



Nuclear
Energy

Side Event to the
61st General Conference 2017

Nuclear High Temperature Heat for Industrial Processes

HTGRs, GEMINI, the PRIME Concept
and the U.S. Advanced Reactor Effort



Mr. Donald R Hoffman

President and CEO

EXCEL Services Cooperation

NGNP Industry Alliance Created in 2010 To Promote HTGR Commercialization

- Alliance promotes the development and commercialization of the HTGR
- Created in response to Energy Policy Act of 2005 authorization of NGNP Project



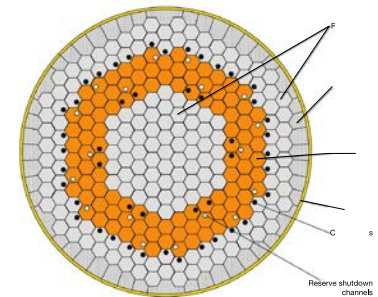
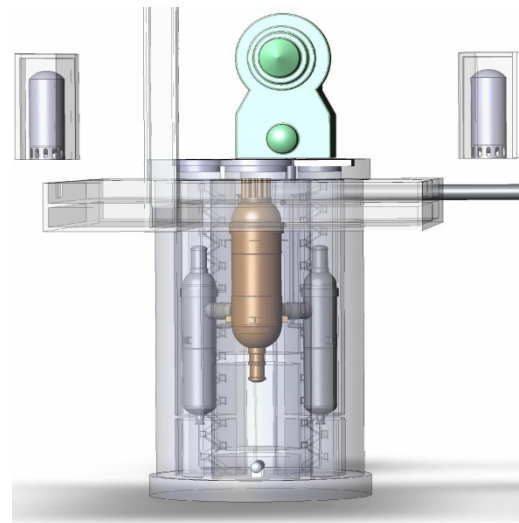
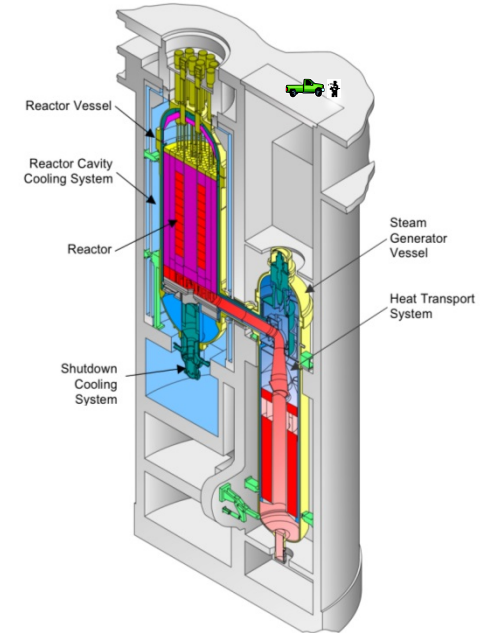
*Southern Ohio Asset
Recovery LLC*

TECHNOLOGY
INSIGHTS



Why the HTGR?

- High outlet temperatures
 - Process heat / steam for industry
 - Greatly increased electric power efficiency
- Safety case second to none
 - Locate next to industrial sites
- Licensability
- Low water consumption
- Deployable now



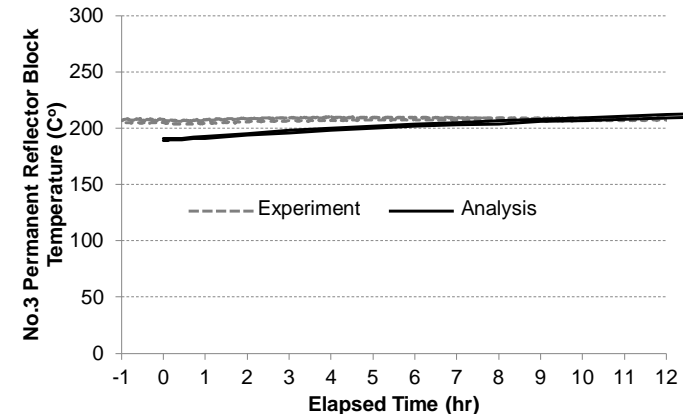
HTGR: Ready to Deploy

- **“The HTR, with outlet temperatures limited to less than 800°C, is suitable for near-term deployment as a demonstration reactor. Graphite-moderated, helium-cooled HTRs have been the subject of U.S. government and industry investment on and off since the 1960s^{**}.”**
- In fact, the U.S. government and industry investment together is over \$3B
- Approx. \$600M DOE investment in fuel, graphite, etc. since 2006

****Assessment of the Technical Maturity of Generation IV Concepts for Test or Demonstration Reactor Applications - INL, BNL, ANL, DOE, ORNL Oct. 2015**

A unique intrinsic safety concept facilitating licensing

- Safety based on inherent physical properties of the reactor (integrity of the fuel up to very high temperature, strong negative temperature coefficient, large thermal inertia, cooling by conduction and radiative heat transfer, chemical inertia of coolant), not on the action of any safety systems
- Safety demonstrated by tests on real reactors (AVR, HTR-10, HTTR)
- No severe core degradation or significant radioactive releases
 - ⇒ Potential for colocation with non nuclear industrial facilities for process heat supply
- Regulators and TSOs reviewed the safety of different projects in different countries (US, G, JP, SA, CN, EU...):
 - Acknowledgement of the safety enhancement provided by modular HTGR
 - Significant decoupling of industrial and nuclear processes recommended, to avoid interactions between the 2 processes detrimental to safety.
- On the basis of previous work performed for NNGNP, US NRC endeavors to modernize its licensing process and adapting it to advanced systems



