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Comments of the Institute for Energy and Environmental Research on the Department of Energy's Notice of Intent to Prepare a Programmatic Environmental Impact Statement for the Global Nuclear Energy Partnership

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These are comments of the Institute for Energy and Environmental Research on the proposed scope of the various alternatives proposed by the National Nuclear Security Administration for the Global Nuclear Energy Partnership (GNEP) as published in its *Notice of Intent To Prepare a Programmatic Environmental Impact Statement on Global Nuclear Energy Partnership.*[1]

The specific recommendations below for items to be included in the scope of the PEIS are italicized and marked either with bullets or arrows.

Note that the term "reprocessing" is used below as a generic term applying to any and all technologies that involve separation of the contents of spent fuel into two or more streams of materials.

1. The Programmatic EIS (PEIS) must include the environmental impacts of "recycling" all the uranium in U.S. spent fuel.

The NOI states that "used nuclear fuel" would be separated into three streams: uranium, "fission products and fuel element structural materials" and transuranics (p. 331). It also states that

> Uranium and transuranics would be incorporated into new fuel to be consumed in reactors to generate electricity.

[1] United States. Department of Energy, "Notice of Intent To Prepare a Programmatic Environmental Impact Statement for the Global Nuclear Energy Partnership" *Federal Register* **72**, no. 2 (January 4, 2007), pages 331-336. The page references to the NOI in these comments are to the *Federal Register* page numbers.

Spent fuel consists of ~94% uranium-238 (U-238), which is not a fuel. Hence, in order for the uranium in spent fuel to be converted into fuel (rather than only a non-fuel part of mixed plutonium-uranium oxide (MOX) fuel), it will first have to be converted into plutonium-239, mainly in fast neutron reactors, which are part of GNEP as currently proposed. There are over 50,000 metric tons of U-238 in existing spent fuel in the United States and there will be on the order of 100,000 metric tons or more from existing reactors by the end of their licensed lifetimes.

If on the order or 100,000 metric tons of U-238 were converted into Pu-239 and used as fuel, it would provide sufficient fissile material for 100,000 reactor-years of operation (1,000 megawatt reactors). This would be sufficient fuel for operating U.S. reactors at the current level (about 100 reactors of 1,000 MW each) for about 1,000 years. Further, it would require constructing a vast number of fast neutron reactors, with attendant accident risks. It would also require reprocessing of reactor spent fuel multiple times until each batch of U-238 is completely (or nearly so) converted into Pu-239. This would create large amounts of low-level-transuranic, and high-level fission product waste. In light of the foregoing, the PEIS would be grossly incomplete unless its scope fully included the following:

- *An estimate of the number of reactor-years, under assumptions of various kinds of reactors in operation, that it would will take to convert the U-238 expected from the current fleet of U.S. reactors into reactor fuel and an evaluation of the accident risks and the associated health and environmental consequences over the time required to effect such a conversion.*
- *The reprocessing required in the combinations of UREX+, pyroprocessing, and/or other technologies that the DOE envisions would be associated with the separations operations and fabrication of Pu-239 fuel, and the low-level, transuranic, fission product waste, and liquid discharges (in volume and radioactivity) that would be created as a result.*
- *The expected book-physical inventory differences expected in plutonium accounting associated with the amount of reprocessing that would have to be done to convert the U-238 to Pu-239.*
- *The implications of the values for expected TRU waste and fission product generation in the process of conversion of U-238 to Pu-239 for volumes of waste to be disposed of deep geologic repositories.*
- *The expected cumulative worker radiation dose implications of the conversion of U-238 to Pu-239.*

2. The PEIS must include at least one alternative where large amounts of contaminated uranium are disposed of as waste.

The NOI does not make any mention of the possibility that large amounts of uranium, possibly contaminated with plutonium and other transuranic radionuclides and some fission products would be disposed of as waste. However, the DOE's GNEP website does:

Under the Global Nuclear Energy Partnership (GNEP), recycling would comprise uranium extraction plus (UREX+) that would accomplish the following:

- Separate uranium from the spent fuel at a very high level of purification that would allow it to be recycled for re-enrichment, stored in an unshielded facility or simply buried as a low-level waste.[2]

IEER's prior work has shown that even depleted uranium, free of any contaminants, cannot be safely disposed of in shallow land burial sites. DOE's own work has also shown the same. Hence, deep geologic disposal would be required in a manner analogous to TRU waste. One of the IEER reports analyzing this issue is at www.ieer.org/reports/du/lesrpt.pdf. Table 5 from that report is reproduced below for convenience.

