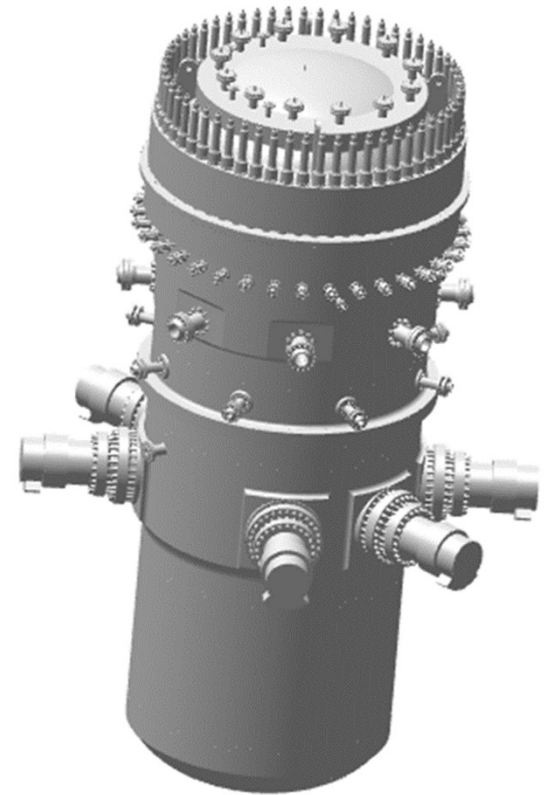


nuward

CEA: JACQUES CHENAIS
TECHNICATOME: MICHEL BRUN



IAEA TWG SMR meeting September 1-3 2020

SUMMARY

- SMR Interests and opportunities
- NUWARD™ Open to international cooperation
- NUWARD™ Status of current design
- NUWARD™ Time schedule for design and deployment
- SMR : A real opportunity to meet market demands

SMR Interests & Opportunities

■ Context

- Electricity is a key vector for limiting CO2 emissions. But the production of electricity with high CO2 emissions remains high (65% in 2000 vs 64% in 2018).
- Nuclear power is a key vector of pilotable low-carbon electricity production (not intermittent) but a relative market share which is decreasing (17% in 2000 vs 10% in 2018)
- Hence a search for a complementary approach to medium and large reactors : **SMR**.

■ SMR additional and relevant nuclear solutions to cope with :

- Carbon free, predictable and flexible generation, complementary to renewable energy strategies
- Affordable and progressive investment, with limited capital costs
- A range of relative small power outputs (from 150 to 400 MWe)
and other opportunities that cannot be properly fit by large reactors, due to site constraints, network capacity or access to the heat sink

