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October 18, 2000

Depleted Uranium Hexafluoride Management
Program (NE-30)
U.S. Department of Energy
19901 Germantown Road
Germantown, MD 20874

SUBJECT: "COMMENTS ON DUF_6 MATERIALS USE ROADMAP," DRAFT, DATED SEPTEMBER 1, 2000

Dear Sir or Madam:

This is in response to the U.S. Department of Energy's (DOE's) recent request for comments on the "DUF_6 Materials Use Roadmap." It is the Nuclear Regulatory Commission's (NRC's) understanding that the roadmap document will be used to decide between alternatives and proposals for depleted uranium (DU) conversion, potential applications, and disposal, including the selection of research and development activities. The NRC's interest in DU disposition arises from the large quantities of DU stored adjacent to NRC-regulated activities at the gaseous diffusion plants (GDPs) located at Paducah, Kentucky, and Portsmouth, Ohio; the continued generation of DU by the GDPs; the likely regulation of any DU applications and recycle activities by NRC (e.g., shielding in containers); and, while not currently planned by DOE, the potential for future involvement of NRC in regulating DU conversion and disposal activities, either as the regulator or as an advisor to the regulating authority. In addition, NRC wishes to remain apprised of DU management activities and the effect that any long-term strategies selected by DOE using this roadmap document might have on future activities involving DU that might be proposed for licensing by the NRC, including future enrichment facilities.

The NRC has previously provided comments to the DOE on DU management alternatives as part of a review of the *Programmatic Environmental Impact Statement for Alternative Strategies for the Long-Term Management and Use of Depleted Uranium Hexafluoride* (DOE/EIS-0269D, December 1997) and in response to a request by DOE for recommendations on the potential uses for and technologies that could facilitate the long-term management of DUF_6 (59 FR 56324, November 10, 1994). Our comments were provided in correspondence to DOE dated May 1, 1998, and January 3, 1995, respectively. In addition, as part of a license application review for a proposed enrichment facility[1], the NRC extensively investigated the management and disposition of DUF_6. NRC staff have reviewed the roadmap document in light of these previous documents and correspondence, and ongoing developments related to DU, including applications and disposal activities that could be used for DU and DU-containing materials. The comments generated by the NRC staff are enclosed.

[1]See, for example, "Safety Evaluation Report for the Claiborne Enrichment Center, Homer, Louisiana," NUREG-1491, January, 1994.

The NRC notes that most of the DUF_6 has been stored for several decades, and significant quantities continue to be generated by ongoing enrichment activities. Historically, only very limited quantities of DU have been consumed by applications or sent to disposal. Current storage methods for DUF_6 employed at the GDPs and by DOE have historically demonstrated only minor impacts to the environment, safety, and health. However, the NRC agrees with the DOE strategy implied by the roadmap that continued, long-term storage of potentially reactive DUF_6 in steel cylinders exposed to the environment cannot be followed indefinitely, and that conversion of the DUF_6 to a more stable form, such as one of the oxides, would provide even safer intermediate storage for possible future applications and/or eventual disposal.

In the aforementioned license application received by NRC for an enrichment facility (see Footnote 1), NRC concluded that DUF_6 disposition was an important activity that could not be deferred, and, if the license had been issued, NRC would have imposed financial and time constraints upon the licensee for DUF_6 disposition. These constraints were based upon conversion of DUF_6 into U_3O_8 and disposal in a deeper-than-shallow land burial facility (for example, an abandoned mine cavity). Shallow land (near-surface) disposal was not a likely option because a generic performance assessment indicated the dose requirements of 10 CFR Part 61 could be exceeded by a wide margin. NRC did not pursue rulemaking related to the disposition of DU from enrichment facilities because the license application was withdrawn.

