From the Accident at the Fukushima Daiichi NPS: Efforts to Improve Safety

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President and CEO, AREVA
Tokyo, April 19, 2012

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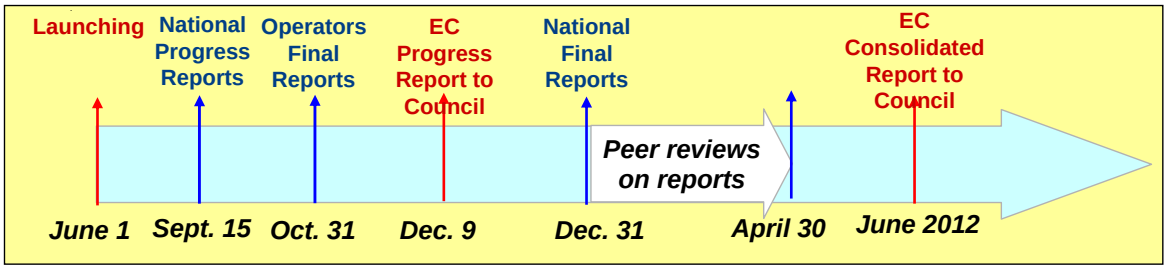
Agenda

- ▶ **Safety assessments in the EU and in France**
- ▶ AREVA
  - ▶ Safety of our customers
  - ▶ Safety of our activities
  - ▶ Safety of our products
- ▶ Some general initial conclusions

EU Agreement on Safety Checks



- Assessments undertaken *simultaneously* by operators in the EU as of June 1, 2011
- 15 countries (inc. Lithuania) and 145 reactors
- Scope: extraordinary triggering events and the consequences of other initiating events

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Complementary Safety Assessments in France 1/2

- Complementary Safety Assessment process was launched by the French nuclear safety authority (ASN)
  - At the request of the French Prime Minister
  - Concerns 150 nuclear installations
  - Organizational and human factors taken into account
  - Involvement of various stakeholders
- ASN report on 79 priority installations was issued on January 3, 2012
  - All these reports are public
  - Report to be sent by September 15 for the remaining installations

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Complementary Safety Assessments in France 2/2

- **General conclusions of the French nuclear safety authority report:**
  - **No immediate shutdown of any of the facilities is required**
  - **A sufficient level of safety is currently achieved for all the facilities**
  - **EDF proposed improvements which are a satisfactory response to the safety objectives**
  - **Principle of a "hard core" of safety approved**
  - **Nuclear Rapid Response Force**

» **French installed base will be equipped with a new, complementary level of defense-in-depth. It is a new step in terms of global safety.**

» **BUT nuclear safety cannot be boiled down to the aftermath of Fukushima. There always have been regular inspections to audit existing safety measures and strict ten-yearly in-service inspections.**

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- Safety assessments in the EU and in France
- **AREVA**
  - Safety of our customers
  - Safety of our activities
  - Safety of our products
- Lessons learned from Fukushima

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Safety is at the Heart of the AREVA Strategy

Safety of our customers

AREVA Safety Alliance

Providing support to utilities: demonstrating and strengthening the safety of their facilities

Safety of our activities

Nuclear safety & radiation protection

Ensuring the highest level of nuclear and industrial safety at all stages of the facilities' life cycle

Safety of our products

EPR™

ATMEA

KERENA

A portfolio of Gen III+ reactors with the highest safety standards

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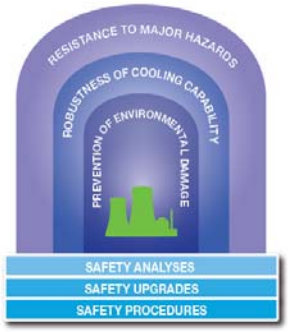
AREVA Safety Alliance Initiative

- **Engaging with utilities to help them meet ever-increasing safety requirements – now more than ever in the post-Fukushima context:**
  - **2011 Nuclear Executive Meeting**
    - **18 CEOs and CNOs from Europe, USA and Asia**

