



KELASA ISLAND (107°04'34" E - 02°24'53" S)

PRESENT STATUS OF A MOLTEN SALT REACTOR NUCLEAR POWER PLANT DEVELOPMENT IN INDONESIA

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- Current Status of Indonesia's NPP (including SMR) Introduction Plan
- Current Status of ThorCon's Thorium Molten Salt Reactor (TMSR-500) Introduction Plan in Indonesia.
- Disclaimer:
 - TMSR-500-related original figures and graphs were taken from ThorCon's publicly available documents, and PT ThorCon Power Indonesia (PT TPI) grants copyright.
 - The TMSR-500 design information and the implementation schedule/timeline in this presentation are still evolving and do not necessarily reflect the ongoing or final design.

Current Status of Indonesia's NPP Introduction Plan

Summary of NPP Introduction Plan

• Introduction Plan (Past)

- Since the 1960s, R&D into the peaceful use of nuclear energy (including NPP) and infrastructure development have been ongoing.
- In 2009, the IAEA's Integrated Nuclear Infrastructure Review (INIR) Phase 1 (19 items) identified **three weak points**:
 - Specific items for plan implementation (national positioning),
 - Plan management system (Nuclear Power Project Implementation Organization: NEPIO),
 - Promoting public understanding and finances.
- **Postponement of political decisions**
- **Fukushima Daiichi NPP accident**

• SMR Introduction Plan (Recent)

- Barge-type thorium MSR (**electric** generation, 500 MW, Bangka Belitung Province) [**TMSR-500**] by ThorCon, a US company.
- A small-scale PWR (**electric** generation, 463 MW, West Kalimantan Province) [**VOYGR-6**] by NuScale, a US company.
- A small-scale thorium MSR (**heat** utilization, 1 GW (25 units), East Kalimantan Province) by Copenhagen Atomics, a Danish company.
- A small-scale BWR (**electric** generation, 300 MW) by GE Hitachi/Hitachi-GE, a Japanese-American company. [**BWRX-300**]

NuScale PWR (SMR)

- US Awards Grant As Asian Nation Plans First SMR On Island Of Borneo (2023/3/21)
- Jakarta has chosen US reactor company NuScale to provide technology for the SMR unit
- Smelter (Alumina)



Memorandum of Understanding :
National Electric Power Company (PLN), National
Research and Innovation Agency (BRIN)

Thorium Molten Salt (SMR)

- Danish Companies Sign Agreement For \$ 4 Billion Thorium SMR In Borneo (2023/5/22)
- Copenhagen Atomics, Topsoe, Alfa Laval, and Aalborg CSP (Denmark)
- Pupuk Kaltim, Pertamina New & Renewable (Indonesia)
- Aim is to deploy nuclear plant on Indonesian island for ammonia production (Fertilizer)
- Site: Bontang (Eastern Borneo)
- 1 GWth (25 SMRs)
- 2028 COD, 50-year life-time



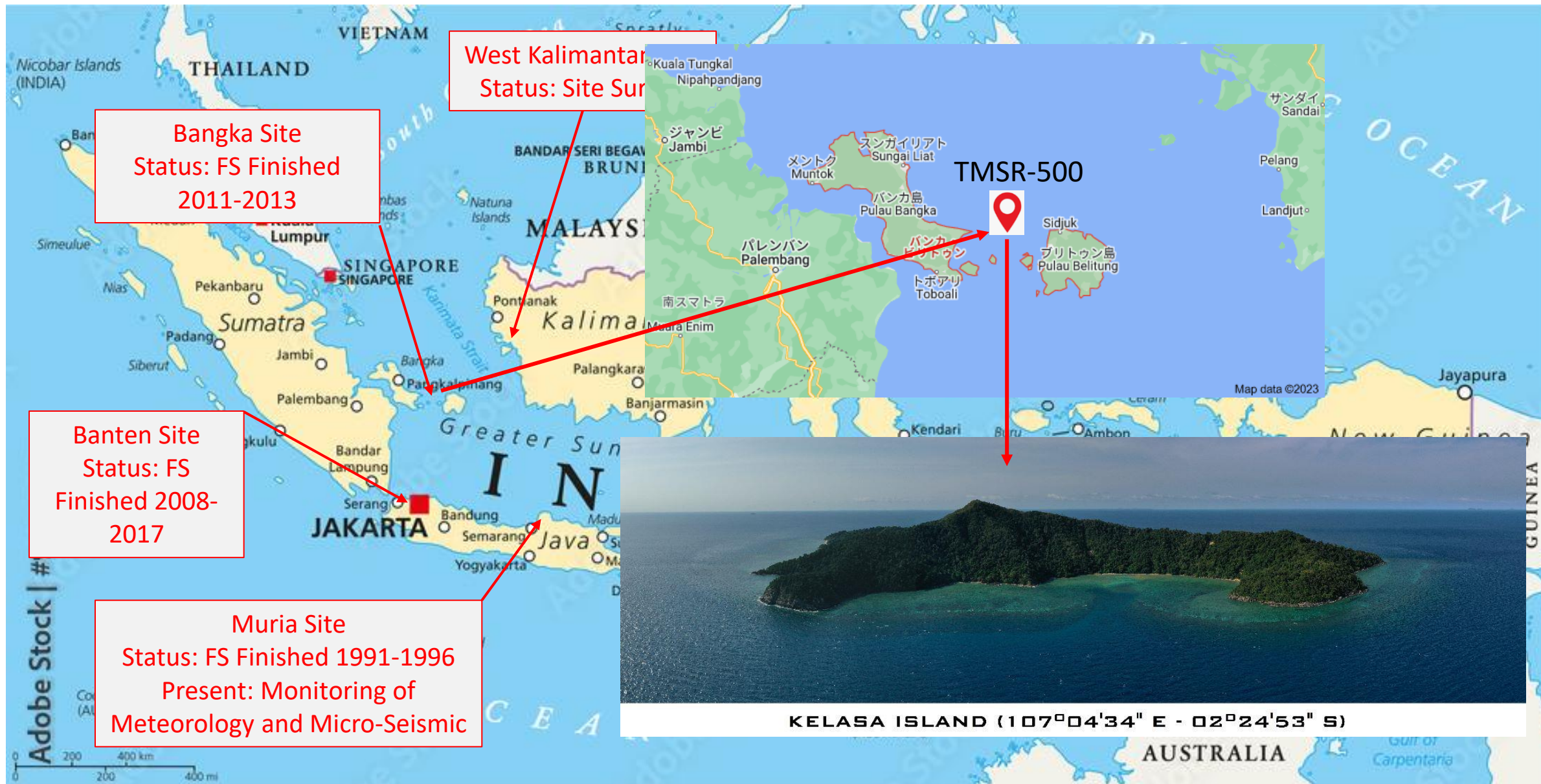
Memorandum of Understanding:
National Oil Company (Pertamina),
East Kalimantan Fertilizer Factory State Company
(Pupuk Kaltim)

