ATMEA1 A NUCLEAR REACTOR DESIGNED TO WITHSTAND EXTREME EXTERNAL HAZARD SITUATIONS

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AGENDA

- A GLANCE ON ATMEA
- A GLANCE ON ATMEA1 REACTOR
- ATMEA1 REACTOR SAFETY FEATURES

ATMEA a Joint Venture between two world nuclear leaders

ATMEA1

1 NUCLEAR ISLAND DESIGNED

ATMEA

AREVA
forward-looking energy

2 WORLD LEADING NUCLEAR SUPPLIERS

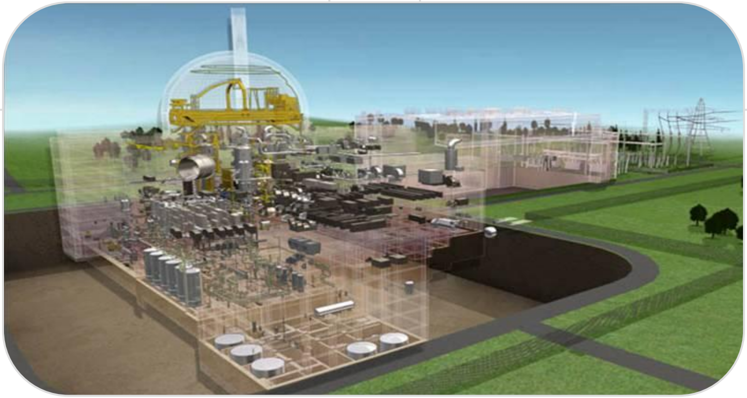
1 JOINT VENTURE

MITSUBISHI
HEAVY INDUSTRIES, LTD.

Brief Overview of The Company

- **Company name**: **ATMEA S.A.S.**
- **Office Location**: **Paris La Defense**
- **President & CEO**: **Philippe Namy**
- **Deputy CEO**: **Satoshi Utsumi**
- **Establishment:** **November 2007**
- **Capital**: **126 Million Euros**

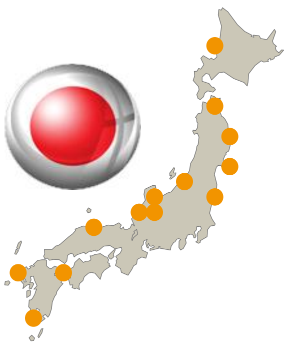
- Scope of activities: Development, Marketing & Sales, Construction & Commissioning activities for the **1100 MWe class Generation III+ ATMEA1 Nuclear Island**
- The ATMEA company is the **exclusive vendor** of the ATMEA1 Nuclear Island



ATMEA1 Reactor: A mid-sized Generation III+ PWR

Strong support from 2 countries and 2 Nuclear Leaders

- **Full support of 2 nuclear leading countries**



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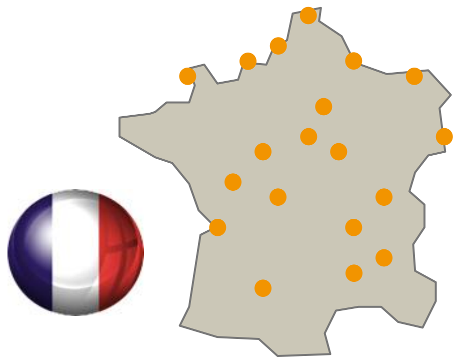


= 113 Reactors under operation

● Power plants under operation

- **AREVA and MHI providing large nuclear engineering experience**

MITSUBISHI HEAVY INDUSTRIES, LTD. **+** AREVA forward-looking energy **= 130 PWR built**

ATMEA's achievements and current activities

We are here today

2006/2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014

Conceptual Design

- Definition of main features
- Project engineering manual
- Conceptual safety features

⌖ IAEA Report

- ATMEA1 selection
- Jordan Project
- Final decision pending
- Standard Detailed Design
- ASN* Review

⌖ Conclusion of ASN Safety Options Review

- CNSC* (Canada) Review

⌖ Report expected

Basic Design

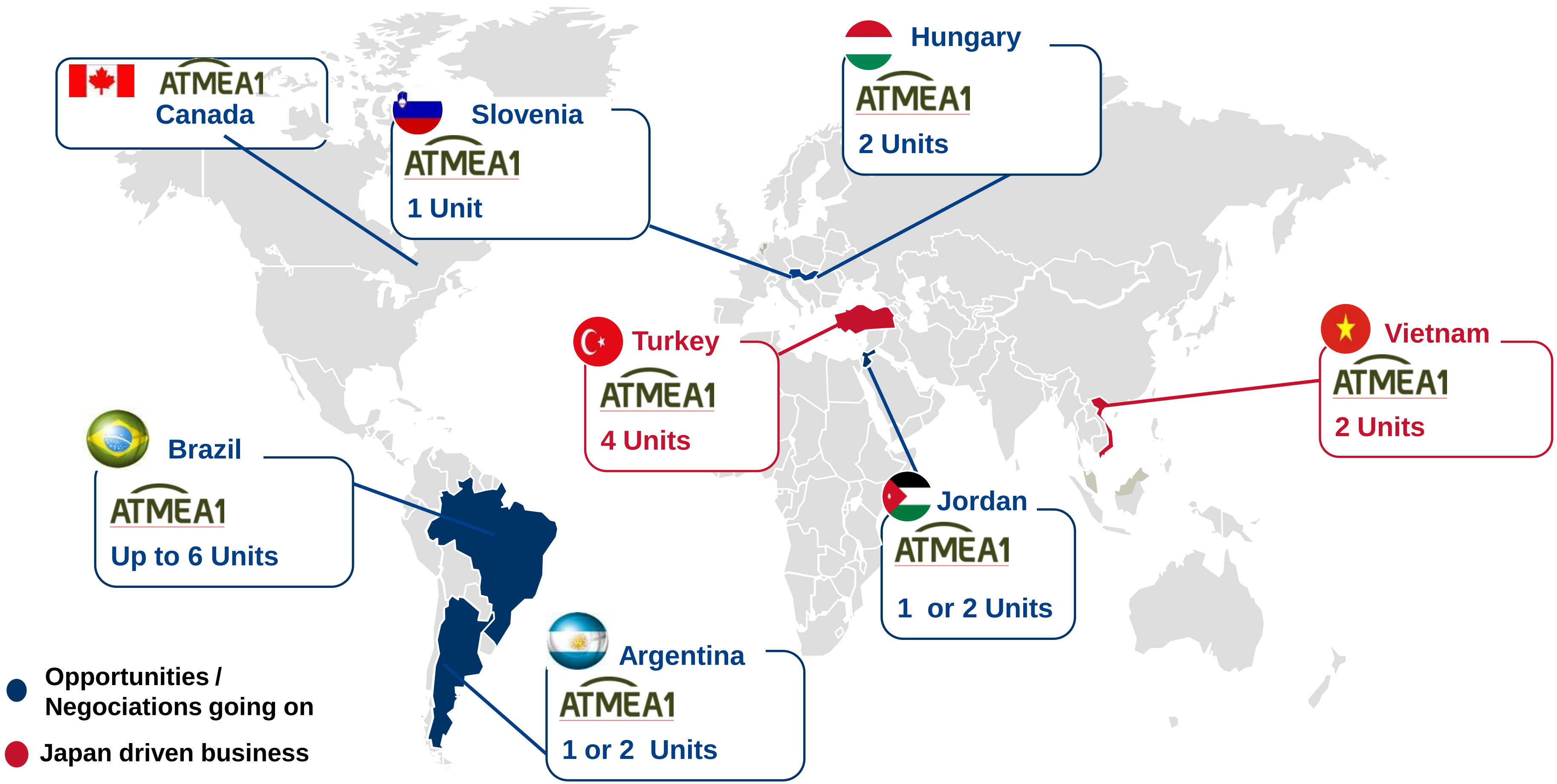
- Functional requirements
- Safety requirements
- General arrangement
- Core system & component design
- Standard Preliminary Safety Analysis Report