NUCLEAR EXECUTIVE MEETING
Paris, September 29-30, 2011

  - **AREVA 2012 Safety Alliance Seminars**
    - **Fleet Safety, Frankfurt - May**
    - **Public Confidence, Paris - June**
    - **Nuclear Economics, London - September**

- **A safety framework structured around three imperatives:**
  - **Resistance to Major Hazards**
  - **Robustness of Cooling Capability**
  - **Prevention of Environmental Damage**



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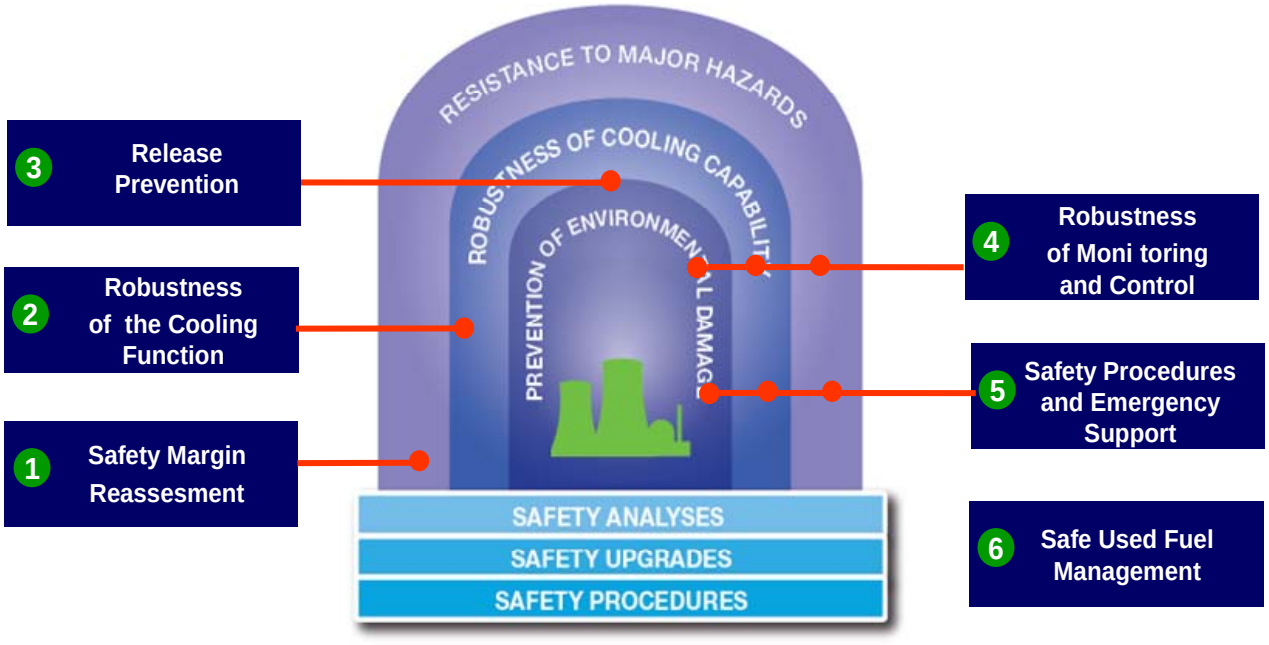
The 6 Main Safety Themes



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1 Safety Margin Reassessment

Confirm Plant Design Basis and reassess margins for Major Hazards

Preparing approaches to support utilities :

- **Answer inquiries during the safety check process**
- **Define appropriate action plans to comply with potential future regulation**

Example 1:
Safety Margin Re-Assessment

- **Identify potential weak points systematically, including cliff-edge effects (fire, flood, severe weather conditions..)**
- **Develop mitigation plans**
- **Increase grace period as necessary**

Example 2:
Seismic Analysis Evaluating NPP Behavior

- **Seismic margin assessment**
- **Evaluation of reactor coolant system, piping and supports and other safety systems**
- **Recommendation of needed design improvements**

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2 Robustness of Cooling Function