Table 5: Summary of our ResRad dose calculations for shallow earth disposal of DU_3O_8 powder under a variety of assumptions for an arid climate. The annual doses for the uranium isotopes as shown include the contribution from their respective decay products as well. It is important to note that the doses are given in rem per year as opposed to mrem per year. (All numbers have been rounded)

Scenario	U-238 Dose	U-235 Dose	U-234 Dose	Total Peak Dose (rem per year)	Time at Peak Dose (years after emplacement)
higher K_d (clay) low effective moisture low erosion	88	47	200	336	17,412
higher K_d (clay) moderate effective moisture low erosion	78	42	185	306	17,412
higher K_d (clay) low effective moisture moderate erosion	72	30	109	210	9,807
higher K_d (clay) moderate effective moisture moderate erosion	67	28	104	199	9,807
lower K_d (sand) low effective moisture low erosion	32	26	121	179	17,403
lower K_d (sand) moderate effective moisture low erosion	658	14	124	795	13,433
lower K_d (sand) low effective moisture moderate erosion	38.4	21	81	141	9,807
lower K_d (sand) moderate effective moisture moderate erosion	658	14	124	795	13,433

Notes:

- The K_d values used for the uranium and its decay products were taken from the ResRad data collection manual for the indicated soil type. All other soil parameters not set to default values remained at the values appropriate to clay.[102]
- low effective moisture = rain of 0.178 m/yr and an evaotransportation coefficient of 0.9
- moderate effective moisture = rain of 0.356 m/yr and an evaotransportation coefficient of 0.7
- low erosion = 0.0005 m/yr
- moderate erosion = 0.001 m/yr

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[2] "Global Nuclear Energy Partnership: Integrated Spent Fuel Recycling Capability" on the web at http://www.gnep.energy.gov/gnepProliferationResistantRecycling.html, viewed on June 4, 2007.

The above table shows that even at dry sites the radiation doses at time of peak dose is far in excess of the allowable limit of 25 mrem to the most exposed organ (or whole body if the radiation is uniform over the body) even at dry sites. The DOE's own work as well as that of the NRC has shown that disposal of uranium in shallow land burial is unsuitable at wet sites. It is to be noted in this context that low-level waste disposal regulations do not impose any time limit on the protection of populations, so that it is essential to consider peak dose when assessing potential compliance and health effects.

→ *The scope of the PEIS should therefore include an analysis of the health and environmental effects of disposal of uranium at the level of enrichment it is expected to be disposed of as well as at the levels of its expected contamination with transuranic and fission product radionuclides. This should include an analysis of the consequences of shallow land burial in wet and dry areas to the time of peak dose.*

→ *The scope of the PEIS should also include as assessment of the costs of disposal in a manner that would comply with low-level waste disposal regulations as specified at 10 CFR 61 Subpart C.*

3. The security and environmental effects of storing fission products for hundreds of years should be analyzed.

The DOE's proposal as currently explained on its website envisions storage of "short-lived fission products" until they are sufficiently decayed for disposal as low-level waste:

> Under the Global Nuclear Energy Partnership (GNEP), recycling would comprise uranium extraction plus (UREX+) that would accomplish the following:
>
> …
>
> - Extract short-lived fission products, cesium and strontium, and prepare them for decay storage until they meet the requirements for disposal as low-level waste. [3]

Cesium-137 and strontium-90 have half-lives of about 30 years and 28 years respectively. If the large amounts of these radionuclides in spent fuel are to be extracted and disposed of as low-level waste instead of disposal in a spent fuel repository as part of the once-through fuel use system, envisioned, for instance, in the Nuclear Waste Policy Act, then storage of these radionuclides for ~300 years would be required. The health and environmental risks, the security risks, including protection from terrorist attack, and technical issues such as the longevity of the storage containers should be considered. The scope of the PEIS should include:

- *The assessment of radiation risks to the public and the environment from several transfers of cesium-137 and strontium-90 to new canisters.*

[3] "Global Nuclear Energy Partnership: Integrated Spent Fuel Recycling Capability" on the web at http://www.gnep.energy.gov/gnepProliferationResistantRecycling.html, viewed on June 4, 2007.

- *The processing and/or packaging of cesium-137 and strontium-90 that would be required prior to disposal as low-level waste.*
- *A compliance assessment of disposal of cesium-137 and strontium-90 as low-level waste with 10 CFR 61 Part C at the time after storage that these radionuclides would be disposed of in the types of facilities proposed for disposal (including shallow land burial facilities, if these are proposed to be used).*
- *The risks to the public, including airborne releases and possible contamination of surface and groundwater with cesium-137 and strontium-90 in case of serious accidents seismic events, or terrorist attack on storage facilities.*

4. The consequences of operation of UREX+ and any other aqueous reprocessing technologies for water resources should be explicitly examined in light of past experience.

