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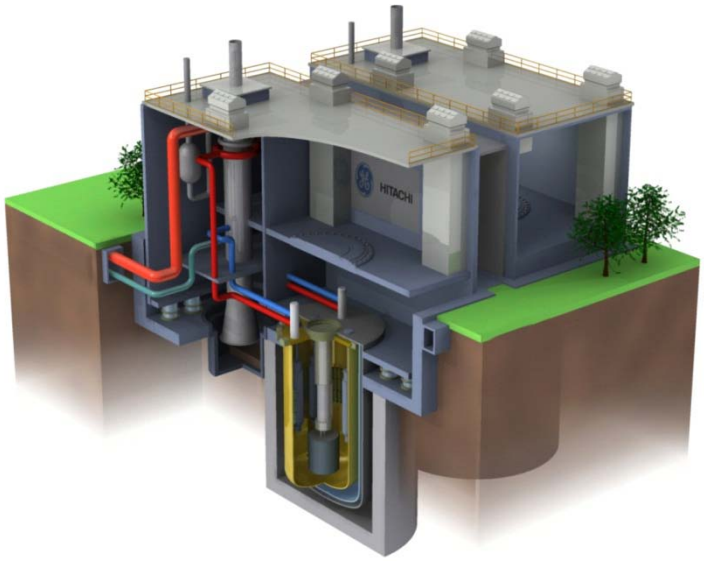
Plutonium Reuse with PRISM



Initial Feasibility Proposal

CMS ID #1-2PA2F8

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1. Background:

Earlier this year, GE Hitachi Nuclear Energy (GEH) submitted comments to the UK Department of Energy and Climate Change (DECC) in response to UK's consultation on the long-term management of civil plutonium. Following this submission, GEH has been performing work to further elucidate and refine the application of GEH Power Reactor Innovative Small Module (PRISM) plutonium reuse technology for a UK-specific plutonium management application.

PRISM is a fast reactor and GEH understands that the Nuclear Decommissioning Authority (NDA) concluded that fast reactors are not credible. GEH agrees that legacy fast reactors (large, loop, oxide-fueled sodium reactors) most commonly thought of when considering fast reactors are likely not credible for UK plutonium reuse. GEH believes that the UK's conclusion, does not apply to PRISM because it is unlike legacy fast reactors in key areas that matter most for cost effective plutonium reuse and this can be technically illustrated.

GEH also understands that NDA concluded it is not realistic for the UK Government to wait until fast reactor technology is present in the commercial electricity marketplace before making a decision on how to manage plutonium stocks. GEH agrees with this policy conclusion; early nuclear industry expectations that commercial nuclear power would evolve to a fast reactor fuel cycle have not occurred and the UK should not wait for this to occur. However, this policy position does not appear to suggest the prohibition of fast reactor technology as a tool by utilities or other companies to provide a better and more cost effective reuse alternative if this can be shown. This is a subtle, but important distinction. It would not be reasonable to expect the NDA or other international organizations to be entirely aware of all industry technology under development since some technologies, applications, or developments may be controlled internal to corporations prior to release. Therefore, we applaud the DECC consultation process which solicits broad external input thereby helping to ensure policy decisions do not inadvertently preclude alternate technological methods of achieving policy objectives such as plutonium reuse.

The work GEH has undertaken primarily involves careful evaluation of the business arrangements that would be required to implement PRISM for plutonium reuse in the UK. Specifically, we are currently engaging potentially interested operators/utilities/constructors and partners. This work is necessary for GEH to develop a potential plant offering for this application and we believe it also has value to the Nuclear Decommissioning Authority's (NDA) decision process for plutonium management. The application of PRISM technology for UK plutonium reuse is UK-specific, and since we would expect NDA to have specific standards or requests in understanding the application of such technology so the work is consistent and comparable to similar evaluations performed of other potential plutonium management technologies,

