Rolls-Royce safety I&C supports licenseability of VVER new construction and modernization

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VVER 2016, Prague 31 October 2016

Trusted to deliver excellence

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Our market has changed

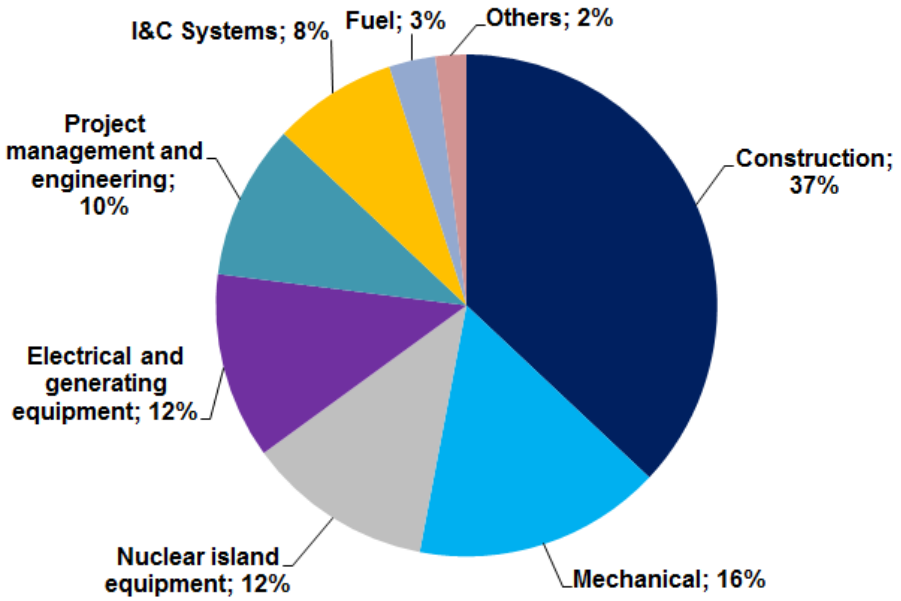
Safety I&C is a major focus of Safety Authorities and can lead to significant cost overruns

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

- 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

NPP percentage cost breakdown in %

Source: OCDE



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

On-going…

- HANHIKIVI-1 Conceptual design phase for safety I&C
- MOCHOVCE 3&4 Neutron instrumentation system
- LOVIISA 1&2 I&C modernization

The key sucess factors :

- **An early Conceptual Design Phase**
- **Collaboration among all stakeholders**
- **Simple and flexible design**
- **Strong 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
- 3 x VVER Balakovo and Kalinin, upper level modernisation

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Cutting edge technology remains a MUST

Rolls-Royce sponsoring the British project, to create a car that can reach up to the supersonic speed of 1,000 Mph with Rolls-Royce engine.

Eniac, first digital computer in 1947, Weight 50t

CPU, 2016

Particularly in I&C: You may compare the size of the first digital computer and the CPU used now

