From:	Tom Clements <srswatch@gmail.com>
Sent:	Monday, August 12, 2024 4:59 PM
To:	TerraPowerEnvironmental Resource
Subject:	[External_Sender] Natrium EIS scoping comments, by Tom Clements, SRS Watch
Attachments:	Clements Natrium EIS scoping comments to NRC August 12 2024.pdf

Attached you will find a PDF of these EIS scoping comments:

Savannah River Site Watch (SRS Watch) EIS Scoping Comments on Construction of the Natrium Reactor Plant, Kemmerer Power Station Unit 1, in Lincoln County, Wyoming as part of participation in the U.S. Department of Energy's so-called Advanced Reactor Demonstration Program

Please confirm receipt of the attachment, which you can regard as being public in nature.

Submitted by Tom Clements, Director, Savannah River Site Watch, 1112 Florence St., Columbia, SC 29201; srswatch@gmail.com

Federal Register Notice: 89FR49917
Comment Number: 971

Mail Envelope Properties (CAEbcavW80hbNYH4P+ZgKTp3oEnrRw99SPUyLUFkwMYXZQ2Ocdg)

Subject: [External_Sender] Natrium EIS scoping comments, by Tom Clements, SRS Watch
Sent Date: 8/12/2024 4:58:41 PM
Received Date: 8/12/2024 4:59:04 PM
From: Tom Clements

Created By: srswatch@gmail.com

Recipients:
"TerraPowerEnvironmental Resource" <TerraPowerEnvironmental.Resource@nrc.gov>
Tracking Status: None

Post Office: mail.gmail.com

Files	**Size**	**Date & Time**	
MESSAGE	605	8/12/2024 4:59:04 PM	
Clements Natrium EIS scoping comments to NRC August 12 2024.pdf			477973

Options
Priority: Normal
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:

SRS WATCH

Savannah River Site Watch

August 12, 2024

Office of Administration
Mail Stop TWFN-7-A60M
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
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Savannah River Site Watch (SRS Watch) EIS Scoping Comments on Construction of the Natrium Reactor Plant, Kemmerer Power Station Unit 1, in Lincoln County, Wyoming as part of participation in the U.S. Department of Energy's so-called Advanced Reactor Demonstration Program

This comment is being submitted per the requirements stipulated in the U.S. Nuclear Regulatory Commission's June 12, 2024 Federal Register notice: "US SFR Owner, LLC.; Kemmerer Power Station Unit 1; Notice of Intent To Conduct Scoping Process and Prepare Environmental Impact Statement"
https://www.govinfo.gov/content/pkg/FR-2024-06-12/pdf/2024-12810.pdf

I note that the Federal Register notice says that "The EIS will evaluate the environmental impacts of construction, operation, and decommissioning of the Kemmerer Power Station Unit 1, and reasonable alternatives thereto." Thus, I anticipate that all on-site and off-site impacts associated with reactor construction and operation and waste management, including irradiated fuel, and waste disposal will be analyzed.

Formal request for a NPIA: Given the proliferation risks of a sodium-cooled fact reactor, **I hereby request that a Nonproliferation Impact Assessment (NPIA)** be prepared by a non-NRC entity as part of the EIS process. Ideally, a group like the JASON could be selected to prepare this important document that must be part of NRC decision making.

As sodium-cooled reactors can be operated to "breed" plutonium, the separation of which from spent fuel is via pyroprocessing (electrometallurgical treatment) or reprocessing, and as the Natrium reactor is reported to use high-assay low-enriched uranium (HALEU), which has its own proliferation risks - as outlined in the *Science* article of June 7, 2024: "The weapons potential of high-assay low-enriched uranium, Recent promotion of new reactor technologies appears to

disregard decades-old concerns about nuclear proliferation" - I request the NPIA be prepared and released along with the draft EIS. Such a document must be in the public realm by the time the public can comment on the draft EIS.

Proliferation aspects of this reactor are also associated with environmental impacts and thus the environmental and health impacts associated with those Natrium reactor proliferation concerns must be reviewed.

Cost of Natrium Reactor Construction

I understand that the pre-construction cost estimate of the reactor has soared to about $9 billion. Please discuss the overall cost of the reactor, how it will be financed to completion, and what public and private funds are now dedicated for construction.

How much funding will be in hand before construction starts?

