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Steam Cycle HTGR

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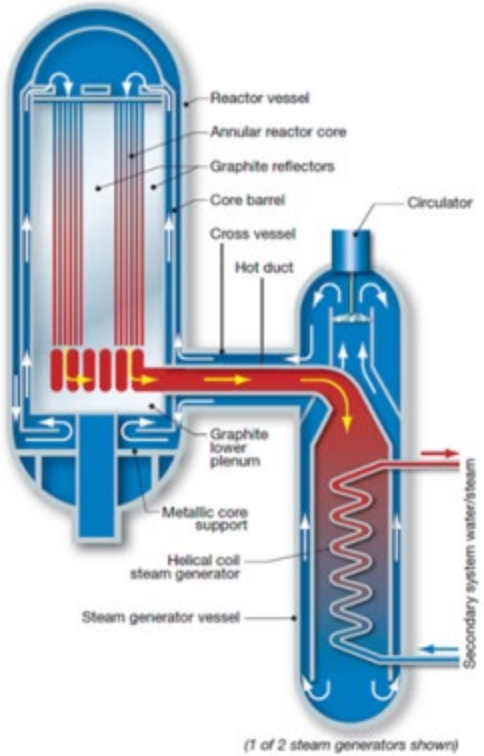
Panel Discussions

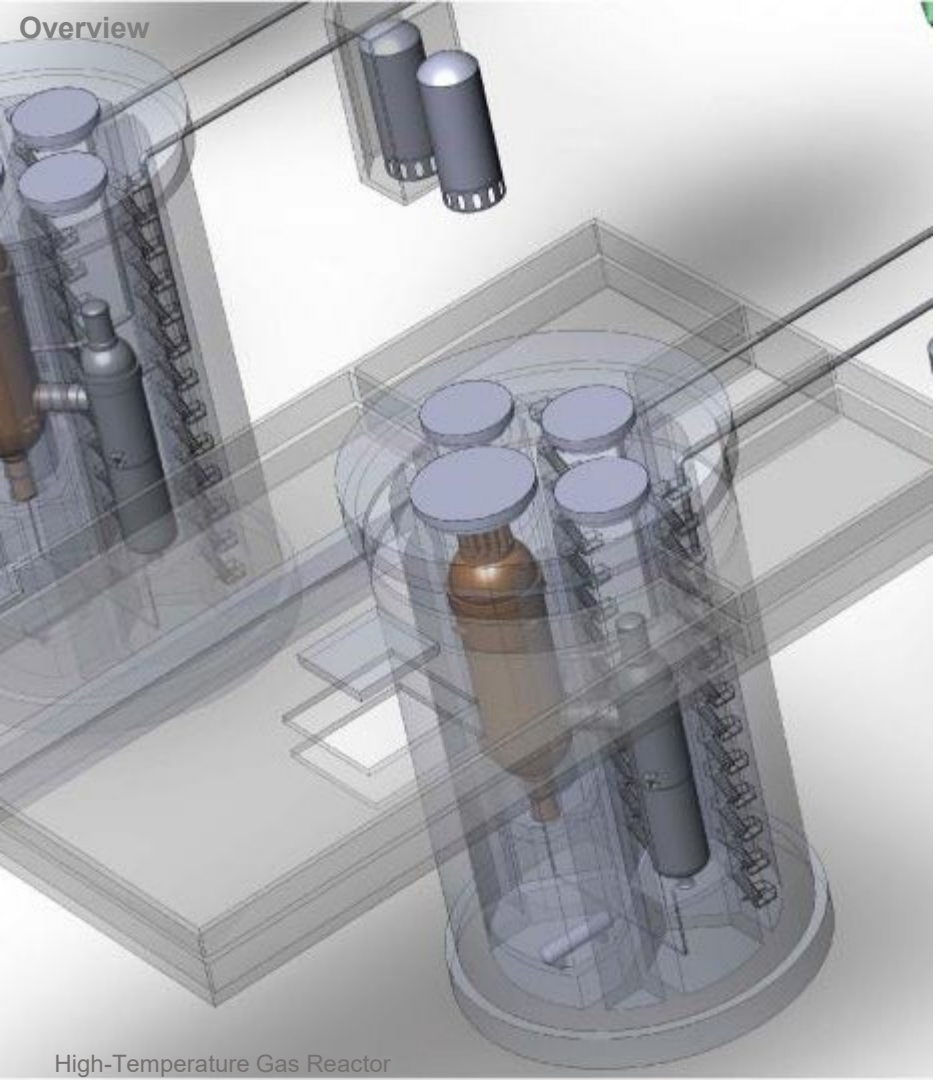
NASE&M Committee on Laying the Foundation for New and Advanced Nuclear Reactors in the United States