BWRX-300 (SMR)

- At the invitation of the METI, in 2023, the Indonesian National Energy Council (DEN) visited Japanese companies (Hitachi GENE, IHI and JGC) collaborating with the US-promoted SMR (BWRX-300) project.



経済産業省 資源エネルギー庁との原子力エネルギー政策に係る情報交換



Current Status of ThorCon's Thorium Molten Salt Reactor (TMSR-500) Introduction Plan in Indonesia.

ThorCon Summary

Martingale

- Martingale Inc. (Parent Company)
- 2015: TMSR-500 Deployment Plan to Indonesia



ThorCon
Intl.

- 2018: ThorCon International Pte. Ltd. (Subsidiary)
- Jakarta Rep. Office (Singapore Head Office)



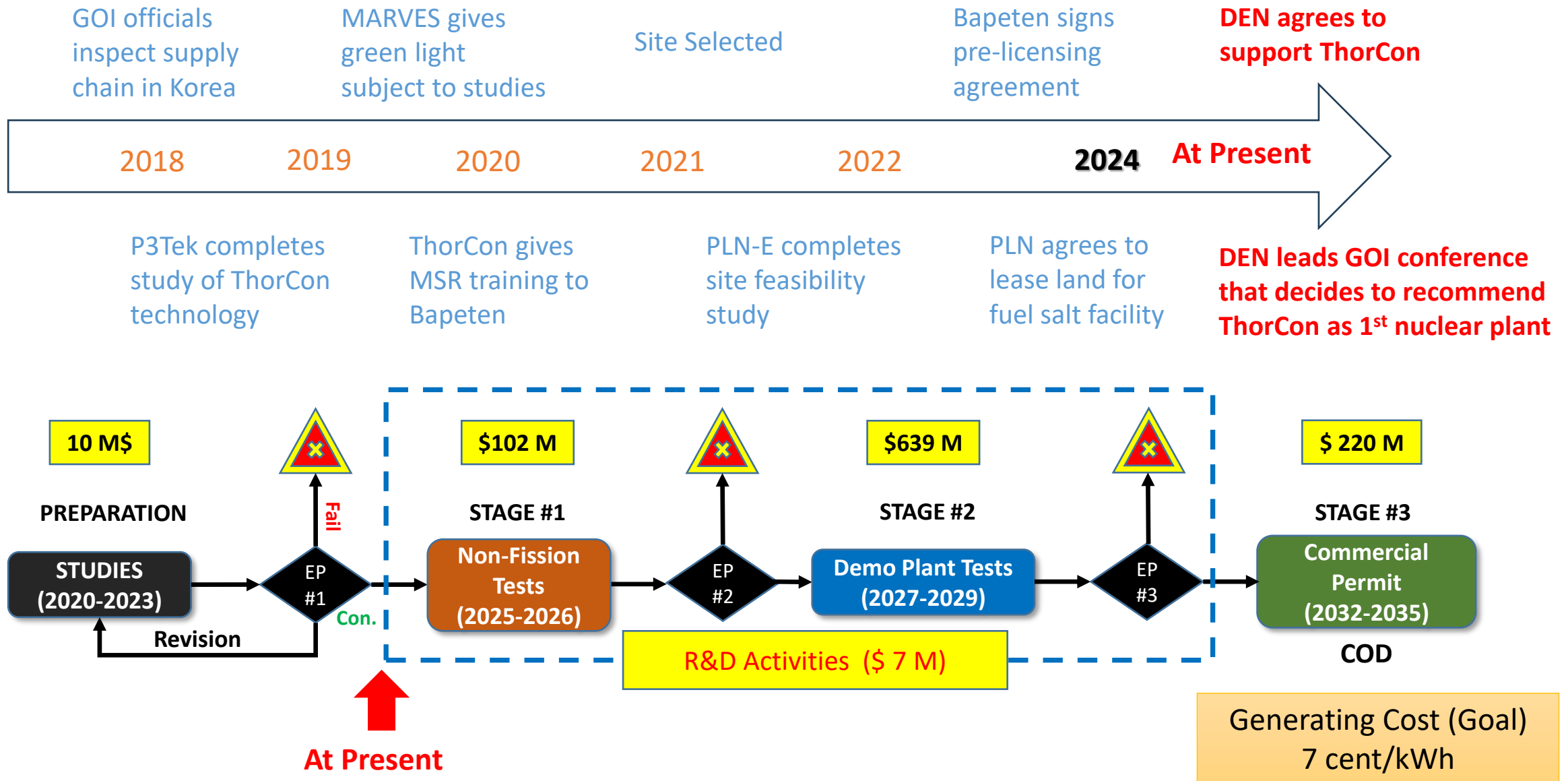
PT ThorCon
Power
Indonesia

- 2021: PT ThorCon Pow. Ind. (FDI Company)
- Bangka-Belitung Prov. Branch Office

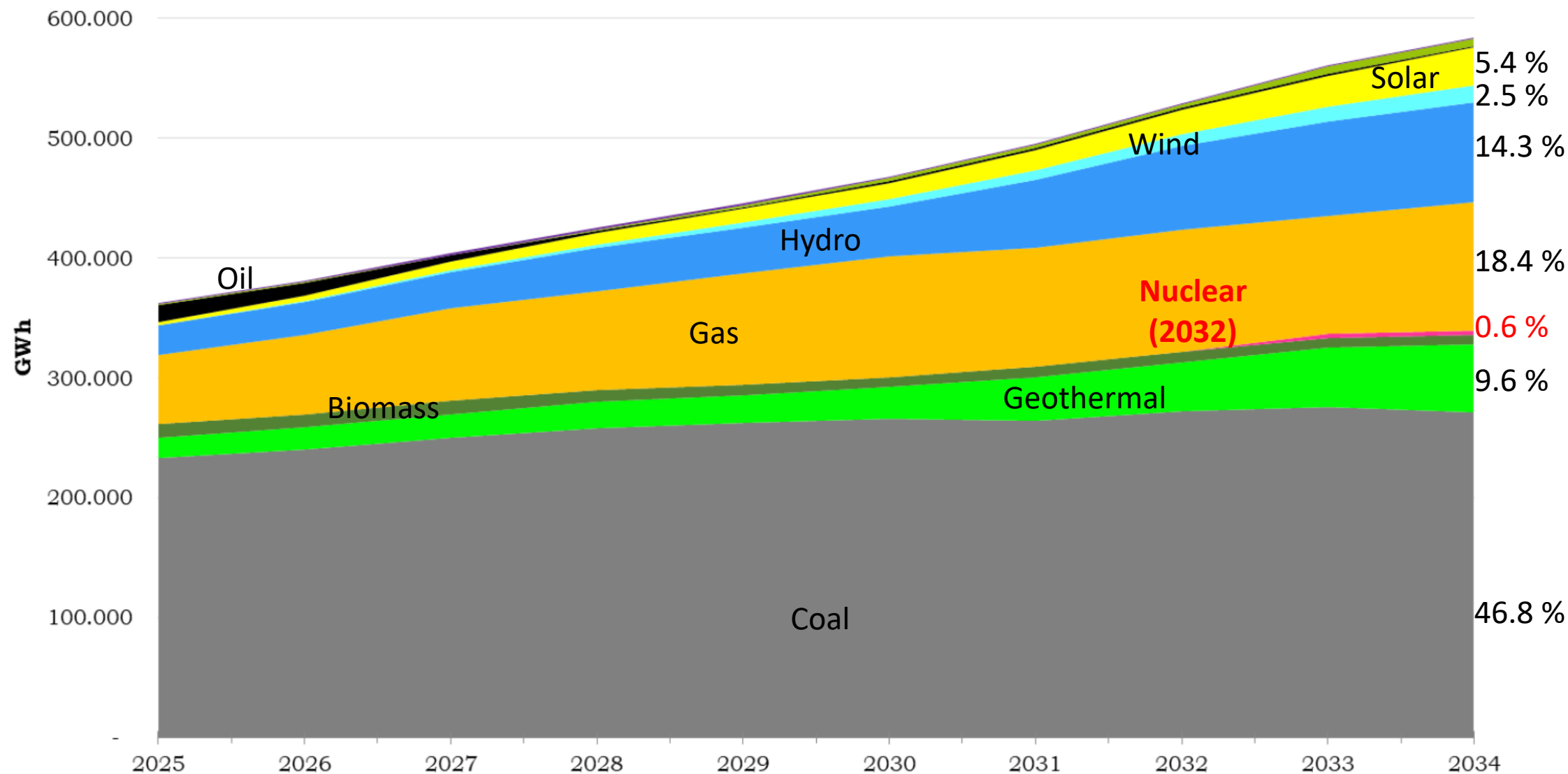


Kelasa Island (TMSR-500 Site)

TMSR-500 Deployment Time Line



Energy Mix (2025-2045) ARED Scenario



Present

Domestic Activities by PT TPI for TMSR-500 Demo Plant

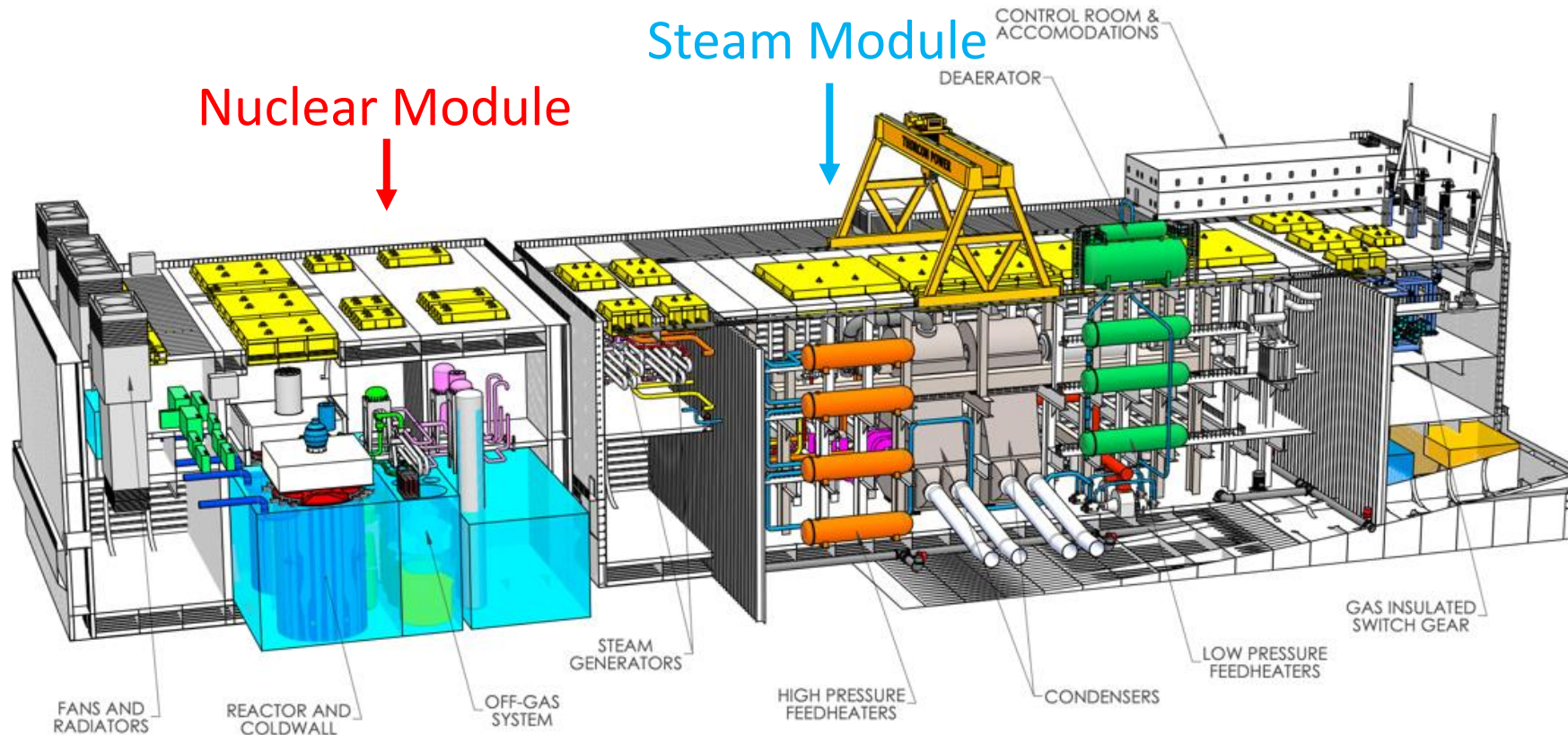
Activity	Collaboration Institute	Phase/Status	Results and Remarks
Feasibility Study	PLN Enjiniring (PLN subsidiary Company)	2021–2023 (completed)	Survey and evaluation results of the site, power grid, and economic viability (details not disclosed).
Public Acceptance Survey	Sebelas Maret University	2021 (completed)	The acceptance rate among residents is 63%.
Safety Evaluation	Gadjah Mada University (UGM) and Empresarios Agrupados (EA)	2022–2023 (completed)	The conceptual design data for the TMSR–500 indicate that it is safe enough to withstand the level of the Fukushima Daiichi nuclear accident.
Engineering Design	ThorCon International & EA	2021–2026 (on-going)	The goal is to complete the basic design of the TMSR–500 by 2026.
Research & Development	BRIN (former BATAN)	2022–2025 (on-going)	Technical consultations and information exchanges
Fuel Salt Laboratory Development	Bandung Institute of Technology (ITB)	2021–2025 (on-going)	Developed a purification technology for FLiNaK salt. The physical and chemical properties of FLiNaK salt are similar to those of the actual fuel salt (NaBe system).
Ecological survey of Kelasa Island	Bangka Belitung University & UGM	2022–2023 (completed)	An initial baseline of the ecosystem on Kelasa Island and its surrounding areas