Comply to the future requirements in term of grace period and robustness

Preparing an optimized combination of Safety Upgrades:

- **Diversified Water and Power Supply**
- **SBO Solutions**
- **Alternate Power Supply for Monitoring, Control, Communications, Habitability**
- **Alternate Heat Sink (Reactor and Pools)**

Safety Upgrade Examples:

- **Flexibility to use existing Power & Water sources**
- **Alternate and Protected Heat Sink**
- **Primary and Secondary Bleed and Feed**
- **Hardened Diesels**
- **Flood-Proof motors**
- **Diversified and Bunkerized Water and Power Supply Buildings**
- **Fuel Cells (Helion) pre-series stage**

R&D Example:

- **Mobile plug and play Power and Water Supply**

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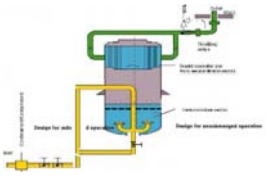
3 Release Prevention

Protect the public and the Environment

Preparing a combination of Safety Upgrades:

- **Containment Integrity Protection (Venting)**
- **Radioactive release prevention (Filtering)**
- **Monitoring of Severe Accident Conditions**
- **Prevention of Hydrogen explosions**

Passive Autocatalytic Recombiner (PAR)



Containment Filtered Venting System

Safety Upgrade Example:

- **Filtered Containment Venting Systems largest references worldwide for PWRs (including VVERs), CANDUs, BWRs**
- **Backfitting PARs to existing Operating Plants**

R&D Project Example:

- **Improve Capture Efficiency of Organic Iodine**

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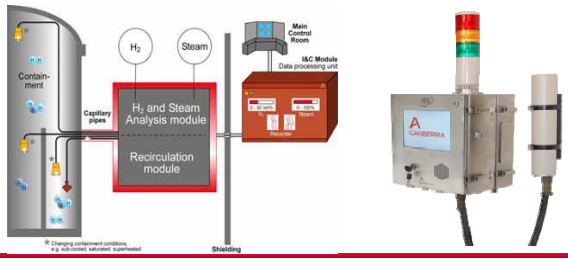
4 Robustness of Monitoring & Control

Ensure the continuity of Monitoring and Control during the SBO grace period and under Severe Accident Conditions

Preparing a combination of Safety Upgrades:

- **Hardened and augmented Monitoring and Control systems**
- **Remote capabilities**
- **Computer systems to track, analyze, and manage diverse data (radiation, temperature, pressure, …)**
- **Independent monitoring and control power**



Safety Upgrade Example:

- **Hardened Spent Fuel Pool Level Sensor**
- **HERMETIS hydrogen monitoring**
- **PRONAS containment gas sampling system**
- **AREVA/Canberra radiation and environmental monitoring**

R&D Project Example:

- **Remote Monitoring and Control mobile container**
- **Enhanced Spent Fuel Pools environmental monitoring**

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5 Safety Procedures and Emergency Support

Effectively utilize personnel and equipment

Preparing for the enhancement of Safety Procedures & Emergency Support :

- **Analytical basis for Severe Accident Management Procedures**
- **Training and Simulation**
- **Equipment and Support for Emergency Forces**

Safety Upgrade Example :

- **Currently supporting the PWR owner's group in the US to detail SAMGs**
- **Simulators and training covering severe accident**

R&D Project Example :

- **Accident management Container**
- **Emergency monitoring systems**
- **Qualification of essential equipments for Severe Accident Conditions**