Temperature in side reflector after loss of forced flow test of HTTR

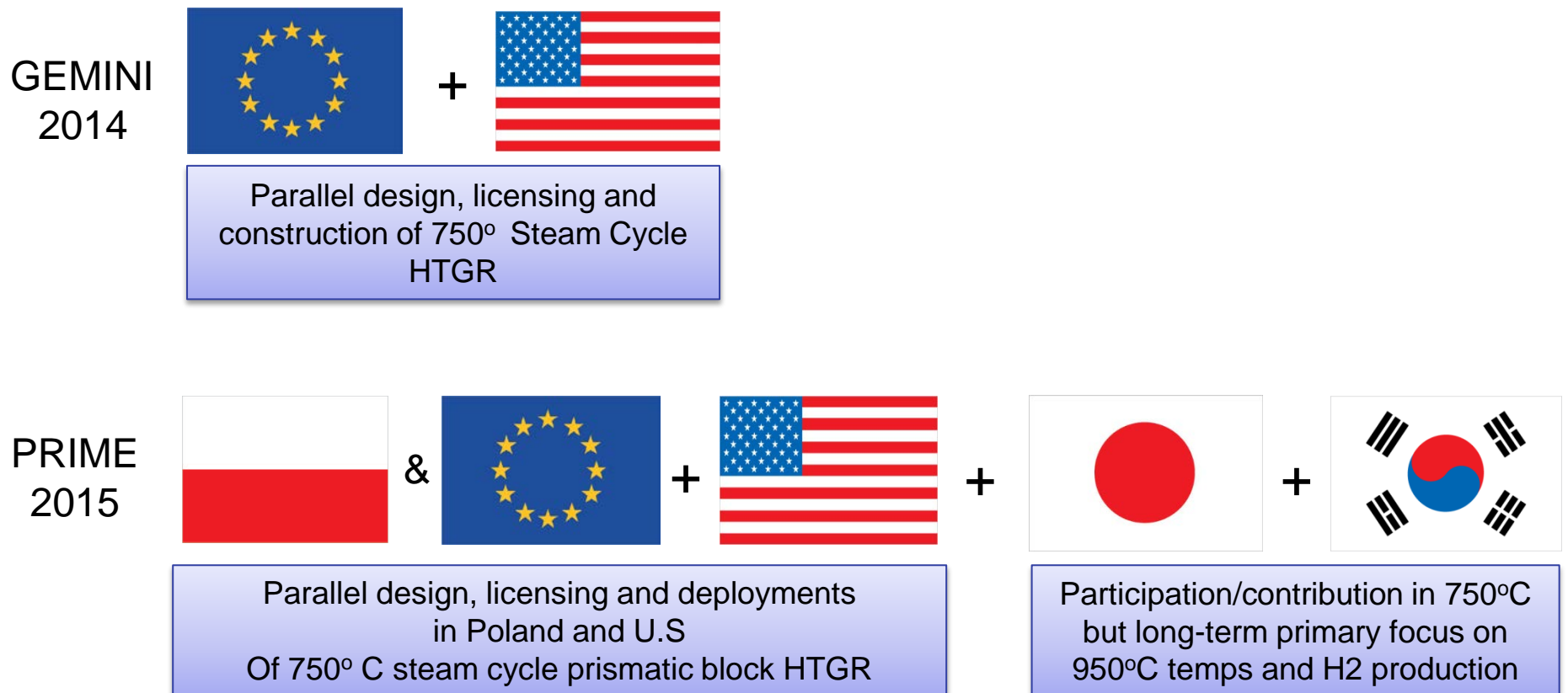
Some Recent U.S. HTGR Milestones

- End-users and designers begin collaboration in 2006, NIA incorporated in 2010
- NIA development of deep understanding of end-user and siting requirements through numerous studies:
 - Waterford Louisiana process heat study with INL and Entergy
 - Canadian oil sands extraction study with PTAC and INL
 - Wyoming Coal to Liquids report with INL
 - Kentucky Coal to Liquids report with INL
- 2012 down-select to prismatic block HTGR – 625 MWt and 350MWt
- Collaborations w/Japan and Korea on HTGRs and H₂ production
- 2014 – 2016 Creation of GEMINI and PRIME concepts
- U.S. site studies: Collaborations with Piketon, Ohio and other sites

Advantages of International Partnership

- Provides additional political interest and support
- Helps ensure funding stability through time
- Increases technical expertise
- Excellent basis for strengthening international relationships
- Excellent mutual and multiple national security benefits
- Broadens accessible markets
- Saves costs

Evolution of GEMINI to PRIME Partnership Concept




Poland: First Mover?

- Poland has historic opportunity to kick-off the PRIME Partnership
- Each PRIME partner country should and will bring its best companies to share this great task together
- U.S. Industry ready to respond: American Prime Nuclear Companies


American Prime Nuclear Companies


 One of largest U.S. engineers and constructors – long HTGR legacy


 One of largest nuclear companies in world: primary U.S. HTGR legacy


 A foremost engineering and project management companies, deep energy expertise

 Regulatory, engineering, technical, and other services to nuclear industry

 A world leaders in carbon based products and HTGR graphite

 Leading U.S. nuclear utility, operator and leader in advanced reactor development and policy

 Unique world class capabilities in nuclear and HTGR engineering and design

 Employs many of the world's leading HTGR experts and has deep expertise in HTGR design and operations

U.S. Sites Recently Evaluated by NIA

- Sites in all quarters of the U.S.:
 - **Piketon / Portsmouth, Ohio** – Focus on process heat, H₂ and electric power
 - **Odessa/Midland, Texas** – integration with Texas Clean Energy program or enhanced oil recovery / desalination
 - **Former Georgia Power Coal Plant Site** – focus on electric power
 - **Idaho Falls** – possible focus on CTL, H₂
- All suitable / good sites: Piketon judged superior