Will ratepayers in Wyoming be billed in advance for the project? Overall, how much of the project will TerraPower attempt to pass on to ratepayers? What happens in the event of further cost escalations? Will the cost to the public, including DOE (taxpayers), be capped? If not, why not?

What are the costs and environmental impacts of fuel fabrication, which the TerraPower ER says will take place at the uranium fuel plant in North Carolina: "Fuel fabrication to support operations at Kemmerer Unit 1 will occur at Global Nuclear Fuels - America, LLC's (GNF-A) proposed Natrium Fuel Fabrication Facility (NFFF), adjacent to and within the contamination-controlled area of its current Wilmington, North Carolina, facility."

As we have seen that the Westinghouse AP1000 project in South Carolina was canceled after $8 billion was wasted, please discuss what will happen to the project if construction starts but isn't finished. Likewise, what would happen to management of the facility and nuclear materials if the reactor actually starts operation but due to financial or technical problems does not continue operation? Please discus the environmental impact of this "start and abandon" option.

Start of Construction or Not?

In a June 10, 2024 news release, TerraPower claimed that "TerraPower Begins Construction on Advanced Nuclear Project in Wyoming."

If construction has actually started, how is this possible without the EIS having been completed and a construction permit being issued?

A closer look at the news release reveals that the title is not accurate (designed to mislead investors and the public?) and that only "groundbreaking" has started.

In the case of the bungled Westinghouse AP1000 reactor projects in South Carolina and Georgia, the NRC was quite clear about the "start of construction" and that it only began once "nuclear concrete" was poured under the reactor island. At the AP1000 projects, groundbreaking started approximately 3 years earlier than the "start of construction."

In the draft EIS, the NRC must clarify what constitutes the "start of construction."

And, given associated environmental impacts with construction, the NRC should make sure that TerraPower does not make claims that construction has started when such is not the case. But the impacts of excavation and spoil disposal must be discussed in the draft EIS.

Risks of Sodium Coolant Accident

The scoping notice confirms that the "Natrium Reactor Plant is an 840 megawatts thermal, pool type, sodium-cooled fast reactor that contains a compact and simple safety envelope and a molten salt energy storage system."

The DOE document dated June 7, 2023, *Pros and Cons Analysis of HALEU Utilization in Example Fuel Cycles*, states that "design features [of a sodium-cooled reactor] that make the reactor coolant boundary less susceptible to energetic releases (e.g., use of near atmospheric pressures, prevention of coolant boiling, removal of the potential for sodium-water interactions)" will be pursued.

What does "less susceptible" mean concerning the reactor design and risk of "energetic releases" involving sodium? Is it possible to eliminate the risk of energetic accidents involving sodium? If not, please explain.

Please discuss potential accidents and their environmental and health impact involving contact of sodium with air and water. Can a devastating accident similar to the 1995 sodium accident at Japan's Monju reactor occur with the Natrium reactor?

Can a sodium-cooled reactor like this actually explode? If so, what would happen to the nuclear fuel and any stored nuclear waste and what would be the impacts of releases of the radioactive material?

Natrium Fuel, Highly Radioactive Spent Fuel and Low-Level Nuclear Waste

The TerraPower Environmental Report is clear about use of HALEU as fuel: "The Natrium reactor is a sodium-cooled fast reactor using High Assay Low-Enriched Uranium (HALEU) metallic fuel. Its initial core will include 162 fuel assemblies containing enriched uranium (U) - 235 as fuel. The fuel employs a metal fuel system instead of oxides." (page 6.1-1)

In the DOE report mentioned above, *Pros and Cons Analysis of HALEU Utilization in Example Fuel Cycles,* the following is stated by DOE: "In a sensitivity study, the impacts of two ARDP reactor types and fuel forms were evaluated. Natrium will be demonstrated using a sodium-bonded metallic fuel, but the commercial version of Natrium will use a sodium-free metallic fuel. Thus, the cons of the sodium-bonded metallic fuel will be eliminated in the commercial version of Natrium."

So, which fuel type will be used during initial operation of the reactor? How long is a fuel-irradiation cycle? For how many cycles will that type of start-up fuel be used? When will use of the sodium-free fuel begin?

What are the environmental impacts of using sodium-bonded metallic fuel and sodium-free metallic fuel?