2. Introduction

GEH proposes to perform a study for NDA of how PRISM can be applied for secure and cost-effective lifecycle management of UK plutonium stocks. The GEH PRISM plutonium reuse plant combines two GEH technologies: a fast spectrum reactor (PRISM), and PRISM fuel fabrication technology. This technology suite provides the NDA with new options for management of plutonium including off-specification plutonium that is chemically contaminated or degraded due to americium ingrowth. This technology is more cost effective and can be more proliferation resistant than other methods of plutonium reuse or other disposal options considered depending on how it is operated. Pursuit of GEH PRISM plutonium reuse provides the NDA with a viable technical solution to drive better short and long-term economics for UK taxpayers. It allows for the most thorough form of plutonium disposal. It also allows the most expedient path to plutonium disposition. GEH PRISM plutonium reuse technology is consistent with the NDA value framework, coupling the interdependencies between nuclear clean up, cost minimization, security, and available low-carbon electricity. It supports policy flexibility among these UK needs in the event that priorities change in future years. It is prudent that NDA have the opportunity to fully understand these benefits because a technology decision for plutonium disposal will set the course for disposal expenditures for decades.

3. GEH Background:

GEH brings over 50 years of commercial nuclear technology experience related to the scope of work addressed in this proposal. In these 50 years of commercial experience, GEH has been involved with every major nuclear technology development, from the propulsion of naval vessels, aircraft and spacecraft, to sodium cooled thermal and fast spectrum reactors. This includes the building of the SEFOR (Southeast Fast Oxide Reactor) test facility and design of the PRISM reactor, and currently the development of laser enrichment technology. The Boiling Water Reactor (BWR) technology was pioneered by GE. GEH has continued to lead the industry with the development of new advanced reactor technologies. The GEH designed Advanced Boiling Water Reactor (ABWR) was the first reactor design to receive a design certification under the U.S. Nuclear Regulatory Commission's (NRC's) part 52 licensing process. The ABWR is also the only design certification for a Generation III plant in operation. GEH and its alliance partner Hitachi GE Nuclear Energy (HGNE) are currently constructing Advanced Boiling Water Reactors (ABWRs) in Japan and Taiwan, and are negotiating to supply an ABWR to Lithuania.

GEH submitted the ESBWR design certification application in August 2005; In March 2011 the U.S. NRC has issued the Final Safety Evaluation Report (FSER) and the Final Design Approval (FDA) of GEH's ESBWR reactor design. These documents represent the completion of an exhaustive regulatory review process that included GEH responses to more than 6000 requests for information from the NRC and 10 revisions to the Design Control Document. The formal signing ceremony of these documents occurred in Washington DC on March 9, 2011 on the sidelines of the Regulatory Information Conference. The issuance of the FSER and FDA follows the Advisory Committee on Reactor Safeguards' (ACRS) positive recommendation to the NRC dated October 20, 2010. Meanwhile, the ESBWR has received interest globally including from the U.S., India, Finland, Poland, and Sweden.

In addition to supplying reactors, GEH provides a wide range of services to operating nuclear power plants including outage management, power uprate, water chemistry optimization, reactor internal components, plant performance analysis services and advanced instrumentation and nuclear fuel for BAR and CANDU.

4. Scope:

Study and generate a report to document three key areas for initial feasibility assessment of a GEH PRISM plutonium reuse plant to aid the NDA decision process. These are Licensing, Waste Disposal, and most importantly: Commercial Implementation. The specific scope within each area is provided below.

- Licensing: An important commercial risk to enable new nuclear technology is a sovereign government's approach to evaluate safety and related factors for nuclear licensing. GEH will perform the following in the licensing as part of this study:

  An assessment by an independent organization of the ability to license the GEH PRISM Plutonium Reuse Plant (an integral plant that includes reactors, fuel storage, and fuel fabrication) in the UK. This will include an assessment against the specific UK Safety Assessment Principles (SAP). Prior to GEH selection of GEH's supplier for the independent licensing assessment, GEH will inform NDA of which supplier GEH has preliminarily selected and obtain NDA feedback on this selection. If NDA has concerns with the specified supplier, GEH will work with NDA to resolve any such concerns and discuss alternative supplier selection as needed.

- Waste Disposal: GEH's PRISM plutonium reuse plant has the flexibility to reuse a wide variety of plutonium materials to produce electrical energy. UK-specific regulation and policy for waste disposal must be considered. The study will include a wide variety of technical input on PRISM to support an NDA waste disposability evaluation. This will include a compositional mass balance of a PRISM fuel bundle, heat generation rate curves for a PRISM bundle, isotopic compositions of the used fuel, and other necessary characteristics of the used fuel that relate to disposability as well as applicable supporting documentation. NDA agrees to provide GEH with a copy of the waste disposability assessment.

