



# **"Advanced Reactor Designs"** **PBMR - Nuclear Power Beyond Electricity**

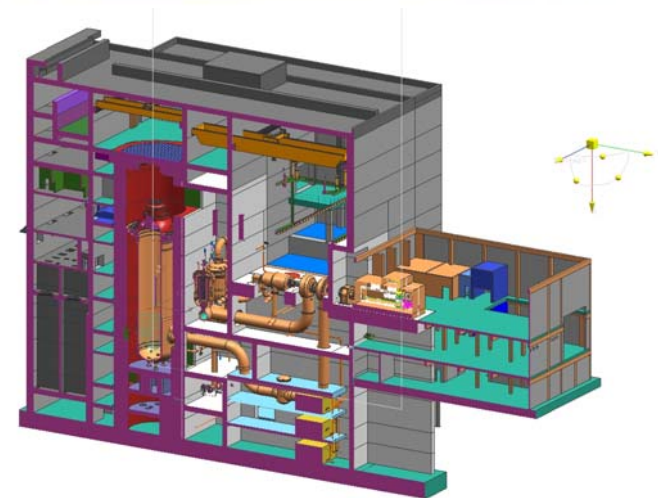
**Edward G. Wallace**  
**Senior General Manager – US Programs**  
**PBMR Pty Ltd.**

**March 15, 2007**  
**US Nuclear Regulatory Commission**  
**Regulatory Information Conference**

**Rockville, MD**

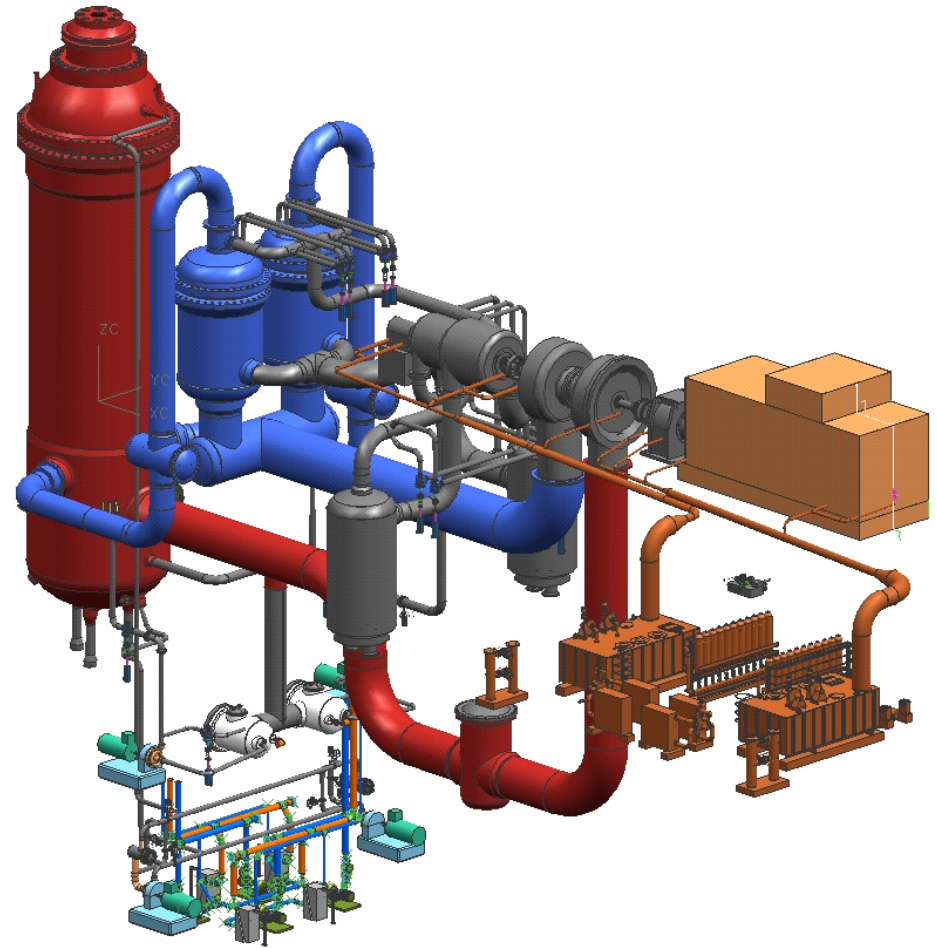


- Basic design completed and detailed design ongoing
- International supply team in place; long lead procurement started
- Extensive test programs underway
- Over 1200 full-time staff at PBMR and suppliers
- Construction scheduled 2008; criticality 2012
- Eskom issued LOI for follow-on plants to a total of 4,000 MWe
- Provides demonstration for expanded applications

