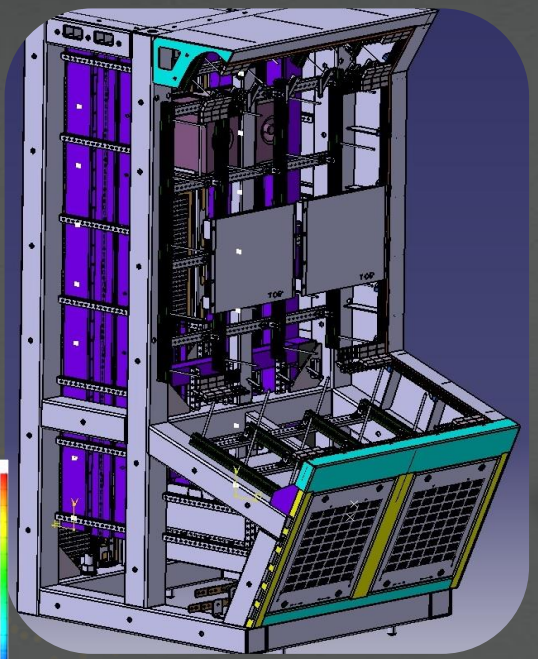
Reduction of Operation & Maintenance costs due to a better maintainability

Designing, constructing and testing control rooms

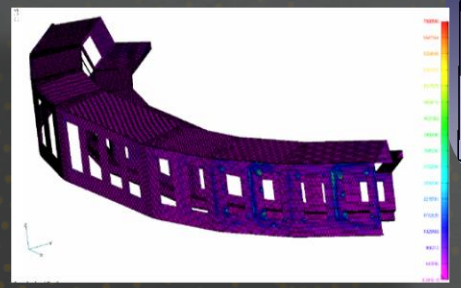
Control Rooms



HFE and Basic Design



Mechanical & Electrical design



Qualification

Verification & Validation Mock-up

Manufacturing

Testing & commissioning

Electrical and I&C cabinets for NPPs

Switchgear cabinet

Motor Control Center (MCC) cabinet

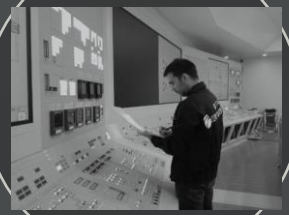
UPS cabinet

Local I&C Cabinet

EXPERIENCES FROM CR SUPPLY

Compliance with regulatory standards and appropriate QA program

Controlling the supply chain