■ Expressions of interests and market perspectives worldwide



NUWARD™: OPEN TO INTERNATIONAL COOPERATION



**NUWARD™ launched
at IAEA General
Conference last Sept.
2019**



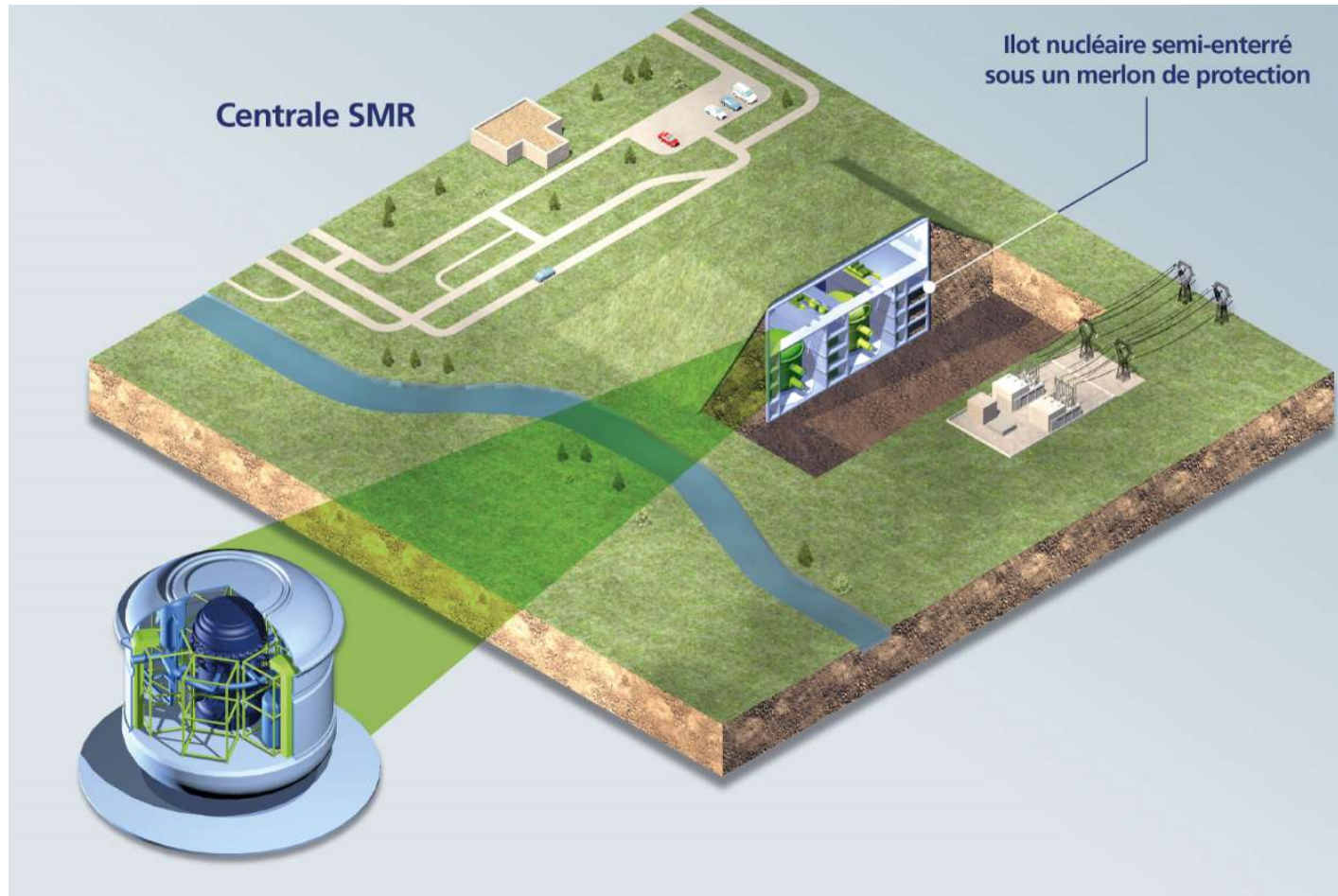
**Framework agreement
signature in Sept. 2019
between Westinghouse,
EDF & CEA to explore
potential cooperation on
SMR development**



