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Flexible and Independent Monitoring Systems for Severe Accidents

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Severe accident Monitoring System
Motivation

Fundamental problem

at the Fukushima Dai-Ichi Plant after the accident :

Lack of information about the true situation of the units for the reasons

1. **Failure of the power supply and the lack of an accident-proof back-up battery system.**
2. **The monitoring system for the emergency case was not designed for these types of accidents.**

Obvious need for accident-proof instrumentation systems which can cope with emergency cases.

(General problem since common nuclear standards (US Reg. Guides 1.97, KTA 3502, RCC-E or YVL) lack of specific requirements for severe accidents)

Severe Accident Monitoring System
General Measures

Activities by the major national regulatory agencies to analyze and re-evaluate the safety of nuclear plants:

- **U.S.A.: the NRC implemented the Near Term Task Force program**
- **EU: stress tests at the European nuclear plants**
- **Japan: Formation of a new national regulatory authority in Japan and their numerous activities, as for instance, a safety assessment on 50 shut-down plants.**
- **CH: Re-evaluation of the safety of the Swiss nuclear plants**

- **Target: Elaboration and implementation of appropriate measures**

Severe Accident Monitoring System
Specific Needs

Several recommendations for Tier 2 and 3 by the NRC´s NTTF imply new instrumentation and monitoring solutions:

- Rec.3: Potential enhancements to the capability to prevent or mitigate seismically-induced fires and floods
- Rec. 5.2: Reliable hardened vents for other containment designs
- Rec. 6: Hydrogen control and mitigation inside containment or in other buildings
- Rec. 9.1/9.2: Emergency Preparedness (EP) enhancements for prolonged station blackout (SBO) and multi-unit events
- Rec. 9.3: Emergency Response Data System (ERDS) capability
- Rec. 10: Additional Emergency Preparedness (EP) topics for prolonged station black-out (SBO) and multi-unit events
- Rec. 11: Emergency Preparedness (EP) topics for decision making, radiation monitoring, and public education (long-term evaluation).

Severe Accident Monitoring System
Revised or New Standards

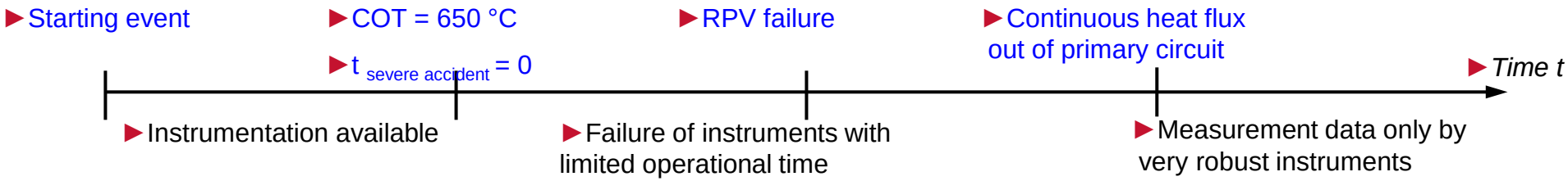
Currently, the important IEEE 497 standard is revised to cover also instrumentation for severe accidents and is harmonized to be accepted by the IEC member states:

- **IEEE Revision of IEEE 497** (Dec.2010) "*IEEE Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations",* NPEC, Subcommittee 6, Working Group 6.1, ongoing
- **IEC – IEEE Dual-logo Project** on accident monitoring systems for nuclear power plants by adaptation of IEEE 497 standard and converting it into an IEC standard, IEC Subcommittee 45A, Working Group 9, decision June 2013.
- **IAEA Technical Report** "*Accident Monitoring Systems for Nuclear Power Plants",* Sept.2012 – Dec.2013

Severe Accident Monitoring System
Four Phases of the Accident

Event in four phases

Phase 1	Phase 2	Phase 3	Phase 4
Design Base Accident (DBA)	Beyond DBA	After core melting	Stable decay
Duration: > 1h /(BWR), 2h	*Approx. 3 – 4 h*	*Plant related duration*	*Several years*



General assumptions for AREVA´s system:

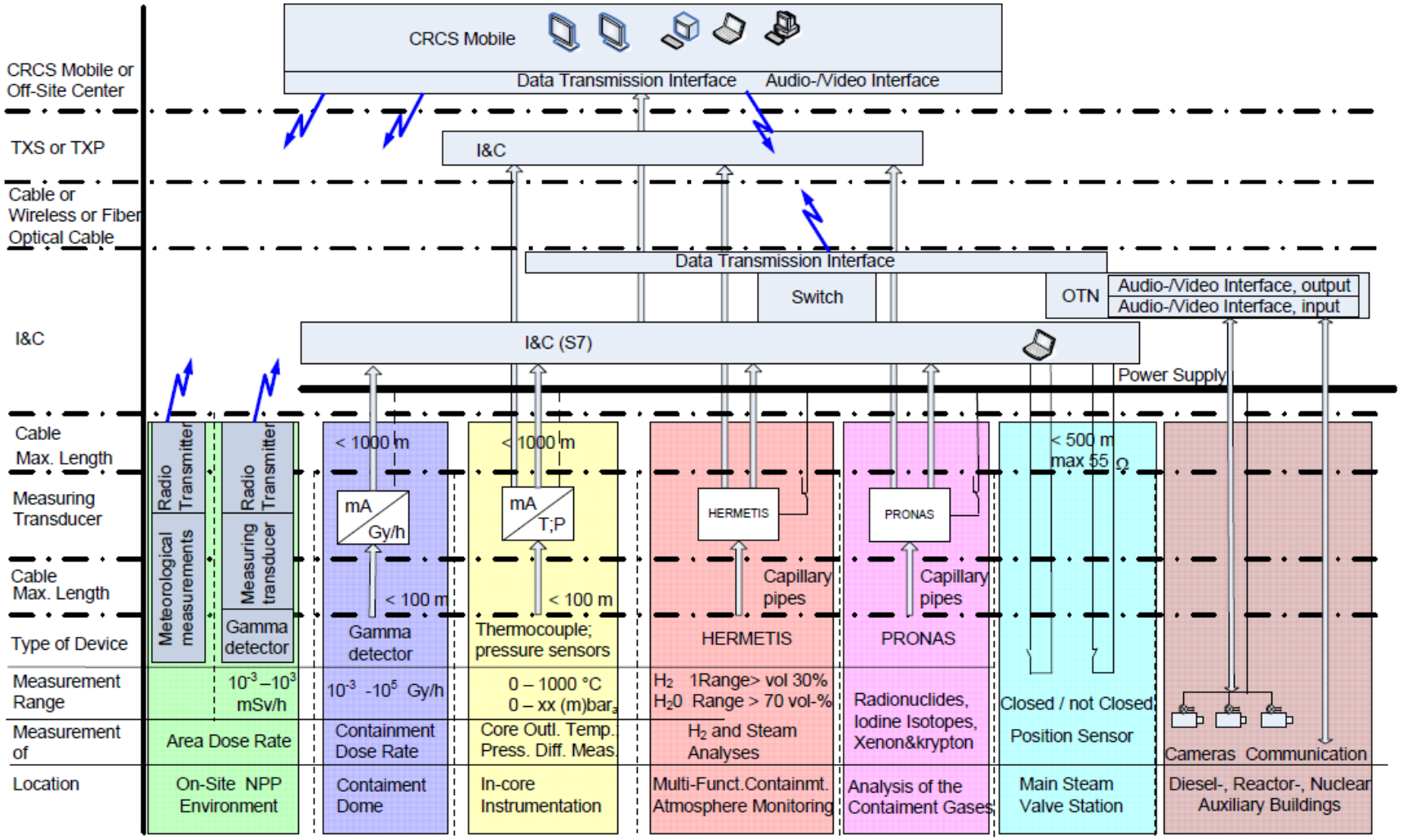
- **Complete Station Black-Out (SBO) for 7 days**
- **No I&C-signals inside the MCR and the ECR**
- **First access not earlier than 12 hours (trapped-in staff !)**
- **All buildings without appropriate seismic design and/ or flooding protection destroyed**

Severe Accident Monitoring System
Basic Requirements

Guidelines for AREVA´s Concept

- *Fully independent, additional to other safety or operational instrumentation but with least possible connection to it.*
- *Selection of available, most suited systems for a set of selected parameters relevant to accidents, qualification not mandatory.*
- *Investigation of the entire signal chains (sensors, cabling, trays, penetrat-ions) and definition of appropriate measures for hardening etc.*
- *Power supply from own battery or power generator system for 100+ operational hours, energy efficient solution*
- *Transmission by point-to-point radio (or by fiber optical cables) to a remote control/ observation room.*
- ***Not a perfect "one fits for all" system***
  but a catalogue of subsystems - ready to compose and tailor a monitoring system for the individual plant.

Severe Accident Monitoring System
System Architecture



System Architecture

Advantages of AREVA´s System

- Mostly independent and autonomous with own power supply.
- Individual configuration to the specific situation and needs of the plant, the national authorities or the preferences of the owner.
- Due to the modular built-up existing systems can be easily integrated, and, also an installation by phases and individual preferences or needs can be easily realized.
- Most subsystems are well-suited to withstand a severe accident and can be taken from the shelf.
- Combination or integration with comprehensive accident management systems possible.
- Oriented towards the future, i.e. easy adaptation to new requirements by legislation or new technical developments.

▶ Thank you for your kind attention

End of presentation

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