NEA workshop

Innovation in water cooled reactor technologies

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The EPR / ATMEA design includes, from its origin, all safety progresses.
EPR safety objectives

- Reduce core damage frequency by a factor 10
- Reduce radiological releases in case of an accident
  - design basis accidents: no protection measures for the population
  - practical elimination of scenarios leading to large and early releases
    *(hydrogen explosion, core melt under pressure, steam explosions)*
  - in case of a severe accident, only protection measures limited in area and time can be tolerated (eg no permanent relocation)
- Increase robustness against terrorist attacks
  *(eg large commercial aircraft crash)*

*Severe accident mitigation is included in the design.*

*These objectives define the Gen 3 (or 3+) reactors.*
Severe accident mitigation

Prevention of high pressure core melt

- Prevention of high pressure core melt
- Short and long term function of containment ensured

Elimination of H2 risk

- Elimination of H2 risk
- Prevention of steam explosions

A comprehensive and deterministic severe accident approach.

A dedicated, independent and qualified line of defence in depth.
EPR resistance to external hazards

- Strong resistance to earthquakes
- Protection against malvolant action
- Watertight buildings and doors

Margin assessment show with a high level of confidence that
- a Fukushima quake would have not led to a severe accident
- buildings would have resisted the tsunami and kept the safety systems operable
Flooding can be caused by a variety of phenomenon, in many places of the world, even in the absence of outstanding tsunami.
6 emergency diesels plus batteries: redundant, diversified and protected

- **Physical protection**: Diesels & fuel tanks housed in reinforced buildings
- **Physical separation**: 2 buildings located on each side of the reactor building
- **Redundancy & diversification**: 4 main 100% redundant diesels, 2 additional SBO diesels, batteries: 12h autonomy
Support system: heat-sink

- Water intake is a system, to be protected
- Heat-sink is also a part of the environment

*water can turn into mud, disappear, be loaded with debris, ice etc…*

Because heat-sink can be impaired by changes in the environment, there is interest to consider an alternate heat-sink.
Main Coolant Pumps

- 220 MCP built by AREVA
- Excellent track record
- Innovation on seals
  - Stand Still Seal System
  - Hydrodynamic Seals

*Leak tight MCP seals (without injection) make a significant safety step*
Digitalized I&C

- Major breakthrough in nuclear since N4
- Much enhanced analysis and synthesis capabilities
- User friendly (HMI) and much suited to the young generations

A major safety progress in the human factor field
ATMEA1 benefits from EPR and APWR innovations
The major innovation in Gen 3 / Gen 3+ is expected in the safety philosophy and objectives.

Technology and engineering innovation to be evaluated in this respect.