Proven Technology

The ATMEA1 reactor has been designed hand-in-hand with utilities to consider and anticipate their requirements. With a proven design with evolutionary features that has been positively assessed by both French and Canadian nuclear safety authorities according to their highest level of safety requirements, and benefiting from a secured supply chain, the ATMEA1 reactor is the solution the global market can rely on.

Straightforward Licensing Process

The ATMEA1 reactor meets international regulatory requirements, and codes and standards. Its design is built on technologies already licensed or validated and components that have been running and tested. It benefits from the EDF Group and MHI extensive experience in licensing reactors and nuclear facilities across the world.

Smooth Project Execution

The ATMEA1 reactor brings high confidence to utilities with regard to project execution benefitting from robust and advanced construction techniques and lessons learned, from the EDF Group and MHI experience across the world.

- Secured design: standard reactor design completed and easily adoptable to site conditions.
- Secured manufacturing: evolutionary design using tested and running equipment, for which the size, weight, material and manufacturing methods are already known.
- Secured supply chain: the ATMEA1 reactor projects will benefit from the EDF Group (including Framatome) and MHI global supply chain

High Confidence for Operation and Maintenance

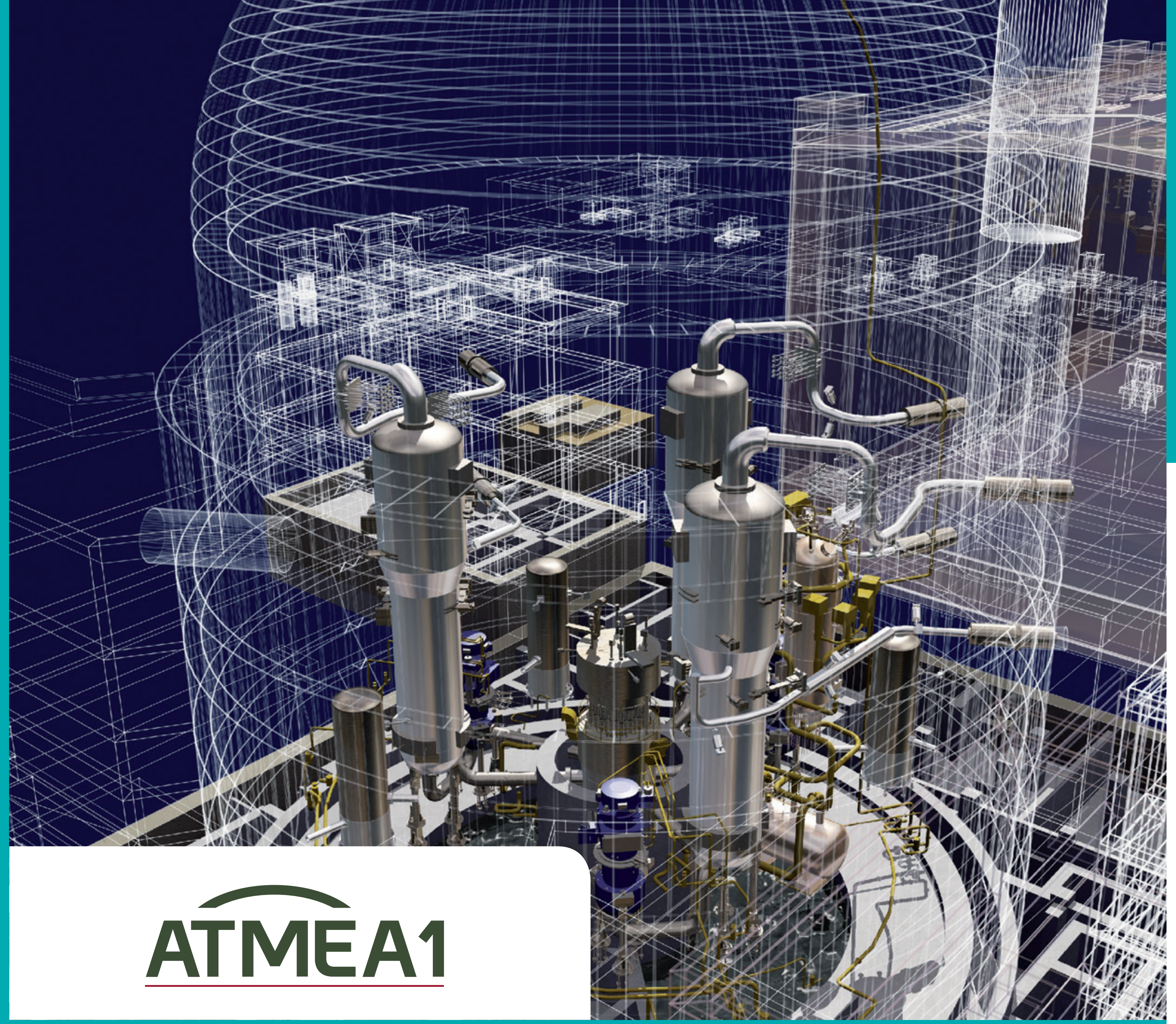
The design of the ATMEA1 reactor takes into account utilities requirements and leverages EDF Group's operating experience equivalent to approximately 1700-reactor years.

