

Development of licensable solution of safety I&C for international projects in compliance with safety authorities

Philippe MOULY
I&C Senior expert
Rolls-Royce Civil Nuclear, France

**VII International Forum of Nuclear Industry Suppliers ATOMEX 2015 –
October 13-15,2015 Moscow**

Trusted to deliver excellence

© 2015 Rolls-Royce Civil Nuclear SAS



Rolls-Royce

Overview

- **Complying to foreign safety authorities rules with Russian design**
- **Technology and processes**
- **The near future : Hanhikivi-1 support to ROSATOM**



Our I&C solutions



Safety Systems

Ensure the safety of nuclear reactors by meeting the functional & safety requirements for digital safety I&C systems

Control and monitoring systems

Improve the plant availability and reduce operational, maintenance and training costs

Instrumentation

Safe and accurate measurements of neutron and thermodynamic information, in all types of conditions

Customer support

Integrated long term solutions to support operation across the lifecycle of the reactor

Integration

Driven by safety and availability, manage a comprehensive I&C dedicated solution

Safety and performance through technology and long term support



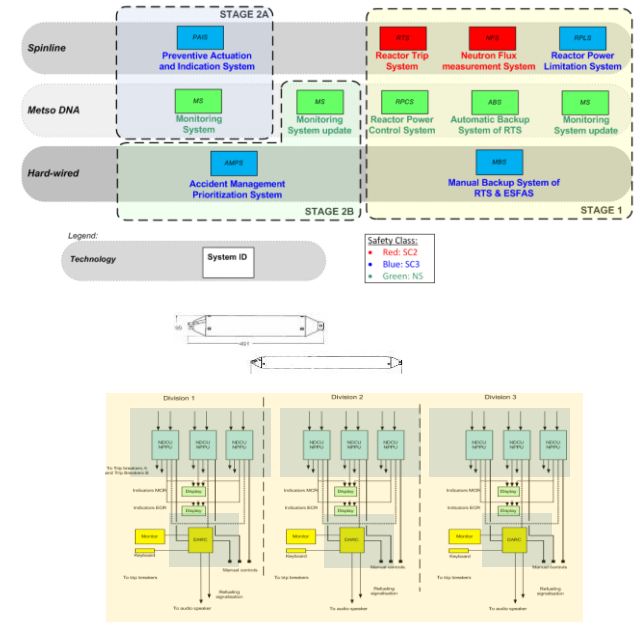
Complying to foreign safety authorities rules with Russian design