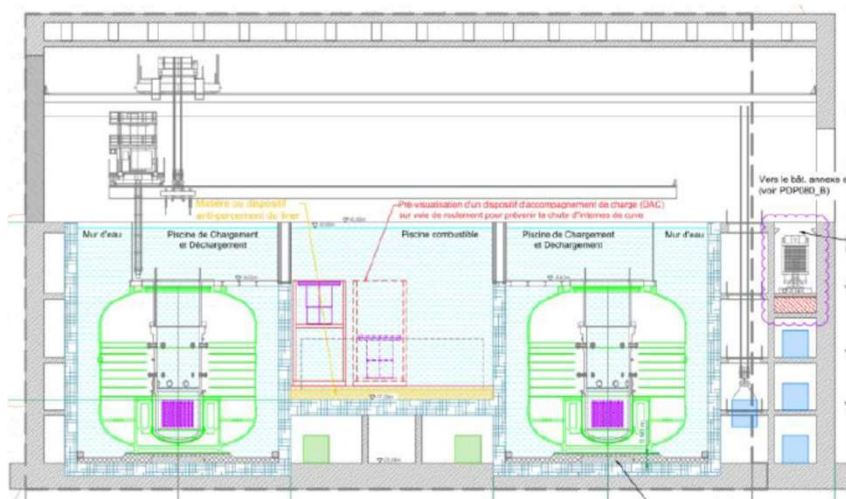
NUWARD™: A NEW COMMERCIAL REACTOR

- A safe, small, innovative and competitive reactor
 - **Innovative integrated reactor** : architecture without primary loops, compact primary components especially steam generators located inside the pressure vessel
 - **High level of safety** : resistance to hazards, passive systems with large grace period (no classified power supply/no external heat sink/no operator action), severe accident management, for a safe operation during several days
 - **Two independent reactors facility** : simplified and optimized architecture with a modular design and fabrication
 - **Low carbon energy, flexible and continuous generation** : complementary with renewable intermittent sources and with large nuclear power plants, alternative to existing fossil sources and allowing other applications (Combined Heat & Power, desalination...)
- Widening the Nuclear offer for international nuclear market
 - A facility of two reactors of 170 MWe each, to address the 300 to 400MWe market segment

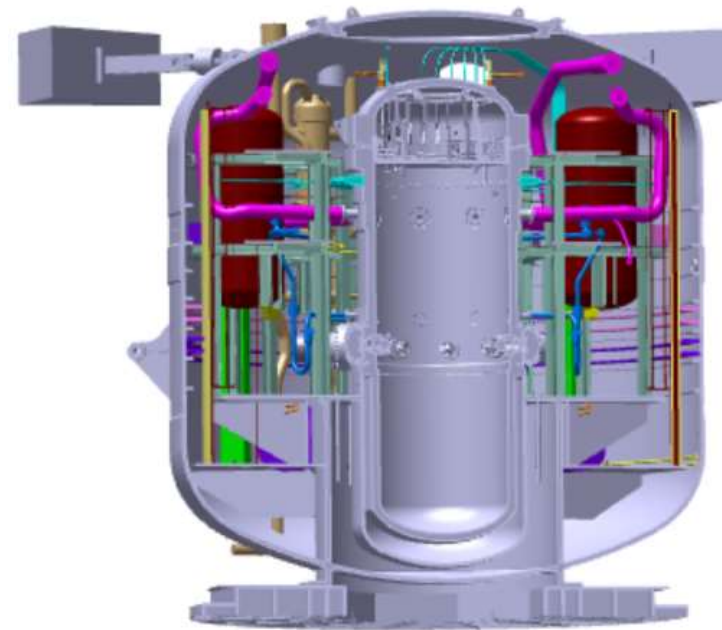
TO REPLACE A 340MWE COAL BASED ELECTRICITY PLANT



NUWARD™ DESIGN PROGRESS SUMMER 2020 – OVERALL DESIGN

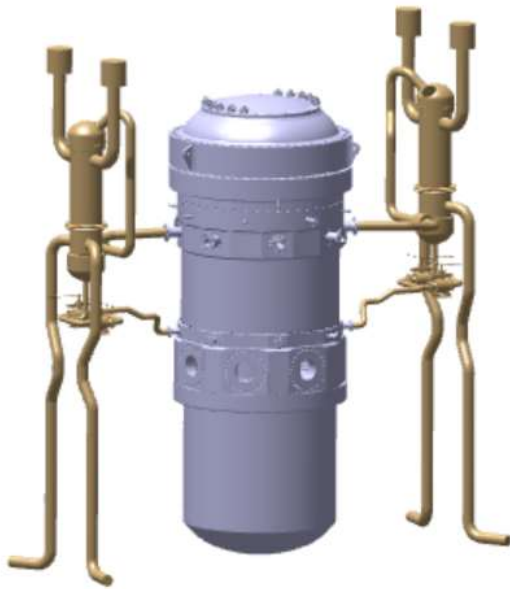


Optimization of the NI layout for a two-reactor configuration.