Framatome HTGR Design Experience

Developing a Gen IV Future

- **1960s, 70s, and 80s**
  - Framatome **GmbH** – Pebble Bed HTGRs
    - AVR – 46 MWth test reactor, THTR – 750 MWth cogeneration reactor, HTR-Module – 200 MWth
- **1990s and early 2000s**
  - GT-MHR – 600 MWth prismatic core, Brayton cycle. Collaboration with Russian Federation and General Atomics
- **Mid to late 2000s**
  - **ANTARES** Project - 600 MWth prismatic core, Indirect cycle with heat recovery steam generator
  - **US DOE NGNP** project - Modified ANTARES design
- **Late 2000s to present** (North America)
  - **Steam Cycle HTGR** – 4x625 MWth, prismatic core **cogeneration** of process steam and electricity
  - **Four scaled variances** of the reference plant (All use the same fuel and the same fuel block.)
    - **315 MWth** single SG
    - **180 MWth** EU steam only
    - **54 MWth** remote site
    - **7 MWth** mobile





High-Temperature Gas Reactor

Steam Cycle HTGR (SC-HTGR)

Framatome Inc. Reference HTGR

- Designed to serve industrial energy market

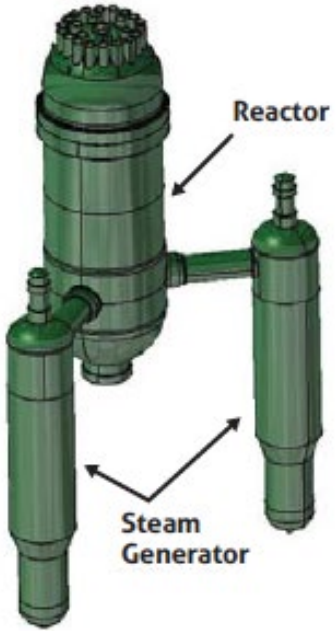
  Power and **process heat/steam**

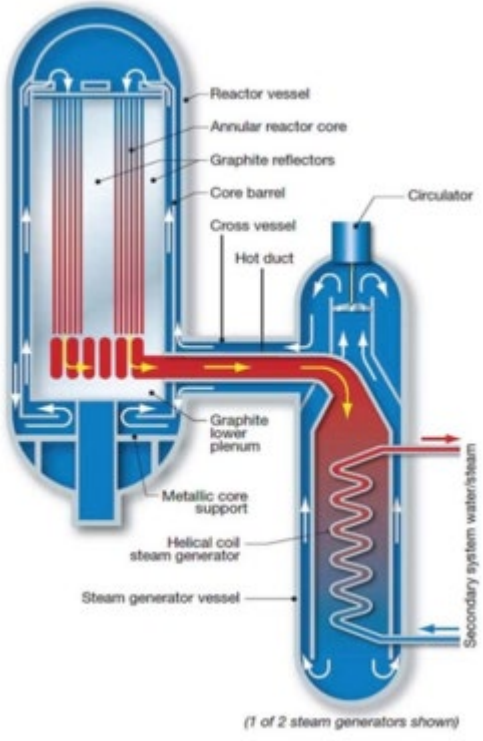
- Key Features

  - Scalable design from 4-module 2500-MWth plant to single-module 7-MWth micro mobile plant
  - Flexible operation for load following/load switching
  - Passive decay heat removal
  - Inherent and walk-away safety
  - TRISO coated particle fuel
  - High technology readiness levels
  - Conventional steam cycle
  - No new material or basic R&D needs

- Design Status – Conceptual
- Deployment Schedule – ≤10 years
  (final design, license, construct)

4 x 625 MWth SC-HTGR





Reactor outlet temperature	750°C
Reactor inlet temperature	325°C
Primary coolant pressure	6 MPa
Main circulator power	4 MWe (each)
Main steam temperature	566°C
Main steam pressure	16.7 MPa

