Addressing I&C Post-Fukushima requirements:

From regulatory requirements analysis to systems design and hardened instrumentation

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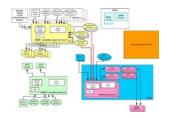




Introduction

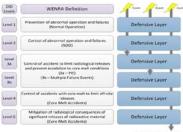
Regulatory requirements Analysis

Systems Design





Conclusion









INTRODUCTION

- **New Regulations**
- **Upgrades / New systems requirements**
- How to ensure compatibility with existing systems
- **Need for Hardened equipment**

IAEA Report on Strengthening Nuclear Regulatory Effectiveness in the Light of the	Western European WEENRA Nuclear Regulator's Association		
Accident at the Fukushima Daiichi Nuclear Power Plant	Safety of new NPP designs Study by WENRA Reactor Harmonization Working Group	CONTRACTORY OF MARKET AND A CONTRACTORY OF A CONTRA	USSINGLATION OF CONTRACT OF CO
	October 2012	Interim Staff Guidance Periodon 0	Interim Staff Guidance Revision 0
	RHWG		Rolls-Roy

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REQUIREMENTS ANALYSIS: REQUIREMENTS TO COMBINE

New Post-Accident requirements:

- Stricter application of Defense-in-Depth
- Hardened equipment

Existing Requirements:

- Regulations
- VVER plant Design
- Site Specificities



Compatibility with existing systems, Diversity



REQUIREMENTS ANALYSIS: PRINCIPLE OF DEFENSE IN DEPTH

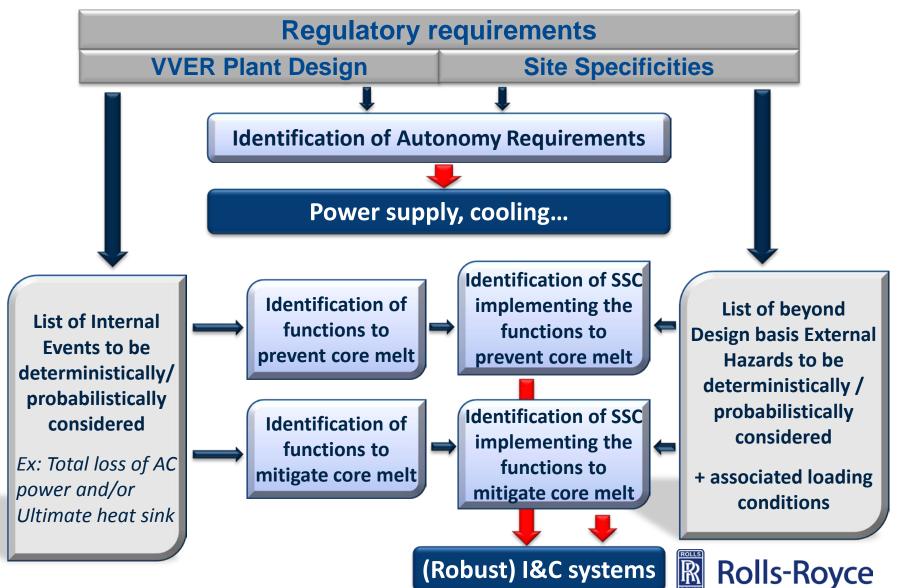
DiD Levels	WENRA Definition	Event Event Event
Level 1	Prevention of abnormal operation and failures (Normal Operation)	Defensive Layer
Level 2	Control of abnormal operation and failures (AOO)	Defensive Layer
Level 3a	Control of accident to limit radiological releases and prevent escalation to core melt conditions	Defensive Layer
	(3a – PIE)	
Level 3b	(3b – Multiple Failure Events)	Defensive Layer
	Control of accidents with core melt to limit off-site	
evel 4	releases (Core Melt Accidents)	Defensive Layer
	Mitigation of radiological consequences of	
Level 5	significant releases of radioactive material (Core Melt Accidents)	Defensive Layer