Japan/ Turkey IGA for the 2nd Turkey NPP with 4 ATMEA1

**ASN: French Safety Authority *CNSC: Canadian Nuclear Safety Commission*

ATMEA Worldwide Commercial Activities

- **ATMEA1 Reactor selected in many countries as a potential technology for New Power Plant**



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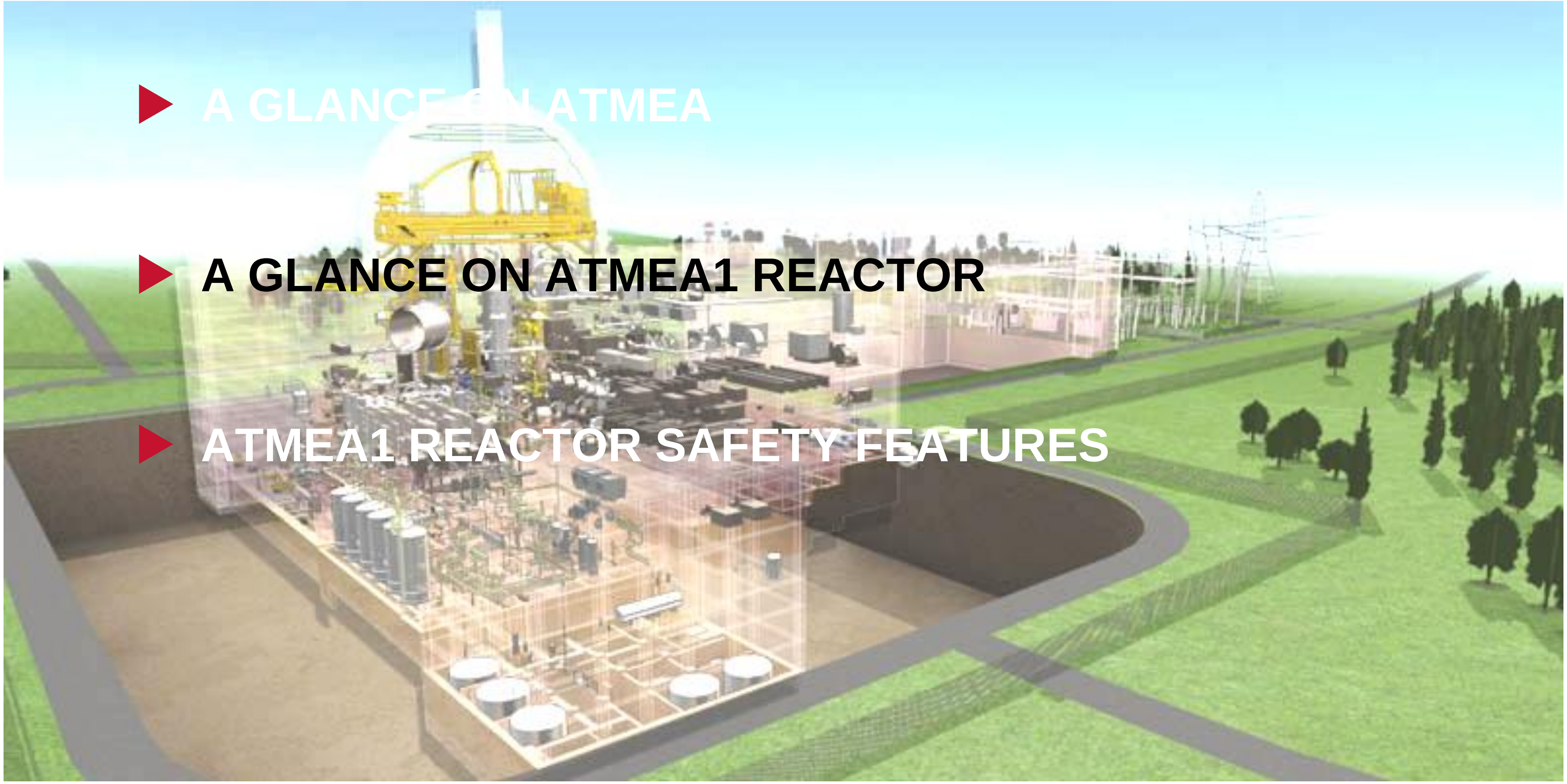


