Rolls-Royce cooperation approach applicable in Hungary, and further VVER projects in Europe

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Trusted to deliver excellence

Rolls-Royce

We are an independent world leader of digital safety I&C solutions for the nuclear industry

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

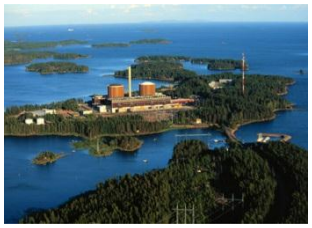
Rolls-Royce

We rely on a long history of on-time delivery of large I&C projects VVER reactors

On-going…

- MOCHOVCE 3&4 Neutron instrumentation system
- LOVIISA 1&2 I&C modernization

STUK Fortum



The key sucess factors :

- An early Conceptual Design Phase
- Collaboration between all stakeholders
- Simple and flexible design
- Srong processes

… and previous major I&C projects

- 4 x VVER Dukovany, whole Protection System modernization
- 2 x RBMK Ignalina, Diverse Reactor Trip
- 2 x VVER Metsamor, Neutron Flux Monitoring
- 2 x VVER Kozloduy, Neutron Flux Monitoring

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We rely on Spinline™ a validated safety I&C technology by Safety Authorities worldwide

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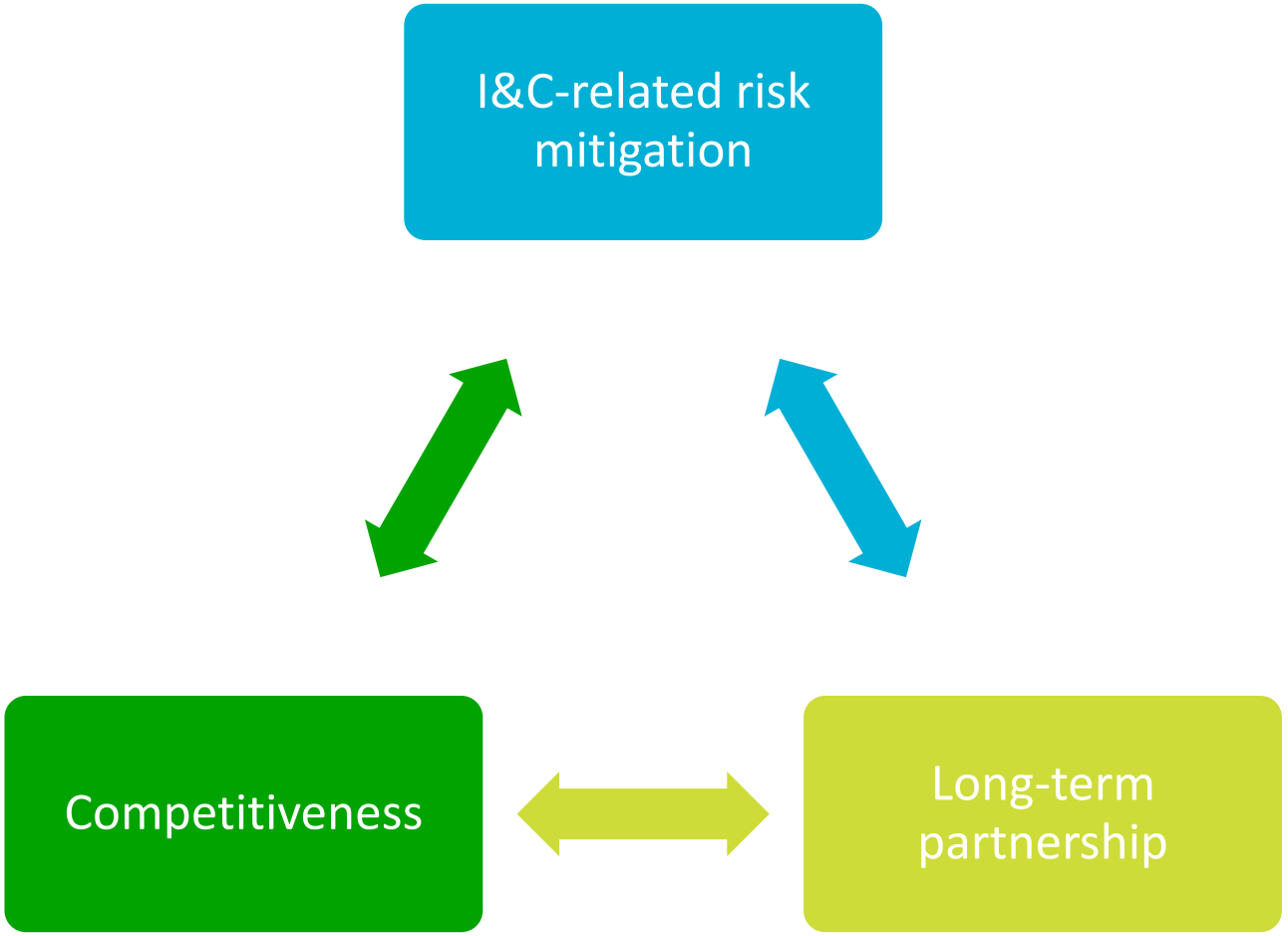
Our ambition is to support Rosatom's ambition on the export market facing key challenges