The NRC has not developed specific recommendations for management and disposition of DOE's DUF_6 inventory. While beneficial uses of the DUF_6 may be forthcoming in the future, NRC recommends that, because of the large DOE quantities of DU and the current, excess worldwide inventories of DUF_6, DOE should assume that a significant portion of the DOE DUF_6 will require disposal as waste. Disposal of DUF_6 will require conversion to a more stable physicochemical form, such as one of the oxides (e.g., U_3O_8). In the past, NRC has recommended that U_3O_8, which is thermodynamically stable and relatively insoluble, is a likely form for long-term storage and disposal. Dense uranium dioxide forms may also be suitable, based upon recent ore deposits found in Canada and the many investigations related to its behavior in spent nuclear fuel. We note that uranium tetrafluoride is not likely to be a suitable material for disposal of significant quantities of DU based upon its corrosivity and relatively high solubility as compared to the oxides. Also, disposal of significant quantities of DU as the metal may require more engineered barriers and restrictive geology and hydrology requirements. At the present time, we do not have adequate information on the properties of other potential DU forms (e.g., coated uranium monocarbide) to provide an assessment regarding their suitability for disposal. In addition, disposal of a significant fraction of DOE's DU inventory would likely require one or more dedicated, unique facilities. Based upon our earlier analyses, such a large quantity might well be disposed of in a mined cavity, perhaps an exhausted uranium mine or even as a backfill or shielding material in a geologic repository for spent fuel, providing for better confinement of the DU material. Thus, we believe the roadmap needs to state that disposal, as the oxide, in a dedicated facility, is the likely baseline.

If beneficial uses of DU develop in the future, such applications will likely depend upon the high density of the DU chemical form; for example, for counterweights or shielding. Furthermore, after use, the dense DU form is likely to require disposal. Thus, for compatibility with disposal facilities, for reduced storage requirements, to minimize conversion facility numbers and types, and to reduce schedules and costs, a likely candidate for applications may be dense uranium dioxide forms. We believe the roadmap needs to recognize this linkage between disposal, storage, and future applications, and perhaps identify the dense dioxide form as the baseline.

Finally, industry utilization of facilities that convert uranium hexafluoride into the dense dioxide for nuclear fuel applications is significantly below the capacities of some of these plants. Potentially, several thousands of tonnes of capacity may be available each year. Operation of portions of such facilities without the nuclear fuel requirements may result in reasonable costs and tangible reduction of risk almost immediately, and provide materials for research and development activities into applications and disposal, with minimal impact to the workers, the public, and the environment. There are other facilities that may also be underutilized. DOE may wish to revise the roadmap to consider the use of some of this underutilized capacity as part of its DU program.

If you have any questions regarding the staff's review, please contact Alex Murray of my staff at (301) 415-7854.

Sincerely,

/RA/

Eric J. Leeds, Chief
Special Projects Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Material Safety
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Review and Comment on,
"DUF_6 Materials Use Roadmap," Draft, dated September 1, 2000.

General Comments:

1. The report is generally well-written, provides context of the problem, and limits the scope of the discussion where appropriate.

2. **Large quantities of materials:** The roadmap identifies large quantities of materials from the DU activities (approximately 500,000 tonnes as uranium). Most of the regulations mentioned in the roadmap are based upon relatively small quantities of DU and DU-derived materials. The reuse or disposal of such large quantities of DU and DU-origin materials would likely result in the appropriate regulators re-examining the situations and existing regulations, and will likely result in rulemakings with public participation for new regulations or waste acceptance criteria. Environmental Impact Statements (EISs) are likely to be needed. The roadmap may want to reflect this likely effect.

3. **Regulatory requirements:** The document appears to understate the importance of meeting regulations, particularly for recycle/reuse applications and the ultimate disposition of DU from these applications. For example, on page 19, one of the "institutional challenges" is the likelihood that an investment can modify regulatory barriers. Compliance with regulatory requirements is an important and mandatory consideration in the selection of DU forms and alternatives. Many of the regulations are outside the control of the DOE DU program. It would seem a better approach and criterion would be to demonstrate compliance with regulations instead of modifications.

4. **Baseline:** The roadmap briefly discusses but does not clearly identify a baseline for planning purposes and for comparison with potential alternatives. The roadmap should consider including such a baseline based upon the programmatic EIS (PEIS), its Record of Decision (ROD), and previous analyses. Based upon Nuclear Regulatory Commission (NRC) analyses from the Claiborne enrichment plant application, a likely candidate for the baseline would be conversion to U_3O_8 followed by disposal in a dedicated, deep facility.