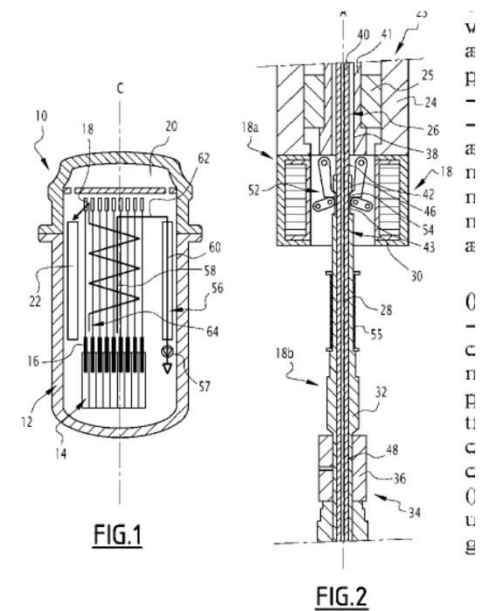
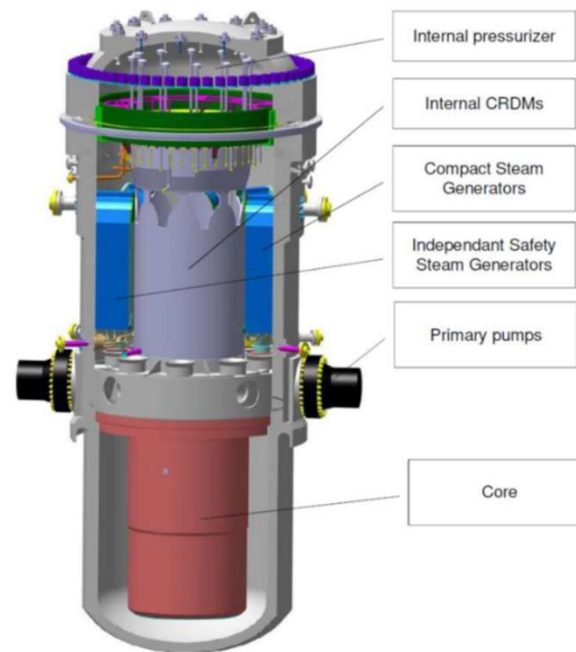
Refinement and optimization of the containment layout to simplify modular integration

NUWARD™ DESIGN PROGRESS SUMMER 2020 – REACTOR SYSTEMS



Improved design of the RRP passive HRS (thermohydraulics, safety, mechanical and thermomechanical)

Improved design of vessel internals : hydraulics and upper internals



NUWARD™ DESIGN PROGRESS SUMMER 2020 – INNOVATIVE TECHNOLOGIES (CSG)



Compact SG: set of mock-up
to set-up the manufacturing
process



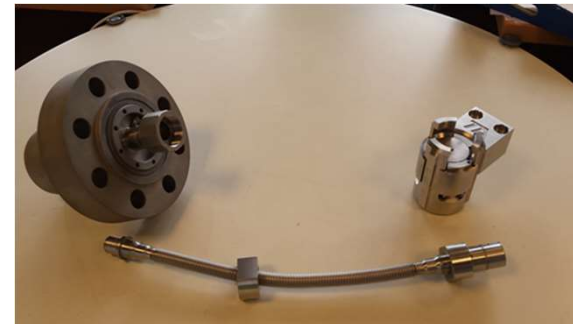
Experimental validation:

- SIMPA Temperature/pressure thermohydraulic testing of CSG performance in SG function : done
- EVEREST: P/T testing loop for the RRP passive system: loop and S-CSG mock-up are under construction

NUWARD™ DESIGN PROGRESS SUMMER 2020 – INNOVATIVE TECHNOLOGIES (CRDM)