International Activities by ThorCon International

- **Milano Multiphysics (MMP) in Italy**: Technical support, design analysis, and optimization of the TMSR-500 (2020-present).
- **Empressarios Agrupados (EA) in Spain**: Engineering consulting (2021-present).
- **Bureau Veritas (BV) in the United States**: Support for technical qualification in the integration of reactors, encapsulation (fuel management system), and hulls (2022-present).
- **Virginia Tech. University in the United States**: Research and development on fuel salts.
- **University of California, Berkeley in the United States**: Research and development on molten salts.

500 MW ThorCon Molten Salt Reactor (TMSR-500) Power Plant

Demonstration Plant to Be Tested for Licensing in Indonesia



Design Goals:

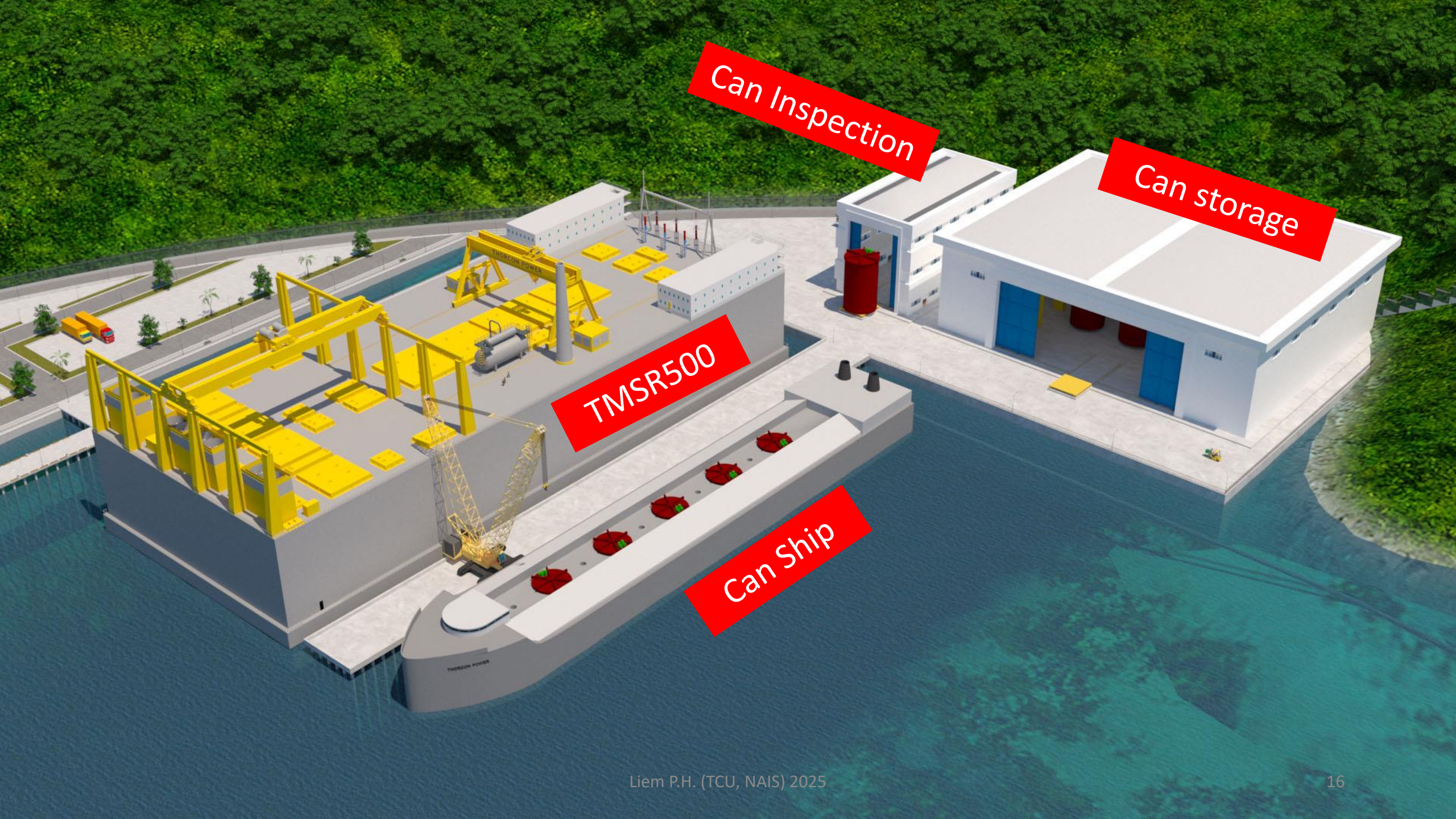
- 1 GWe costs \$1.2 billion
- 7 Cent \$/kWh
- 2 years to build and install
- 46 – 48 % thermal efficiency
- Blackstart
- Load following @ 5%/min

