From: Eric Benner
To: Leslie Fields
Date: 7/24/02 9:50:02 AM
Subject: **Fwd: FYI -** NMSS/FCSS's Summary of GT-MHR Preapplication Planning Meeting

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L-7

From: Bill Gleaves NMSS
To: Alex Murray; B. Jennifer Davis; C.W. (Bill) Reamer; Charles Miller; Charlotte Abrams; E. William Brach; Eric Leeds; Joseph Giitter; Melvyn Leach; Sharon Steele; Tim Harris
Date: 12/4/01 8:33:19 AM
Subject: FYI - NMSS/FCSS's Summary of GT-MHR Preapplication Planning Meeting

Hi all,

The subject meeting was held in the ASLB Hearing room on Monday, 12/03/01. This summary has a tilt toward NMSS issues. I am the project manager coordinating NMSS activities with respect to the GT-MHR.

Bill Gleaves
415-5848

SUMMARY:

Purpose of meeting: To plan/discuss GT-MHR (DOE Gen IV reactor) preapplication.

This meeting is not fee recoverable - but future meetings may be. NRR has set up a TAC no. for this review. I will be setting up a preapplication TAC for NMSS.

Tom King - quickly following this mtg., a Secy paper on GT-MHR pre-application will be written.

Background:
GT-MHR design initiated ~ 1994 ~ 600 MWt
Peach Bottom U/1 = 40MWe
Fort St. Vrain = 330 MWe
MHTGR (He reactor with steam turbine) = 532 MWe (received PSAR)

Expectations for GT-MHR: (Walter Simon - Sen. VP General Atomics)
- Familiarize staff with technology
- ID/resolve license issues.
- candid dialogue NRC & designer
- evaluate alternative approaches to safety.

GT-MHR advisory group (Dan Keuter, Entergy, Chairman of executive advisory group)
The energy advisory group is doing review/adaptation/FOK work on licensing, engineering, construction/operation, fuels (incl. fuel fab. qualification, & fuel cycle costing), & near term deployment.

GT-MHR plant design (Arkal Shenoy, GA)
Design Goals & Specs:
300 - 1200 MWe
avail: >80%
no public release GT 5E-7/yr.
10% cost advantage over fossil.
Passively safe.
no operation action.
long time intervals for corrective actions.
actively supported by users & suppliers.
TRISO coated particle fuel.

helium cooled, refractory coated fuel, graphite moderated, passive reactor. 48% conversion efficiency.
Reactor design same as Ft. St. Vrain (FSV) with improvements such as carbon control rods

Comparison with current technology:

LWRs produce 50% more HLW.
" " 150% more Actinides
" " 100% more thermal discharge.
High fuel burnup: ~150K MWday/ton for Pu; isotopic composition is unattractive for weapons.
Carbon Control rods vs. Metallic @ FSV.
Jan. 2000 - conceptual design done-preliminary design started in Russia.
Prototype GT-MHR planned in Tomsk, Russia by 2009. With a 4 module plant complete by 2015.

Expecting commercial plant order in 2006 following COL/DC & ESP. (will send letter to NRC of intent to license in 2003?)

Steam cycle MHTGR ~38% eff., GT-MHR ~48% efficient.

AMY CUBBAGE - REGULATORY update
- SECY 010207 on Excelon white papers,
- draft SECY Paper on Excelon's licensing approach.

"Safety Approach" Presentation (Larry Parm - General Atomics):
how modular approach differs:
~passive safety - re-application of known technology.
~fission product containment in TRISO particles (~2000 psi inside the particles)
~ max. 1200C fuel temperature
~ 1600C max fuel design temp.
~ max. Fuel failures >2000C!
~ stron neg. reactor temperature coef. --Important

MAJOR SAFETY FUNCTIONS (3)
- CONTROL HEAT GENERATION
- REMOVE DECAY HEAT
- CONTROL CHEMICAL ATTACK

Reactor may be critical after shut down after 2 days due to Xenon decay. But self stabilizing. Reactor core is hollow cylinder with not optimum neutron economy. Core geometry was driven by coolability and passive cooling design goal - not neutron economy.

Theory: Max T in core (design goal: 1600C) is well below radionuclide retention T (decomposition of SiC=2000C).

RISK FROM WATER INGRESS:
~no high pressure source of water.
~precooler & intercoolers are water cooled, but lower pressure than operating reactor. During shutdown, RELAP 5 analysis showed water transport to reactor very small.
~ air ingress : particle is deeply imbedded in graphite blocks. Air can only enter core thru vessel failure (low probability)
~ new high quality graphite is less susceptable to oxidation. NOTE: not all parts of core are likely to contain high quality carbon - as a cost cutting measure (source: UCAR carbon representative)
~ the large quantity of air needed for significant oxidation is not available to the core.

small leak (1/2" dia. hole) in RX is worst case accident for dose.

A leak with graphite oxidation produces the equivalent of only ~10% of decay heat. So it is manageable...?

The design of containment filtration is not specified for US.
<u>Sept 11 changes</u>:

Solidifying design in below ground silo. No specific changes made to siting.