5. **Subjectivity and performance requirements:** The report does not include any objective or numerical criteria for making the determinations of utilization, economics, technical maturity, other impacts etc. by the DOE reviewers and workshops. For example, the criterion on pages 18 and 19 are qualitative and very subjective. What are the baseline costs and Environmental Safety and Health (ES&H) impacts, what are the deltas, etc.? Such objective criteria would make it easier for readers to understand the different categories and rankings. In addition, performance of similar alternatives may vary with the application. For example, DU metal may be used as a gamma shield for spent nuclear fuel (SNF) containers, but it does not obviate the need for a heterogeneous neutron shield on the container. Dense oxide compounds of DU (e.g., in the concrete forms) are likely to have significantly different shielding effects for SNF cask applications depending on densities, interstitial forms etc.; some may have sufficient performance to eliminate the labyrinthine air cooling passages typically required on concrete storage casks. Other DU forms may not have adequate performance to eliminate the cooling passages. However, the roadmap seems to assume they all behave similarly. Without some objective criteria

and performance requirements, it is not possible for the selected routes to be substantiated, and there may be questions raised by interested parties and intervenors as the roadmap/program develops.

6. **Uncertainties and errors:** The roadmap does not adequately discuss uncertainties and errors in the ranking of the alternatives. It is likely that there are large uncertainty bands around the potential impacts (including costs) from the different alternatives, particularly for those which are new and untried. Given such uncertainties, for example, it is not clear how differentiation and selection of one DU oxide shielding route over the others can be substantiated. In addition, there may be errors in the analyses. For example, on page 24, there is a mention of "... a complicated process designed to produce high-quality nuclear fuel ..." for one of the shielding alternatives. This appears out of place and is a likely error, and would seem to penalize this alternative as compared to the other DU shielding alternatives.

7. **Cost versus safety:** The document emphasizes cost; it is mentioned on almost every page. Relatively little is said about safety and regulatory compliance. A more balanced approach seems more appropriate.

8. **Life-cycle approach:** The roadmap mentions deferral of activities, such as DU disposal, in several places (e.g., page 20). For balance and accuracy, it would seem that complete analyses would be used, with similar bases. For example, for all alternatives, the roadmap should consider a life-cycle approach that includes the impacts from conversion, storage/use, any reconversion/repackaging needed for disposal, and disposal itself.

9. **Linkage:** The roadmap does not appear to appreciate the linkage between the application and/or end state(s) of DU and the conversion operations. For example, if DUF_6 is converted and stored as the metal, it is comparatively difficult to convert the DU metal into an oxide for disposal if metal applications do not develop. Thus, the roadmap may have to realize the linkage more explicitly. For example, prior NRC analyses have indicated a large supply of DU world-wide, and, even if significant applications and alternatives develop for DU in the future, it is likely that a significant fraction of the DU will still require disposal as a waste. In addition, after use by the application, the DU may become a waste. Thus, it would seem that the roadmap would give preference or assign a higher ranking to DU forms that are compatible with disposal. Prior NRC analyses indicate that the oxides are the most likely candidates for disposal. In addition, many potential applications for DU display advantages because of its density, and, thus, the roadmap may want to display a preference for dense oxide forms, such as sintered uranium dioxide, for both applications and disposal, as low density oxide forms are relatively difficult to densify to the ranges needed for the applications once they have been manufactured.

10. **Uranium tetrafluoride (UF_4):** UF_4 is mentioned in several places as a candidate material for long-term storage and disposal. The NRC has previously analyzed the disposal of DU[2]. The analysis noted that the hydrolysis and oxidation reactions of UF_4 with water and air in a disposal environment would produce quantities of HF that could compromise the integrity of

[2] "Final Environmental Impact Statement for the Construction and Operation of Claiborne Enrichment Center, Homer, Louisiana," NUREG-1484, August 1994.

the disposal facility and disturb the environment. In particular, the HF from UF_4 tends to corrode steel and attack concrete, accelerating the migration and release of both uranium and other materials in the disposal facility. Furthermore, some of the uranium tetrafluoride would convert to the more soluble and hazardous uranium oxyfluoride. NRC found that drinking water, intruder construction, and intruder agricultural scenario doses were unacceptably high for a fluorinated waste form (i.e., exceeding 10 CFR Part 61 limits), even without consideration of the daughter ingrowth radionuclides that would occur during disposal time periods. NRC found the oxides to be more suitable for disposal and, under the appropriate conditions (reducing conditions, mine disposal, etc.), capable of meeting Part 61 dose limits. In addition, the ROD for the PEIS does not include conversion to UF_4. Thus, UF_4 is not a likely candidate for disposal in large quantities. It is recommended that this is reflected in the roadmap.