- A GLANCE ON ATMEA
- **A GLANCE ON ATMEA1 REACTOR**
- ATMEA1 REACTOR SAFETY FEATURES

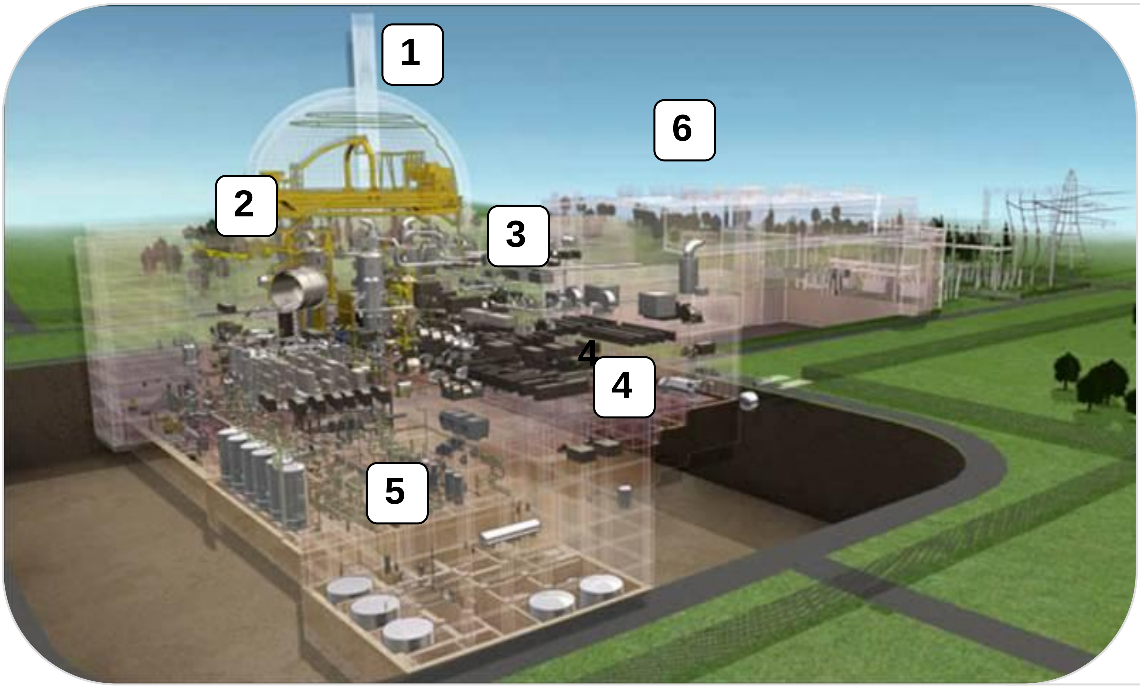
Compilation of Nuclear technology of MHI and AREVA

Integrated design based on proven technology

ATMEA1

ATMEA1 Reactor main features

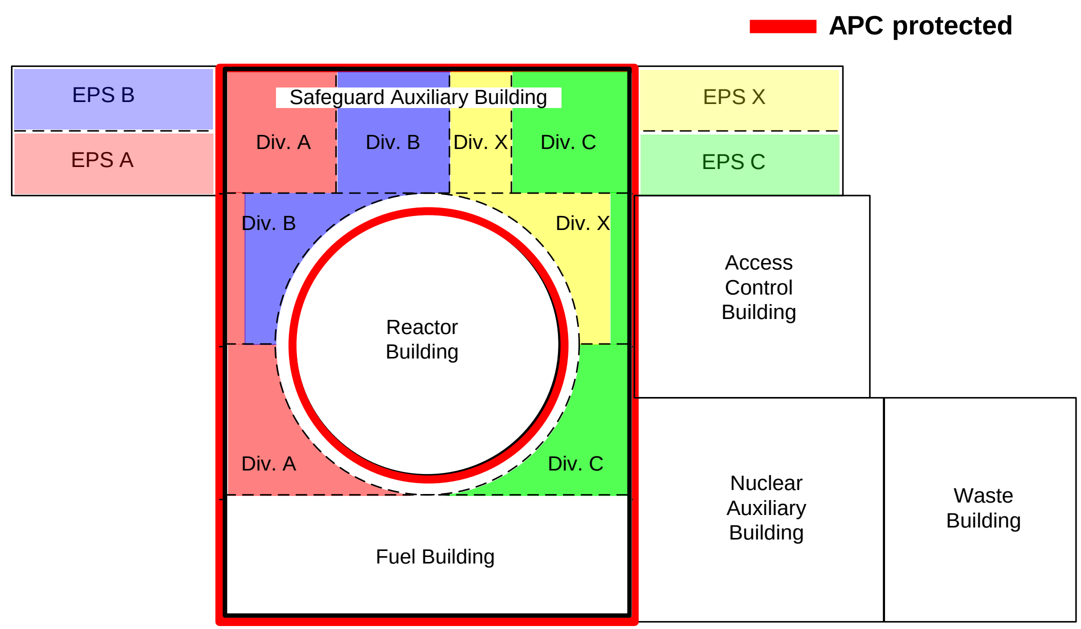
Reactor Type	3-Loop PWR	Safety System	3 train reliable active system with passive features + 1 diversified safety train
Electrical output	1100 – 1150 MWe (Net)	Severe Accident Management	Core catcher Hydrogen re-combiners
Core	157 Fuel Assemblies	Resists airplane crash	Pre-stressed Concrete Containment Vessel
Steam Pressure	More than 7 MPa	I&C	Full Digital



1. Reactor Building
2. Fuel Building
3. Safeguard Building
4. Emergency Power Building
5. Nuclear Auxiliary Building
6. Turbine Building