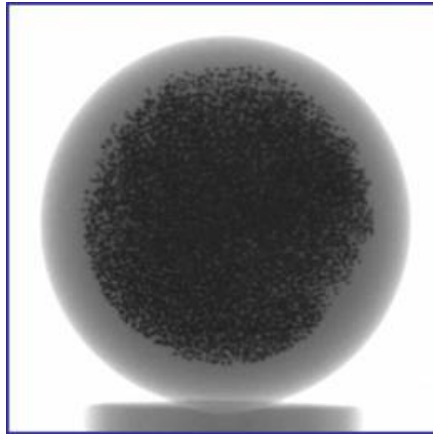




- 400 MWth/165 MWe
- Helium gas coolant
- Graphite moderated
- 900° C core outlet temp
- 9 MPa pressure
- Brayton power cycle
- On-line refueling
- Modular design and construction



# Technology Development for PBMR Fuel Supply



- Technology Transfer
- Equivalence

Full Size 5 kg coater  
Early fuel for testing

- Large scale batch process
- 270,000 fuel spheres/year

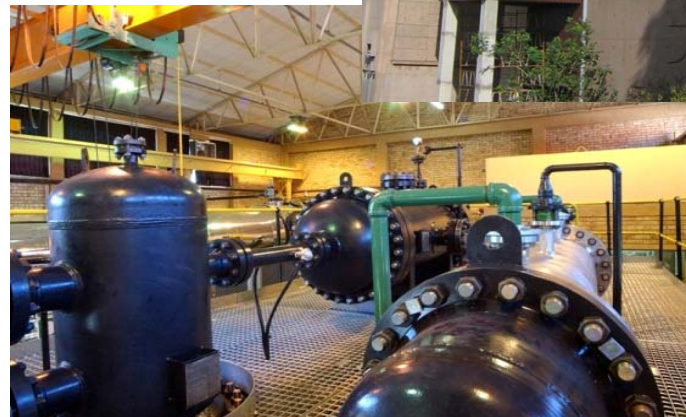
# Test Facilities Supporting PBMR

- Micro-Model
- Helium Test Facility
- Heat Transfer Test Facility
- Plate-out Test Facility
- Natural Convection with Corrosion (air ingress)
- Critical Facility

Helium  
Test  
Facility



Heat  
Transfer  
Test  
Facility



NRC 2007 RIC

From Left to right: HPTU Main test vessel, Blower vessel, Water cooler

# Manufacturing of Long Lead Components Already Started





# Process Heat Applications

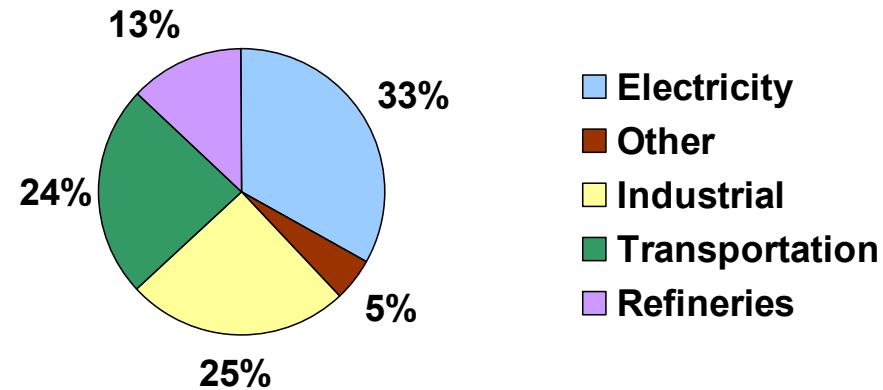


# US Carbon Energy Use Perspective



- Fossil sources >90% of energy use
- Nuclear power supplies <20% of the electric sector and none of the remaining sectors
- Greater role by nuclear in electricity sector would have positive impact on CO<sub>2</sub> emissions
- Nuclear can further reduce CO<sub>2</sub> emissions in other energy sectors

