

**Union of Concerned Scientists Comments on the Energy Department's Draft Global
Nuclear Energy Partnership Programmatic Environmental Impact Statement
(GNEP DPEIS)**

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March 16, 2009
Washington, DC

The Union of Concerned Scientists (UCS) opposes the Department of Energy's preference, as stated in the GNEP DPEIS, to "close the nuclear fuel cycle," that is, to change the U.S. strategy for disposal of commercial spent nuclear fuel from direct emplacement in a geologic repository to reprocessing and separation of fissile materials for fabrication into new reactor fuel. UCS opposes spent fuel reprocessing for reasons of security, safety and cost, as expressed in detail in its comments on the scope of the GNEP DPEIS and other publications, including the 2007 report *Nuclear Power in a Warming World* (NPWW), which is described and referenced in Chapter 1 of the DPEIS.

A review of the GNEP DPEIS indicates that the document provides no new or compelling data or analysis to support DOE's "preference" for closing the fuel cycle. The technical analysis is of extremely poor quality and is riddled with unsupported assumptions, misleading comparisons and major omissions. The fact that DOE expresses its preference without selecting a specific strategy for closing the fuel cycle makes it appear that this process is fully in sync with DOE's standard "decide, announce, defend" mode. DOE is not in a position to express a preference for the closed fuel cycle unless it can point to a scenario that clearly demonstrates that its goals can be met and that effectively responds to the technical arguments against such a preference.

Many of our criticisms of the GNEP program deal with security and proliferation issues. We have reviewed the National Nuclear Security Administration's December 2008 Draft Nonproliferation Impact Assessment (DNIA), which was issued as a companion document to the GNEP DPEIS. Although we are aware that DOE is not formally accepting public comments on this document, we are attaching comments on the DNIA for your consideration.

COMMENTS ON THE DPEIS

1. The DPEIS contains a misleading comparison of the nuclear waste disposal impacts of the various alternatives.

The analysis in Chapter 4 of the DPEIS does not consistently compare the waste disposal impacts of the various alternatives over a 50-year implementation period. For instance, table S.4-2 of the summary implies that after 50 years of operation, the "recycle" options involving thermal and/or fast reactors produce no spent fuel that must go to a repository

and that the “thermal load reduction factor” for recycle options involving fast reactors is a factor of more than 200 relative to the once-through cycle. However, this result is based on the unstated assumption that the entire fleet of reprocessing facilities, fuel fabrication facilities, and reactors using actinide fuel will be fully replaced and continue to operate beyond the 50-year implementation period. If the system is not replaced, then all the irradiated fuel in process (that is, in reactor cores and in storage awaiting reprocessing) will require geologic disposal. In addition, all the separated actinides and fresh actinide-based fuel in process will require geologic disposal if there are no reactors to use them as fuel. Thus a large fraction of the thermal load associated with the actinides will have to be returned to a repository. Like a pyramid scheme, this scenario ultimately depends on the availability of a new generation of reactors and other facilities to process the leftover waste from previous generations. If new reactors do not become available, the system collapses.

As UCS discussed in NPWW, the National Academy of Sciences and other analysts have shown that it would take a very long time for a closed fuel cycle system to reduce the in-process inventory of spent fuel, fresh fuel and separated actinides to a small fraction of the starting inventory --- hundreds to thousands of years, depending on the nuclear power growth rate, the assumed conversion ratios, and the assumed separation factors, among other assumptions --- even if the system works perfectly. Therefore, if the system breaks down prematurely, the amount of in-process material requiring geologic disposal would be a significant fraction of the initial inventory. The PEIS should contain a table that assesses the geologic disposal impacts should the system fail to operate after the 50-year implementation period. For the case in which the system is assumed to continue to operate for hundreds to thousands of years, DOE must consider the impacts of the additional construction needed to build replacement facilities for the entire period.

The DPEIS waste tables are also misleading because they fail to include important waste streams. For instance, the listed waste quantities do not include reprocessed uranium, “because any recovered uranium could be reused.” However, the DPEIS does not contain any analysis of the technical challenges, costs and other feasibility considerations associated with the use of reprocessed uranium in lieu of mined uranium, with reference to the failure of other countries to use significant quantities of reprocessed uranium, resulting in the stockpiling of vast quantities of the material. It is more likely that much or all of this material will have to be discarded as waste, and that possibility should be analyzed in the PEIS. Moreover, the quantities of reprocessed uranium should be presented in terms of metric tons heavy metal (MTHM) as well as volume.