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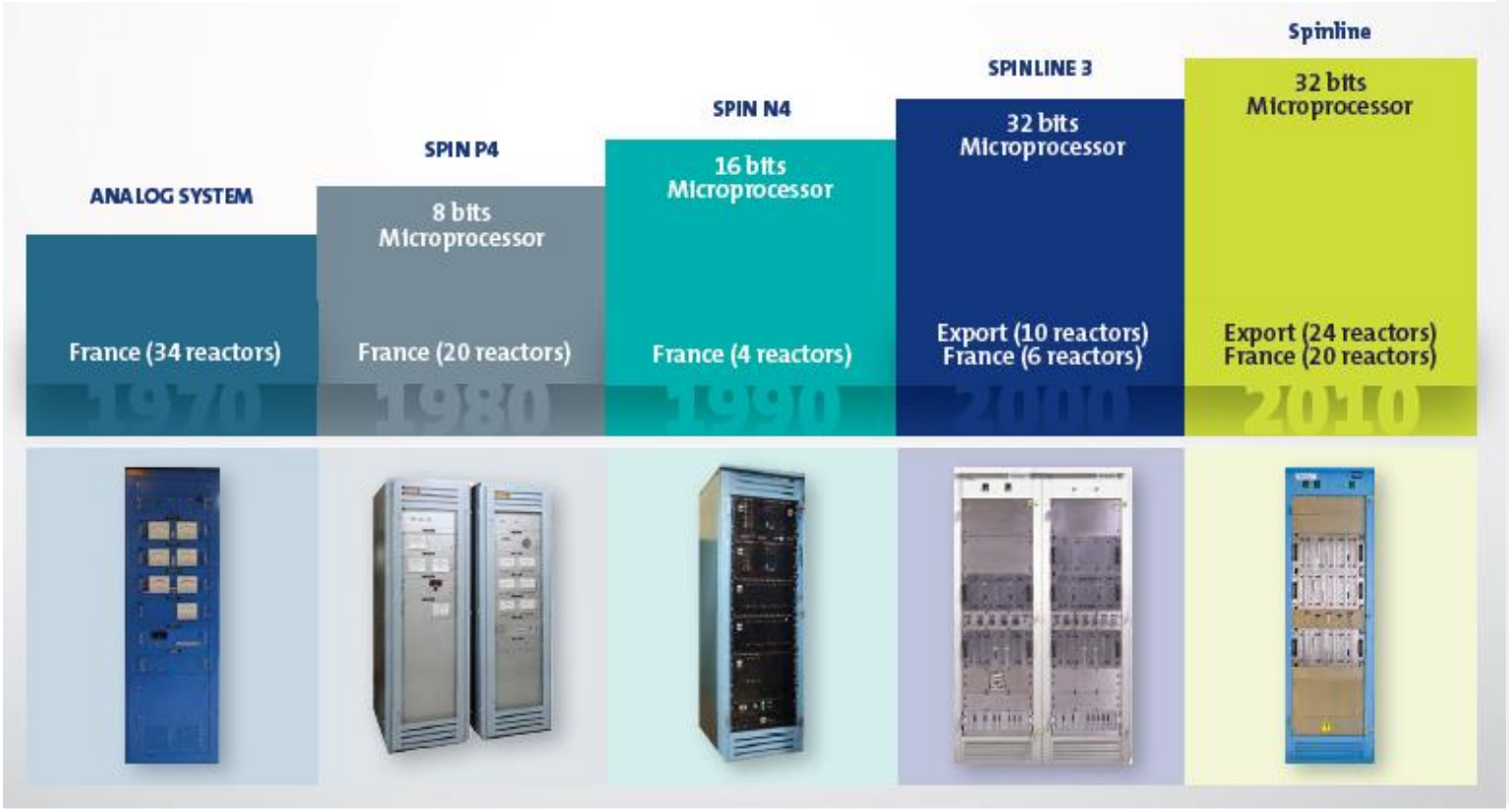
Cutting edge technology remains a MUST

Our Spinline digital safety I&C technology is in permanent evolution



Next generation Spinline®

Freescale MPC 860

Gen 3 Export
Newbuilds
Retrofit projects

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

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Beyond technology : Design flexibility

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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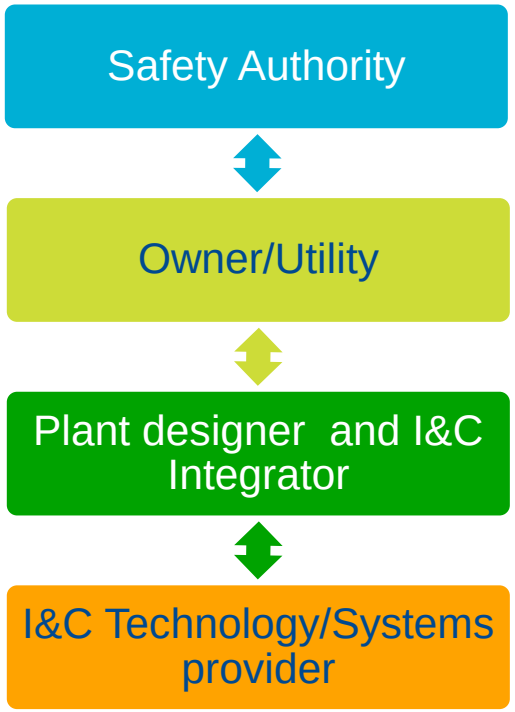
Upfront collaborative phase :