Furthermore, ATMEA shareholder companies, the EDF Group and MHI, are world leaders in providing support for reactor operation and maintenance. In particular the EDF Group together with French Nuclear Industry brings a unique know-how, based on the integrated operating feedback experience of the largest nuclear operator in the world.

Main Features of the ATMEA1 Reactor

Thermal output	3,300 MWth
Electrical output	~1,200 MWe (Net)
Thermal efficiency	~37%
Plant availability	92% (Target)
Fuel flexibility	12 to 24-month operation cycle length Available for 0 – 100% MOX loading
Load follow operation	100% – 25% (1% – 3% per minute), including automatic frequency control, instantaneous return to full power capability, and effluent reduction by variable temperature control
Design plant life	60 years
Primary system	3-loop configuration
Safety system	3-train, reliable active system with advanced accumulators
Severe accident mitigation	Core catcher and hydrogen recombiners ensure the long-term integrity of the containment
Provisions for airplane crash	Safety related buildings protected against commercial airplane crash through reinforcement or physical separation
Seismic condition	Available for high seismic area
Regulation compliance	Worldwide including US, Europe, Japan

ATMEA
Tour AREVA – 1, place Jean Millier – 92400 Courbevoie – France
www.atmea-sas.com



ATMEA1

Driven by Safety,
Based on Experience,
Powered by Performance:

"The Solution for Your Project"

ATMEA

The ATMEA company is a joint venture between France's EDF Group and Japan's Mitsubishi Heavy Industries (MHI). It incorporates the unrivaled experience and competences of its shareholder companies: two world renowned leaders in the nuclear industry (EDF and MHI) and the extensive expertise and capabilities of Framatome. The combination of these complementary strengths has been leveraged to develop a Generation III+ medium-sized PWR technology, the ATMEA1 reactor.

ATMEA

It allows to offer or support comprehensive solutions over the entire nuclear value chain, ranging **from reactor design, construction, commissioning, operation and maintenance to nuclear fuel supply, waste fuel management, and decommissioning,** as well as support in **financing** and **human capacity building.**

Building-on our shareholders experience, we can rely on more than 40-year worldwide PWR experience:

- **+ 130 reactors built worldwide***
- **+ 350 reactors served worldwide***
- **Solid experience in Gen III design, licensing and construction** derived from EPR reactor technology and on-going projects

* Combined EDF Group & MHI track-record

With the backing of the French and Japanese governments, we are a **true partner in any nuclear power plant project** and are here to **provide support in the long run.**

Civaux nuclear power plant, France
Photo courtesy of Framatome

Ohi nuclear power plant, Japan
Photo courtesy of Kansai Electric Power Co., Inc

EDF

MITSUBISHI HEAVY INDUSTRIES

Highest Level of Safety

Safety is an absolute priority in the ATMEA1 reactor design. **The highest level of safety** is achieved through **powerful active systems,** with **passive systems** called upon only for specific actions if robust and proven efficient.
The design is based on improvements in **all levels of defense-in-depth.** There is an optimized balance between system diversity and redundancy and **severe accident management systems have been validated** using a deterministic approach for beyond design situations to ensure that **the plant remains safe and under control.**

Emergency diesel generators

Welding in the water storage pool

Advanced accumulator

Core catcher

PROTECT
Resistance to External Hazards

The ATMEA1 reactor is, by design, protected against external hazards.

→ High level of seismic activity

- Earthquake-resistant civil design based on Japanese experience.
- Proven and reliable equipment resistant to a very high level of seismic activity.

→ Flooding

- Platform elevation and dry-site concept prevent plant flooding.
- Additional margins as electrical and I&C equipment is located in upper floors and all safety-related buildings are protected by water-tight walls and doors.

→ Malevolent acts including a commercial airplane crash

- Reinforced concrete shielding and geographical separations protect all equipment needed to bring the plant to a safe state without any off-site support.

A fully built-in and protected set of equipment protects the reactor against extreme external hazards with no need for any off-site support.

COOL
Cooling Capabilities

The ATMEA1 reactor boasts a number of systems and water reserves to ensure that cooling capacity is always operational.

→ Diversified and redundant cooling systems

- 3 x100% trains, each capable of bringing the reactor to safe shutdown on its own, and designed to maintain cold shutdown conditions.
- One diversified train to ensure cooling, electricity supply and accident management in extreme circumstances.