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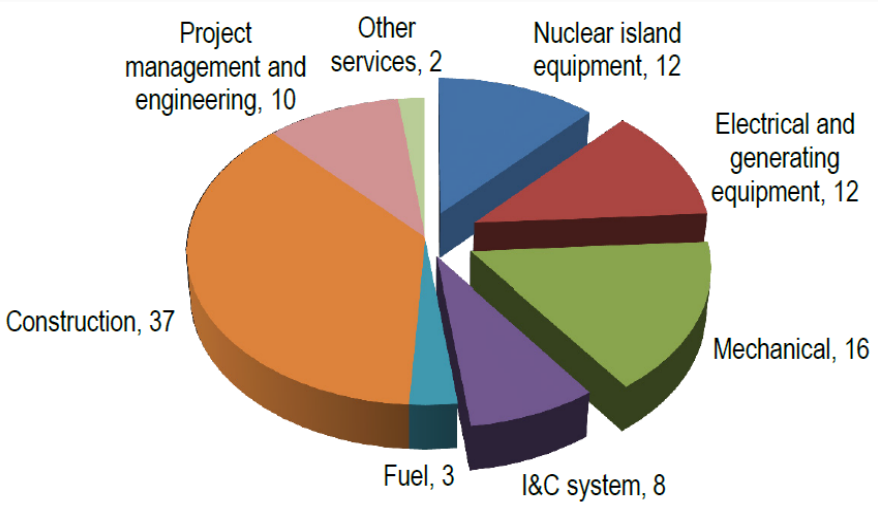
Safety I&C is a major focus of Safety Authorities and can lead to significant cost overruns when poorly managed

I&C represents « only » 8 to 10% of the NPP cost and safety I&C a fraction of it

However, challenges faced by some utilities, reactor vendors and I&C suppliers in receiving the local Safety Authority's approval has led to large delays and cost overruns with major financial and reputational impacts

Figure 35: NPP percentage cost breakdown



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A key lessons learnt : the Reference Plant's I&C design only is not sufficient

I&C Architecture needs to be adapted to each application instead of imposing a standard solution:

- Based on the Defense in Depth and Diversity needs;
- With due defense against Common-cause Failure, utilizing **diversity**, **redundancy** and **independence.**

Gradual shift in Regulations and Standards:

- From focusing on individual pieces of **equipment** to rather focusing on the **system (or overall architecture)** as a whole (systems engineering approach);
- From being prescriptive about **technical features** to becoming rather prescriptive about the **process** that one has to follow;

Still subject to interpretation by the Safety Authority

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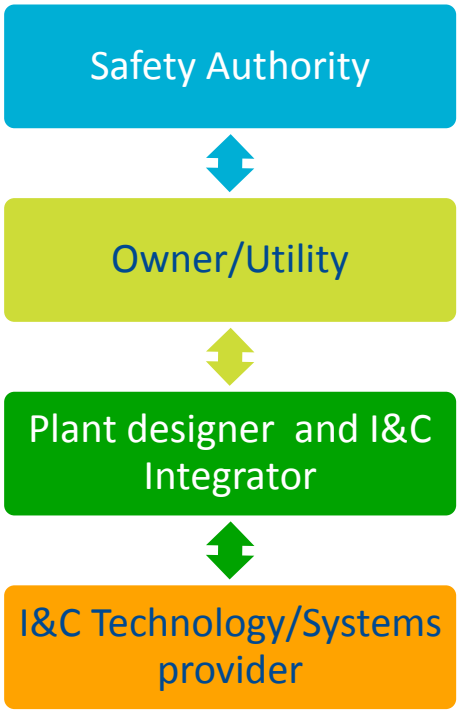
Upfront collaborative phase :