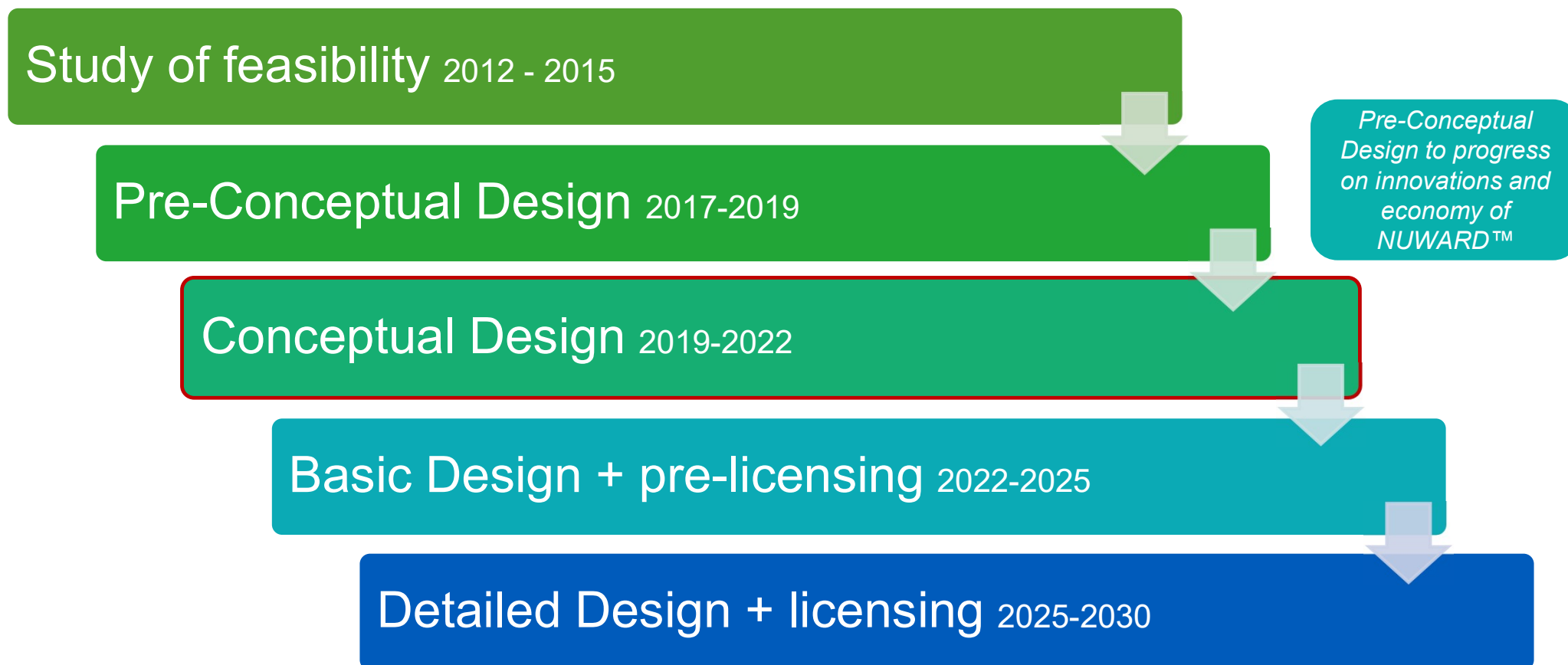


**Electrical CRDM : Two
hermetic technologies of
motor under high
temperature testing**



**In-vessel wiring: high
temperature testing
(HT/HP testing already
OK for penetration)**

NUWARD™ / ROADMAP OF DEVELOPMENT



SMR : A real opportunity to meet market demands

A proper response to high expectations

- A relevant and affordable solution for carbon free electricity
- Compatible with renewables and complementary with large nuclear

As world leaders in nuclear technology and operation, France is engaged with NUWARD™ to develop a valuable and competitive SMR solution in international cooperation

World Nuclear Exhibition in Paris next December 8-10th 2020 will focus on SMR technology during the third day (« SMR Day ») with two round tables « SMR Technical pitch and debate » and « SMR Harmonization and Beyond »