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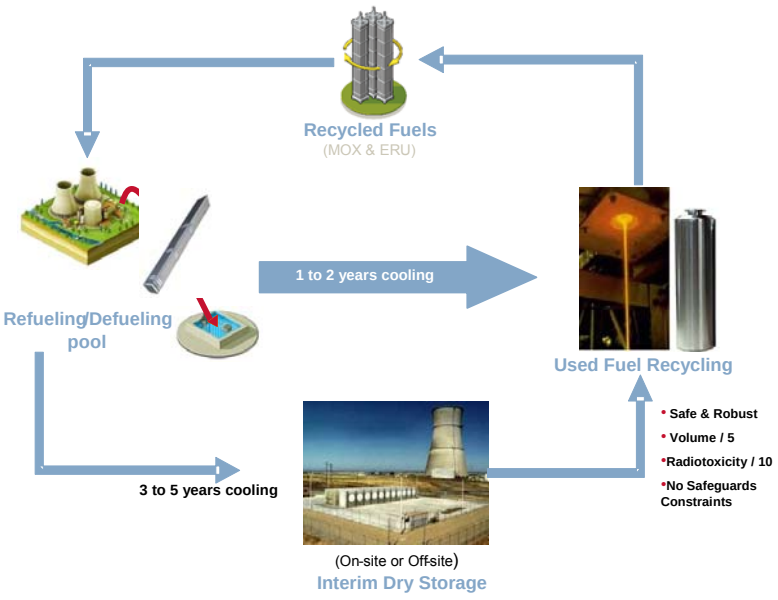
6 Safe and Optimized Used Fuel Management

- **Harden pools to meet potential new safety guidance & requirements**
  - **Safety and Risk Analysis**
  - **Safety Upgrades (e.g. Improving robustness of cooling capabilities, remote control, SFP make-up)**
  - **Safety procedures (e.g. Enhancing contingency arrangements and training)**
- **Reduce used fuel inventory and radionuclide in reactor pools**
  - **Near term, by shipping used fuel for Recycling (e.g. less than 1 year of cooling)**
  - **Should recycling not foreseen in the near term, Transfer Used Fuel to Dry (3 to 5 years of cooling)**
- **Prepare for rapid transportation, if used fuel shipping is needed**



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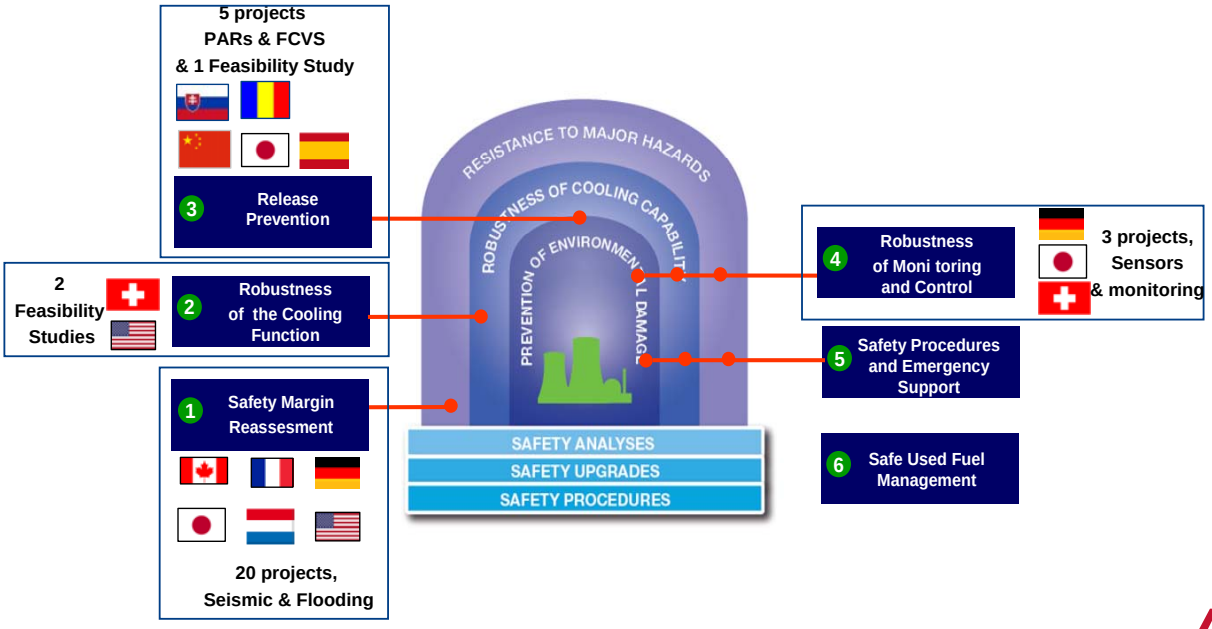
Working closely with Users Groups worldwide
31 projects launched in 11 countries - March 2012