11. <u>Use of existing facilities:</u> There are many existing conversion facilities with licenses that are currently operating below capacity. For example, conversion facilities for uranium dioxide production currently have unutilized capacities of several thousand tonnes annually. In addition, removal of the constraints associated with nuclear fuel manufacture may allow even higher capacities and lower costs to be achieved. The roadmap should consider a preference for approaches that use existing facilities and can expediently start processing DU in the near-term.

12. <u>SNF and Repository Applications:</u> As noted by the roadmap, DU can be converted and fabricated into shielding materials suitable for SNF applications, including storage, transportation, and disposal. DU may also have backfill, shielding, or other applications in the repository (e.g., macroscopic criticality poison). The repository could even be considered as a potential disposal site for DU. However, these are applications over which DOE has significant control and influence. Consequently, DOE may wish to emphasize these applications more and assign higher preferences for them in the roadmap. In addition, DOE may want to consider proposing the use of DU as an option in these alternatives, as part of repository activities or a Part 72 license application. Currently, no repository documentation considers DU in any significant quantities, and no licenses or license applications for SNF containers/casks include DU.

13. <u>Licensing SNF Shielding Applications of DU:</u> The proposed applications of DU in SNF storage casks seem reasonable. However, the roadmap would benefit from a brief discussion of SNF cask requirements, the regulations (Part 72 and the associated guidance in the standard review plan), and licensing, and outline an approach that would lead to the successful licensing by the NRC of a cask containing DU material as a shielding component. Successful licensing is likely to involve significant activities that are not readily apparent from the roadmap, including third-party testing, qualification of materials/personnel/facilities, quality assurance activiites, DU contamination control (during manufacture and use), decontamination and decommissioning, disposal of the DU/container, financial assurances, etc. As noted in the roadmap (see page 20, for example), DU in concrete formulations are not likely to be suitable for use or disposal in the SNF repository. Thus, DOE may want to consider including a preference for non-concrete DU forms in the roadmap.

14. **Health physics of DU applications:** From a health physics perspective, the roadmap only has limited analysis or consideration of the radiation safety aspects of the end point use of DU products. The end use of DU products will need more analysis in the future, as these proposed avenues are pursued and tried. The eventual disposal of the DU or DU products is a low-level waste issue, and may also have radiation safety issues. These health physics issues may decide the viability of the DU application.

15. **Use of DU as catalysts:** DU was used in the 1960's as a catalyst in the plastics industry under AEC licenses. The facilities producing the catalyst and using the catalyst had substantial DU contamination and were difficult sites to decommission. Both sites (Chemetron and BP Chemicals) are on the NRC's Site Decommissioning Management Plan. The Chemetron license was finally terminated in 1999; decommissioning at BP Chemicals is still continuing. Based on this experience, the use of DU as a chemical catalyst could leave facilities with substantial decommissioning liabilities. The roadmap should consider this as part of its evaluation of alternatives.

16. **Other radionuclides in DU:** The draft roadmap mentions the legacy DU that was a product of recycled uranium from reactor fuel and core blankets. These contained trace amounts of radionuclides such as neptunium-237, technicium-99, and plutonium-239. These trace amounts of isotopes usually do not present a health physics/radiation dose problem when compared with the inherent radiological and toxicological concerns of the DU matrix. However, in the recent past, the concern has arisen that there is no exempt quantity or concentration for plutonium, and it was DOE that required an NRC license for the organizational entities (in this case the Army and its contractors, and a company in Massachusetts that manufactured ingots from scrap DU) that were receiving large quantities of DU metal containing the mentioned trace elements.

    The DOE may wish to consider tracking and tracing all the DU that has these trace elements from reactor recycled uranium, and place these immediately in the disposal path to eliminate the radiological concern (be it small compared to DU) and the issue of allowing trace amounts of Pu-239 into the public domain. Alternatively, the roadmap could identify a preference for only large, controlled reuse of such contaminated DU (e.g., in SNF containers). The issue of licensing has already occurred in the case of DU shielding for Army tanks, with the policies implemented on a case-by-case basis. If the NRC and DOE had to do this case-by-case for new recipients, the task could become an enormous drain on assets.

17. **Transportation and facility location:** To alleviate some of the transportation concerns with the DUF_6, the DOE should consider using facilities nearby or building the conversion/processing facilities as close to the stockpile of DUF_6 as possible, to minimize DU transport, until after its conversion to a more stable item. This could be identified as a preference in the roadmap.