UREX+ is an aqueous process, not dissimilar to the PUREX process, though different in some details. There would be liquid discharges from a UREX+ or other similar reprocessing plants. The Savannah River, for instance, is already contaminated with tritium and iodine-129 from past reprocessing operations (which were mainly for weapons operations).

The scope of the PEIS should include:

- *An evaluation of the discharges of tritium and iodine-129 from UREX+ or other reprocessing technologies for water resources. In the case of the Savannah River and other water bodies already contaminated with tritium and iodine-129, the evaluation should include the cumulative impact of past and potential future contamination.*
- *An evaluation of compliance with tritium guidance maximum contaminant levels that have been issued under CERCLA, notably in Colorado (500 picocuries per liter) and California (400 picocuries per liter).*

5. The consequences to the NPT of the GNEP proposal need to be analyzed.

The NOI makes no mention of the potential of GNEP to undermine the Nuclear Non-Proliferation Treaty (NPT). Article IV of the NPT grants to parties in good standing the "inalienable" right to commercial nuclear technology. The GNEP proposal is precisely a proposal to alienate that right from most of the parties to the NPT and reserve it only for those countries that already have reprocessing or uranium enrichment capability. This would extend what has been called the "nuclear apartheid" system in nuclear weapons to critical aspects of commercial nuclear technology.

The scope of the PEIS should include analysis of the security, health, and environmental impacts of the proposal on stimulating the demand for reprocessing and uranium enrichment technologies around the world. This should be considered in the context in which the GNEP proposal is being floated -- North Korea having tested a nuclear weapon, Iran acquiring uranium enrichment technology, the Gulf Cooperation Council *announcing a program of civilian nuclear energy development, Brazil refusing Additional Protocol inspections of its new enrichment plant, and other heightened interest in commercial nuclear technology). The health and environmental impact of states and/or terrorist groups acquiring weapons-usable materials (even if defined as "proliferation-resistant) on the United States in case of the use of dirty bombs or nuclear bombs should be included in the evaluation.*

6. The claim of proliferation resistance for certain technologies needs to be analyzed by certain criteria.

Proposed reprocessing technologies as well as transfer of reactor technologies are stated to be proliferation resistant. The NOI contains no objective criteria for that term. Specifically, it is recognized that nuclear weapon states or other states like Japan that already possess large amounts of separated plutonium (either weapon-grade or reactor grade or both). These states would be unlikely to use plutonium contaminated with transuranic radionuclides like neptunium-237 and small amounts of other contaminants for making nuclear weapons. However states that do not now have separated plutonium or uranium enrichment capability could well be content with materials that have mostly plutonium, with most of the rest being other transuranic radionuclides and possibly some uranium for the purpose of making nuclear weapons. Such states and terrorist groups are unlikely to be overly concerned with radiation doses received by workers who handle these materials. It is to be noted in this context that worker radiation doses in the United States and the Soviet Union in the early days of nuclear weapons production were often high.

The scope of the PEIS should include:

- *An objective definition against which proliferation resistance can be assessed.*
- *An assessment of whether the definition suggested would provide a significant level of resistance for states that do not now have nuclear-weapons-usable materials and could not easily acquire them.*
- *An assessment of the proliferation impact of developing compact reprocessing technologies including pyroprocessing or similar technologies. The assessment should include an evaluation of the relatively lower level of difficulty in hiding such plants relative to existing PUREX plants, making inspections and verification of compliance with NPT obligations more difficult.*
- *An assessment of whether any of the reprocessing technologies proposed would result in one or more streams of materials that could, in principle, be used to make nuclear weapons (including ones with higher likelihood of "fizzles"). This should include the transuranic stream produced by UREX+ and related technologies and pyroprocessing and related technologies.*

7. The PEIS should analyze the anticipated cost and performance of GNEP in light of the poor performance of the DOE in large projects.

At least one alternative in the PEIS should include the possibility that many facilities will be built and operated but that their operation will not be as designed or anticipated. The record of the DOE in developing challenging new technologies is not reassuring. The problems with facilities as diverse as the National Ignition Facility, the Yucca Mountain project, the pre-treatment of high-level waste at the Savannah River Site (where the in-tank precipitation process was abandoned after 16 years and $500 million were expended) should be reviewed. The lack of performance in these and other DOE efforts has occurred despite enormous cost escalations that have been the hallmark of such projects.

- *The scope of the PEIS should include one alternative where the GNEP reprocessing and fast reactor facilities do not perform well or are abandoned for other reasons such as high cost. For such an alternative, the scope of the PEIS should include and assessment of the health and environmental impacts of GNEP in such a case, including institutional issues associated with caring for the fission product streams containing strontium-90 and cesium 137. This evaluation should take into account potential loss of institutional memory over a period of a hundred years or more in light of past loss of institutional memory over similar periods involving DOE.*