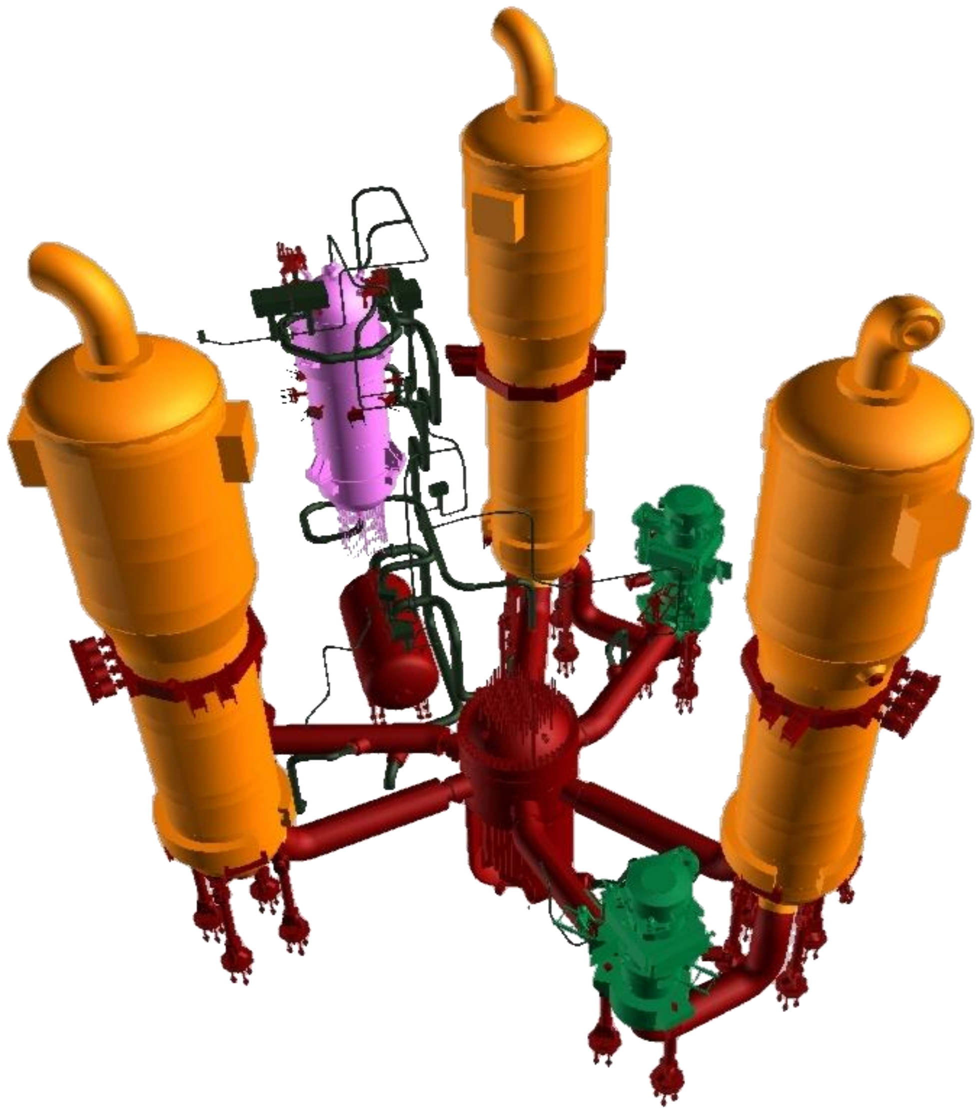
ATMEA1 Reactor Main Features
Main Nuclear Island Buildings

- **Pre-stressed Concrete Containment Vessel**
- **Safeguard building and Fuel building with thickened concrete wall**
- **Protection against large commercial airplane crash (APC) in compliance with US-NRC regulation and European practice**
- **Safety systems and components are protected:**
  - **Either by segregation or bunkerization to secure the required safety functions**
  - **Against Tsunami/Flooding in leak tight buildings**



Primary components - General

- **Typical 3-loop configuration**
  - **Design based on ASME Boiler and Pressure Vessel Code**
  - **Experienced materials reflecting the latest experiences of AREVA and MHI**
  - **Design applying the latest technologies of AREVA and MHI**



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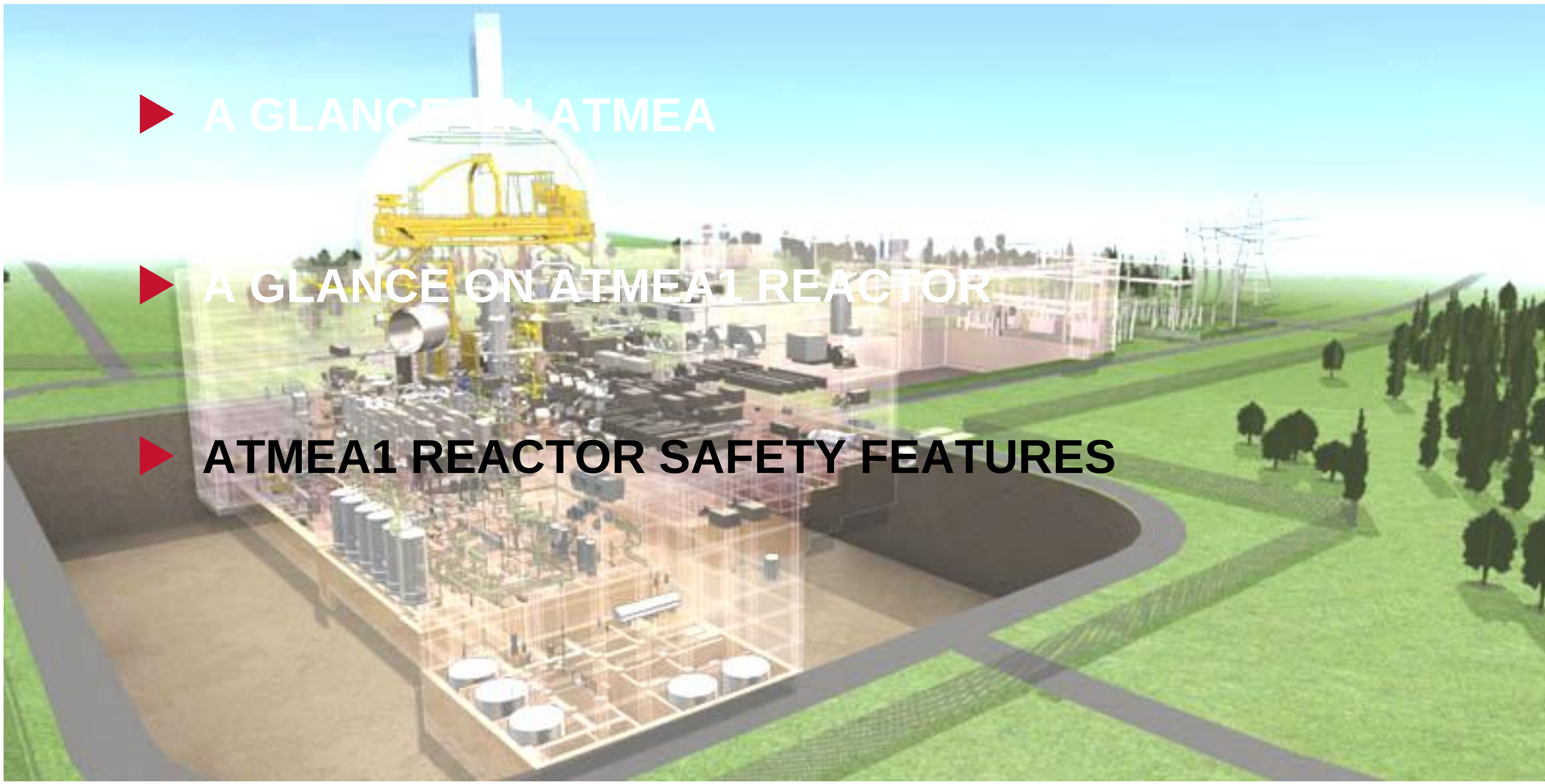
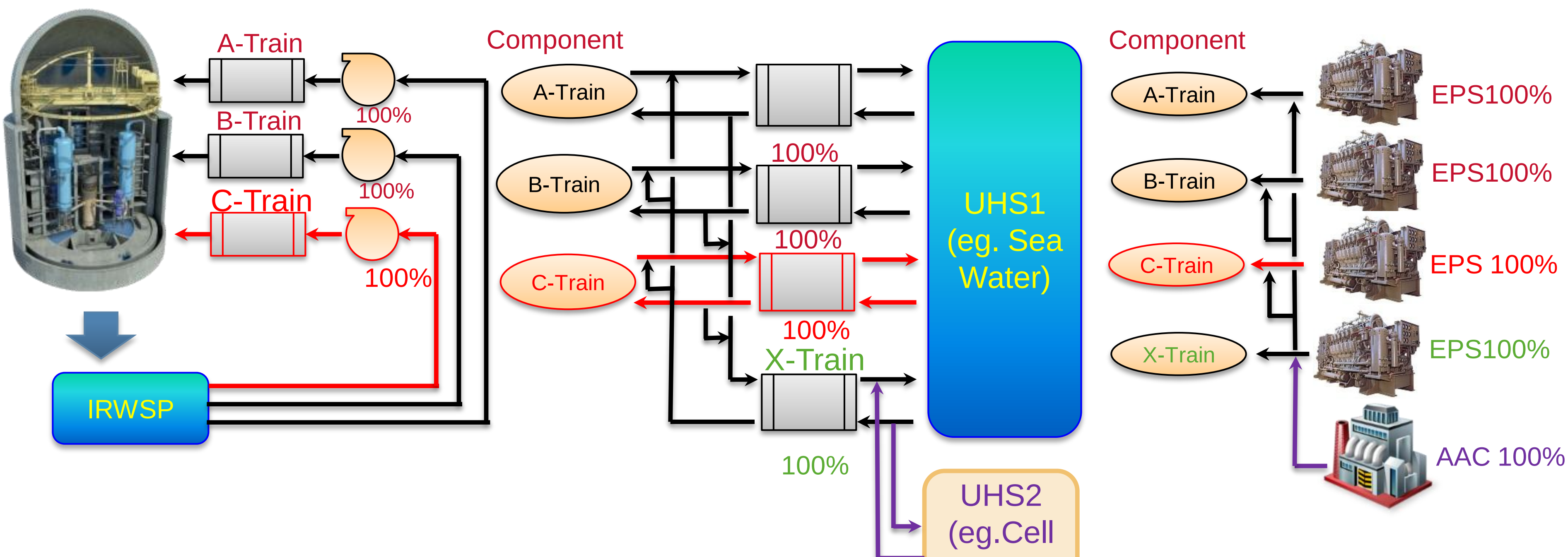