Key success factor for successful I&C licensing vs. tendering the Reference Plant's main I&C package

- **From our experience, it is necessary to set up a Pre-project "Conceptual Design Phase" for the I&C important to safety**
  - Led by Rosatom's Plant Designer and Rosatom's I&C Integrator
  - Involving the Owner and the Safety Authority
  - Involving one (or several) I&C technology providers

- **Goals of this collaborative initiative are :**
  - Agree interpretation of requirements from country-specific guides, WENRA, Owner, Plant Designer and translate into I&C language
  - Define the overall I&C Architecture based on requirements
  - Allocate functions and requirements to I&C systems
  - Allocate systems to platforms to check technology and economic feasibility
  - Get early review from the Safety Authority on main principles

- **This will reduce Rosatom's licensing risk and provide design optimization of the overall I&C**



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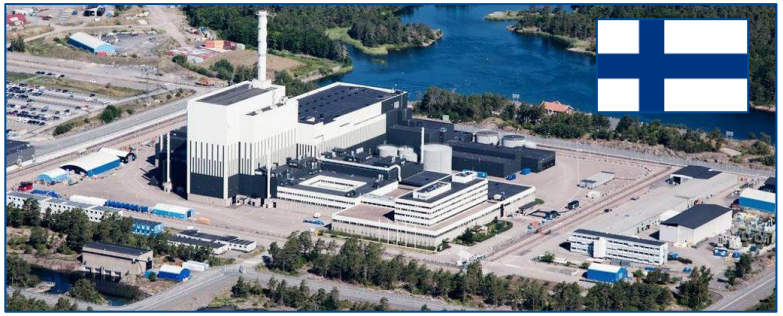
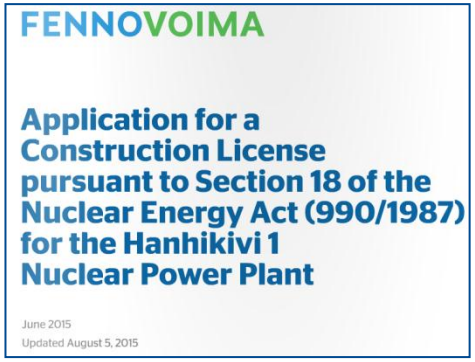
Our experience in Finland will benefit Rosatom for Hanhikivi-1

- Rolls-Royce has been involved since March 2013 with the Plant Designer Atomproekt, the Plant I&C Designer and Integrator VNIIAES 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.



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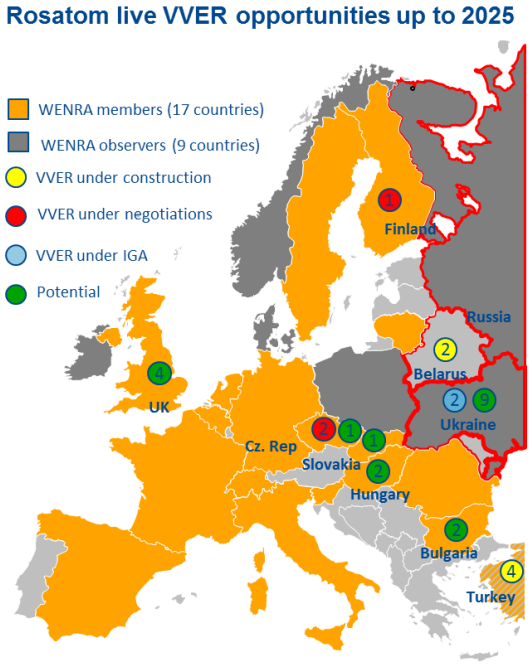
We are ready to extend this approach to the next VVER units in WENRA Countries

- Rolls-Royce's objective is to develop a Safety I&C approach for VVER-1200 (AES-2006) in regulatory regimes known as stringent and subject to WENRA recommendations
- Hanhikivi-1 and Paks II make up 3 units for which replication can provide significant economics savings
- Localization is of essence and our approach involves local Hungarian partners



Source: Rosatom, WENRA

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