World CO<sub>2</sub> Emissions by Sector

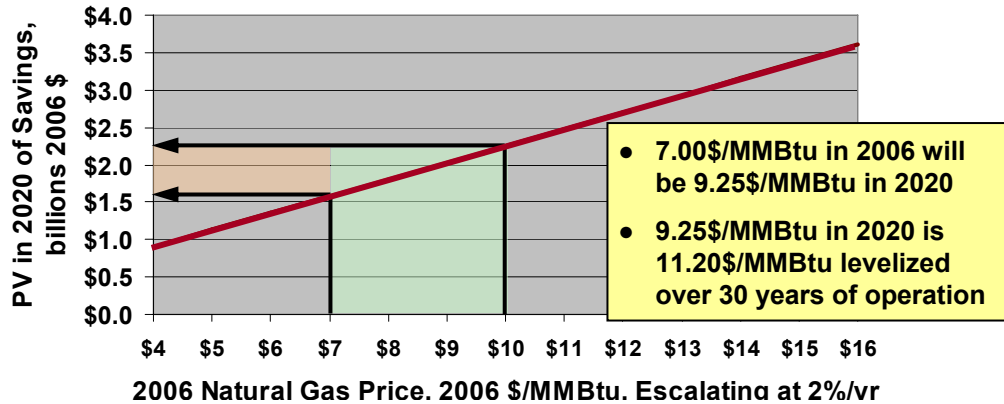




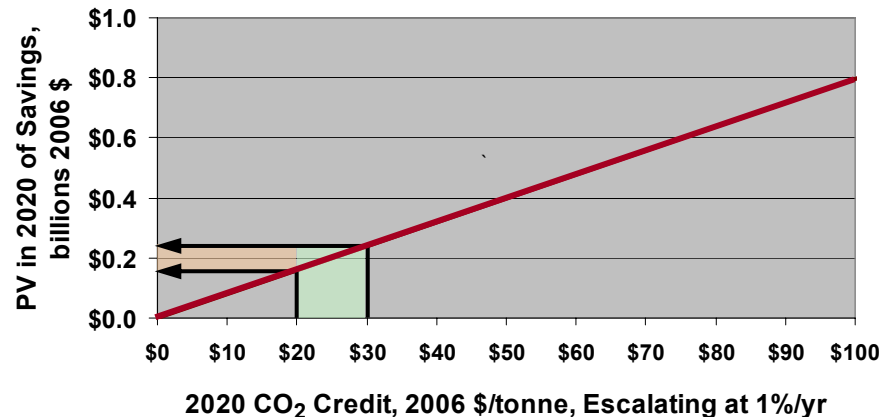
# Present Value of Replacing Natural Gas in Process Heat Plant



**30 Years Savings Displacing 500MWt Equivalent of Natural Gas**  
(10% real discount rate, 2020-2050 operation)



**30 Years Savings from CO<sub>2</sub> Credits 500MWt Equivalent of Natural Gas**  
(10% real discount rate, 2020-2050 operation)