Key success factor for a 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

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 the licensing risk and provide design optimization of the overall I&C

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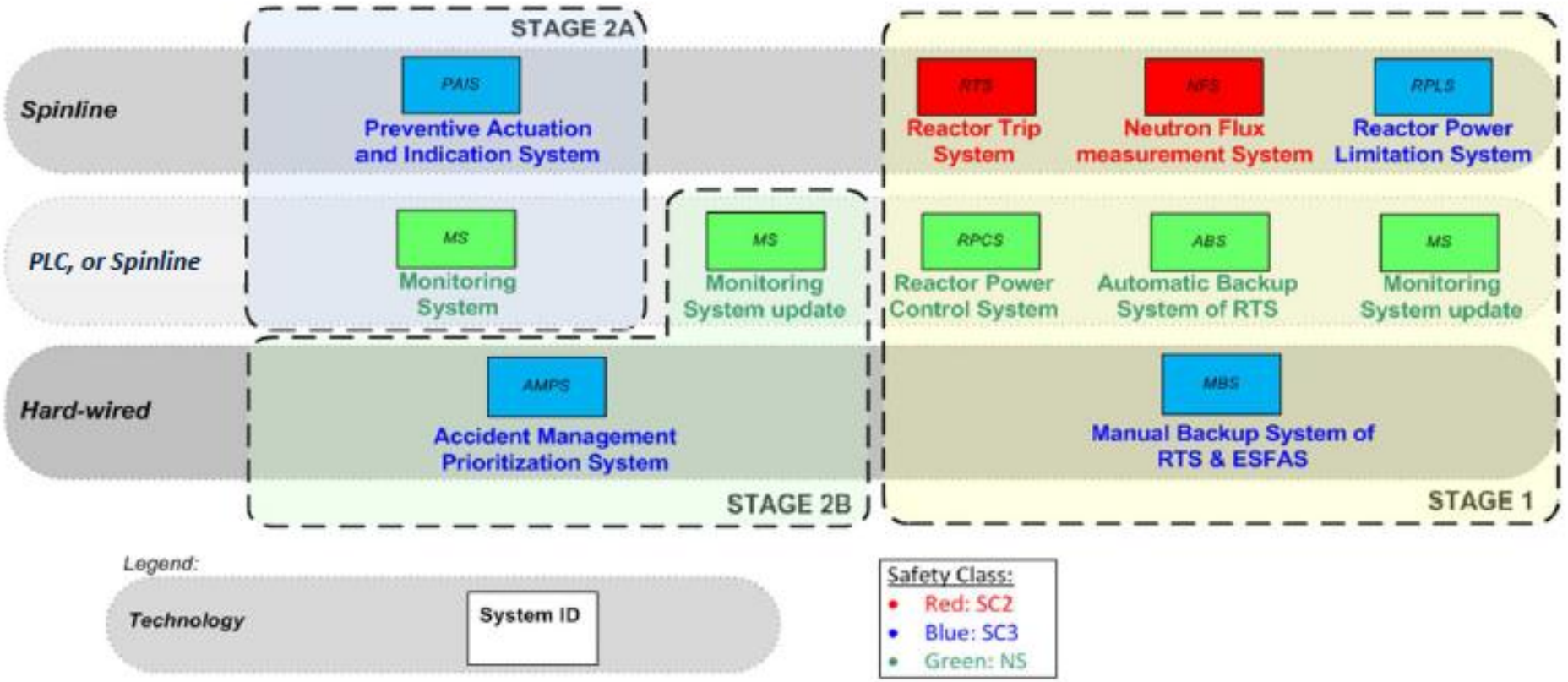
Our Finnish reference - Loviisa 1,2 modernisation