Acceptable Residual Risk



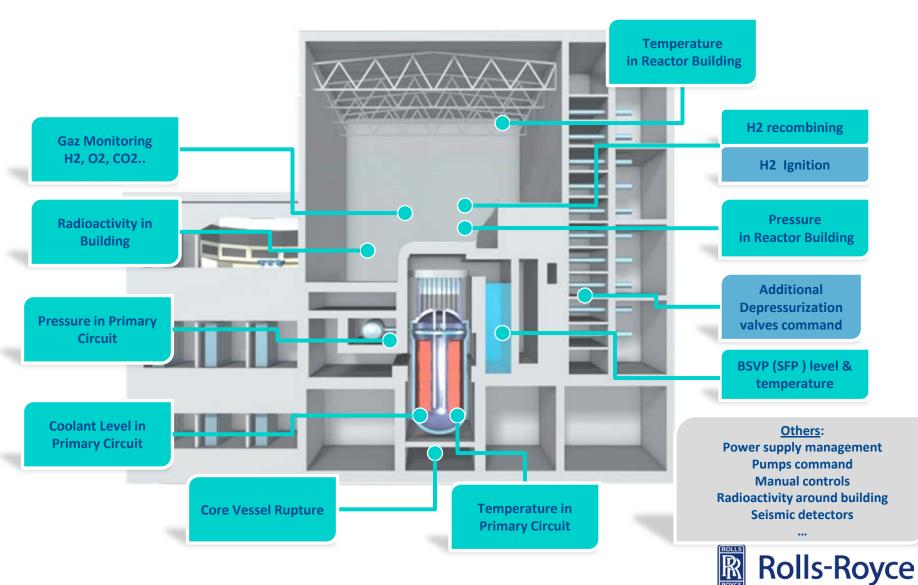
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FROM REQUIREMENTS TO SYSTEMS DEFINITION



VVER 2013: Addressing I&C Post-Fukushima Requirements

ACCIDENT SYSTEMS: BASE I&C FUNCTIONS



SYSTEM DESIGN: FLEXIBLE AND MODULAR

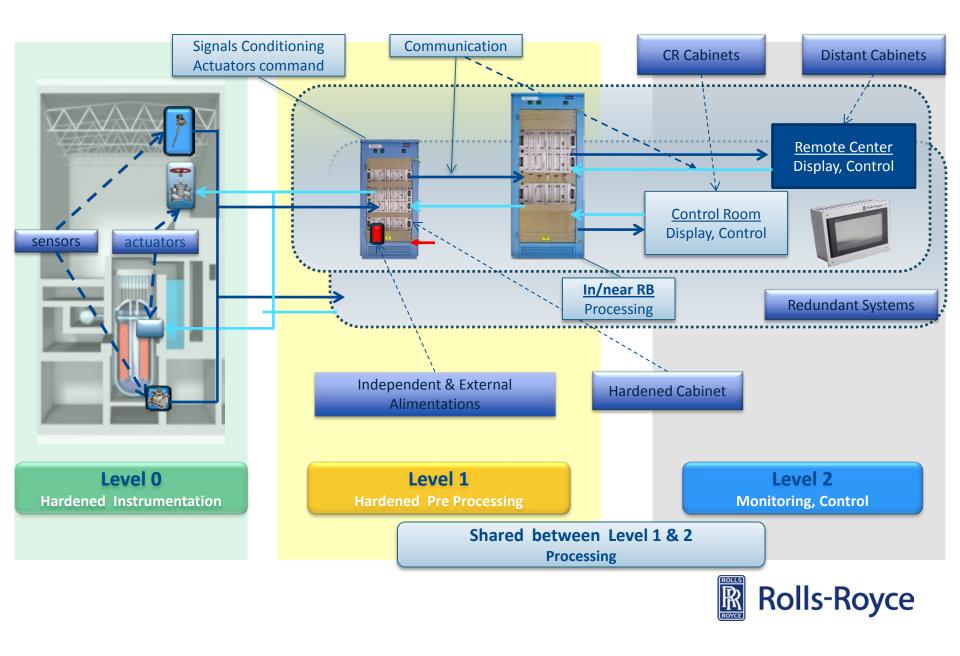
I&C Technology choice guided by: Regulations, Site specificities, VVER plant design, Experience

- Compatibility with existing systems/sensors
- Technology platform: ex. SpinlineTM
- Variety of functions to implement
- D3: Defense-in-Depth & Diversity

