Status Report - ACP100S (China)

Downloaded on: Nov 17, 2026 2:27 PM CET

Published Date : Oct 17, 2024 7:23 PM CET

1. Overview

- ☐ **In Operation**
- ☐ **Under Construction**
- ☐ **Described in**

Link to PRIS	--

- ☑ **New Concept**

Number of Units	--
Year	2026

Reference Plant

Name of Site	--
Link to PRIS	--
Net Power Output (MWe)	125
Gross Power Output (MWe)	--

1.1 Introduction

ACP100S was developed based on its land-based reactor ACP100 whose pilot project has been under construction in Hainan province in China to provide capacity of 125 MW(e) per module. It inherits most of the main features of ACP100 with integrated design and could be used for power generation, desalination, heating, for offshore and open sea area, and isolated island, etc. It mainly adopts passive safety system with active passive measure as an implement to cope with the marine environment. It could be constructed in the shipyard and delivered to the sites, and satisfy the safety requirement of third generation PWR.

The ACP100S is a multipurpose power reactor designed for coastal and open sea areas, or isolated island where central electric grid is hard to reach. It could be used for electricity production, heating, steam production or seawater desalination.

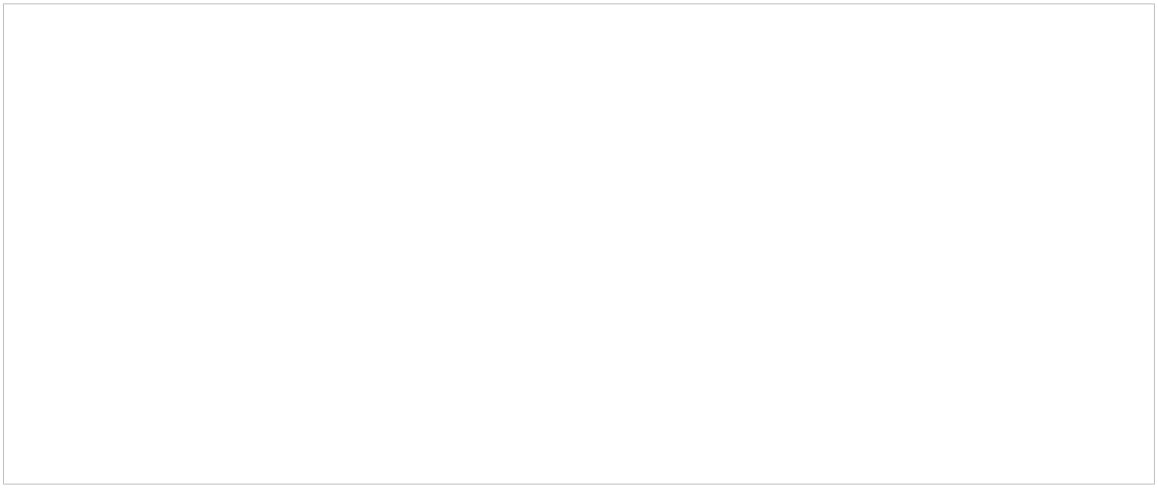


Figure 1. ACP100S design concept

1.2 Development Milestones

2012	The concept design of ACP100S completed
2018	The basic design of ACP100S completed
2019	Preliminary feasibility study for one site completed
2021	Preliminary design of ACP100S completed
2023	The demonstration of marine nuclear power completed
2024	The feasibility study of demonstration project completed
2026	Target to start construction

1.3 Design organization or vendor company

1.4 Links to designer/vendor website

1.5 Design Description

The ACP100S realizes design simplification by integrating the primary cooling system and enhanced safety by using the cooling water from the sea. It adopts mature design philosophy with land-based ACP100 being constructed. ACP100S could be constructed in the shipyard and factory, which greatly improve the economic competitiveness.