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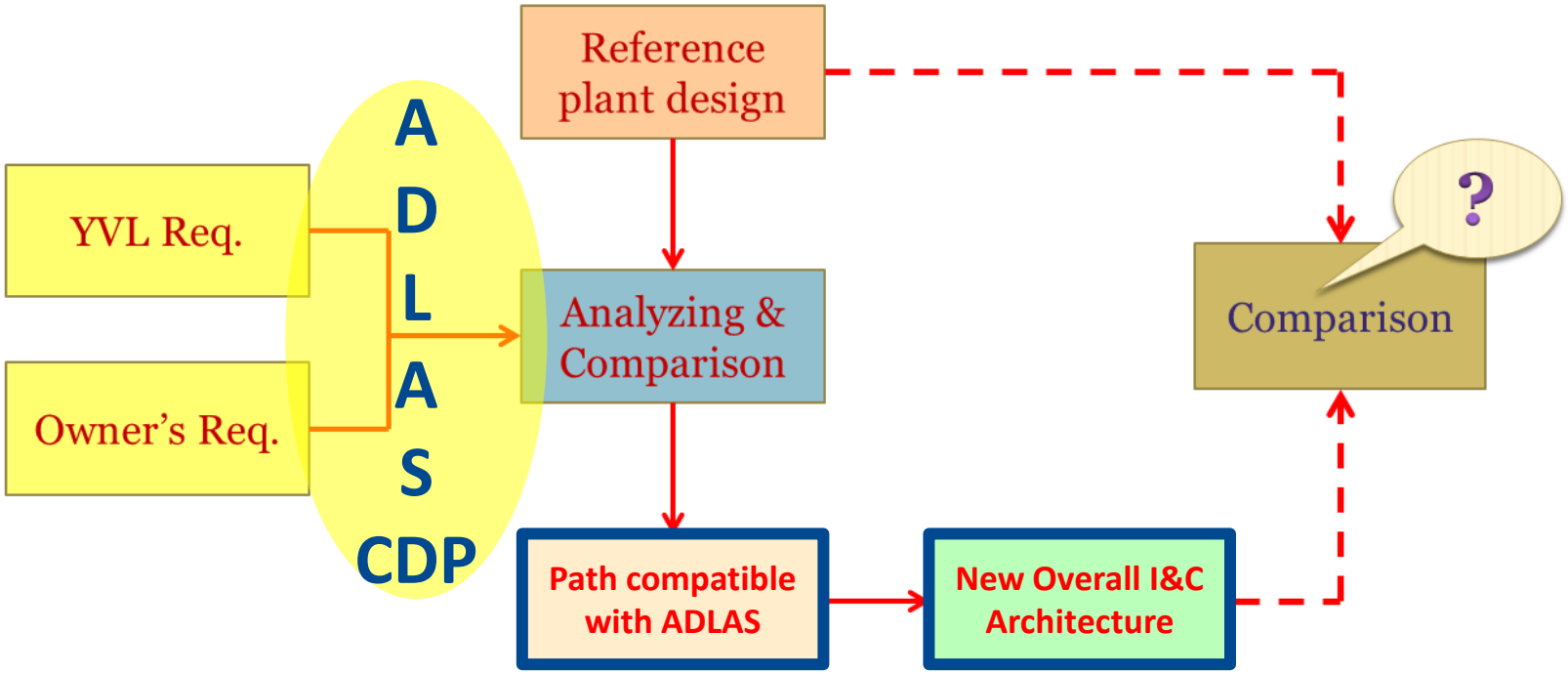
VVER Designs Evolution (4)