- **The on-going projects :**

- LOVIISA 1&2 modernization
- Mochovce Neutron Flux Monitoring

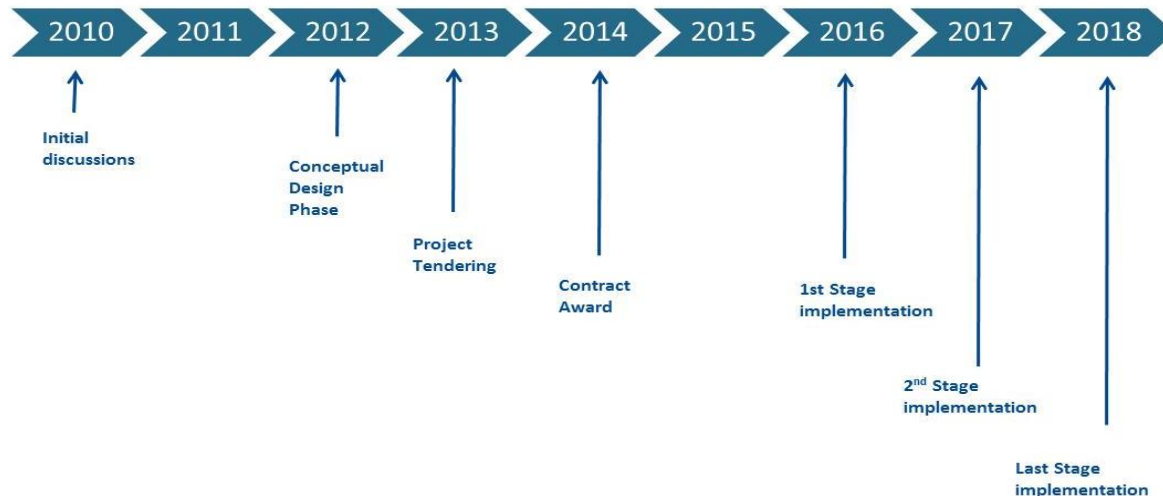
- **... and previous projects :**

- 4 x VVER Dukovany, whole protection system
- 2 x RBMK Ignalina, Diverse Reactor Trip
- 2 x VVER Metsamor, Neutron Flux Monitoring
- 2 x VVER Kozloduy, Neutron Flux Monitoring



LOVIISA 1&2 Modernization project

- Rolls-Royce Scope of Supply - Systems:
 - Spinline™ digital based safety systems: Preventive Actuation and Indication System (PAIS), RTS, NIS, Reactor Power Limitation System
 - Rolls-Royce Hard-wired safety systems: Accident Management Prioritization System, Manual Backup System of RTS and ESFAS
 - Non-safety systems : Monitoring System, Reactor Power Control System, Automatic Back Up System of RTS
- Latest update :
 - Detail Design & Field engineering documentation of 1st stage approved by STUK.
 - **Smooth approval process and in the targeted time.**



Rolls-Royce

CEZ Dukovany Safety I&C Modernization

Four VVER-440 operated by CEZ in Czech Republic

Safety I&C systems are modernized with Spinline technology:

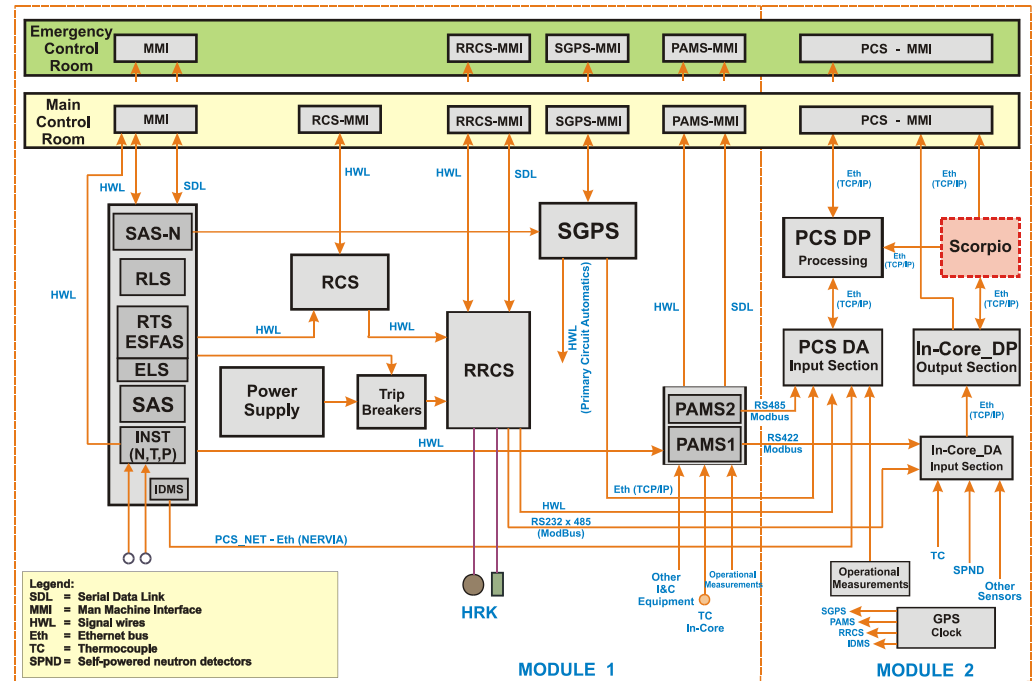
- Ex-core Nuclear Instrumentation System (NIS),
- Reactor Trip System (RTS),
- Engineered Safety Feature Actuation System (ESFAS),
- Emergency Load System,
- Reactor Limitation System,
- Support Action System,
- Reactor Control System,
- Scram breakers