Refueling floor is several ft. of concrete but not designed for missile protection. Could be revised....

1 main control room w/1 aux. shut down area.

The design of dry storage may be rethought from original '80s design.

PREAPPLICATION LICENSING PLAN
GA wants some kind of "licensability statement" from NRC (ex: Secy paper)

Plan:
#1: COL for first module
#2: use first module for verification testing for DC
#3: DC for advanced reactor

5 AREAS FOR DISCUSSION/SCHEDULE
- programmatic & process topics Jan.-Mar. 2002
- licensing approach Feb-April 2002
- technology development (fuel, graphite, core metals) April-Aug 2002
- design description June-Nov 2002
- accident analysis ?
- submittal draft SAR Mar. 2003
- NRC secy on GT-MHR June 2004
- Submit SAR july 2004
- Issue COL june 2007
- DC TBD

NRC STAFF QUESTIONS & ANSWERS:

How do you get a 48% theor. efficiency? ANS: Brayton cycle with rx temperatures delta T of 1600F-1100F. Calculated 48% eff. at core exit T of 1550F. Reactor has no bypass flow that would reduce efficiency, as it does in PBMR. 100% of He gas goes from RX to turbine.

On HLW disposal, what are waste volumes? Is is similar to PBMR 10x increase in waste volume? ANS: if the fuel compacts (pellets) are left in the graphite blocks when disposed of, then the volume is the same as PBMR. However, if the compacts are removed from the blocks it gets a volume reduction of ~5, or about 2x LWR waste volume. When separated, the compacts would be HLW and the graphite blocks would be LLW.

Is a fuel facility planned for the US to support GT-MHR? If so when and where? Discuss how the fuel will be fabricated. ANS: Yes a plant is planned. No schedule as yet but should be looked at in the next couple of years.

On spent fuel pool...how is fuel stored in the interim? ANS: The spent fuel assemblies are stored in drywells in a water-cooled storage pool. Cool-off time is approximately 1-2 years. Then it could be transferred to a dry on site storage facility if desired.

What is the burnup of the fuel? ANS: there are 2 types of fuel. For the fissile Pu, 19.9% of the core, the burnup is 150K MWday/ton. For the fertile Uranium, in the balance of the core, the burnup is 20-30 MWday/ton. Total core enrichment is approximately 14wt%.

How does irradiation affect carbon and graphite with the high burnups. ANS: not a problem. gasses are designed to be held up in lighter carbon in TRISO particle, and expansion/shrinkage of particles are also accomodated. Example: NRC licensed core for Ft. St. Vrain of 93% enrichment for 800K MWday/ton (stated in meeting by GA, not confirmed)

Refueling? ANS: Expected 18 month fuel cycles (during which 50% of primary core graphite will be replaced) It is planned for a 22 day refueling outage. Changes may be made for practical reasons to go to a 24 month outage cycle for the 4 unit plant.

Graphite life expectancy? ANS: For permanent core side reflectors - life of plant; for removable outside reflectors - replace every 6-8 years; ½ of core graphite blocks every 18-24 months; for the inside core removable reflectors - replace every 6-8 years; for central core permanent reflectors - life of reactor.

WHAT THEY DID NOT DO:
They did not address the issue of containment or confinement. The steel structures for the core, power conversion system, and generator are containments, but the concrete structure is a non-filtered continuously vented.

CC: Amy Cubbage; Bill Gleaves; Donald Carlson; Eric Benner; Jack Davis; Jack Guttmann; John Flack; Jose Ibarra; Josephine Piccone; Michael Weber; Robert Pierson; Scott Flanders; Stuart Rubin

AGENDA

Draft

NRC Meeting with General Atomics and DOE on the GT-MHR

December 3, 2001, 8:30 am - 4:00 pm;

ASLBP Hearing Room T3B45

8:30 - 8:45am	Opening Remarks and Introductions (Jose Ibarra)	NRC
8:45 - 8:50am	DOE Remarks (Tom Miller)	DOE
8:50 - 9:00am	Remarks and Expectations (Walter Simon)	GA
9:00 - 9:15am	Interest by Potential Applicants (Kenneth Hughey)	UAB
9:15 - 10:00am	Overview of GT-MHR (Arkal Shenoy) • Design Summary	GA
10:00 - 12:00	Break	
12:00 -12:45pm	Overview of GT-MHR Continued • International Program • U.S. Commercialization	GA
12:45 - 1:00pm	Questions and Answers	All
1:00 - 1:15pm	NRC Status of Generic Gas-Cooled Rx Issues (Amy Cubbage)	NRC
1:15 - 1:30pm	Break	
1:30 - 1:45pm	GT-MHR Safety Approach (Larry Parme)	GA
1:45 - 2:00pm	Pre-application Plan (Larry Parme)	GA
2:00 - 2:30pm	Open Discussion/ Plans for Next Meeting	NRC/GA
2:30 - 3:00pm	Questions and Answers	All
3:00 - 4:00pm	Closing Comments	NRC/GA