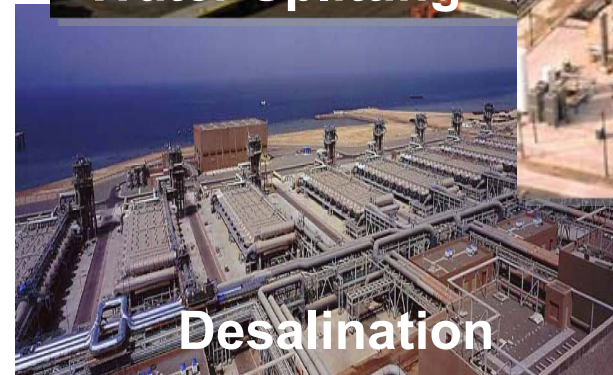
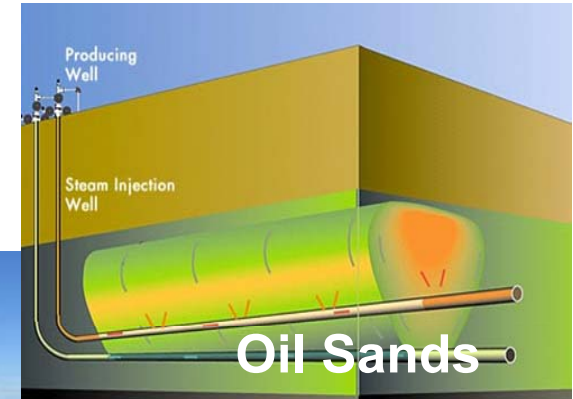
•At \$7.00/MBtu gas in 2006, the PV of the gas alone for process heat is \$1.6B

•If gas as a heat source is displaced, the PV of the CO<sub>2</sub> credits @ \$20/ton are worth another \$150M

•This represents the minimum opportunity for nuclear plants (excludes avoided capital costs of gas boilers, or sequestration equip.)



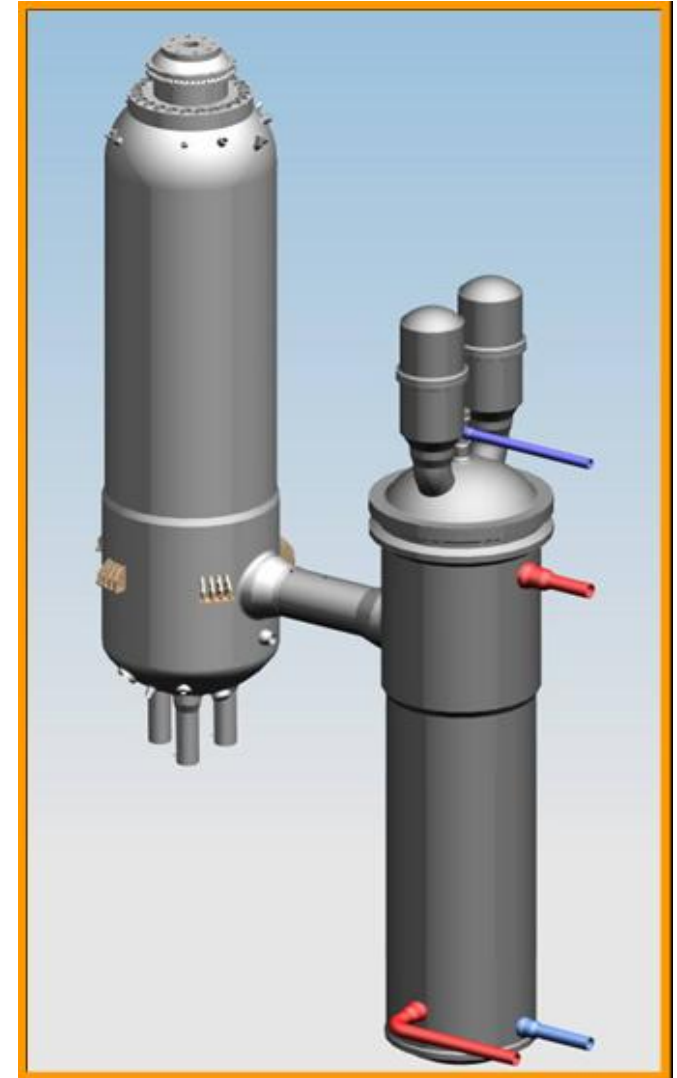
- **Steam Generation**
  - Oil Sands / Enhanced Oil Recovery / Shale Oil
  - Cogeneration
  
- **Steam Methane Reforming**
  - Hydrogen
  - Ammonia
  - Methanol
  
- **Water-Splitting ( $H_2$  &  $O_2$ )**
  - Bulk Hydrogen
  - Coal-to-liquids
  - Coal-to-methane
  