175 cabinets

Completed on time – no impact on electricity production and within budget

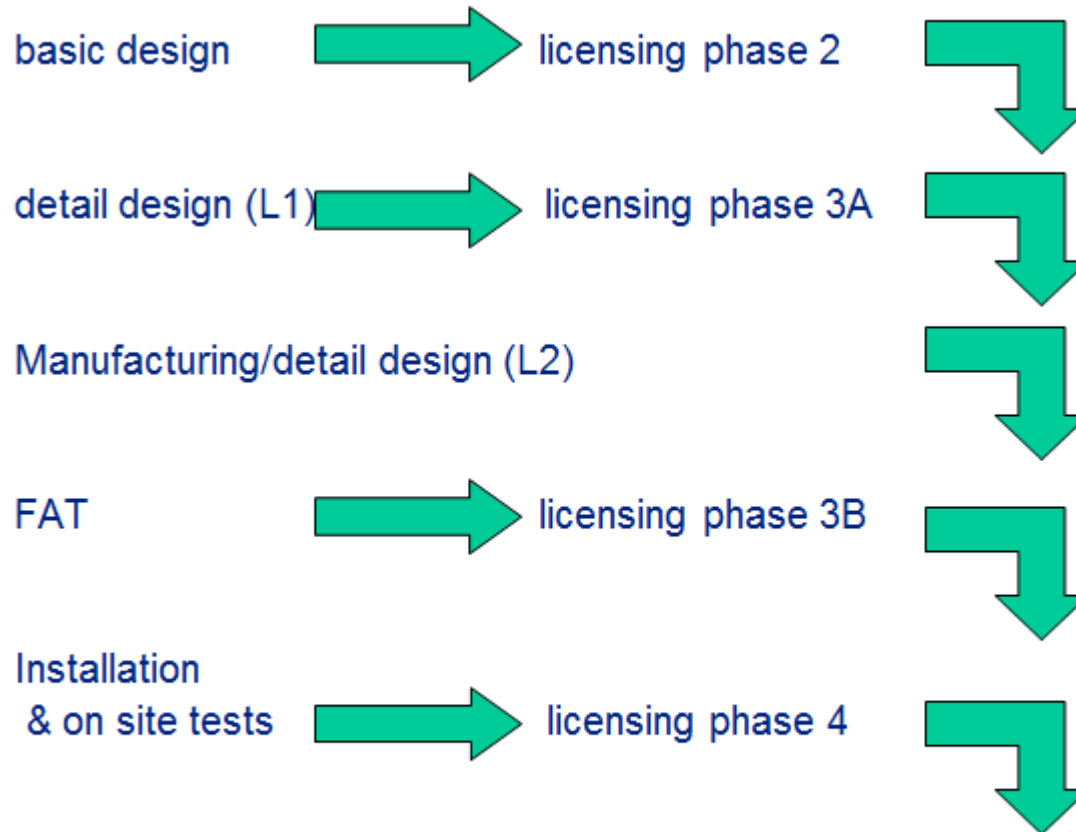
LTS agreement with end-user

Joint partner: Areva NP



Rolls-Royce

Dukovany Design and Licensing process



Start of the unit with the new I&C system



Rolls-Royce

Technology and processes

- **I&C Architecture: adaptable to each application, instead of imposing a standard solution:**
 - Flexible to application needs
 - Based on the Defense in Depth and Diversity needs
 - Numbers of redundancies and Number of levels in each system

- **Flexible set of Building Blocks:**
 - Standard industrial components & specialized nuclear equipment
 - Designed according to Nuclear I&C standards and
 - Pre-qualified according to “enveloping” NPP environmental conditions