Another source of wastes that are not accounted for in the DPEIS tables is the decontamination and decommissioning (D&D) of all associated facilities, including all fuel cycle facilities. The 50-year cumulative impacts table appears to account for the waste generated by the D&D of reactors, but apparently does not include the D&D wastes generated by all the additional facilities that are required for the closed fuel cycle options, including reprocessing plants, actinide fuel fabrication plants and HLW and Cs/Sr solidification plants. The reason for this omission, according to section 4.9.2, is that the D&D waste generation is proportional to the size of any facility, and the square

footage of all the fuel cycle facilities would be far less than the square footage of all the reactors that would require D&D. the DPEIS concludes from this that the D&D waste from fuel cycle facilities would be an insignificant factor, and it is not necessary to account for it.

The DPEIS provides absolutely no data to support this assertion. But the claim that the D&D waste volumes associated with reactors would be comparable to those of fuel cycle facilities that have processed plutonium, other actinides with high radiotoxicities, and intensely radioactive spent fuel solutions, is absurd. D&D of fuel cycle facilities will generate GTCC LLW of a different character than most of the GTCC LLW from nuclear power plants, and future waste classifications may need to take this into account. Moreover, the labor costs and radiological risks associated with D&D of a reprocessing plant or actinide fuel fabrication facility will clearly be far greater per square foot than those associated with a reactor that has not melted down. The PEIS should contain detailed estimates of these waste streams for all scenarios with as much quantitative information as possible at this stage. The costs associated with D&D of large, extensively contaminated facilities like reprocessing plants must be properly accounted for.

2. The analysis of accident impacts for mixed-oxide (MOX) fueled light-water reactors is incorrect and significantly underestimates the true impacts of MOX fuel use because it assumes the use of weapon-grade and not reactor-grade plutonium.

The DPEIS contains an analysis of the health consequences of beyond-design-basis accidents at light-water reactors fueled with mixed-oxide (plutonium-uranium) fuel (Section D.2.3.1). This analysis was based on the core inventory of a light-water reactor containing a 40%-MOX core that was originally calculated for the 1999 Surplus Plutonium Disposition EIS (SPD EIS). However, use of the SPD EIS core inventory is invalid for the GNEP PEIS because the isotopic composition of the plutonium contained in the MOX fuel analyzed in the SPD EIS was weapons-grade, whereas the MOX fuel that would be used in the GNEP program would be fabricated from commercial reactor-grade plutonium.

The difference in isotopics has a significant impact on the core inventory of highly radiotoxic, alpha-emitting actinides such as Pu-240 and Am-241. In addition, the initial plutonium concentration must be higher for reactor-grade plutonium than for weapons-grade plutonium. A 2001 study by this author showed that the population dose resulting from a beyond-design-basis accident involving a LWR using reactor-grade MOX fuel is two to three times greater than the dose resulting from the same accident if weapons-grade MOX is assumed. (E.S. Lyman, "Public Health Risks of Substituting Mixed-Oxide for Uranium Fuel in Pressurized-Water Reactors," *Science and Global Security*, Vol. 9, pp. 33-79, 2001). Therefore, the PEIS must repeat these calculations using the correct core inventories.

Since the DPEIS also discusses the possibility of multiple recycling of MOX fuel in LWRs in section 4.5, the PEIS should assess the impact of this practice on severe accident consequences, as the radiological hazard of the fresh fuel will continue to increase with each recycle, and the associated generation of higher actinides in the reactor will also be greater, resulting in a more hazardous actinide source term.

3. The analysis in the DPEIS of accident risks associated with the Advanced Recycling Reactor is inadequate.

The DPEIS relies on information cobbled together from a variety of different sources on fast reactor safety, including the Clinch River Breeder Reactor Plant (CRBRP) environmental report, to analyze the accident impacts of the Advanced Recycling Reactor (ARR). The DPEIS admits that almost no details about the design of the ARR have been fixed, but asserts anyway that the CRBRP data will clearly bound the ARR accident impacts because the ARR would have advanced safety features that would “eliminate potential scenarios or reduce their likelihood by orders of magnitude.” This is pure speculation about a design that doesn’t even yet exist. However, there is reason to believe that the ARR could well pose more severe risks than the CRBRP, depending on the actual design.