- **Desalination**



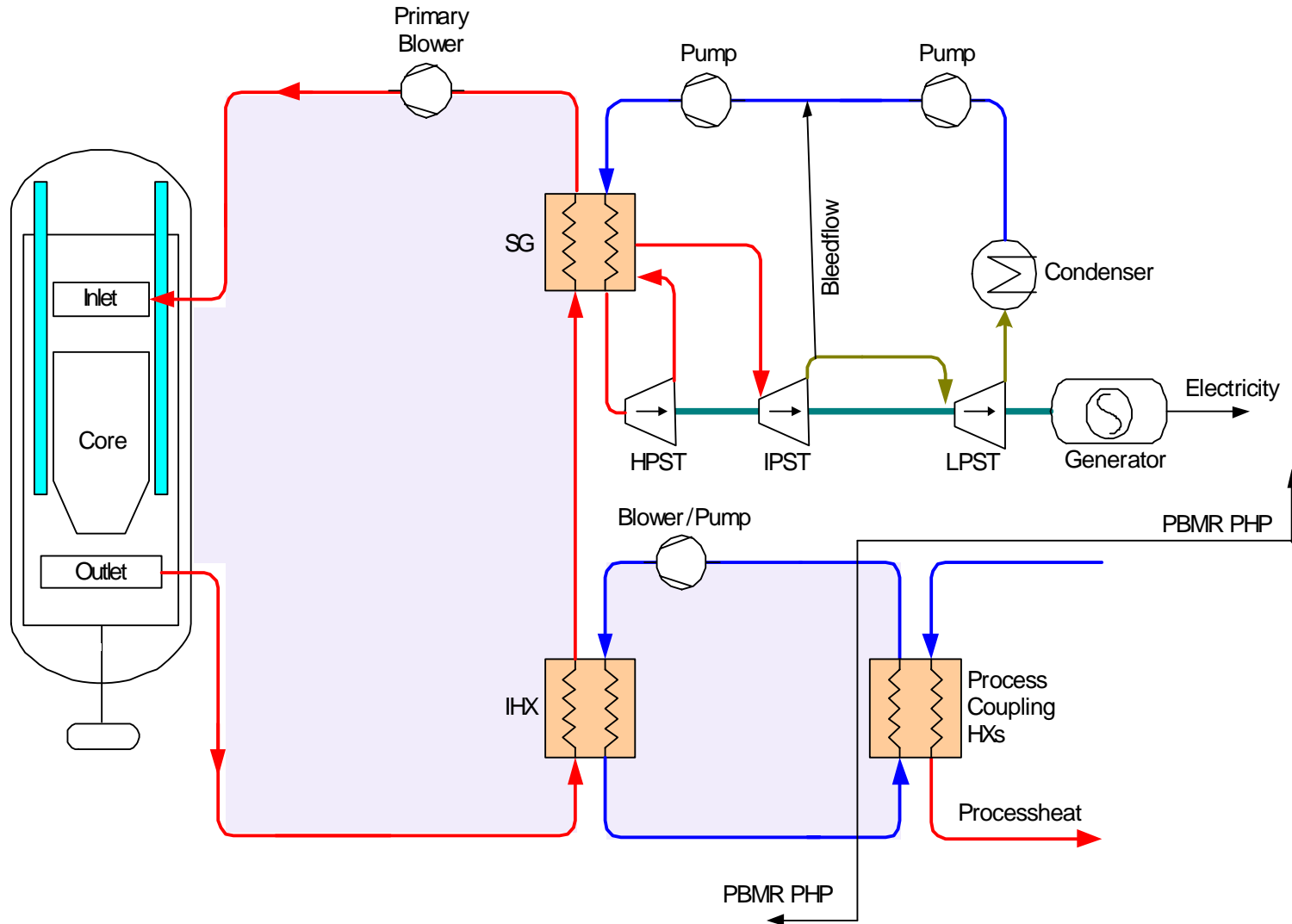
# Process Heat Plant Builds on PBMR Basic Electric Plant