Design Features:

- MSR, graphite moderator,
- thermal spectrum, replaceable cores.

Built in shipyard, towed to site, ballasted down onto seabed.

Nuclear Module is replaced every 8 years



Can Inspection

Can storage

TMSR500

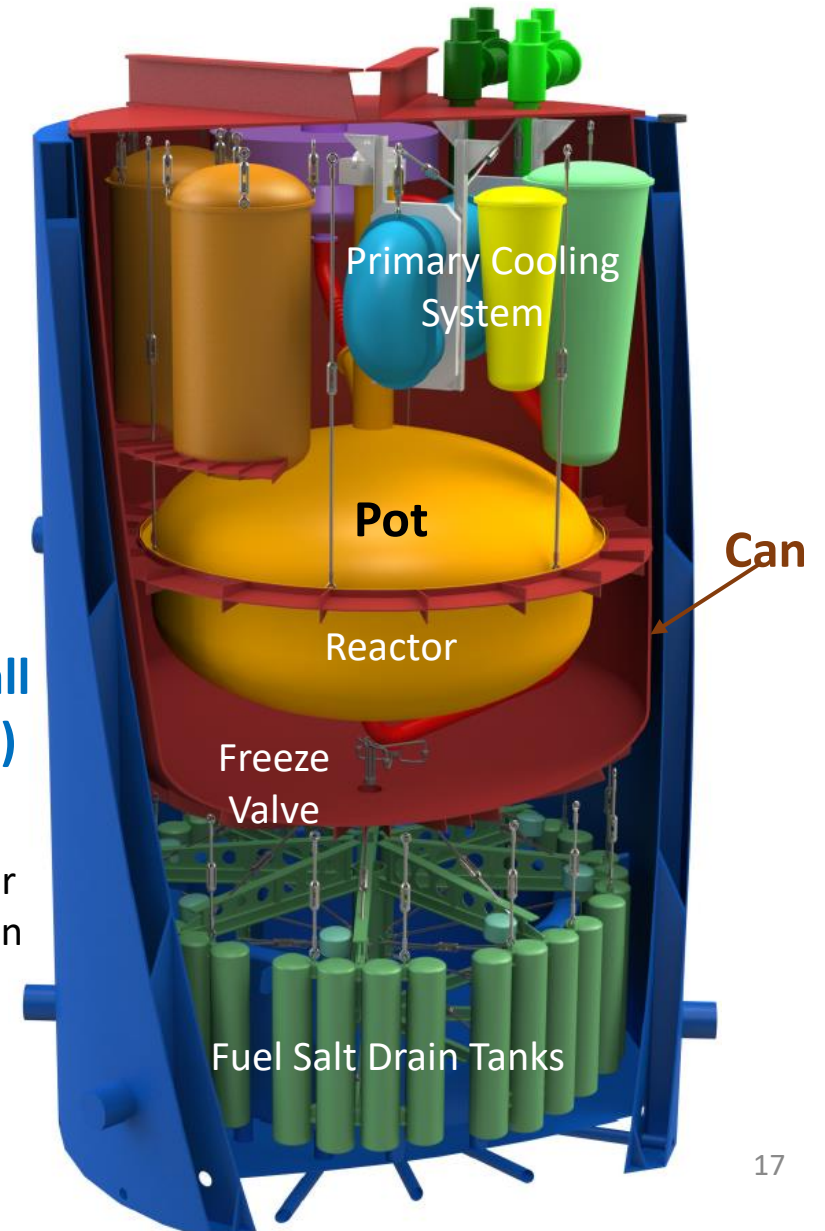
Can Ship

TMSR-500 Main Design Parameters

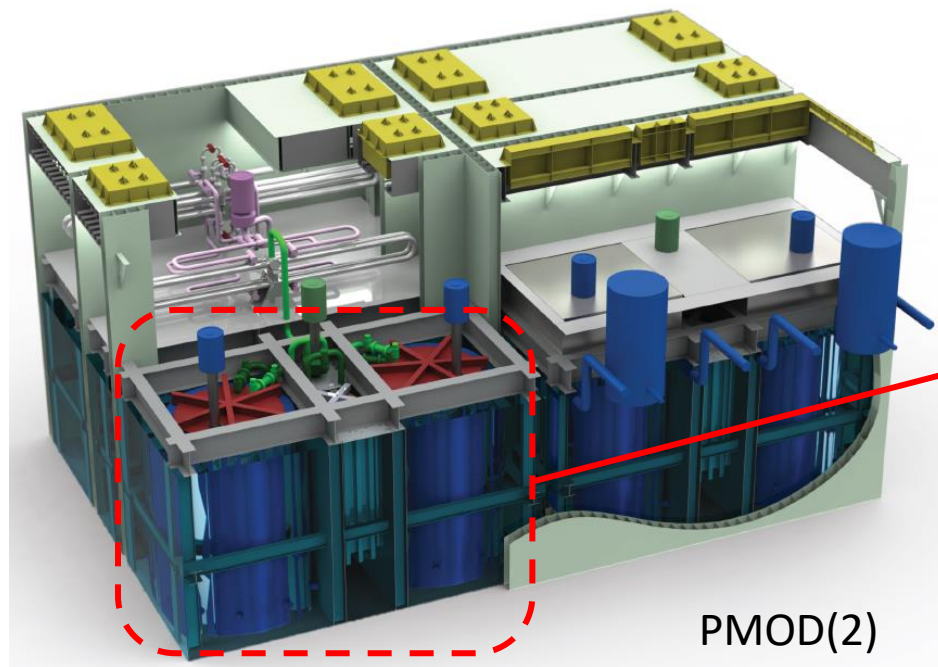
Design Paramter	Value
Electrical Output/Barge	500 MWe (@250 MWe/Reactor)
Operation Mode	Base Load or Load Following
Core Cycle	8 years (max.)
Maintenance Schedule	Every 4 years: 30 days
Capacity Factor	90 %
Fuel Salts	NaF-BeF ₂ -UF ₄ -ZrF ₄ or NaF-BeF ₂ -ThF ₄ -UF ₄ -ZrF ₄
Enrichment	19.85 % (initial), 4-5 % (add)
Moderator	黒鉛
Structures	ステンレス鋼
Fuel Inlet/Outlet Temp.	560 °C/ 704 °C
Fuel Flow Rate	1.1 (m ³ /s)
Pressure	2 - 8 (bar)