→ Over 30 days of autonomous cooling and electricity

- Multiple large onsite water reserves and a second fully protected diversified Ultimate Heat Sink.
- 4 safety classified Emergency Power Sources backed-up by an additional diversified AC generator.

Under **accident conditions:**

- Active systems initiated automatically bring the plant to a **controlled state** in **less than 1 hour.**
- **Less than 24 hours** are required to bring the plant to a **cold shutdown state.**

CONFINE
Containment Integrity

In the very unlikely event of a severe accident, the ATMEA1 reactor boasts a number of features to ensure that the accident remains confined within the plant.

→ Depressurization valves, provisions against steam explosion, passive autocatalytic hydrogen recombiners, a core catcher and the containment design itself prevent internal explosions.

→ The leaktight containment, dedicated heat removal systems and core catcher prevent the release of radioactive materials outside of the reactor.

Flexible response to accident conditions to avoid unnecessary plant degradation.

No exclusion zone required.
No emergency evacuation required.

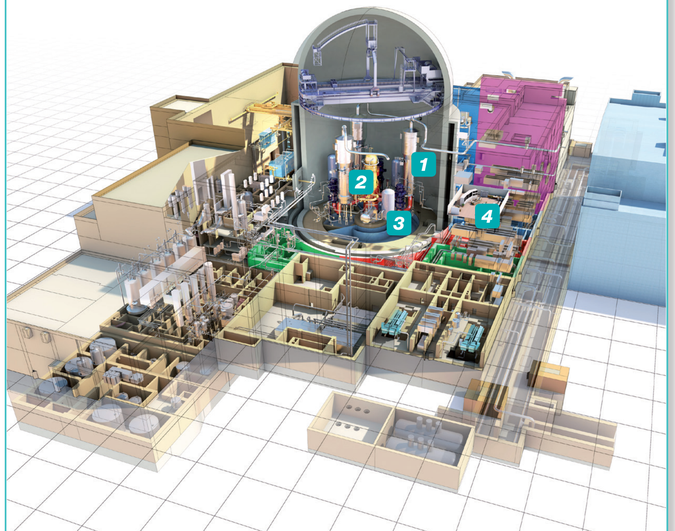
The ATMEA1 Reactor: Designed for Safety and a Lifetime of Reliable Electricity Generation at a Competitive Cost.

1 Steam generator allowing a ~37% thermal efficiency

2 Reactor pressure vessel designed for a 60-year lifetime

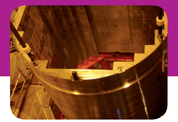
3 High-performance **reactor coolant pump** for improved efficiency

4 Control room with advanced digital I&C systems



Competitive Power Generation

The reliable, medium-sized ATMEA1 reactor **uses the latest evolutionary reactor technology** with **all systems proven and operating** for decades in PWRs **around the world.**
It offers **high economic and operational performance** for a lifetime of **stable electricity generation costs.**



Heavy neutron reflector

Reactor fuel loading

Outage operations

Advanced engineering

COST EFFECTIVE
High Economic Performance

→ A 60-year operating life with no costly replacement of heavy components

- Built-in heavy neutron reflector protecting the reactor vessel.
- Use of specially selected material to prevent stress corrosion cracking.

→ Plant availability of 92% (Target)

- Reduced outage costs thanks to on power maintenance and flexible outage schedules.
- Reliable design, systems and equipment ensure stable, uninterrupted production.

→ Thermal efficiency of ~37%

- State-of-the-art steam generator allowing an unrivaled thermal efficiency of ~37%.

→ Reduced operation and maintenance costs

- Large forgings and fewer welds on the primary loop.
- Reduced inspection constraints as there are fewer welds and easier access to components.

OPERATOR-FRIENDLY
Easy, Smooth and Safe Operation and Maintenance

→ Human factors engineering

- Inspection and operation activities considered at the design stage for plant layout.

→ Improved protection and safety of workers

- Lowest occupational exposure in line with the most stringent requirements.

→ The ATMEA1 reactor technology is an evolution of well-known PWR technology concepts and procedures

- Operation, maintenance and accident management are made easier and the risk of human error is reduced.

→ Advanced digital I&C systems

- More than 80 safety I&C systems have been installed in 44 reactors, in 17 countries, offering the most user-friendly, human-machine interface.

FLEXIBLE
Flexible to Meet Operator Needs

→ Flexible operation and maintenance

- Flexible fuel management: 12 to 24-month fuel cycle, allowing the operator to plan outages while always benefitting from low fuel costs per MWh.
- Extended load-follow and frequency control capabilities.

→ Adaptation to site and grid conditions

- ~1,200 MWe (net) reactor, designed for 50 or 60 Hz and to cope with degraded grid conditions.
- Suitable for diverse cooling sources, various ambient and seismic conditions.

Highly competitive in terms of performance and cost of electricity through:

- **High thermal efficiency**
- **High plant availability**
- **Flexibility in operation**