- A GLANCE ON ATMEA
- A GLANCE ON ATMEA1 REACTOR
- **ATMEA1 REACTOR SAFETY FEATURES**

Integrated design based on experienced technologies

▶Safety Design based on Existing and Proven Technology, with Increase of redundancy and diversity

Front System (SIS, CSS)	Cooling Chain (CCWS,ESWS)	Power Supply (EPS, AAC)



SIS: Safety Injection System
CSS: Containment Spray System
IRWSP: In-containment Refueling Water Storage Pit

CCWS: Component Cooling Water System
ESWS: Essential Service Water System
UHS: Ultimate Heat Sink

EPS: Emergency Power Source
AAC: Alternative AC power source

Safety and robustness

ATMEA1 robust design with its redundant and diversified safety features ensures best-in-class safety

Internal events - External hazards - Internal hazards

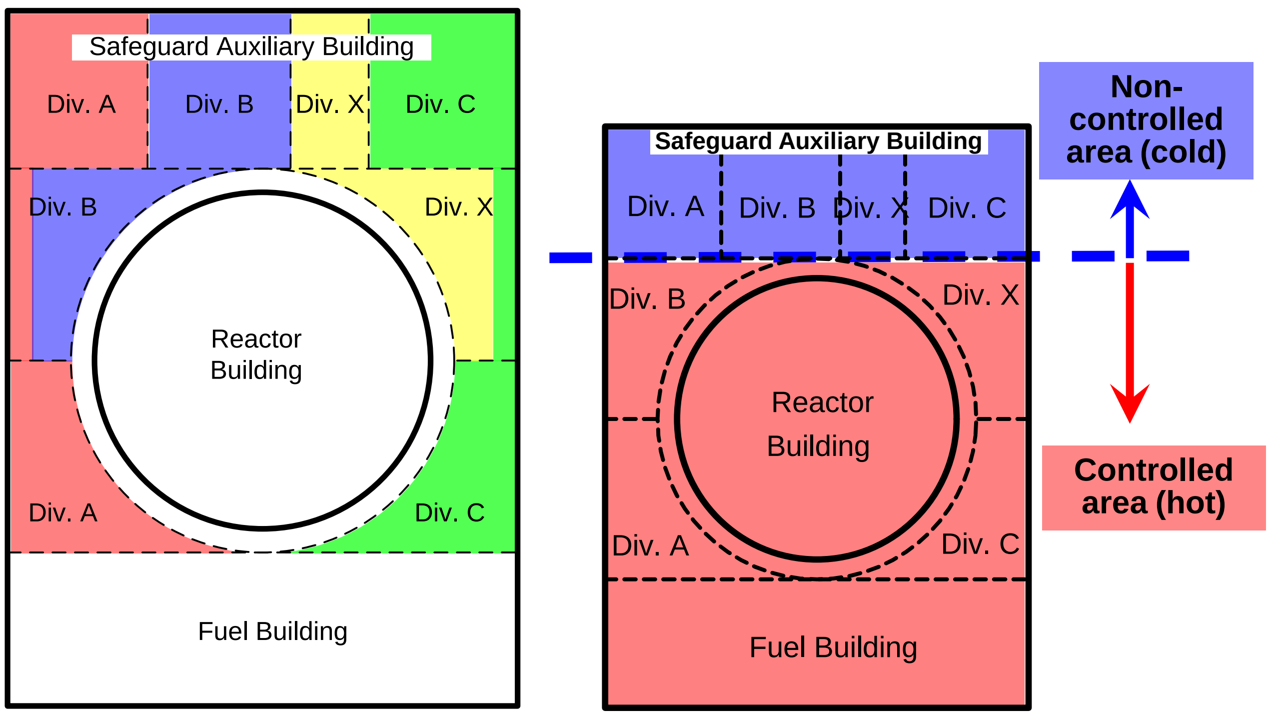
PROTECT: Robust design, reliable equipment and clearly separated safety trains

