Statement of Brad Morse
Program Assistant
Alliance for Nuclear Accountability
June 15 Public Hearing on the Supplement to the Draft Surplus Disposition EIS
Morning Session

The Alliance for Nuclear Accountability is a network of organizations concerned with nuclear weapons, nuclear waste, materials disposition, and public health. ANA members are by and large community groups living in the shadows of the Department of Energy nuclear weapons complex.

ANA member organizations have a lifetime of experience with the legacy of fifty years of Cold War policy and production. It is with that experience that the 27 member organizations of the Alliance for Nuclear Accountability join with the over one hundred
other organizations and individuals from more than a dozen countries in opposition to the 1
use of weapons-grade plutonium as MOX fuel in commercial reactors. When that Pandora's Box of Plutonium is opened, we will be hard pressed to close it.

COMMENTS AND QUESTIONS ON THE SUPPLEMENT

I wanted to open with one question of some detail, and I hope I can have it answered today. On page 8 of Appendix P of the Supplement, table 6 indicates that the SPD Draft EIS estimated annual waste generation of .5 liters/year of liquid TRU waste, and .3 liters/year of liquid low level waste. The offeror estimated 500 liters/year of liquid TRU
waste, and 300 liters/year of liquid low level waste. I don't want to be trivial right away, 2
but is it the position of DOE that it was 1000% off in estimating annual waste generation. I ask this not as much out of concern of the total annual waste generated, but out of concern for where else an error of this magnitude may have occurred and its consequences. When that Pandora's Box of Plutonium is opened, we will be hard pressed to close it.

Question #1: What is the source of this error and has it been corrected?

The DOE and its predecessor agencies have a reputation for secrecy and a lack of meaningful public input. While the DOE has made strides in the right direction in recent years, the public process around the MOX proposal is shameful. Throughout the public process associated with the Draft Surplus Plutonium Disposition EIS, we in the NGO community were told time and again that the DOE couldn't possibly hold hearings in communities around nuclear reactors that were candidates for the MOX program, until the DOE knew which reactors were selected. Now we know the Catawba, McGwire, and
North Anna reactors have been chose, and still the DOE declines to hold hearings in 3
those communities. It is my most sincere hope that DOE reconsiders this decision, and does give communities which could endure decades of plutonium shipments in and out, and which assume the risk of a plutonium accident, the chance to voice their opinion. And how is it that we know which reactors will irradiate MOX fuel, without having yet completed the Environmental Impact Statement? The Department of Energy has done a discredit to itself and the public by its rush to judgement, and it has violated at least the spirit of NEPA.

Question #2: Doesn't the awarding of a MOX contract pre-determine the hybrid approach and the use of MOX?

DCR012

DCR012–1 **MOX Approach**

DOE acknowledges the commentor's opposition to the use of weapons-grade plutonium in MOX fuel and irradiating it in commercial reactors. DOE has identified as its preferred alternative the hybrid approach. Pursuing both immobilization and MOX fuel fabrication provides the United States important insurance against potential disadvantages of implementing either approach by itself. The hybrid approach also provides the best opportunity for U.S. leadership in working with Russia to implement similar options for reducing Russia's excess plutonium in parallel. Further, it sends the strongest possible signal to the world of U.S. determination to reduce stockpiles of surplus plutonium as quickly as possible and in a manner that would make it technically difficult to use the plutonium in nuclear weapons again.

DCR012–2 **Waste Management**

Initial estimates provided in support of the MOX data report indicated that liquid TRU waste generation would be on the order of 0.5 l/yr (0.1 gal/yr) and liquid LLW generation would be approximately 0.3 l/yr (0.08 gal/yr). As part of the request for proposals for the MOX fuel fabrication and irradiation contract, DOE asked prospective offerors to review the projected resource requirements and waste estimates included in the SPD Draft EIS to determine if they considered them reasonable for the proposed MOX facility. DCS stated that overall the waste estimates were consistent with their experience, but they noted that the liquid radioactive waste estimates appeared low and probably should be on the order of m^3/yr instead of l/yr. Thus, the estimates were increased to 500 l/yr (132 gal/yr) and 300 l/yr (79 gal/yr), equivalent to 0.5 m^3/yr (0.6 yd^3/yr) and 0.3 m^3/yr (0.4 yd^3/yr).

Although the waste generation estimates were increased by a factor of 1000, they are still very small. For example, 300 l/yr (79 gal/yr) would fill approximately one and a half (208-l [55-gal]) drums. As described in Chapter 3 of Volume I, the F- and H-Area Effluent Treatment Facility at SRS can process 1.9 million m^3/yr (2.5 million yd^3/yr) which is equivalent to 1.9 billion l/yr (0.5 billion gal/yr) of liquid LLW. Therefore, 300 l/yr (79 gal/yr) of additional liquid LLW would be a very small portion of the waste that could be processed in the F- and H-Area Effluent Treatment Facility.

In other cases, DCS reported that their estimates were lower than those presented in the SPD Draft EIS. For example, DCS estimated that fewer workers would be needed to operate the MOX facility and thus the average worker dose would be much lower.

DCR012–3 **General SPD EIS and NEPA Process**

Since the inception of the fissile materials disposition program, DOE has supported a vigorous public participation policy. It has conducted public hearings in excess of the minimum required by NEPA regulations to engender a high level of open and public dialogue on the program. The office has also provided the public with substantial information in the form of fact sheets, reports, exhibits, visual aids, and videos related to fissile materials disposition issues. It hosts frequent workshops, and senior staff members make presentations to local and national civic and social organizations on request. For example, at the invitation of South Carolina State Senator Phil Leventis, DOE attended and participated in the public hearing that was held in Columbia, South Carolina, on June 24, 1999. Additionally, various means of communication—mail, a toll-free telephone and fax line, and a Web site (http://www.doe-md.com)—have been provided to facilitate the public dialogue. It is DOE policy to encourage public input into these matters of national and international importance.

