ASTRID (CEA with its industrial partners EDF, AREVA NP, ALSTOM, BOUYGUES, COMEX NUCLEAIRE, TOSHIBA, JACOBS, ROLLS-ROYCE and ASTRIUM Europe, France)

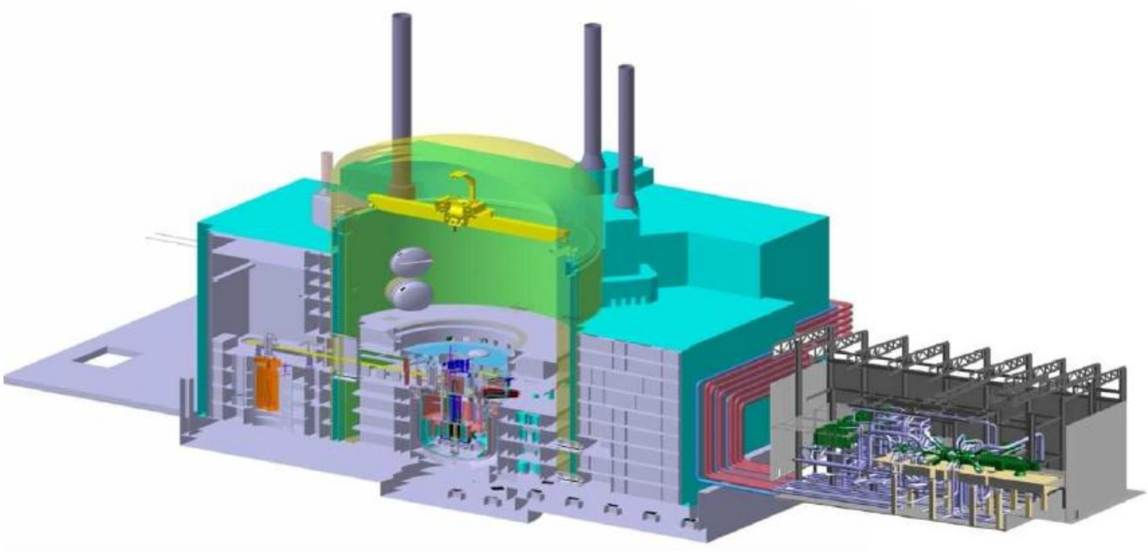

FIG. 1. Schematic view of ASTRID

Full name:	*Advanced Sodium Technological Reactor for Industrial Demonstration*
Designer:	*CEA with its industrial partners (EDF, AREVA NP, ALSTOM,BOUYGUES, COMEX NUCLEAIRE, TOSHIBA, JACOBS, ROLLS-ROYCE and ASTRIUM)*
Reactor type:	*Pool type*
Electrical capacity:	*600 MWe*
Thermal capacity:	*1500 MWth*
Coolant	*Sodium*
Primary Circulation	*Forced*
System Pressure:	*0.3 MPa*
System Temperature:	*475 °C*
Fuel Material:	*MOX*
Fuel Cycle:	*4 x 360 EFPD*
No. of safety trains:	*3 trains*
Emergency safety systems:	*Hybrid*
Residual heat removal systems:	*Hybrid*
Design Life:	*60 Years*
Design status:	*Pre-conceptual design*
Planned deployment/1st date of completion:	*The basic design phase is planned from 2016 to 2019.*
New/Distinguishing Features:	*ASTRID will be designed to pursue the R&D on sodium fast reactors and demonstrate the feasibility of transmutation of minor actinides*

Introduction

The Generation IV International Forum (GIF) was launched to create an international R&D framework capable of boosting research on the most efficient technologies. According to GIF, four main objectives defined to characterise the future reactor systems are sustainability, cost-effectiveness, safety and reliability and proliferation resistance and protection against any external hazards. At the same time, the French Act on the sustainable management programme for radioactive materials and waste stipulates the commissioning of a Generation IV reactor by 2020.

The CEA launched the conceptual design of a sodium-cooled fast reactor in 2010, with industrial partners. This project has been called ASTRID which stands for 'Advanced Sodium Technological Reactor for Industrial Demonstration'.

Description of the Nuclear System

During the preconceptual phase of the design, several options have been studied.

Regarding the core, the chosen low void effect core retains a number of advantages in terms of longer cycles and fuel residence times. It complies with all the control rod withdrawal criteria, while increasing safety margins for all unprotected-loss-of-flow (ULOF) transients and improving the general design. This core concept involves heterogeneous axial $UPuO_2$ fuel with a thick fertile plate in the inner core and is characterized by an asymmetrical, crucible-shaped core with a sodium plenum above the fissile area. The reactivity effect associated with sodium expansion achieved by design (sodium plenum and heterogeneous fertile plate) is negative in the event of a total loss of primary coolant, and can result in an overall negative void effect if a boiling phase is reached.

Some choices have already been made during the pre-conceptual design phase for the primary and secondary circuits: pool-type reactor with conical '*redan*' (inner vessel) made to allow for extended ISIR access.

In terms of the reactor block, it has been decided to use three primary pumps together with four intermediate heat exchangers. Each intermediate heat exchanger is associated with a secondary sodium loop which includes modular stream generators or sodium-gas system and the chemical volume control system.

Description of the Safety Concept

To provide defence in depth against scenarios such as the melting of the core, the ASTRID reactor will be equipped with a core catcher. It will be designed to recover the entire core keeping the corium in a sub-critical state while ensuring its long-term cooling. As other safety related components, it must be inspectable. At this stage, several options are being investigated in terms of the possible core-catcher technologies, locations (in-vessel or outside the vessel) and attainable performance levels.

The containment will be designed to resist the release of the mechanical energy caused by an hypothetical core accident or large sodium fires, to make sure that no countermeasures are necessary outside the site in the event of an accident.

Deployment Status and Planned Schedule

The pre-conceptual design phase was launched in October 2010 and involves 3 phases. The first was a preparatory phase that ended with an official review which launched the following phase in March 2011. The pre-conceptual design phase aims at analysing the open options in order to choose the reference design. Finally, the conceptual design started in 2013 and aims at consolidating the project data to obtain a final and consistent conceptual design by late 2015. The basic design phase is planned from 2016 to 2018.