COOL DOWN: Ensure the residual heat removing function by redundant and diversified safety features

CONFINE: No/very limited environmental impact even under extreme conditions

Protection against Internal events – All hazards

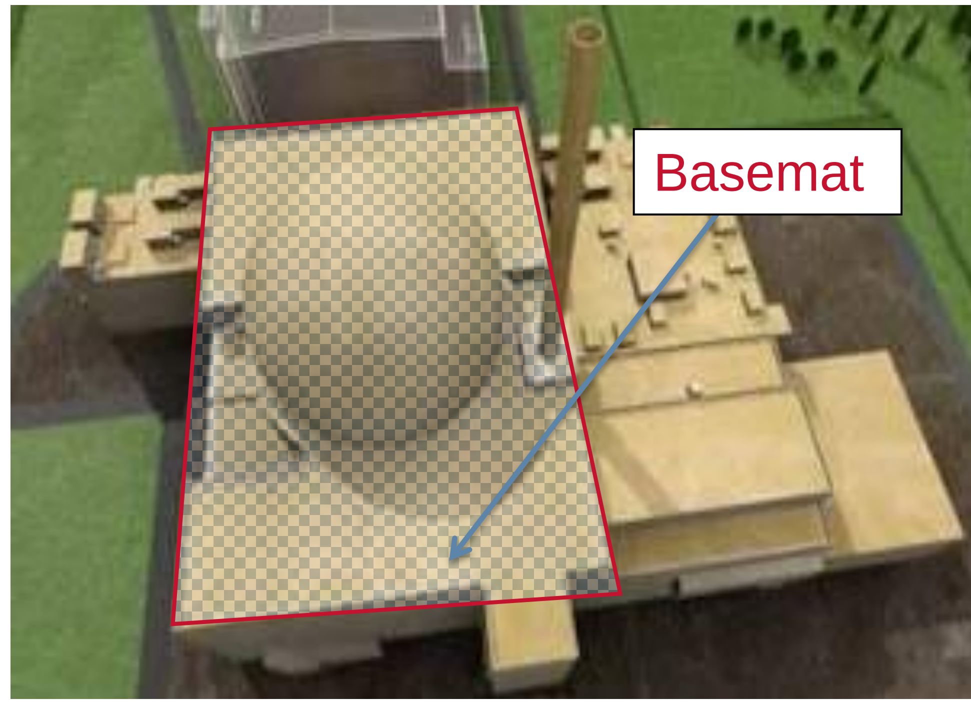
- Clear divisional separation
  - Each safety train
  - Controlled area and non-controlled area
- All safety systems/equipment protected against external hazards



Protection against external hazards

Seismic design

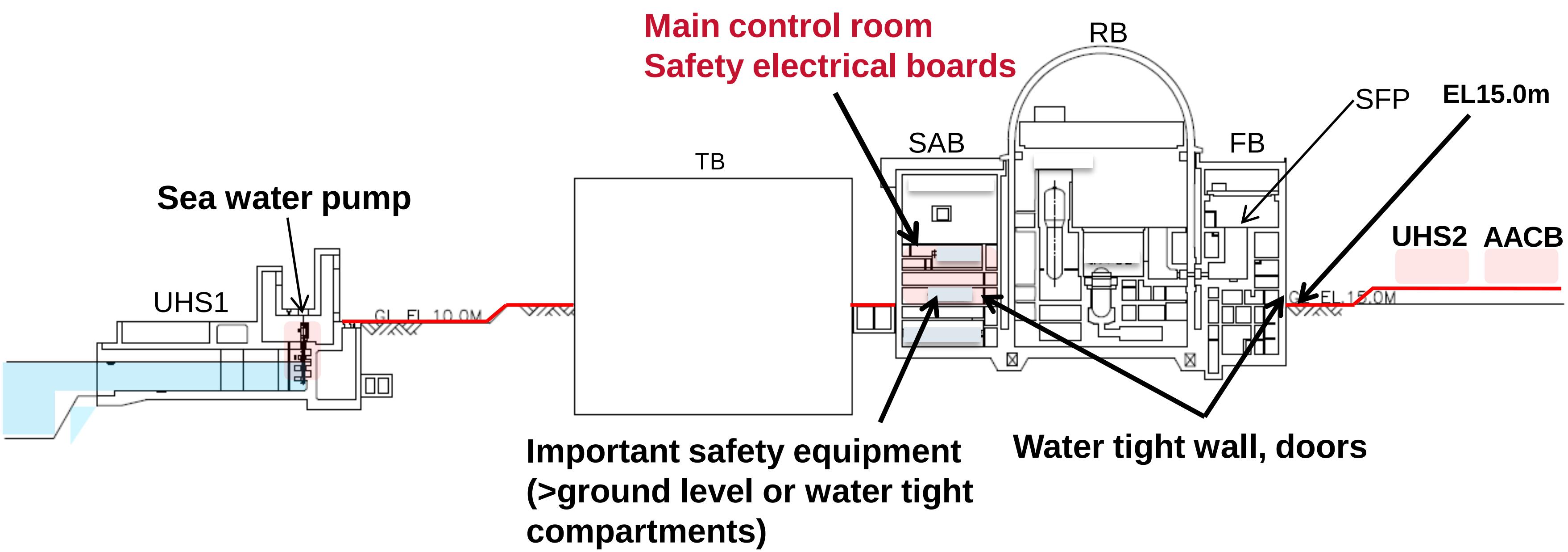
- Thickened outer walls of buildings against seismic shear force
- Large rectangular basemat to improve seismic stability
- Functions of reactor and primary system, fuel pool, all safety systems to be kept against seismic events



Protection against external hazards

Tsunami and Flooding

- The ground level should be set to a level to avoid consequences from a Tsunami
- Important buildings are protected with water-tight walls and doors
  - Fuel building, Reactor building, Safeguard building
  - Emergency Power sources buildings, AAC building
  - Essential Service Water System route
- Electrical equipment and I&C equipment are located in upper floors



Protection against Air Plane Crash (APC)