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Constant Investments for a High Level of Safety

- **Over the period 2007 – 2011 our CAPEX related to safety stood at €2 billion**
  - **Renewal/replacement and upgrading of our industrial facilities**
  - **Deployment of the most advanced technologies**
  - **Development and optimization of nuclear fuel**
- **For the period 2012 – 2016 we will invest a further €2 billion in safety**

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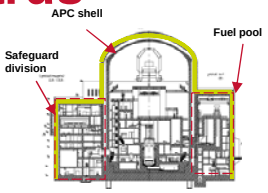
EPR™ and ATMEA1 reactors: designed to meet the most demanding nuclear and industrial safety standards

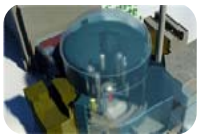
Ability to withstand exceptional accidents and natural events

- External shell
- Earthquake proof
- Doors able to withstand explosions and flooding



Ability to withstand an airplane crash

- External containment protecting critical buildings



Reducing the risk of a serious accident with core melt

- Independent safety trains + physical separation
- Emergency diesel generators in two different buildings

No impact on local populations near the site in the event of a serious accident

- Core catcher: to collect the corium

Designed to benefit from nuclear accident lessons, they would have resisted Fukushima

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Post-Fukushima Safety Authorities' Assessments on AREVA Designs

- **Safety checks performed in Europe following European directives highlighted the intrinsic Robustness of the EPR™ design:**
  - **France: the National Authority ASN reported that "*the enhanced design of [the EPR™ reactor] ensures already an improved robustness with respect to the severe accident*" in its Complementary Safety Assessment (CSA)**
  - **Finland: STUK highlighted in its final report that "*Earthquakes and flooding are included in the design to ensure safety functions to a high level of confidence*"**
  - **UK: ONR issued the EPR™ interim Design Acceptance in December '11, stating that there is no '*show stopper*' regarding EPR™ safety**
  - **France: ASN's final report on the safety of the joint AREVA/MHI ATMEA 1 has approved ATMEA 1's safety and design options, pointing out that ATMEA 1 "*took into account lessons learnt from the Fukushima-Daiichi accident*".**

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- **Lessons learned from Fukushima**

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Safety lessons from Fukushima (I)

1. **The Fukushima accident did not put in doubt current Gen 3+ safety options for reactor safety. On the contrary, it confirmed them.**
   - Major Gen3+ designs would have survived the accident
   - Only Gen3+ options are acceptable for new builds from now on.
   - Since Japan and France are respected Gen 3+ designers, the situation can be turned to our common advantage on the export market.

2. **The accident showed the need for better emergency response systems, procedures and organizations**
   - Dimension emergency response systems for a simultaneous accident on several reactors
   - Plan for solid and redundant communication lines in accident situations and try them out repeatedly in advance.
   - Put in place the organizational capacity and resources required to manage and emergency situation

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Safety lessons from Fukushima (II)

3. **No single safety device or philosophy is 100% safe. Therefore, the key word is "redundancy"**
   - Reactors must be as robust as possible against external shocks, then have multiple redundant safety devices to keep cooling capacity;
   - If all else fails, passive devices must be included to protect the environment;
   - There is no magic bullet: both passive and active safety concepts have a role.

4. **Public acceptance will be key to the restart of nuclear around the world ; it will require more than ever a policy of transparency and continuous dialogue**

5. **We are all in this together**
   - An accident somewhere is an accident everywhere; the entire industry must show solidarity. As a leader, AREVA will continue to play its part.
   - A long work lies ahead to clean up the site and allow a return to normal life. AREVA is ready to support this work with all its experience and technologies.

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