Very strong safety case for HTGR

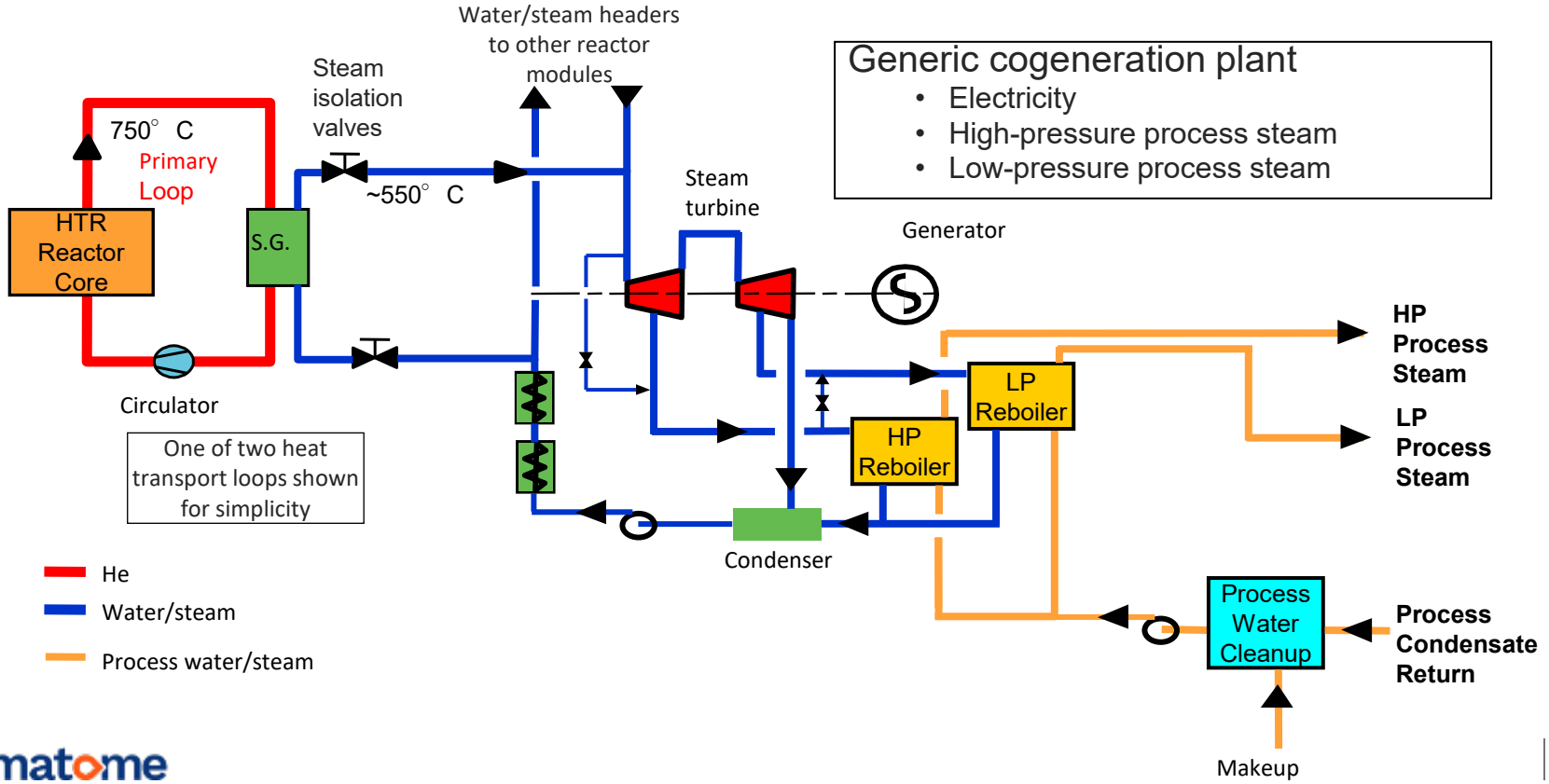
- ✓ Intrinsic safety, fuel robustness
- ✓ Resistance to natural disasters, human error/equipment failure
- ✓ Following DBAs:
  - ✓ No explosive gases produced
  - ✓ No need for evacuation
  - ✓ Repair and return to power operation

SC-HTGR Used Fuel Path

SC-HTGR Fuel

- UCO Kernel, TRISO coated particles, Enrichment 14.5% ^{235}U,
- Graphite fuel blocks – 1020 blocks
- Refueling Interval – 18 to 24 months, ½ core replacement
- Refueling time – 21 days breaker to breaker
- Fuel Qualification
  - Step 1 – Generic [Topical Report EPRI-AR-1(NP), SER expected June 2020]
  - Step 2 – Design specific – DOE AGR irradiation data and design specific accident scenarios
- Burnup – qualified up to 19% FIMA, also exploring deep-burn option (60%FIMA)
- Used fuel disposition path-
  - Once through – fuel block or fuel compact long term retrievable or permanent storage
  - Reprocessing

HTGR Single Reactor Module Design
Versatile Solution for Many Applications



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