HTGR Reactor

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Lewis Lommers

Lewis Lommers leads High Temperature Gas-Cooled Reactor engineering at AREVA Inc.

He has over 25 years of experience working on HTGRs in various areas including system design, transient analysis, performance optimization, and overall concept development. His experience covers several High Temperature Gas-Cooled Reactor (HTGR) concepts including the Modular High Temperature Gas-cooled Reactor (MHTGR), Gas Turbine Modular Helium Reactor (GT-MHR), ANTARES (an indirect cycle HTGR concept that AREVA developed internally from about 2002 to 2007), and Next Generation Nuclear Plant (NGNP).

He has a Bachelors degree in Mechanical Engineering from the University of Washington and a Masters degree in Nuclear Engineering from Purdue University.

Responses to questions by Newal Agnihotri, Editor of Nuclear Plant Journal. The responses are for the HTGR concepts being promoted by the NGNP Industry Alliance Limited and its members. They are not necessarily reflective of the opinions or positions of the US Government's NGNP Program.

1. *What is the cost in mills (1/10 of the US cent) per kilowatt hour for producing electricity with a NGNP's HTGR reactor? Provide the following breakdown: maintenance cost, operation cost, and fuel costs.*

- *Fixed O&M (w/o Fuel) –14 mill/kWhr*
- *Variable (Inc. Fuel) – 11 mill/kWhr*
- *Total – 25 mill/kWhr*

Note:

This does not include capital or other project costs.

Costs are for an electric only plant. For cogeneration applications, costs will vary depending on specifics of the application.

This is not an all-in production cost or a means to compare technologies on cost since capital investment and investment return has not been described in the responses.

The Alliance has done extensive economic analysis to characterize the market and associated economics. We have developed an commercialization strategy and an enterprise architecture that identifies capability and costs associated with: a development venture; a deployment project; infrastructure framework; technology expansion that includes lesson learned, operational experience (OE) and advanced materials research and development; and activities for program direction anticipated to support maturing technology application, on-going economic analysis and providing insight into additional markets and opportunities. Estimated costs to complete each of the Enterprise activities are listed in the updated business plan.

2. *What improvements have been made to the instruments within the Reactor Pressure Vessel (RPV) as compared to current reactor technology for measuring pressure, temperature and other parameters?*

Significant improvements in instrumentation technology are not required for the Steam Cycle High Temperature Gas-cooled Reactor (SC-HTGR) design. We have eliminated the requirements for extensive incore instrumentation. The primary thermal measurements are limited to inlet and outlet coolant temperature and the coolant flow rate. Neutron detectors for the reactor protection system are located outside the reactor pressure vessel (RPV). A traversing flux monitor is used periodically to measure the axial power profile.

3. *What diagnostic mechanisms have been built in to monitor the degradation of material, cables, equipment and instruments within the RPV?*

The SC-HTGR has ceramic core. There are no cables in the core. The metallic components in the reactor pressure vessel are located in areas that are only exposed to the cool core inlet temperature and are designed to retain their mechanical properties for the life of the component.

4. *What prototype testing has been done to validate the design to protect problems during construction and operation of the NGNP's HTGR reactors?*

All key equipment, including the reactor core, the helium circulators, the steam generators, and the vessels are based on technology which has been proven either in previous HTGR projects or other industrial applications. During final design and pre-fabrication development, mockups will be used as appropriate to confirm configuration and fabrication approach. Confirmation testing of components or component modules will be performed as necessary prior to installation.

5. *Who will be responsible for refueling the reactor? Will it be the nuclear power utility or the manufacturer?*

Refueling will be performed by the utility personnel. SC-HTGR refueling is accomplished with remote mechanical refueling machines based on the concept proven successful at Fort St. Vrain. Specific fuel movements are controlled by the automated system according to a preplanned sequence developed prior to each refueling campaign. All movements are monitored from the refueling control station, and all movements are recorded and reviewed to confirm the accuracy of the refueling operation.