Process focus: Gradual shift in standards & regulations

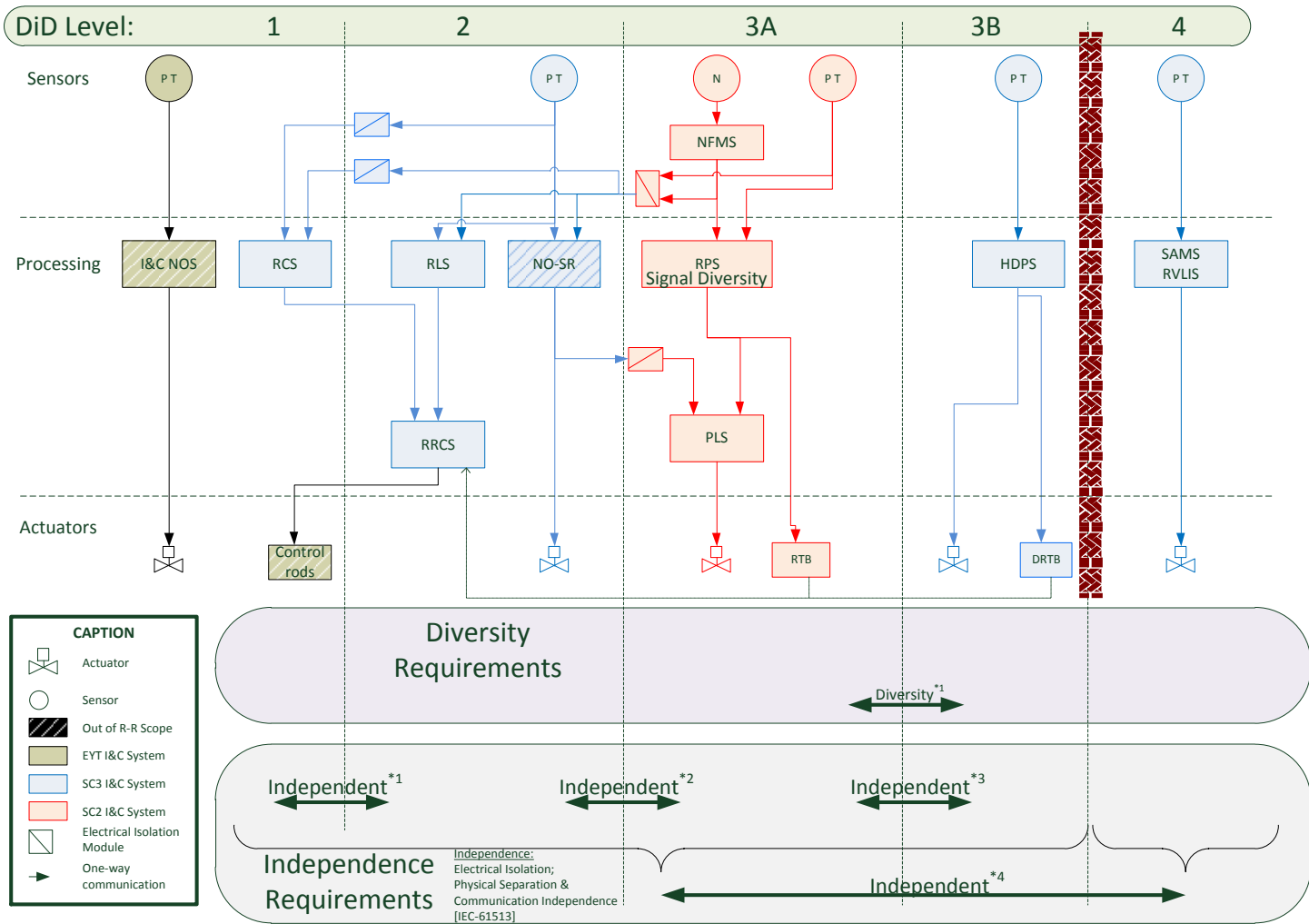
- **Equipment-based approach -> System approach**
 - **HOW systems are developed vs end-result**
 - **Increasing need for independent teams**
 - **Formal Requirements Engineering**
-
- **Validated Technology + Processes are of the first interest to justify the more and more demanding requirements on diversity (ie WENRA)**

Лицензирование Спинлайн в мире

IEC standards, Finnish Reg Guides YVL, NRC certification in 2014 : another step of experience



Diversity & architecture



The near future: Support to Rosatom for Hanhikivi-1

- Rolls-Royce has been involved since March 2013 alongside the Plant Designer Atomproekt, the Plant I&C Designer and Integrator and the EPC/General Contractors Rusatom Overseas and Titan-2



- On 30 June 2015, Fennovoima submitted their Construction License Application for FH1 NPP, stating that Rolls-Royce is one of the two possible suppliers of the Safety automation.