Evolutionary approach in Hanhikivi-1 NPP design



- Each modern NPP design ever is something new and deferent from other previous

Source : Atomproekt presentation in IAEA conference in St Petersbourg (*Denis Kolchinsky*)

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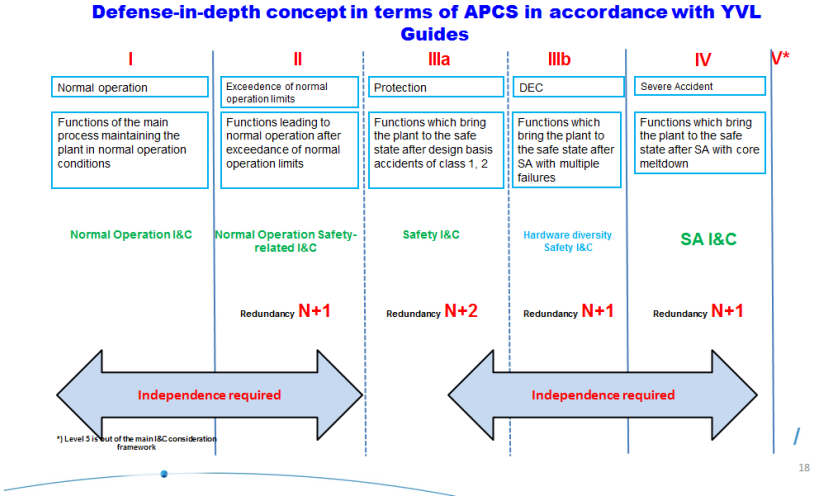
Proposed implementation of « Evolutionary Approach in Hanhikivi-1 NPP Design » to Defense in Depth, Independence and Diversity concept

АТОМПРОЕКТ

NPP project in Europe



Source : Atomproekt presentation in IAEA conference in St Petersbourg (Kleymenov S., Konoplev N., Zubritsky I.)

1. **Collect input from ADLAS**
2. **Elaborate <u>precise</u> and (only) necessary independence requirements**
3. **Application to the Atomproekt's Defense in Depth concept.**
4. **Allocation of Task Categories to « I&C Architectures » and « I&C Systems » and identification of differences between ADLAS Reqs and Reference VVER I&C Architecture**
5. **Elaborate Overall I&C Architecture**