Specific Comments:

1. It is recommended that the cover page is improved to include the authors or principals involved, affiliation(s), draft report/revision numbers, etc.

2. In various places in the report, reference is made to the final chemical form of the DU. In some cases it notes oxides and metal; and in other cases it notes tetrafluoride, oxide and metal. Clarification is recommended.

3. On page 5, only 3 tonnes of uranium metal are identified. It is recommended that this number be verified, as other DOE sites have significant quantities ("thousands of tonnes") that could conceivably require management in this program.

4. On page 6 et seq, Section 2.2 provides an assessment of the current regulatory status of DU. Several of the assessments are short and appear to underemphasize key considerations, such as the following:

   - NRC has already determined that large quantities of DU will likely require disposal as LLW, that the oxides (specifically U_3O_8) are the likely form for disposal, and that a unique disposal facility may be required for better confinement of the materials. This was based upon doses from groundwater pathways which, for near-surface facilities, exceeded limits by over an order of magnitude.
   - Residual radioactive uranium in byproducts (e.g., in HF) are usually addressed as specific license amendments by the NRC. Granted amendments usually have typical residual levels of uranium much lower than the 500 ppm level identified in the text.
   - The cylinders should only have surface contamination of radionuclides. This may simplify reuse/recycle of the steel cylinders. The roadmap may want to indicate a preference for surface decontamination (as opposed to volume decontamination) methods.
   - Section 2.2.5.3 should be revised to include general licenses for DU. General licenses do not require a license application. These are discussed in 10 CFR 40.25.
   - It is suggested that a discussion of Parts 71 and 72 related to casks, and Parts 60 and 63 related to the repository, is included, as these may be potential applications and alternatives for significant quantities of the DU.
   - The roadmap may wish to acknowledge that the disposition of significant quantities of DU will likely entail additional regulator review.

4. On page 7, the text should note the existence of NRC rulemaking considerations for 10 CFR 40.13 dealing with unimportant quantities. For example, see the NRC discussion at http://www.nrc.gov/NRC/COMMISSION/SECYS/secy1999-259/1999-259scy.html that addresses the issue of unimportant quantities of source material less than 0.05% by weight of a mixture, compound, solution or alloy. This is due to the concern that pathways—and, hence, the public doses—can vary significantly for the same concentration levels, and, in order to meet public dose limits, the unimportant quantity usually corresponds to a value well below 0.05%.

5. On page 8, Section 2.2.6 makes reference to statements made in NUREG-1484 related to disposal of DU at LLW facilities. Specifically, the report states that "NRC has determined that near-surface disposal facilities in wet locations are extremely unlikely to successfully make such a demonstration if they accept DU_3O_8." This statement appears to indicate a generic conclusion that is out of context. NUREG-1484 is the Environmental Impact

Statement for the proposed Claiborne Enrichment Center project (see Footnote 2). As part of the assessment of potential environmental impacts of the project, the disposal of DU was evaluated assuming a generic LLW disposal facility in the humid southeast. The EIS concluded that it was likely that deep disposal would be required to dispose of DU wastes. The analysis was not done using characteristics of a particular site. The roadmap discussion may wish to highlight the finer points from the EIS analysis that may have wider applicability; for example, the use of an oxide DU form, a unique disposal facility with better confinement, etc. In addition, an arid site will change the performance assessment and dose results. However, the magnitude of the dose from the generic assessment exceeded the regulatory limits by a significant margin. It may be appropriate to state that disposal of all or most of DU at a single LLW disposal facility may not comply with a site's waste acceptance criteria. As noted in Table A.1, additional discussion with specific disposal facilities may be required to establish an optimal disposal approach.

6. On page 11:
   - first bullet: DUF_4 is not a likely option and is outside the ROD on the PEIS. It is recommended that this reference to UF_4 and other references throughout the text are deleted.
   - Fifth paragraph: the reference to the disposal of "stable fluorine compounds as LLW" needs clarification. Is this referring to stable uranium-fluorine compounds or uranium-contaminated fluorine compounds?
   - Fifth paragraph: "Direct disposal is the reference path for all ..." It would be beneficial to have this statement clarified and one, unique baseline identified for the roadmap.