FENNOVOIMA

Application for a
Construction License
pursuant to Section 18 of the
Nuclear Energy Act (990/1987)
for the Hanhikivi 1
Nuclear Power Plant

June 2015
Updated August 5, 2015

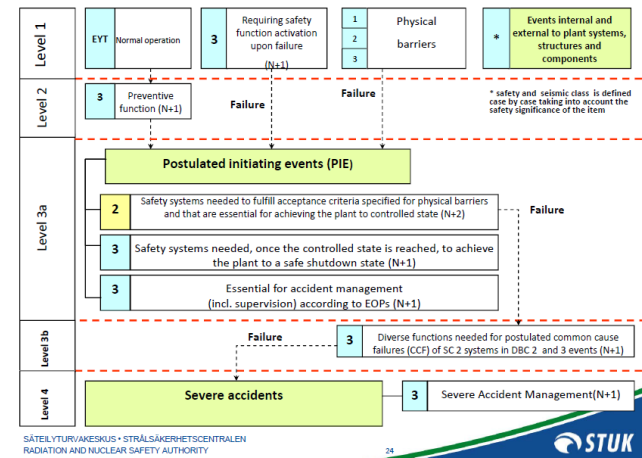


Rolls-Royce

Hanhikivi-1 Conceptual Design

- From our experience, it is necessary to set up a Pre-project “Conceptual Design Phase” for the I&C important to safety, led by the Russian Plant I&C Designer and Integrator, involving the Plant and Reactor Designers as well as the Owner and the Safety Authority.
- The goal of such common initiative would be to mitigate licensing risks by :

- Agreeing interpretation of YVL Guides
- Defining the overall I&C Architecture
- Allocating functions to systems
- Defining the Safety Classification
- Allocating Systems to Platforms
- Getting early STUK review on main principles

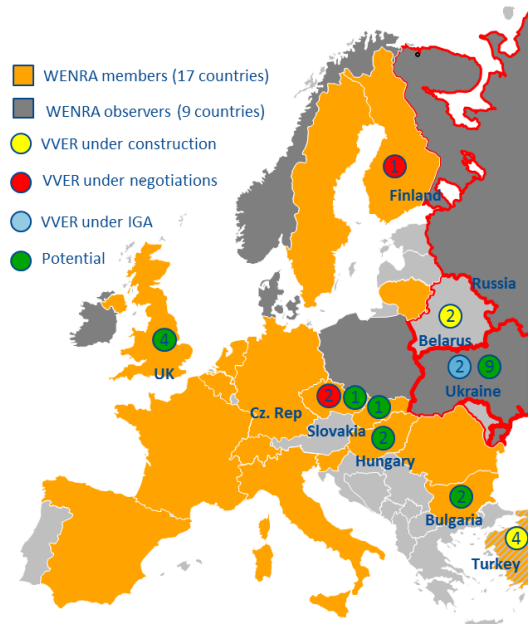


Rolls-Royce

Extend this approach to the VVER Next Units for a Fleet in WENRA Countries

- Rolls-Royce's objective is to develop a Safety I&C fleet approach where VVER-1200 (AES-2006) design is to be unified, for Regulatory regimes known as stringent and subject to WENRA recommendations
- Hanhikivi-1 and Paks II form a first Fleet of 3 Units, where replication can provide significant economics savings and Licensing and Project risks reduction to Rosatom

Rosatom live VVER opportunities up to 2025



Source: Rosatom, WENRA



Rolls-Royce

Thank you for your attention!

Questions?

Trusted to deliver excellence



Rolls-Royce