Double Wall (Cold Wall) Silo

Cooling water
flows between
walls



ThorCon's Fission Island – Power Module (PMOD) Concept



PMOD(1)
(250 MWe)

PMOD(2)
(250 MWe)

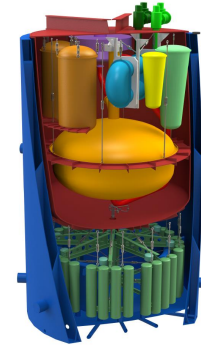
Electric Output 500 MWe

Plant Name

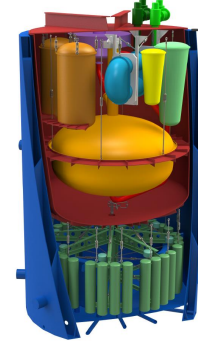
TMSR-500

PMOD(1)

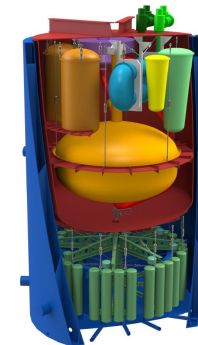
PMOD(2)



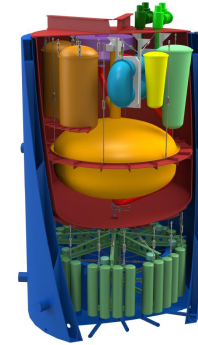
Can(1)
(250 MWe)
Operation



Can(2)
(0 MWe)
Cooling



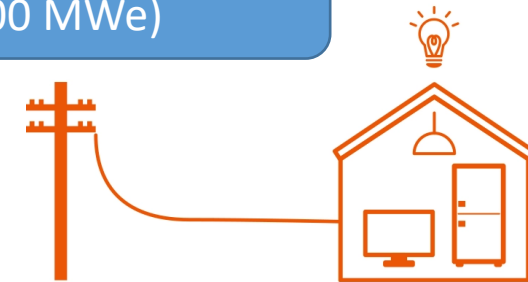
Can(1)
(250 MWe)
Operation



Can(2)
(0 MWe)
Cooling

Super-critical Steam Loop
(500 MWe)

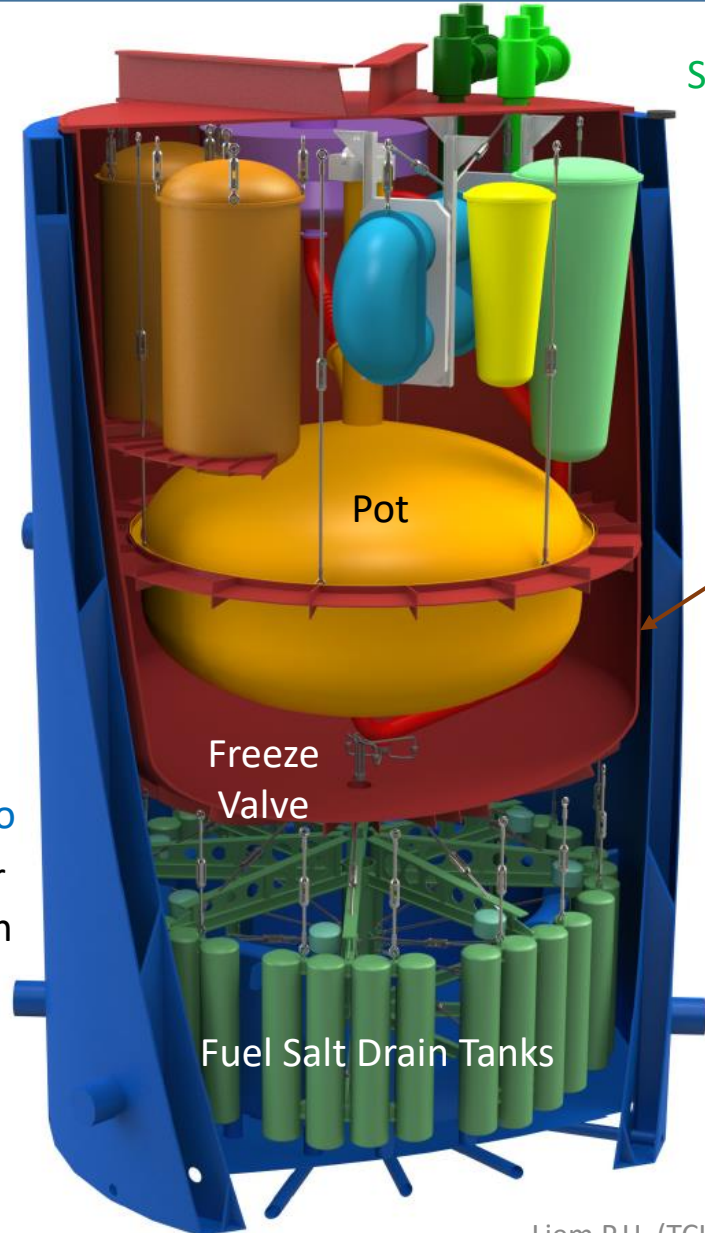
4 + 4 years
Operation-Cooling
Cycle



ThorCon's Pot/Can/Silo Concept

Can thermal output	557 MW
Can electrical output	250 MW
Plant efficiency	46.3%
NaF-BeF ₂ -ThF ₄ -UF ₄	fuelsalt
76/12/10.2/1.8	mol pct
Vapor Pressure@704C	≤3 Pa
Fuelsalt flow kg/s	2955
Pot inlet C	565
Pot outlet C	704
Loop transit time	11.6 sec
Pot outlet press	2.6 barg
α_K :pcm/K	-3