→ Need of flexible and modular technologies



Modularity: Complete I&C Architecture



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NEED FOR HARDENED EQUIPMENT

Equipment must withstand harsh environmental conditions

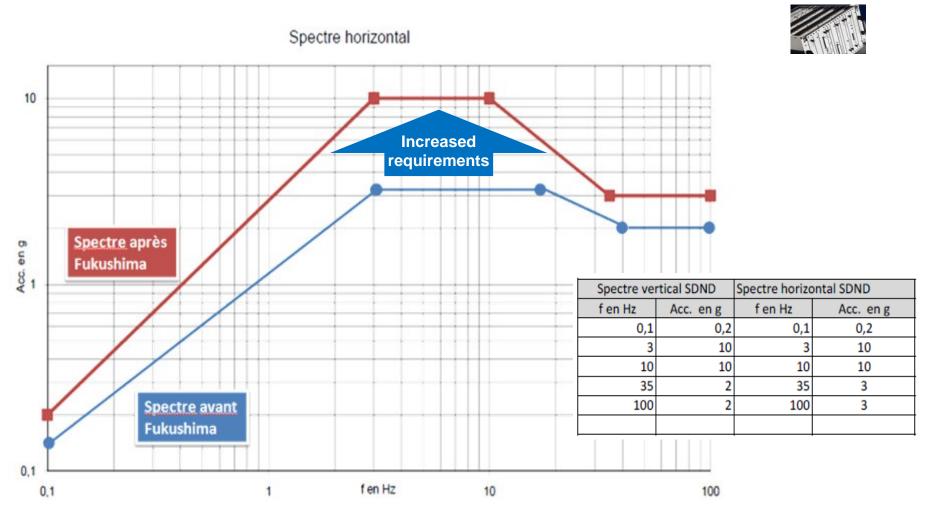
Stringent Seismic requirements

Instrumentation:

Example: Bibloc pressure transmitter



Hardened cabinets & racks

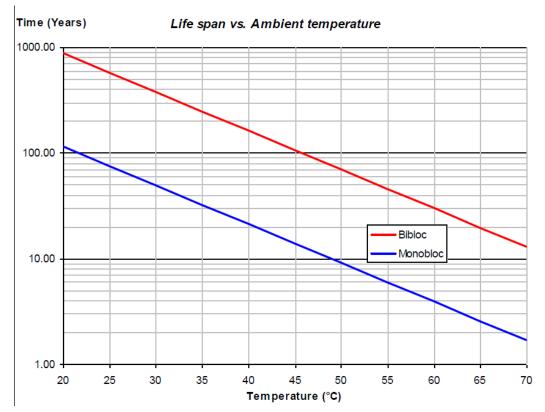




Bibloc pressure transmitters

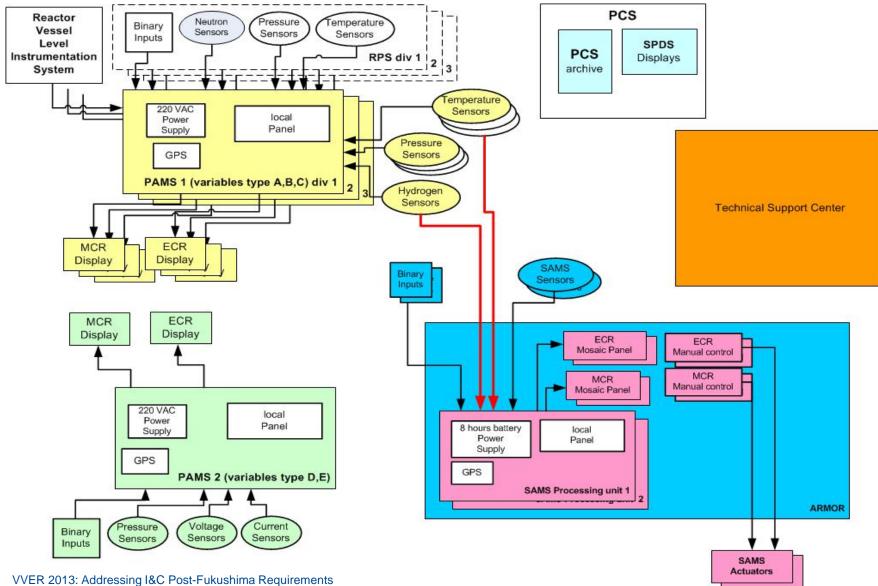
Two types of pressure transmitters:

- Monobloc: electronics inside the reactor building
- Bibloc: electronics deported outside the reactor building





Example of SAMS & PAMS



CONCLUSION

Solutions are adapted to each plant:

- Regulations
- Site & VVER specificities
- Compatibility with existing systems & sensors

 \rightarrow Need of:

- Requirement analysis Method
- Flexible and modular system
- Hardened instrumentation



Questions?

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