Some of the discussion in the DPEIS is presented as if it would apply to any ARR design. This is not the case. For example, on page D-62, the DPEIS cites the successful EBR-II loss-of-flow and loss-of-heat-sink tests and indicates they are applicable only to metallic-fueled fast reactors, yet it then goes on to make a conclusion about the safety of the ARR in general. Moreover, the positive results of the tests at EBR-II, which had a power rating of 62.5 MWth, cannot be directly extrapolated to larger fast reactors like the ARR (with a power rating up to 2,000 MWth) with far larger sodium void coefficients.

A primary difference between the ARR and the CRBRP or any other fast reactor that has operated is that the ARR specified in the DPEIS will use TRU fuel instead of plutonium-uranium fuel and operate at a low conversion ratio of 0.5, instead of at a conversion ratio near or greater than one. The safety implications of these features is profound. The addition of other actinides to plutonium reduces the delayed neutron fraction in the core, decreasing its stability under small changes in reactivity. In addition, the attainment of low conversion ratios requires reducing the uranium-238 content of the core relative to a breeder reactor by removing blankets and increasing the actinide enrichment of the fuel. This leads to a reduction in the Doppler coefficient, a parameter that plays a very important role in fast reactor systems by providing negative reactivity feedback and limiting the explosive energy release associated with core disassembly accidents. Therefore, accident risks drawn from a database of (mostly small) plutonium-fueled fast reactors with conversion ratios near 1 cannot be used to bound the accident risks of a large, TRU-fueled burner with a low conversion ratio.

This section is extremely confusing to us and we believe it needs to be extensively revised. The PEIS should select a small number of candidate ARR, define their design parameters in reasonable detail, and analyze their bounding accident impacts (i.e.

energetic core disassembly accidents) to the fullest extent possible given the remaining uncertainties.

4. The DPEIS uses technically meaningless measures like “radiotoxicity” to compare the environmental impacts of the alternatives.

The DPEIS uses the metric of “radiotoxicity” to compare various fuel cycle options and argues that closed fuel cycle alternatives can dramatically reduce the time necessary for the radiotoxicity of high-level waste to decay to that of natural uranium ore.

“Radiotoxicity” is a meaningless measure to assess the impacts of repository waste disposal because it assumes that there is no partitioning of different radionuclide species in groundwater and ultimately in downstream drinking water. However, in any repository there will be partitioning, the details of which depend on the repository geochemistry. However, solubility-limited radionuclides like plutonium will generally leach at lower rates than soluble radionuclides and therefore would contribute far less to the radiation exposure of critical groups. Professor Thomas Pigford of UC Berkeley debunked the utility of the concept of radiotoxicity many years ago and it is disheartening that DOE continues to refer to this misleading measure. The DPEIS points out that “radiotoxicity is not a regulatory standard relevant to the disposal of spent fuel and high-level radioactive waste.” There are sound technical reasons why this is the case.

Moreover, any reduction in repository dose rates has to be balanced by the increased risks associated with environmental releases of the extracted actinides in the event of accidents or terrorist attacks on TRU fuel transports, TRU fuel fabrication, TRU-fueled reactors, and TRU storage sites. While the “benefits” of reduced repository source terms will only be experienced far in the future, the risks associated with TRU extraction and processing are incurred by the current generation.

COMMENTS ON THE DNIA

UCS appreciates that the National Nuclear Security Administration (NNSA) honored the requests of many stakeholders by preparing the Draft Nonproliferation Impact Assessment (DNIA) and informally soliciting public comment, even though NNSA maintains that there is no legal requirement for doing so.