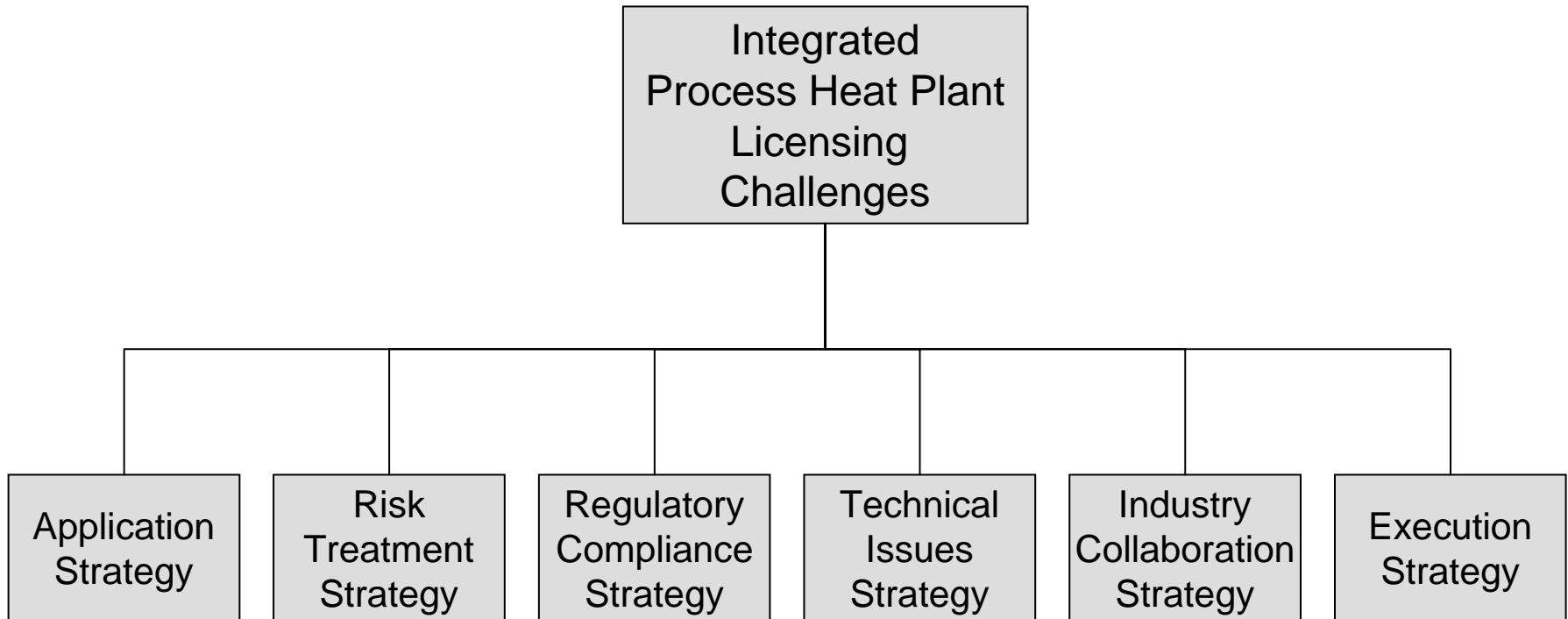
- Reactor and auxiliary systems identical
- Fuel identical
- Safety case has same bases plus interface issues
- Simplified primary circuit with intermediate heat exchanger replacing turbo-machinery
- Process plants use traditional equipment



# PHP Configuration for Hybrid Sulfur



# PHP Licensing Contain Unique Challenges





## In Closing....

- The PBMR program is progressing rapidly towards construction of the first Generation IV reactor
- The key PBMR US licensing issues are important to generic NRC initiatives in regulatory reform and non-LWR licensing requirements including process heat applications
- Licensing challenges for process heat applications with a non-LWR add some new wrinkles that will benefit from early vendor, regulator, industry engagement
- PBMR design and licensing efforts lay the groundwork for the NGNP regulatory program required by the Energy Policy Act of 2005
- Cooperative research and development can broaden, leverage and accelerate the development of high temperature gas reactors as well as lead to more efficient and effective regulatory processes