The *Pros and Cons Analysis of HALEU Utilization in Example Fuel Cycles* also says "The back-end LCF *[Levelized Cost of Fuel]* of Natrium is significantly reduced because the sodium-free metallic fuel does not need additional treatment before disposal." (page ii) And, "The Natrium concept has a front-end and back-end fuel cycle cost lower than that of the Analysis Example Reactor, owing to higher burnup and direct disposal of SNF, but higher than the Basis of Comparison." (page 27)

Thus, fully discuss the environmental impacts of irradiation and temporary storage and direct disposal of the Natrium spent fuel. Will this fuel be reprocessed at any point in the future? Please discuss environmental impacts of plutonium and its possible fabrication into fuel and subsequent irradiation in the Natrium reactor or elsewhere.

Discuss the environmental impacts of irradiation sodium-bonded fuel and the storage and disposal of such irradiated fuel? Where will it be disposed of and will it be processed in any way before disposal? Will this spent fuel be reprocessed or pyroprocessed prior to disposal? Would plutonium be separated? If so, what will happen to the plutonium? Please discuss environmental impacts of plutonium and its possible fabrication into fuel and subsequent irradiation in the Natrium reactor or elsewhere.

Where will the Natrium fuel be disposed of? Where is the repository for such disposal? If there is no repository, what happens to the long-term management of the spent fuel? What would the repository "acceptance criteria" - which don't exist - be to accept the Natrium's sodium-bonded and sodium-free fuels?

The *Kemmerer Power Station Unit 1 Environmental Report* https://www.nrc.gov/docs/ML2408/ML24088A072.pdf states: "RADTRAN was used to determine doses due to accidents involving shipments of irradiated fuel during transportation from the point of origin (Kemmerer Unit 1) to its disposal facility (Yucca Mountain)." Page 6.2-6

The above statement in the ER is startling in that Yucca Mountain has been canceled due to the fact that it would have faced huge licensing hurdles. Has the NRC made it clear to TerraPower that Yucca Mountain is not going forward? Why are they proposing Yucca Mountain as disposal facility for the Natrium spent fuel?

How could TerraPower list a terminated geologic site for the geologic repository to which the Natrium spent fuel will go? Just where will the Natrium spent fuel go and when? What are the environmental impacts in a range of HLW disposal facilities (that do not exist) and different geologic conditions at each facility?

Likewise, the ER report says that: "US Ecology Hanford Site was selected as it is open to the Northwest Low-Level Compact of which Wyoming is a member (Reference 6.2-8 and Reference 6.2-11)." Page 6.2-6 The draft EIS must fully review environmental impacts of disposal of Natrium LLW in the US ecology site or elsewhere.

Plutonium Breeding a Possibility in the Natrium Reactor?

The DOE document *Pros and Cons Analysis of HALEU Utilization in Example Fuel Cycles* states:

> The nuclear fuel cycles of the listed advanced reactor concepts are tallied in Figure 2.1. The dominant nuclear fuel cycle is once-through, followed by continuous recycle (CR). Most advanced reactor concepts based on the once-through fuel cycle use HALEU fuels with an enrichment range of 10%–19.75%. In comparison, several SMRs based on LWR technologies utilize conventional LEU fuel (< 5%). Evolutionary LWRs and accident-tolerant fuels use 5–10% enriched fuels, but the evolutionary LWRs and fuel concepts are not considered here because the present study focuses on HALEU utilization in advanced reactor concepts. The CR reactor concepts and once-through breed-and-burn reactor concepts require NU or depleted uranium (DU) at an equilibrium state, but they also need HALEU for starting the reactors and for the initial reactor cycles when the bred fissile is insufficient. (page 3)
>
> For quantitative comparison of the HALEU utilization, it was assumed that the initial core is fully loaded with HALEU fuels and one-fifth of the core is replaced during each reload cycle. HALEU fuel is used for the first five cycles. Then, the recovered U/Pu fuel is used as the reloading fuel from the sixth cycle to the end of reactor lifetime (which is assumed to be 80 years). A lifetime-averaged HALEU requirement was then calculated and used in the present study. (page 7)
>
> The prime benefit of using 10% - 19.75% HALEU is to allow advanced reactor designs with advanced coolant materials and a compact and leaky core. For instance, sodium- or lead-cooled fast reactors have been proposed and are under development because of various attractive features of reactor performance (ability to breed fissile and burn waste, higher thermal efficiency with higher operating temperature, excellent inherent safety features, etc.). However, fast reactors cannot achieve

> criticality without a certain amount of fissile (such as HALEU or recovered Pu) in the charge fuel. In particular, the HALEU is absolutely needed for once-through fast reactors. Similarly, a compact and leaky reactor, such as an MR, requires HALEU to maintain criticality for a reasonably long cycle length (e.g., a few years) without refueling. (page 29)

Thus, please review environmental impacts of operating the Natrium reactor as a breeder reactor. The above DOE document reveals this isn't speculative.