7. On page 11 and elsewhere: one of the disposition strategies would be to use some of the DU in the design of the HLW repository. As noted in the roadmap, these concepts are currently not in the EDA-2 HLW design for the repository. The report also notes that depending on the use of the DU material, it may need to be considered as part of the source term. Making changes to the design documents to accommodate DU usage could affect the development of the HLW repository and its documentation. DOE has significant involvement and control in the repository program, and this roadmap may wish to highlight those DU disposition alternatives that could be part of the repository system.

8. On pages 12 and 19, a review by "... a diverse group of experts ...," individual researchers, and a "workshop" are mentioned. As written, this invites scrutiny. This does not appear to be a peer review panel. The roadmap would benefit from a better description of and more information on this process and the individuals and organizations involved. The workshop should be referenced and a summary included as an appendix.

9. On page 13, it is recommended that DU as the tetrafluoride and the metal are not listed as suitable forms for disposal in large quantities.

10. On page 14 et seq, Table 3.2 lists potential beneficial uses of DU. Many of these are identified with trade or other names which do not readily communicate their form and function. It would be helpful to have a brief description of these in an appendix, with explicit references. In addition, many of these incorporate "DU oxides." The roadmap needs to recognize that all "DU oxides" are not the same and significant differences in performance—and acceptance by users, and residual ES&H impacts—may exist and should be reflected

in the table and text. Repository shielding applications should be added as a candidate path. Finally, the table should be checked for errors. For example, the "PYRUC" shielding material does not involve concrete.

11. On page 14 and elsewhere, the roadmap does not seem to factor in the potential ES&H and health physics impacts from the DU reuse scenarios. For example, the first item listed in the DU matrix and shielding products is Cement-Lock^{tm}, and this high density concrete can be formed into useful products. Based upon the NRC's experience, it should be emphasized and well stated that this product should not be used for structures that form or are part of an inhabited enclosure or structure. The emanation of radon and other daughter products could present radiological concerns in an enclosure of any kind. The roadmap may wish to indicate a preference for those approaches that maintain radiological confinement, surveillance, and control (e.g., SNF cask and repository applications) as contrasted to those alternatives that do not.

12. On page 18 et seq, the roadmap mentions disposition decision and evaluation criteria. Only subjective criteria are listed in the report. More objective criteria with numerical values would be beneficial. In addition, the text notes, "The reference path is taken to be conversion of the DU to a stable form followed by disposal at a site where large amounts of DU would be acceptable in the near surface without need for a waste form matrix such as grout." It would be helpful to have this as an actual baseline with more specific details. Also, based upon the NRC analyses and 10 CFR Part 61 regulations, this "reference path" may not be acceptable to the regulators.

13. On page 20, a path of "heavy concrete" is identified. This term could apply to several of the alternatives presented in Section 3, and clarification would be helpful. A further explanation of the prohibition on DU/concrete forms in the repository would be beneficial. In addition, the text identifies heavy concrete as having the potential to defer the costs of DU disposal and to be used as an LLW disposal package. More explanation would be helpful.

14. On page 24, Table 4.3 lists disposition paths for which barrier-reduction activities are not recommended. It is not clear if these alternatives have been peer-reviewed and if the developers (many of whom may be within or associated with DOE) have been given the opportunity to present their alternatives. For example, DOE was recently assigned a patent on DUPoly, and is pursuing a patent for PYRUC. Also, there may be errors; for example, the entry for PYRUC mentions high-quality nuclear fuel.

15. Sections 5 and 6 discuss recommended activities and DOE's approach to DOE disposition. These sections seem repetitive. DOE may want to consider combining the two sections and using more of a program-oriented approach (Phase I, Phase II, etc.). This would lead more directly into the program plan mentioned on page 37. As already noted in previous comments, disposal of large quantities of DU as either the tetrafluoride or the metal is not recommended. In addition, for reuse alternatives, it would seem preferable for the roadmap to lead to an endstate of successful licensing.

16. The appendix contains a significant number of statements related to DU disposition. These are not referenced and appear to be very subjective. There appear to be errors in the table. For example, Table A.2 has an entry indicating DU in concrete is equal in cost to normal concrete for SNF applications, and further reductions are possible. This is extremely

unlikely to be correct just for the storage mode. The inclusion of DU concrete disposal after use will increase the cost differential because it is unlikely that DU concrete can be placed in the SNF repository. As another example of an error, the entry for PYRUC states a low cost savings potential, yet there are peer reviewed publications that indicate significant cost savings potential with this route.