HIGH TEMPERATURE GAS REACTORS HAVE UNIQUE ABILITY TO USE BRAYTON CYCLE

- 50% Increase
- GT-MHR
- GAS TURBINE CYCLE (BRAYTON)
- STEAM CYCLE (RANKINE)
- WATER REACTOR

PLANT EFFICIENCY

TURBINE INLET TEMPERATURE, °F

400 1000 1600
TECHNOLOGY ADVANCEMENTS HAVE ENABLED THE GT-MHR

- Small Passively Safe Modular Helium Reactor
  - turbine size requirements reduced
  - insensitive to turbine failure accidents
- Large Gas Turbine Engines
  - significant increase in industrial applications
  - size now match modular reactor size
- Magnetic Bearings
  - eliminates oil ingress concerns
  - improves performance and reliability
  - rapidly increasing industrial experience; larger sizes
- Compact Heat Exchangers
  - dramatically improves efficiency
  - size improves design integration
  - extensive fossil operating experience

GENERAL ATOMICS
600 MW(t) GT-MHR REDUCES POWER COST BY 45% COMPARED TO 350 MW(t) STEAM CYCLE

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<th>Efficiency</th>
<th>Normalized Busbar Cost</th>
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<td>350 MW(t) MHR-SC 38%</td>
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<td>450 MW(t) MHR-SC 38%</td>
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<td>450 MW(t) MHR-GT 48%</td>
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<td>600 MW(t) MHR-GT 48%</td>
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45%
IN SUMMARY, GT-MHR IS A GENERATION IV SYSTEM

- Inherent safety Features - No core melt
- High thermal efficiency resulting Lower Cost
- Significantly reduced environmental impact
- Superior radio-nuclide retention for long-term spent disposal
In Russia under joint US/RF agreement for management of surplus weapons Pu

Sponsored jointly by US (DOE) and RF (Minatom);
supported by Japan and EU

Conceptual design completed; preliminary design complete early 2002
INTERNATIONAL GT-MHR PROGRAM

- Design, construct and operate a prototype GT-MHR module by 2009 at Tomsk, Russia
- Design, construct, and license a GT-MHR Pu fuel fabrication facility in Russia
- Operate first 4-module GT-MHR by 2015 with a 250 kg plutonium/year/module disposition rate

\[\text{\ldots Fuel contains Pu only} \]
\[\text{\ldots No fertile component} \]
Russian Technological Developments. Recuperator

Heat Exchange Element Fabrication

Recuperator Heat Exchange Element

Tests of full scale heat exchange element in helium test facility
COMMERCIALIZATION PROGRAM

COMMERCIAL PROGRAM = INTERNATIONAL PROGRAM TECHNOLOGY + URANIUM FUEL RATHER THAN Pu FUEL

Plant construction can start in 5 years

GENERAL ATOMICS
# COMMERCIAL PROGRAM FOLLOWS INTERNATIONAL PROGRAM

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**Complete Design & Development**, **Construction License**, **Complete Proto Constr**, **Complete Proto Demo**, **Start Full Power Ops**, **Complete Plant Preliminary Design**, **Complete SAR**, **Complete SER**, **Complete Final Design**, **Complete Automated Fuel Fab Plant Pilot Plant**, **Complete Tests**, **Ltr of Intent**, **Order for First Comm Plant**, **Start Plant Construction**, **Startup of Module 1**, **Mod 2**, **Mod 3**, **Mod 4**
LIMITED ENGINEERING WORK REQUIRED

COMMERCIAL PLANT ENGINEERING

- Prepare Incremental Design Items
- Performance Assessments
- Transfer International Program Technology
- Safety and Licensing
- Define Commercial Plant Requirements
PLANT REQUIREMENTS PLANNED FROM SEVERAL SOURCES

Externally Imposed Requirements
- US regulatory requirements
- US codes and standards

Utility/User Requirements
(safety, economics, etc)

Technology from International Program

COMMERCIAL PLANT REQUIREMENTS
TECHNOLOGY TRANSFER ACTIVITIES

INTERNATIONAL PROGRAM TECHNOLOGY

→ Preparation of SDDs to US standards
  - info from equivalent docs prepared to Russian stds

→ Adaptation of design & tech dev reports
  - verify compliance to US requirements

→ Adaptation of dwgs & specs
  - convert to US codes and stds

GENERAL ATOMICS
INCREMNENTAL ENGINEERING WORK

INCREMNENTAL ENGINEERING

Low Press, Vented (LPV) Reactor Bldg

60 hz Power Generation

Uranium Fuel Fab Plant Design & Qual

RCCS for LPV

Uranium Core Design

......No New R&D

DOE002-0951

Obtained and made public by the Natural Resources Defense Council, March/April 2002