Airplane Crash protection objectives

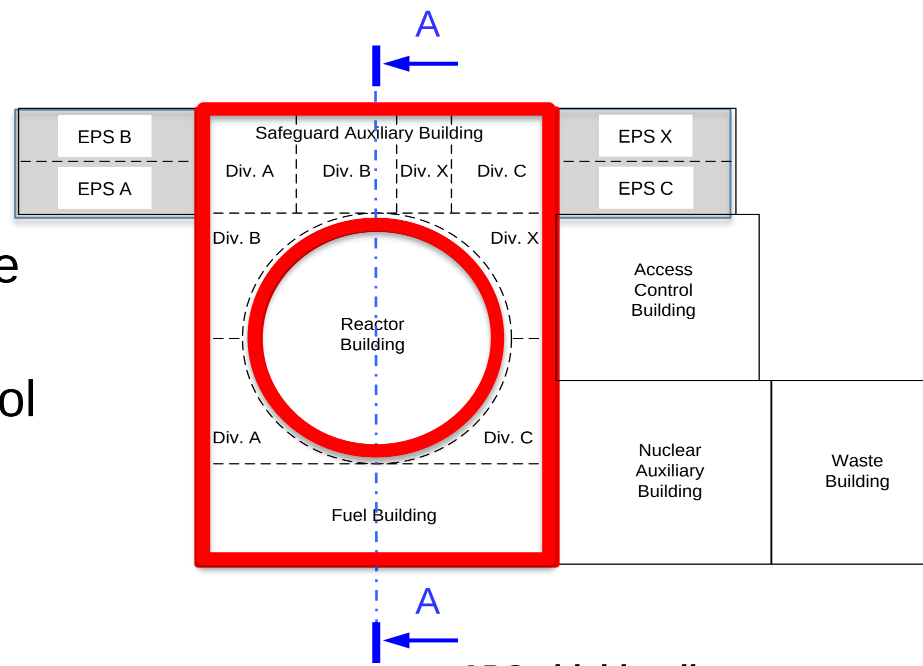
Ensures that:

- The reactor core remains cooled, the containment remains intact
- Spent fuel cooling and spent fuel pool integrity are maintained
- No-offsite countermeasures necessary

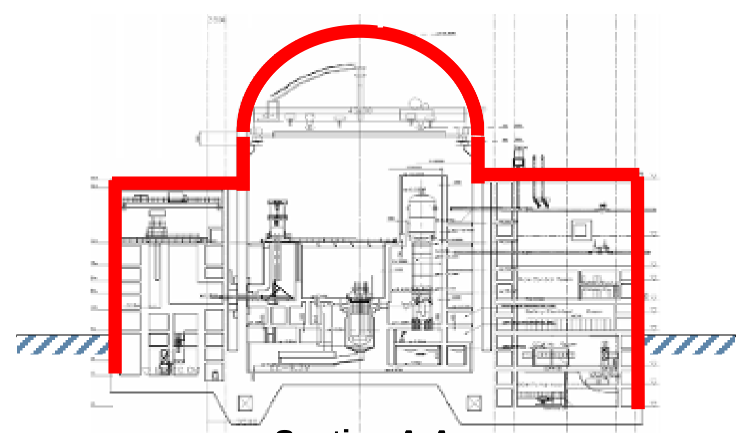
Airplane Crash protection features

ATMEA1 buildings are protected :

- By shielding (APC wall) : RB, FB, SAB
- By segregation : EPS buildings, AAC building



APC shield wall



Section A-A

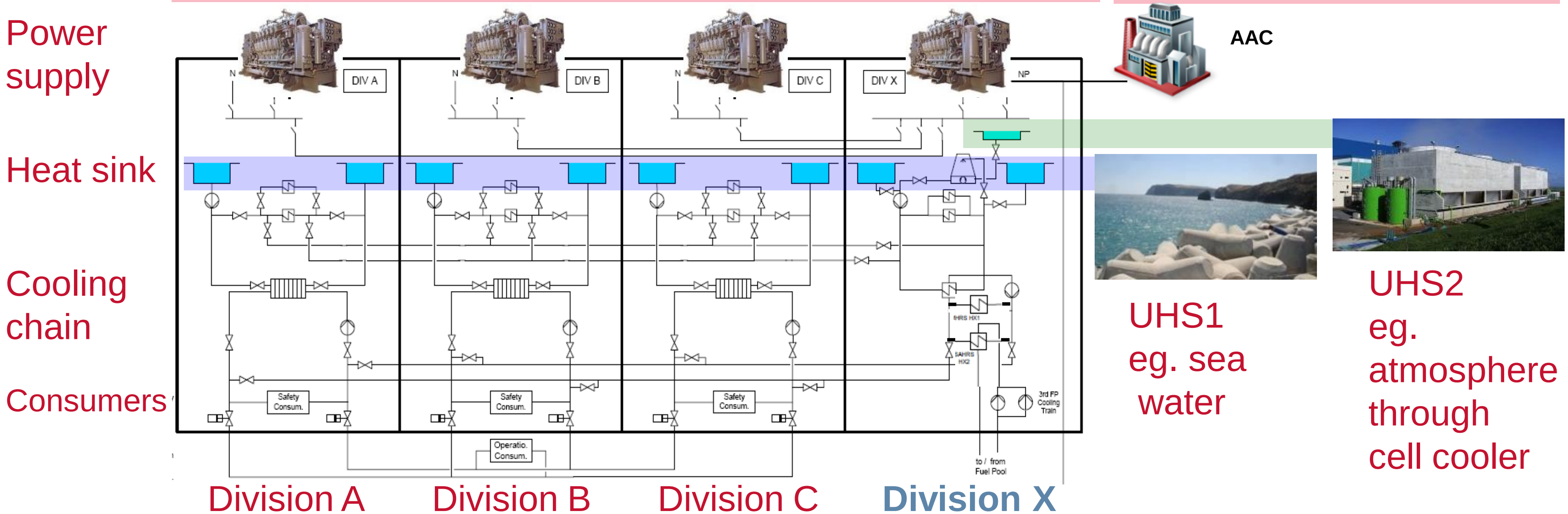
COOL DOWN and Support Systems
Diversified heat sinks and power sources

- 3 x 100% safety trains plus one additional safety train (Div X)