1.6 Licensing Application Support Documents

1.7 Reactor Unit in PRIS

2. Category Fields

Table 1: ARIS Category Fields

ARIS Category	Value	Units of Examples
Current/Intended Purpose	Commercial – Electric/Non-Electric	e.g. Commercial – Electric/Non-electric, Prototype/FOAK, Demonstration, Experimental
Main Intended Application (once commercial)	Baseload, Non-electric (district heating, steam production or seawater desalination.)	e.g. Baseload, Dispatchable, Off-grid/Remote, Mobile/Propulsion, Non-electric (specify)
Reference Location	On Coast, Inland, Floating-Fixed, Marine-Mobile	e.g. On Coast, Inland, Below-Ground, Floating-Fixed, Marine-Mobile, Submerged-Fixed (Other-specify)
Reference Site Design (reactor units per site)		e.g. Single Unit, Dual Unit, Multiple Unit (# units)
Core Coolant	H2O	H2O, D2O, He, CO2, Na, Pb, PbBi, Molten Salts, (Other-specify)
Reactor Core Size (1 core)		e.g. Thermal Power < 30 MWth, 30 MWth ≤ Thermal power < 1000 MWth, 1000 MWth ≤ Thermal power ≤ 3000 MWth, Thermal power > 3000 MWth
Reactor Type	PWR	e.g. PWR, BWR, HWR, SCWR, GCR, GFR, SFR, LFR, MSR, ADS
Reactor Size	SMR	e.g. PWR, SMR
Neutron Moderator	H2O	e.g. H2O, D2O, He, CO2, Na, Pb, PbBi, Molten Salts, (Other-specify)
NSSS Layout	Integral	e.g. Loop-type (# loops), Direct-cycle, Semi-integral, Integral, Pool-type
Primary Circulation	Forced	e.g. Forced (# pumps), Natural
Thermodynamic Cycle	Rankine	e.g. Rankine, Brayton, Combined-Cycle (direct/indirect)
Secondary Side Fluid	H2O	e.g. H2O, He, CO2, Na, Pb, PbBi, Molten Salts, (Other-specify)

Fuel Form	Fuel Assembly/Bundle	e.g. Fuel Assembly/Bundle, Coated Sphere, Plate, Prismatic, Contained Liquid, Liquid Fuel/Coolant
Fuel Lattice Shape	Square	e.g. Square, Hexagonal, Triangular, Cylindrical, Spherical, Other, n/a
Rods/Pins per Fuel Assembly/Bundle	17x17	e.g. #, n/a
Fuel Material Type	Oxide	e.g. Oxide, Nitride, Carbide, Metal, Molten Salt, (Other-specify)
Design Status	Basic Design	e.g. Conceptual, Detailed, Final (with secure suppliers)
Licensing Status		e.g. DCR, GDR, PSAR, FSAR, Design Licensed (in Country), Under Construction (# units), In Operation (# units)
Neutron Spectrum	Thermal	e.g. Fast, Thermal

3. Parameter Fields

Table 2: ARIS Parameter Fields

ARIS Parameter	Value	Units of Examples
Plant Infrastructure		
Design Life	40	Years
Lifetime Capacity Factor		%, defined as Lifetime MWe-yrs delivered / (MWe capacity * Design Life), incl. outages
Major Planned Outages		# days every # months (specify purpose, including refuelling)
Operation / Maintenance Human Resources		# Staff in Operation / Maintenance Crew during Normal Operation
Reference Site Design		n Units/Modules
Capacity to Electric Grid	125	MWe (net to grid)
Non-electric Capacity		e.g. MW(th) heat at x °C, m3/day desalinated water, kg/day hydrogen, etc.
In-House Plant Consumption		MWe

Plant Footprint	8000 (FNPP)	m2 (rectangular building envelope)
Site Footprint		m2 (fenced area)
Emergency Planning Zone		km (radius)
Releases during Normal Operation		TBq/yr (Noble Gases / Tritium Gas / Liquids)
Load Following Range and Speed		x – 100%, % per minute
Seismic Design (SSE)	N/A	g (Safe-Shutdown Earthquake)
NSSS Operating Pressure (primary side)	15	MPa(abs), i.e. MPa(g)+0.1, at core outlet
NSSS Operating Pressure (secondary side)	4.6	MPa(abs), i.e. MPa(g)+0.1, at secondary side outlet
Primary Coolant Inventory (incl. pressurizer)		kg
Nominal Coolant Flow Rate (primary)		kg/s
Nominal Coolant Flow Rate (secondary)		kg/s
Core Inlet Coolant Temperature	286.5	ºC
Core Outlet Coolant Temperature	319.5	ºC
Available Tempeature as Process Heat Source		ºC
NSSS Largest Component	RPV	e.g. RPV (empty), SG, Core Module (empty/fuelled), etc.
- NSSS Largest Component Length	10000	mm
- NSSS Largest Component Diameter	3350	mm
- NSSS Largest Component Thickness		mm
- NSSS Largest Component Weight	300	tonne
Reactor Vessel Material		e.g. SS304, SS316, SA508, 800H, Hastelloy N