NNSA states that the purpose of the DNIA is to establish a framework for evaluating the nonproliferation characteristics of the fuel cycle alternatives considered in the DPEIS, and not to evaluate the purpose and need of GNEP. We find that the analysis in large part avoids the overblown and technically flawed claims that DOE has made in the past for the nonproliferation benefits of GNEP and the reprocessing technologies being developed under the Advanced Fuel Cycle Initiative (AFCI), and corrects the record in some important respects. However, in other respects, the document is slanted toward reprocessing options through its repetition of certain assertions that are not supported with historical context or cogent political analysis, and its acceptance of dubious technical claims in the DPEIS as scientific fact. Ultimately, we find the DNIA fails to make a persuasive case for the nonproliferation benefits that it ascribes to the closed fuel cycle alternatives outlined in the DPEIS, and reinforces our view that the No Action alternative --- the once-through cycle --- is the right option.

One general comment is that the document seems to be out of date. For instance, it does not refer to the U.S.-India Agreement for Nuclear Cooperation and the associated domestic legislation carving out exceptions to the 1978 Nuclear Non-Proliferation Act. This development is highly relevant to the discussion and its omission is a major oversight.

Specific comments:

1. The DNIA provides no evidence for the assertion that “the United States would strengthen its ability to influence how other countries engage in recycling” by taking an active role in spent fuel recycling in its domestic program. This has already been contradicted by current events. Since the Bush Administration unveiled GNEP in 2006, warning of the growth of “separated plutonium” stockpiles and encouraging the development of “proliferation-resistant” alternatives to PUREX, there has been zero impact on the current French, British, Japanese or Russian reprocessing programs, which will continue to use PUREX for the lifetimes of their current facilities. On the other hand, the U.S. had a real opportunity to greatly curtail reprocessing by exerting its consent rights over U.S.-origin uranium, but it gave those rights away by negotiating nuclear cooperation agreements with Japan and Euratom that granted programmatic consent to their reprocessing programs. The DNIA does not appear to have any discussion of this.
2. The DNIA accepts as fact the ability of “full actinide recycle” to “reduce dramatically the long-term radiotoxicity of spent fuel,” and asserts that such a

practice would increase public acceptance for U.S. take-back of foreign spent fuel. This is nothing more than a fantasy. As outlined in the above comments on the DPEIS (and clearly demonstrated in the DPEIS tables on relative waste volume production of the fuel cycle alternatives), the actinide recycle schemes will generate far greater near-term environmental impacts, and generate far greater volumes of radioactive wastes, than would direct spent fuel disposal. In addition, they cannot effectively reduce actinide inventories over a reasonable time frame. It strains credulity to conclude that the introduction of such a system in the United States would make Americans any more likely to welcome the import for permanent disposal of foreign nuclear waste any more than the French, the Russians or the Japanese do.

3. The DNIA does present an honest assessment of the so-called “proliferation resistance” of technologies like COEX, UREX+1a and pyroprocessing. It concludes that “there are only minor differences in the proliferation risk between these processes” and that the additional proliferation resistance of these alternatives over PUREX is small. This undermines DOE’s previous claims that these technologies are significantly more proliferation-resistant than PUREX and that much would be gained for the U.S. to convince reprocessing nations that they should switch to one of these technologies from PUREX. Therefore, it is unclear what the U.S. would actually gain by closing the fuel cycle at home using one of these technologies so that it could influence the fuel cycle policy of these other countries (see comment #1 above).
4. The DNIA continues to assert that there is “some benefit” to the modified reprocessing technologies with regard to protection against sub-national threats, even while it concedes that “even with the lanthanides present, the total dose is not very high and would be unlikely to deter an adversary who was willing to accept injury ...” UCS maintains that for this very reason, the “benefit” is insignificant, and agrees with the DNIA that it is appropriate to classify the products of all these technologies as Category I, requiring the highest levels of physical protection and material control and accounting.
5. The chief message of the DNIA seems to be that the proliferation drawbacks associated with an embrace of reprocessing in the U.S. would be outweighed by the nonproliferation benefits associated with the increased influence the U.S. would have in the international fuel cycle arena, and the greater likelihood that the U.S. would be in a position to offer cradle-to-grave fuel cycle services to other countries in exchange for their renunciation of domestic fuel cycle facility development. However, the document provides not a shred of evidence to support that picture. We believe it is far more likely that the signal that the U.S. would send by a return to domestic reprocessing would make it a “must-have” technology for every nation that harbors nuclear ambitions --- a demand that would ultimately overwhelm increasingly feeble attempts to control the spread of this dangerous technology.