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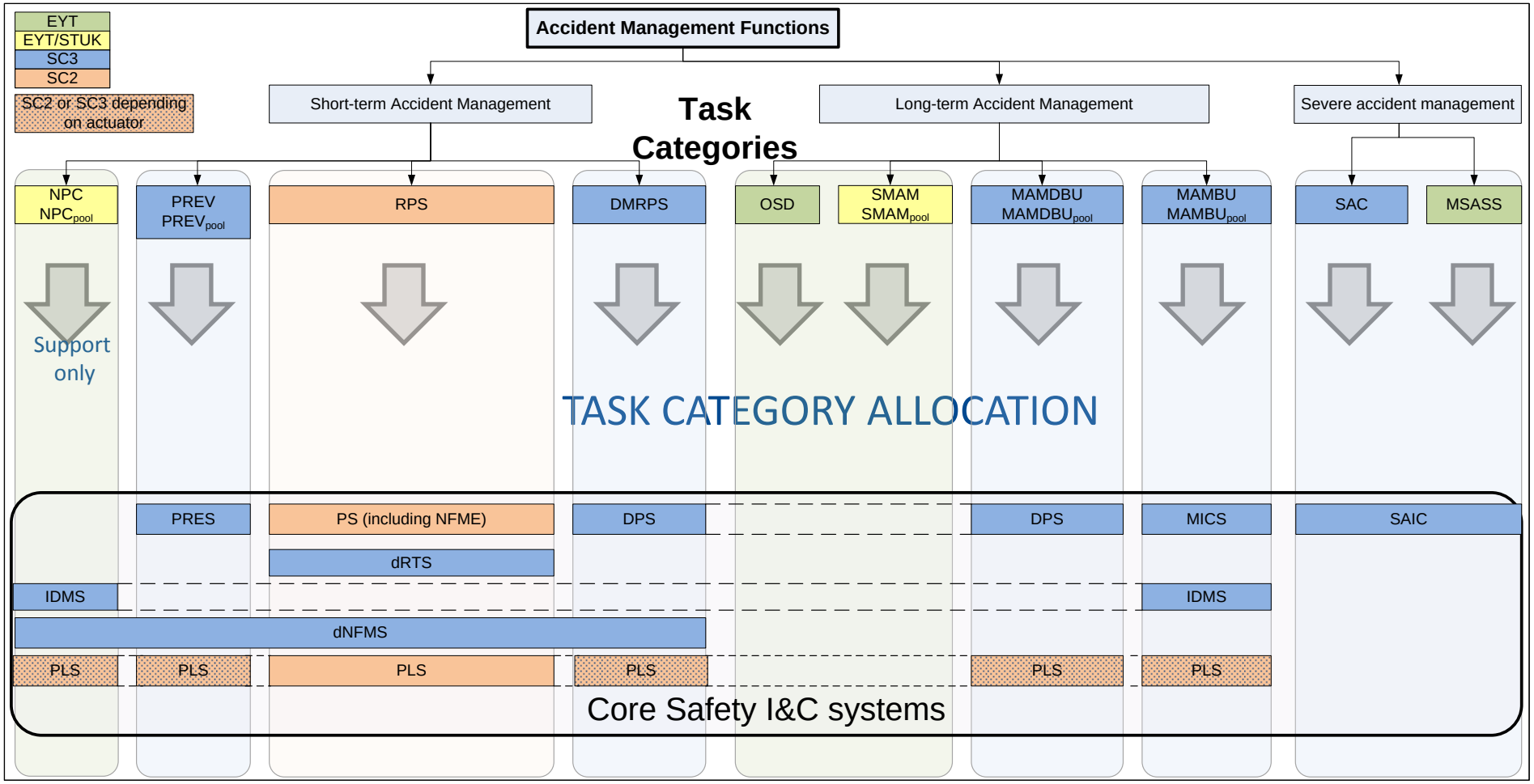
Hanhikivi-1 Task Categories Allocation – selected example