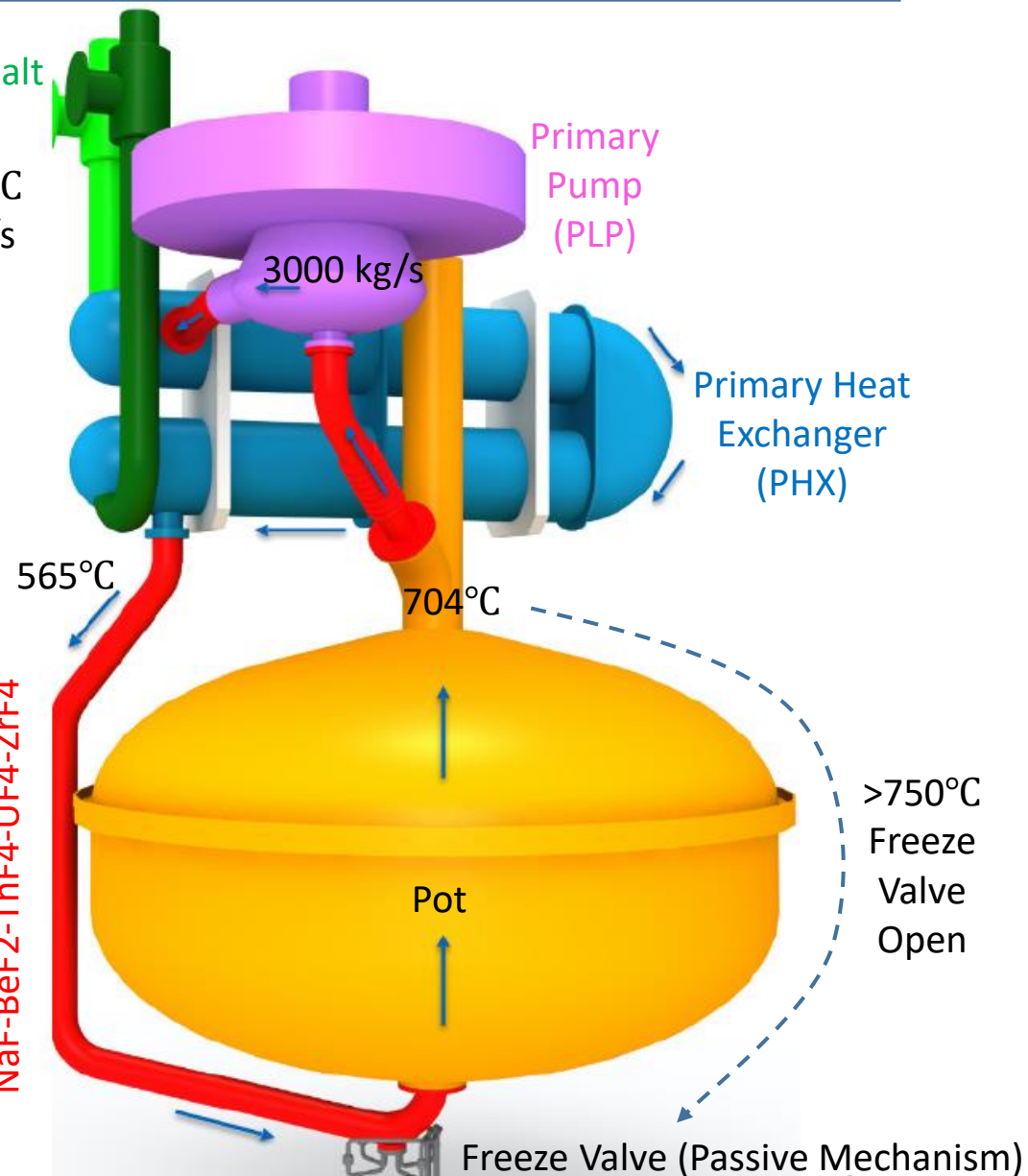
Double Wall
(Cold Wall) Silo
Cooling water
flows between
walls



Secondary Salt
NaF-BeF₂
621/454°C
1543 kg/s

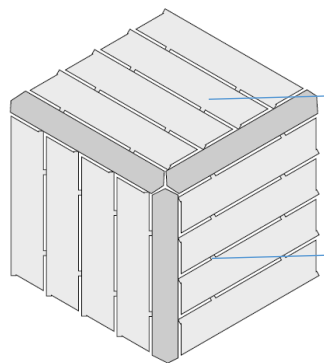
Can

Primary Salt (Fuel)
NaF-BeF₂-UF₄-ZrF₄ /
NaF-BeF₂-ThF₄-UF₄-ZrF₄



Plan Views of Pot at Full Hot Cond.