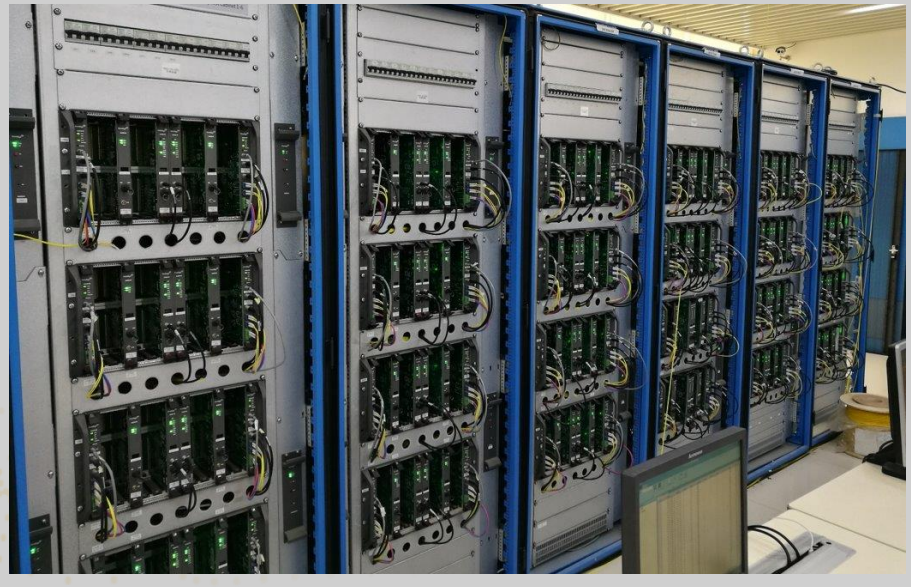


Spare parts and warranty management

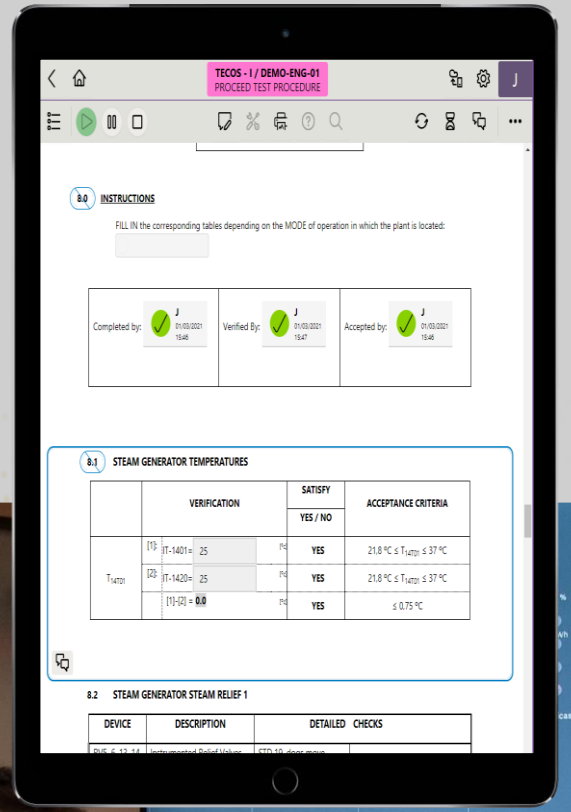
Experience and Know-how

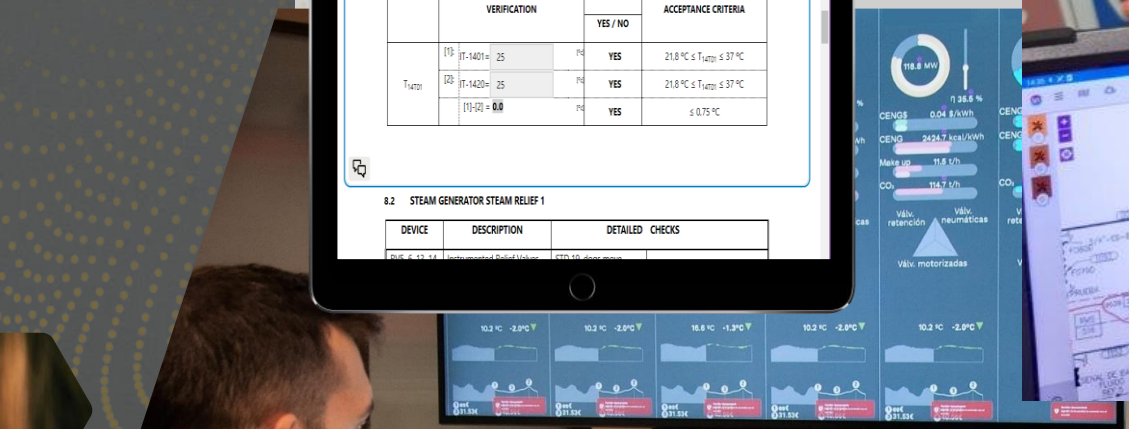
I&C Nuclear Systems

- Analysis of compliance with I&C nuclear regulation standards
- Support to Safety and Licensing Analysis
- Integration of I&C technologies
- Independent Verification & Validation



Digital solutions for improving safety and efficiency in operations





SUM-UP

CONTROL ROOMS FOR NUCLEAR POWER PLANTS

INTEGRATING HFE

REGULATORY STANDARDS

QA PROGRAM

EXPERIENCE

THANKS!

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