  The study will also investigate other waste disposability issues as follows:

  - A description of the technology readiness level of each process step in the plant in the form of a flow sheet describing the process with inputs and outputs.
  - A description of the expected waste inventory and volume.
  - A description of considerations for decommissioning the PRISM plutonium reuse plant.
  - A description of whether there are any unique packaging considerations for PRISM used fuel for disposal in the UK repository.
  - A discussion of whether there are any waste products from the fuel fabrication facility and how these would be managed/dispositioned.
  - A discussion of how Plutonium Contaminated Materials (PCM) would be dispositioned.
  - A discussion of through-put capacity of the plant.
  - A description of any acceptance criteria for UK plutonium input to the PRISM plutonium reuse plant.

  To accomplish the waste disposal work, GEH will need the following representative information from NDA (within 15 calendar days after contract award to support the completion date discussed at the end of this section.

- Approximate quantities of UK plutonium in various forms (e.g. oxide, heavy metal),
- Representative plutonium cleanliness and contaminates known or expected in the plutonium (e.g. chloride, iron) and levels of contaminants/residues (e.g. weight %),
- Representative plutonium isotopics,
- Representative physical state of plutonium (e.g. flowable powder, granular powder, partial or complete solid state, adhered to container),
- Average quantity of MOX available for reuse as feedstock for PRISM fuel,
- Typical cleanliness and contaminants/residues of MOX (e.g. weight %),
- Representative physical state of MOX (e.g. pellets, cracked pellets, partial pellets, powder, larger solid form),
- Definition of technology readiness levels or agreement to use GEH definitions established for US Department of Energy GNEP program,
- ***A previously performed waste assessment for repository disposal of used nuclear fuel (preferably for used MOX fuel, or otherwise for magnox fuel or uranium oxide fuel, etc.),***
- The approximate dimensions of the plutonium containers,
- The configuration of the plutonium containers as it relates to the ability to open the containers (e.g. can in can, double/triple sealed).

Commercial Implementation: The proposed study will describe commercial Implementation of PRISM in UK. This will include evidence and rationale associated with the UK government decision-making process. It will provide an overview of the business case for a plutonium disposition service using a GEH PRISM plutonium reuse plant:

- Engagement and evaluation of credible owners and operators for the PRISM solution in the UK. This will include available evidence of owner/operator interest such as letters of interest of memorandums of understanding between GEH and interested owner/operators. This will include a description of the capability of the organizations to own and operate the plant.

- The potential commercial model and project structure for the engineering, construction and operation of the plant. This will include a high level commercial business case. The PRISM solution provides a large amount of flexibility in operation that is relevant to the project profitability based on the mission goals. This will include financing considerations, value for UK, and schedule considerations for the following activities:

    - Justification,
    - Any research & development,
    - Licensing,
    - Design,
    - Construction,
    - Operation,
    - Decommissioning,
    - Fuel Storage,
    - Disposal

To support GEH's ability to provide the above schedule information, NDA agrees to provide GEH with a list of specific NDA schedule requirements, constraints, preferences, or concerns ***specific to the plutonium disposition objective reasonably in advance of project completion so GEH may consider it in the above schedule information that GEH provides to NDA.***

- Plant life.
- Technology deployment risk. GEH will identify specific PRISM deployment risks, both commercial and technical and how these could be mitigated.
- The report will provide a description of GEH's approach to plant startup.

Final Deliverables:

A report to be delivered 120 calendar days after signed agreement and subject to timely receipt of information from NDA as specified above. A Proprietary version of the report will be provided subject to a mutually agreeable proprietary information agreement or equivalent legal/UK control, which will be needed since much of the information needed by NDA will be commercially sensitive as it will describe the viability of a commercial arrangement. GEH will also provide, however, a redacted version of the report that does not contain GEH Proprietary information and may be made publically available.

5. NDA Cost Share Contribution:

Total requested amount is a cost share contribution of £50,000 British Pounds Sterling. The cost of this work to GEH is approximately [redacted] not including substantial work GEH has already performed at its own discretion to explore the PRISM UK option. [redacted]

6. Terms and Conditions: *[TBD]*