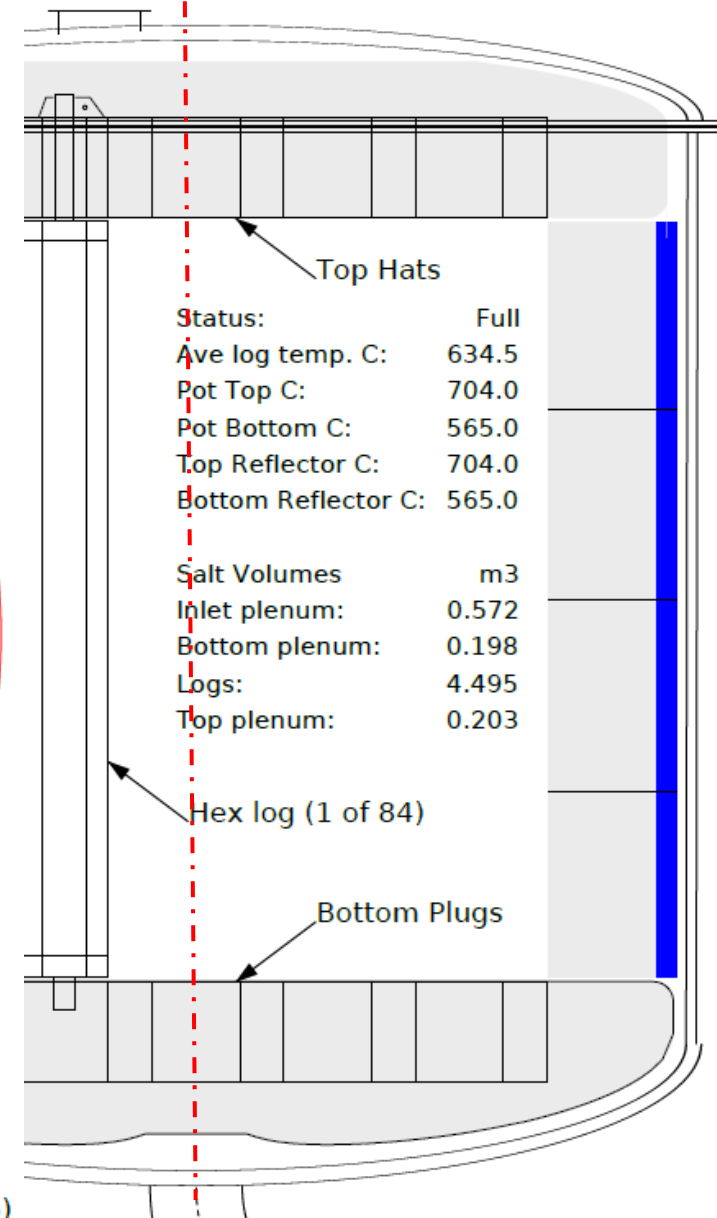
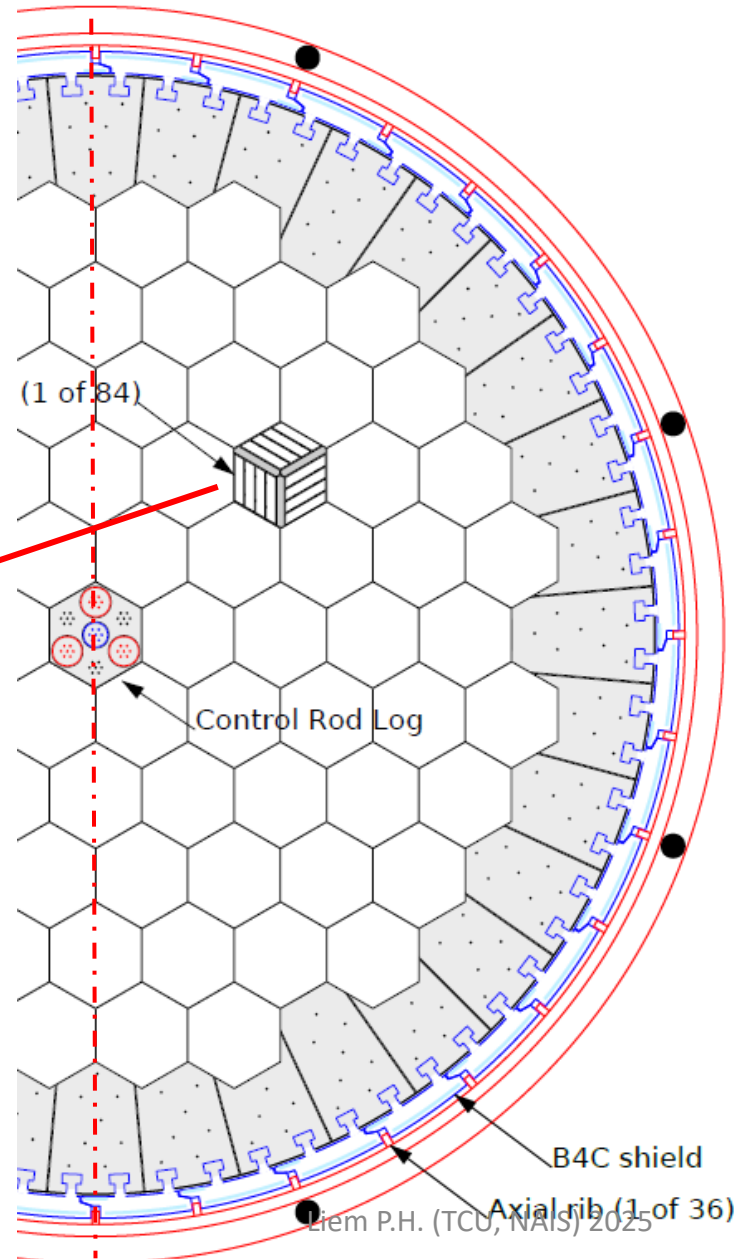
Number of fuelsalt logs: 84
 Salt Volume in logs(m3): 4.495
 Moderator kg: 66089
 Side reflector kg: 42197
 Shield kg: 10402
 B4C Fraction: 0.100
 Hot Pot vessel ID(mm): **4860.96**
 Cold salt annulus width(mm): 5.00
 Hot salt annulus width(mm): 25.24
 Salt volume in annulus(m3): 1.75
 Shield thickness(mm): 100.00



Graphite
4 year life-time

Fuel Salt
3.4 kg/day

Log Hexagon Side (mm): 220.03
 Slab thick(mm): 39.84
 Nub height(mm): 3.80
 Fraction salt: **0.1112**



Pot Height
5500 mm

Closing Remarks

- Indonesia's nuclear power plant plans have been said to have an uncertain future. Against this backdrop, ThorCon's plan to introduce the TMSR-500 offers hope for the realization of nuclear power plants.
- However, because this reactor is considered a next-generation reactor, there is little experience or track record with it, both domestically and internationally. Furthermore, Indonesia lies on the Pacific Ring of Fire, making it prone to natural disasters such as earthquakes, volcanic eruptions, and tsunamis.
- We look forward to the participation and cooperation of international communities in the development of the TMSR-500 plant.