  Each train has sufficient capacity for cooling Reactor core and Spent Fuel Pool

Emergency Power Source and Alternate AC: more than 7 days autonomy

Second Ultimate Heat Sink: more than 7 days autonomy

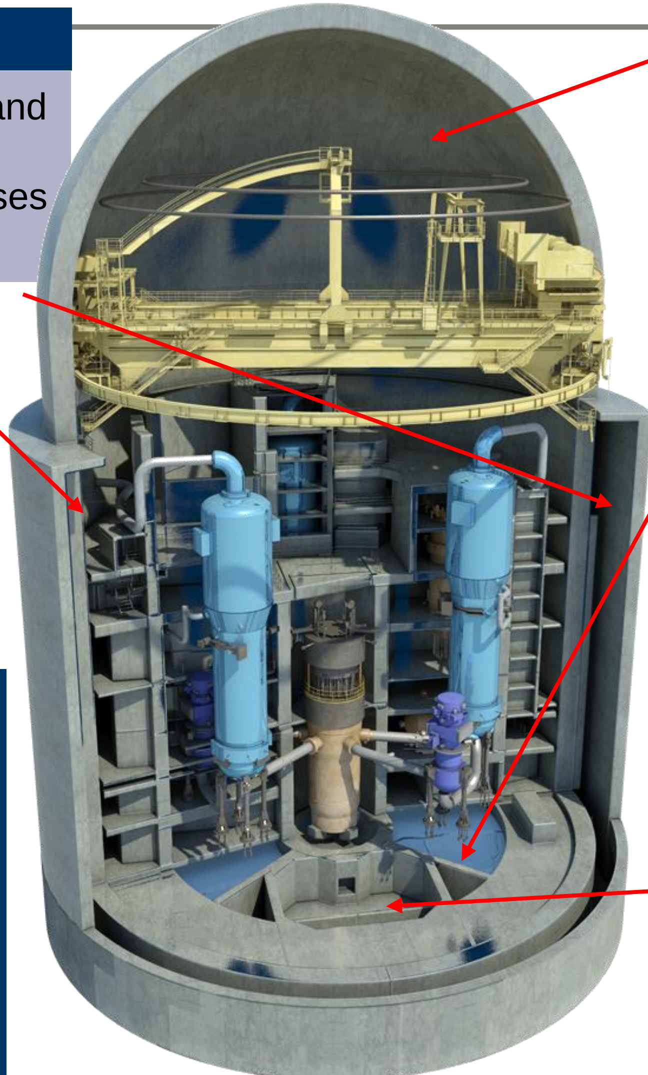


- Division X
  - Diversification in cooling equipment, heat sinks and power source
- Spent fuel (SF) cooling and makeup
  - SF pool with diversified cooling chains and multiple make-up sources

CONFINE : Robust containment and enhanced confinement

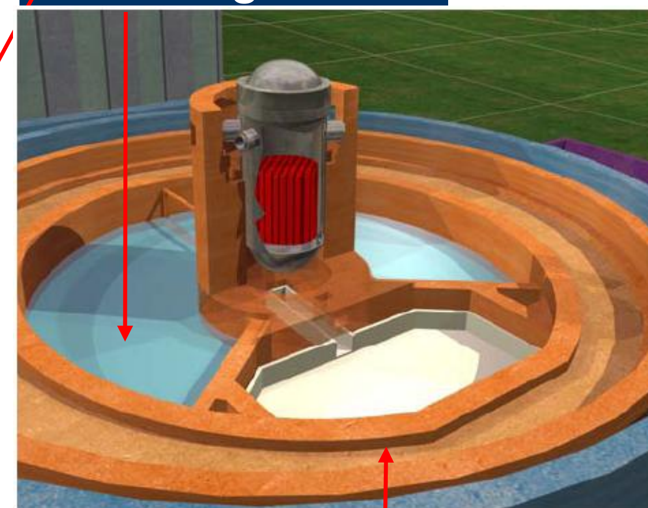
Annulus

Sub-atmospheric and filtered to reduce radioisotope releases



Pre-stressed containment vessel with Steel Liner

In-Containment Refueling Water Storage Pit



Core-catcher

For long-term Severe Accident Mitigation

All potential leakages are prevented or processed and filtered

Extreme External Hazards response

- Highly unlikely extreme external events (e.g., extreme seismic events, external flooding, etc.) present challenges to nuclear power plants

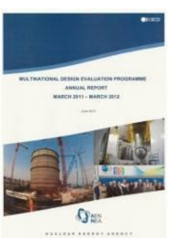
- ATMEA1 design against extreme external hazards
  - Extend protection of necessary "permanently installed equipment" against extreme condition and use them
    - AAC, UHS2, Division-X
  - Mitigation of radiological consequences in case of a severe accident
- For each site, the design is defined considering:
  - Site plausible hazards
  - Site/country specific regulatory requirements, site specificities, emergency capabilities

Review of regulatory statements

ATMEA1 response to extreme external hazards follows latest international regulatory consensus

•**ASN (France) :** review of ATMEA1 safety options
Safety options of ATMEA1 demonstrate its **robustness to extreme events**

•**CNSC** (Canada): For a new NPP design, as a countermeasure against such extreme events, it is expected the use of **installed equipment and resources** or passive design features to maintain or restore core cooling, containment cooling, and spent fuel cooling for a prolonged period of time (e.g. 72 hours)“



•**MDEP** Common position paper (Jan 2013)

Most safety functions of NPPs depend on alternating current (AC) power, hence high reliability of AC power supply is essential. This high reliability is expected to be achieved through an adequate combination of redundancy and diversity. **Ensuring adequate protection of the AC power supply against rare and severe external hazards** is a lesson from the Fukushima Dai-ichi accident. Regarding emergency power supply, **diverse, electrically adequately isolated AC power sources** needs to be required as a part of defense-in-Depth concept of the plant.

The Defense-in-Depth approach needs to be applied also to the ultimate heat sink. The design of new nuclear power plants needs to provide diverse means to provide reactor and spent fuel cooling. **The use of a secondary ultimate cooling water system is an example of diverse means to provide reactor and spend fuel cooling for decay heat removal in case of unavailability of the primary ultimate heat sink.**

ATMEA's Approach to First Lessons Learned from Fukushima

- **Assessment results confirmed robustness of the current ATMEA1 design and its adequate grace time as similar Generation III+ evolutionary reactors**
  - **Resistance against external hazards**
  - **Design margin and absence of "cliff-edge" effect**
  - **Long-term containment integrity under severe accident conditions**

- **For now no need for design modifications in terms of safety options**

First lessons learned from Fukushima have validated ATMEA1's safety approach

- **ATMEA will make a close follow-up of national and worldwide consensus regarding additional safety dispositions that could be raised in the wake of Fukushima accident**

Benefits of ATMEA1

- **Evolutionary Technology integrating PWR experience**
  - **Improved and verified through over 40 years and 130 units**
    - **No** (surprise / revolutionary / unproven) **technologies**
- **Excellence in Safety / Post-Fukushima**
  - **ATMEA1 already satisfying the Post-Fukushima requirements**

THE ATMEA1 REACTOR

A TOP LEVEL EVOLUTIONARY

GENERATION III + PWR REACTOR

THANK YOU