Steam Generator Design		e.g. Vertical/Horizontal, U-Tube/ Straight/Helical, cross/counter flow
Secondary Coolant Inventory		kg
Pressurizer Design		e.g. separate vessel, integral, steam or gas pressurised, etc.
Pressurizer Volume		m3 / m3 (total / liquid)
Containment Type		Dry (single/double), Dry/Wet Well, Inerted, etc.
Containment Volume		m3
Spent Fuel Pool Capacity and Total Volume		Years of full-power operation / m3
Non Electric Application	district heating, steam production or seawater desalination.	-
Core Delta Temperature	33	ºC
Fuel/Core		
Single Core Thermal Power	385	MW(th)
Refuelling Cycle	24	months or “continuous”
Fuel Material	UO2	e.g. UO2, MOX, UF4, UCO
Enrichment (avg./max.)	<4.95	%
Average Neutron Energy		eV
Fuel Cladding Material		e.g. Zr-4, SS, TRISO, E-110, none
Number of Fuel “Units”		Specify as Assembly, Bundle, Plate, Sphere, or n/a
Weight of one Fuel Unit		kg
Total Fissile Loading (initial)		kg fissile material (specify isotopic and chemical composition)
% of fuel outside core during normal operation		Applicable to online refuelling and molten salt reactors
Fraction of fresh-fuel fissile material used up at discharge		%
Core Discharge Burnup	<52	MWd/kgHM (heavy metal, eg U, Pu, Th)
Pin Burnup (max.)		MWd/kgHM

Breeding/Conversion Ratio		Fraction of fissile material bred in-situ over one fuel cycle or at equilibrium core
Reprocessing		e.g. None, Batch, Continuous (FP polishing/actinide removal), etc.
Main Reactivity Control	Control rods, Burnable absorbers and soluble boron	e.g. Rods, Boron Solution, Fuel Load, Temperature, Flow Rate, Reflectors
Solid Burnable Absorber	Gd2O3	e.g. Gd2O3
Core Volume (active)		m3 (used to calculate power density)
Fast Neutron Flux at Core Pressure Boundary		n/(cm²*s)
Max. Fast Neutron Flux		n/(cm²*s)
Core Control Rod Absorber		-
Core Soluble Neutron Absorber	Soluble boron solution	-
Safety Systems		
Number of Safety Trains	Active / Passive	% capacity of each train to fulfil safety function
- reactor shutdown	Active/Passive	- / - / -
- core injection	Active/Passive	- / - / -
- decay heat removal	Active/Passive	- /- / -
- containment isolation and cooling	Active/Passive	- / - / -
- emergency AC supply (e.g. diesels)	Active/Passive	- / - / -
DC Power Capacity (e.g. batteries)		Hours
Events in which Immediate Operator Action is required		e.g. any internal/external initiating events, none
Limiting (shortest) Subsequent Operator Action Time		Hours (that are assumed when following EOPs)
Severe Accident Core Provisions		e.g. no core melt, IVMR, Core Catcher, Core Dump Tank, MCCI

Core Damage Frequency (CDF)		x/reactor-year (based on reference site and location)
Severe Accident Containment Provisions		e.g., H2 ignitors, PARs, filtered venting etc.
Large Release Frequency (LRF)		x/reactor-year (based on reference site and location)
Overall Build Project Costs Estimate or Range (excluding Licensing, based on the Reference Design Site and Location)		
Construction Time (nth of a kind)		Months from first concrete to criticality
Design, Project Mgmt. and Procurement Effort		Person-years (PY) [DP&P]
Construction and Commissioning Effort		PY [C&C]
Material and Equipment Overnight Capital Cost		Million US$(2015) [M&E], if built in USA
Cost Breakdown	%[C&C]/%[M&E]	
- Site Development before first concrete		(e.g. 25/10) (30/40) (20/25) (20/10) (5/15) (----------) (to add up to 100/100)
- Nuclear Island (NSSS)		
- Conventional Island (Turbine and Cooling)		
- Balance of Plant (BOP)		
- Commissioning and First Fuel Loading		
Factory / On-Site split in [C&C] effort		%/% of total [C&C] effort in PY (e.g., 60/40)
Nuclear System		
System Steam Flow Rate		kg/s
System Steam Pressure		MPa
System Steam Temperature		ºC
System Feedwater Flow Rate		kg/s
System Feedwater Temperature		ºC
Reactor Core		
Active Core Height		m

Equivalent Core Diameter		m
Average Linear Heat Rate		kW/m
Average Fuel Power Density		kW/kgU
Average Core Power Density		MW/m3
Outer Diameter Of Fuel Rods		mm

4. Plant Layout, Site Environment and Grid Integration

SUMMARY FOR BOOKLET

The ACP100S is a non-propelled FNPP mounted on the boat, and could be towed to locations where needed with the ability of operating independently. Actually, one or two NSSS modules could be installed on the boat according to the requirement, with the length of the boat about 200meters or 150 meters respectively. The containment figured in the reactor compartment is located in the middle of the boat to lower the effect caused by the ocean. The turbogenerator compartment is located next to the reactor compartment, and accommodations are arranged in astern. The ACP100S has enough space to figure reactor auxiliary compartment and I&C room, the cogeneration facility could be installed on the board or at the coastline according to the operation requirement.