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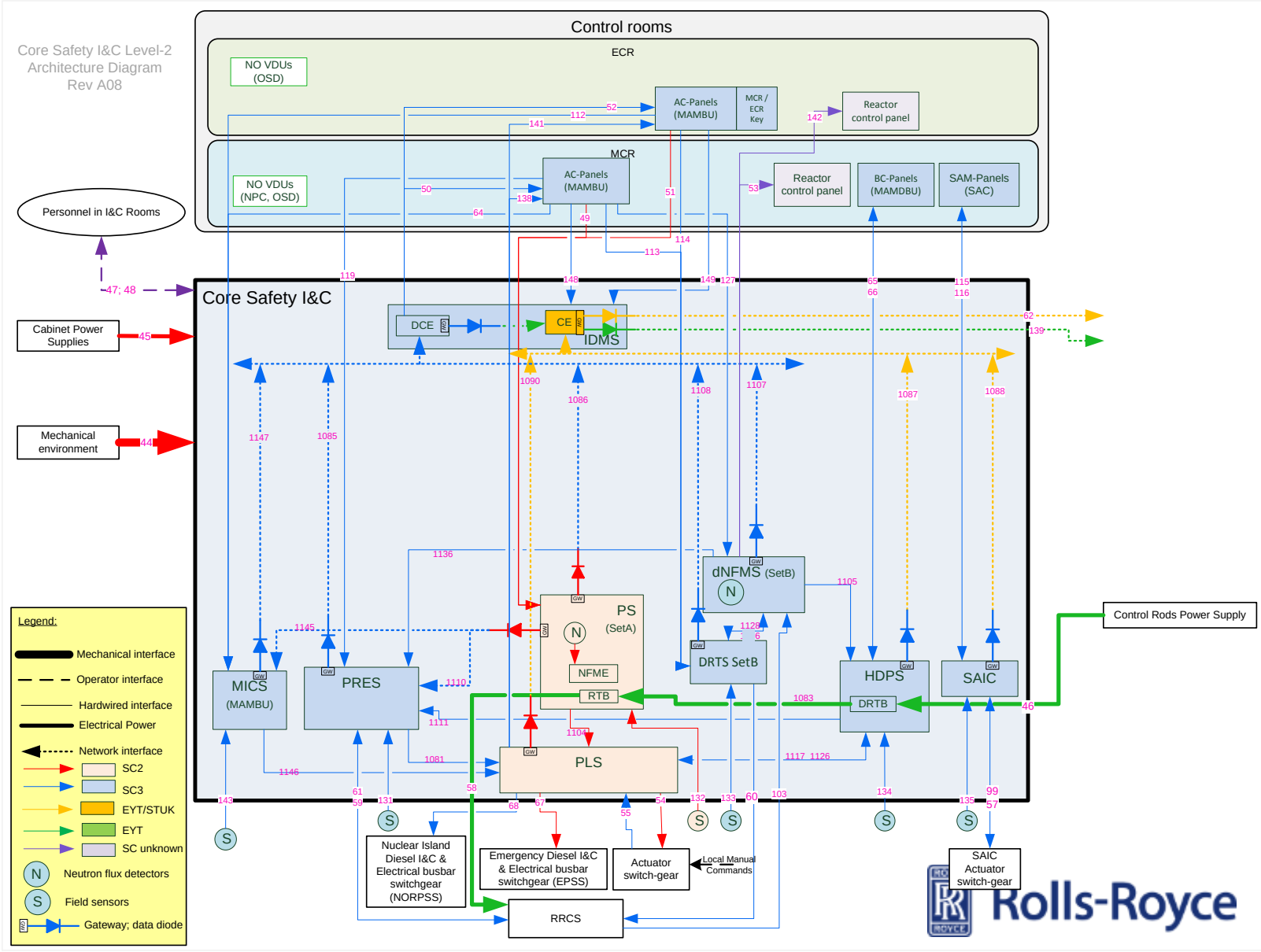
Hanhikivi-1 Preliminary Architecture – Core Safety I&C Systems



A Product Lifecycle Management (PLM) approach

The process of managing product-related design, production and maintenance information

NPP planning	Conceptual design Incl. I&C conceptual design	NPP Construction phase	Operations & Maintenance	Retrofit / modernization	Operations & Maintenance
					
2 years	2 years	5-7 years	30 years	4-5 years	30 years

Rolls-Royce 60 years I&C lifecycle support

Assurance of long term operation through long term delivery of technical assistance, compatible spare parts, and repair services

Construction Phase

Paluel NPP

Technical support
Obsolescence treatment
Spare parts, repair services

Retrofit VD3

Technical support
Obsolescence treatment
Spare parts, repair services

32 years LTSA

25 years LTSA

1984

2016

Paluel NPP (1300 MW)
4 units,
1st commercial Operation:
Unit 1 and 2: 1984
Unit 3: 1985
Unit 4: 1986

1992: Signature of 1st 25 years LTS protocole with EDF

2003 : Update of LTS Protocole, again for a duration of 25 years

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What our today and future Customers will benefit from?

- Long-term anchorage / sustainability / commitment from a supplier that has more than 30 years of projects roadmap ahead
- Strong projects execution experience acquired with largest Utilities, NSSS vendors, NPP Designers
- We will continue to maintain and develop our strong licensing and qualification skills in stringent regulatory environment
- An existing proven technologies that we continuously improve and reinforce along the projects
- Establish local partnerships for the project delivery, and geographical proximity with the End-user through services local presence

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Thank you for your attention !
Questions ?

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