Likewise, review the use of "recovered uranium" (RU) in the Natrium reactor. How would this be done?

And, as mentioned in the section above, would HALEU be initially used as fuel and possibly "for the first five cycles?" What fuel would next be used and where would it come from?

Reprocessing and Reprocessing Plant

If the unstated, ultimate goal is to operate the Natrium reactor as a breeder reactor, please be honest and discuss the environmental impacts of this. The proliferation impacts must also be discussed, particularly in the requested Nuclear Proliferation Impact Assessment (NPIA).

Where would any reprocessing facility - or pyroprocessing facility - be located and what would be the environmental impacts during operation, waste management and storage or separated materials?

We know that TerraPower is interested in reprocessing as documented by their obtaining a grant from DOE on the technology.

According to a March 10, 2022 news release from DOE – "DOE Awards $36 Million to Reduce Waste from Advanced Nuclear Reactors" (https://www.energy.gov/articles/doe-awards-36-million-reduce-waste-advanced-nuclear-reactors) - TerraPower was awarded a grant from the so-called "Advanced Research Projects Agency-Energy (ARPA-E)" to investigate reprocessing of spent nuclear fuel:

> ***TerraPower*** *(Bellevue, WA) proposes a method for the recovery of uranium from UNF with integrated safeguards that harness the volatility of chloride salts at high temperatures.* (Award amount: $8,550,000)

But it is assumed that their work would go beyond "recovery of uranium" and would also look at plutonium "recovery."

Where would separated plutonium be fabricated into fuel for the Natrium reactor? Is the Natrium reactor qualified to use plutonium fuel, either purified or containing actinides?

If reprocessing of the spent fuel is pursued, please discuss storage of reprocessed waste in high-level waste tanks. How would such waste be removed from such tanks and disposed of? I note at West Valley, which operated as a commercial spent fuel facility from 1966-1972, and at DOE's Savannah River Site, which produced 36 metric tons of plutonium for nuclear weapons, that virification is the goal for all the liquid HLW.

How much would a reprocessing plant cost and who would pay for it? Would TerraPower or other commercial users commit to pay the full cost? Would the goal be to get DOE to pay for this unneeded facility? Could the facility be a dual use DOE-commercial facility, reprocessing both DOE fuel and commercial spent fuel? Based on the astronomical construction of the large, complicated plutonium fuel (MOX) plant - now terminated - at SRS and its conversion to a plutonium pit facility (for nuclear warheads), is $25 billion for such a reprocessing facility a ballpark assumption?

Additionally, is there any plan to use plutonium as fuel in the Natrium reactor that would be fabricated from DOE's stock of 40 MT currently scheduled to be downblended at SRS and disposed of as waste in the Waste Isolation Pilot Plant (WIPP)? Does dumping that 40MT of weapon-grade plutonium in WIPP undermine any plans for establishing reprocessing of commercial nuclear fuel in the US?

If reprocessing is part of future plans by TerraPower, as indicated by the grant DOE has awarded them, please provide information showing the economic viability of processing. Likewise, as reprocessing greatly magnifies the management of high-level nuclear waste - by dissolving spent fuel that must be held in tanks - please explain how any claim can be made that reprocessing reduces waste from the Natrium "advanced reactor."

(Living near the DOE's Savannah River Site, I well know the problems caused by reprocessing and that "cleaning up" the mess left behind here by reprocessing is going to take 50 years and longer.)

I would add that if the reactor actually is built and operated that any existing plans by TerraPower - but currently not in the public realm - for operation of the Natrium reactor in breeder mode and with use of plutonium fuel must be discussed at this point, in order to avoid segmentation under NEPA.

Thank you for responding in the draft EIS to all the points raised in these comments.

Submitted by Tom Clements, Director, Savannah River Site Watch, 1112 Florence St., Columbia, SC 29201; srswatch@gmail.com