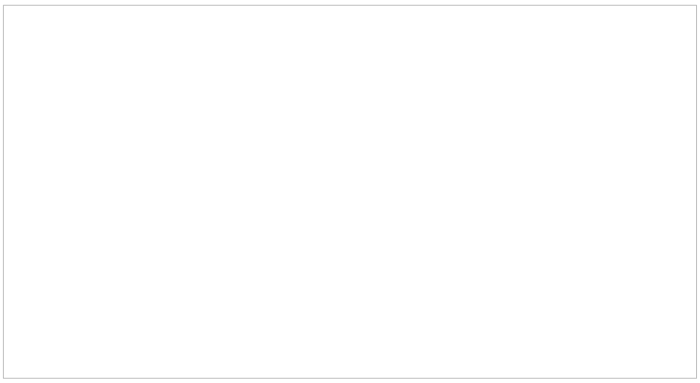


Figure 2. ACP100S marine nuclear power platform

4.1 Site Requirements during Construction
4.2 Site Considerations during Operation
4.3 Grid Integration

5. Technical NSSS/Power Conversion System Designn

SUMMARY FOR BOOKLET

Nuclear Steam Supply System

The integrated nuclear steam supply system (NSSS) design consists of the reactor core, and sixteen (16) once-through steam generators (OTSG). The four (4) canned motor pumps are installed nozzle to nozzle to the RPV. All these technologies provide high inherent safety and avoid large LOCA in large-size nuclear power plant.

Reactor Core

The 57 fuel assemblies (FAs) of ACP100S core with total length of 2.15 m core have a squared 17×17 configuration. The fuel 235U enrichment is about 1.9 – 4.95%. The reactor will be able to operate 24 months at balance fuel cycle.

Reactivity Control

The reactivity is controlled by means of control rods, solid burnable poison and soluble boron dissolved in the primary coolant. There are 20 control rods, with a magnetic force type control rod driving mechanism (CRDM).

Reactor Pressure Vessel and Internals

The RPV and equipment layout are designed to enable the natural circulation between reactor core and steam generators. The RPV is protected by safety relief valves against over-pressurization in the case of strong difference between core power and the heat removed from the RPV.

The internals not only support and fasten the core but also form the flow path of coolant inside RPV.

Reactor Coolant System

The ACP100S primary cooling mechanism under normal operating condition and shutdown condition is done by forced circulation. The RCS has been designed to ensure adequate cooling of reactor core under all operational states, during and following all postulated off normal conditions. The integral design of RCS significantly reduces the flow area of postulated small break LOCA.

Steam Generator

There are 16 OTSGs, which are mounted within the RPV. All the 16 OTSGs are figured in the annulus between the reactor vessel and hold-down barrel. The bottoms of OTSGs are limited their position by the hole on barrel supporting hub, the heads are welded to the reactor vessel steam cavity.

Pressurizer

The pressurizer of ACP100S is located outside of the reactor vessel. The pressurizer is a vertical, cylindrical vessel with hemispherical top and bottom heads.

Primary pumps

The ACP100S uses canned-motor pumps as reactor coolant pumps which are directly mounted on the RPV nozzle. The shaft of the impeller and rotor of the canned-motor pump is contained in the pressure boundary, eliminating the seal LOCA of reactor coolant pump.

Instrumentation and Control System

The Instrumentation and Control (I&C) system designed for ACP100S is based on defence in depth concept, compliance with the single failure criterion and diversity. The diversity in the design of I&C system is achieved through: (1) different hardware and software platforms for 1E and N1E I&C, (2) reactor protection system (RPS) with functional diversity, and (3) diverse protection systems to cope with the common mode failure of the RPS. I&C systems of the NSSS include reactor nuclear instrumentation system, RPS, diverse actuation system, reactor control system, rod control and rod position monitoring system, reactor in–core instrumentation system, loose parts and vibration monitoring system and other process control systems.

5.1 Primary Circuit
5.2 Reactor Core and Fuel
5.3 Fuel Handling
5.4 Reactor Protection
5.5 Secondary Side
5.6 Containment/Confinement
5.7 Electrical, I&C and Human Interface
5.8 Unique Technical Design Features (if any)

6. Technology Readiness

SUMMARY FOR BOOKLET

Testing Conducted for Design Verification and Validation

Since ACP100S is developed based on mature ACP100 most of verification tests have been finished, such as CHF, test relevant with SG, flow induced vibration of internals, etc. Experiments are mainly planned to verify the new design brought by the ocean environment. For example, the control rod drive line cold and hot test, containment scale structure test, and containment suppression test are in progress. ACP100S has a mature NSSS with only small part of verification needed.

Design and Licensing Status

Presently, the licensing of ACP100S is yet to be launched. The preliminary feasibility study of ACP100S has been finished aiming at the site in city of Yantai and Fuqing in the East of China.

6.1 Deployed Reactors
6.2 Reactors under Licensing Review
6.3 Reactors in the Design Stage

7. Safety Concepts

SUMMARY FOR BOOKLET

Engineered Safety System Approach and Configuration

The ACP100S is designed with inherent features, eliminating large primary coolant piping which in turns eliminates large break LOCA. It mainly adopts passive safety system with active passive measure as a supplement to cope with the marine environment. The safety system mainly consists of the passive decay heat removal system (PDHRS), passive emergency core cooling system (ECCS), passive containment suppression system (PCS) and active containment spray system.

Decay Heat Removal System

The PDHRS prevents core meltdown in the case of design basis accident (DBA) and beyond DBA, such as station black out, complete loss of feedwater, small-break LOCA (i.e., to prevent the change of beyond DBA to severe phase). The PDHRS of ACP100S consists of two residual remove exchangers and associated valves, piping, and instrumentation. The residual heat remove exchanger is located in the passive residual heat remove water storage tank mounted on left and right side of shipboard, which provides the heat sink for the emergency cooler. The decay heat is removed from the core by natural circulation. The PDHRS provides core cooling for 72 hours without operator intervention.

Emergency Core Cooling System

The emergency core cooling system (ECCS) consists of two safety injection system and recirculation system, which mainly include two core make-up tanks (CMT), two low head pressure injection pumps and associated injection lines and valves. In the DBA, cooling water from the CMTs would be injected to the reactor core by gravity force to cool down the reactor core, and recirculation would be generated for long term after the DBA accident.

Spent Fuel Cooling Safety Approach / System

ACP100S adopts the mature shore refuelling strategy, and would be towed to the dock when refuelling is needed after one refuelling period of 24 month.

Containment System

The ACP100S use small steel containment containing one module of the NSSS. It's a vertical, cylindrical vessel with hemispherical top and bottom heads, a personnel gate is mounted on the cylindrical side and a hemishperical top gate is set as a refuelling gate. The containment is figured in the reactor compartment which is a reinforced structure of the boat. The containment could withstand the maximum pressure during DBA of NSSS, and also withstand the external water pressure in the sink accident.

Plant Safety and Operational Performances

Nuclear safety is always the first priority. The ultimate goal of nuclear safety is to establish and maintain an effective defence that can effectively protect people, community, and environment from radioactive disaster. To be specific, the design and operation of ACP100S ensures that radiation dose to the workers and to the members of the public do not exceed the dose limits and kept it as low as reasonably achievable. Accident prevention measures ensure that radioactive consequences are lower

than limited dose in terms of all the considered accident sequences and even in the unlikely severe accidents, mitigation of accidents induced influences can be ensured by implementing emergency plan. The design of ACP100S incorporates operational experience of the state-of-the-art design. Proven technology and equipment are adopted as much as reasonably possible. It's estimated that ACP100S has the core damage frequency (CDF) of less than 1×10-5 per reactor year and the large release frequency (LRF) of 1e-6 per reactor year. The load factor is no less than 0.9.

7.1 Safety Philosophy and Implementation
7.2 Transient/Accident Behaviour

8. Fuel and Fuel Cycle

SUMMARY FOR BOOKLET

Fuel Cycle Approach

Spent fuel processing is conducted on the shore, using the service facility prepared at the base harbour, which is similar to the land-based reactor.

Waste Management and Disposal Plan

After waste is transported to the base harbour, the waste management approach and disposal plan is similar to other nuclear power plants.

8.1 Fuel Cycle Options
8.2 Resource Use Optimization
8.3 Unique Fuel/Fuel Cycle Design Features

9. Safeguard & Physical Security

SUMMARY FOR BOOKLET

9.1 Safeguards
9.2 Security
9.3 Unique Safeguards and/or Security Features

10. Project Delivery & Economics

SUMMARY FOR BOOKLET

10.1 Project Preparation and Negotiation
10.2 Construction and Commissioning
10.3 Operation and Maintenance