DOE acknowledges the commentor's request that DOE hold public hearings in the communities near the potential reactor sites that would use the MOX fuel. During the 45-day public comment period on the *Supplement to the SPD Draft EIS*, DOE held a public hearing in Washington, D.C., on June 15, 1999, and invited comments. After careful consideration of its public involvement opportunities, including the availability of information and mechanisms to submit comments, DOE decided not to hold additional hearings on the *Supplement*. DOE provided other means for the public to express their concerns and provide comments: mail, a toll-free telephone and fax line, and the MD Web site. Also, at the invitation of South Carolina State Senator Phil Leventis, DOE attended and participated in a public hearing held on June 24, 1999, in Columbia, South Carolina.

The *Supplement* was mailed to those stakeholders who requested it as well as to those specified in the DOE *Communications Plan* (i.e., Congressional representatives, State and local officials and agencies, and public interest groups around the United States) and the utilities' contact lists. The utilities, Duke Power Company and Virginia Power Company, would operate the proposed reactors (located in North Carolina, South Carolina, and Virginia) should the MOX approach be pursued per the SPD EIS ROD. Further, parties would likely have the opportunity to submit additional comments during the NRC reactor license amendment process.

DOE conducted a procurement process in accordance with DOE NEPA regulations 10 CFR 1021.216. The selected team, DCS, would design, request a license, construct, operate, and deactivate the MOX facility as well as irradiate the MOX fuel in domestic, commercial reactors. However, these activities are subject to the completion of the NEPA process. As stipulated in DOE's phased contract with DCS, until and depending on the decisions regarding facility siting and approach to surplus plutonium disposition are made and announced in the SPD EIS ROD, no substantive design work or construction can be started by DCS on the MOX facility. Should DOE decide to pursue the No Action Alternative or the immobilization-only approach, the contract with DCS would end. The contract is phased so that only nonsite-specific base contract studies and plans can be completed before the ROD is issued, and options that would allow construction and other work would be exercised by DOE if, and only if, the decision is made to pursue the MOX approach.

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Question #3: Knowing the nuclear fuel cycle creates more reactor-grade plutonium, and
looking at footnote #1 on page 3 "Weapons-grade, fuel-grade, and power-reactor-grade
plutonium are all weapons usable."; how do you reconcile the goal of the MOX project of 4
eliminating or reducing weapons-usable plutonium with the fact that MOX irradiation
actually creates plutonium?

Question #4: At a public meeting at the Nuclear Regulatory Commission, I asked the
consortium about the public's ability to gain access to environmental safety & health
records from Europe, based on the notion that the US MOX program would heavily
depend on the European experience with reactor-grade plutonium. I was told "we haven't 5
asked them, and we don't need them" referring to the environmental records. Based on
comments today, I assume that the consortium will indeed be looking at those records.
Could I get a formal response to that question?

DCR012

DCR012–4 **MOX Approach**

The goal of the surplus plutonium disposition program is to reduce the threat of nuclear weapons proliferation worldwide by conducting disposition of surplus plutonium in the United States in an environmentally safe and timely manner. Converting the surplus plutonium into MOX fuel and using it in domestic, commercial reactors is an effective way to accomplish this.

It is true that in the MOX approach only a fraction of the plutonium would actually be consumed in the reactor; but the remainder would be an integral part of massive spent fuel assemblies. The spent fuel assemblies would be so large and radioactive that any attempted theft of the material would require a dedicated team willing to suffer large doses of radiation, along with substantial equipment for accessing and removing the spent fuel from the storage facility and carrying it away.

Reactor-grade plutonium can be made into a nuclear weapon but it presents would be users with much greater difficulties than weapons-grade plutonium. The level of reactor-grade plutonium in MOX spent fuel would be higher than that present in LEU spent fuel but it would still be a very small percentage of the remaining fuel and be highly radioactive. In order for it to be used in a nuclear weapon, the fuel would have to be reprocessed. This is an operation that is very difficult to conceal.

DCR012–5 **MOX RFP**

DOE considered past environmental performance of COGEMA in awarding the contract for MOX fuel fabrication and irradiation services. The operating experience at MELOX is being factored into the MOX facility design and was used to update information in the SPD Final EIS as discussed in Appendix P. More information on COGEMA's environmental record can be found on their Web site at http://www.cogema.com or by contacting Ms. Christi A. Byerly. Her address is: 7401 Wisconsin Avenue; Bethesda, MD 20814. She may also be contacted by telephone at (301) 941-8367. Her fax number is (301) 652-5690, and her email address is cbyerly@cogema-inc.com.

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ALLIANCE FOR NUCLEAR ACCOUNTABILITY * CAROLINA PEACE RESOURCE CENTER * NUCLEAR CONTROL INSTITUTE * PHYSICIANS FOR SOCIAL RESPONSIBILITY * SAFE ENERGY COMMUNICATION COUNCIL * SERIOUS TEXANS AGAINST NUCLEAR DUMPING * UNION OF CONCERNED SCIENTISTS * U.S. PUBLIC INTEREST RESEARCH GROUP

April 21, 1999

The Honorable Bill Richardson
Secretary of Energy
U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC 20585

Dear Secretary Richardson:

We are writing to express our strong objections to one important aspect of the Department of Energy's plans to release a supplement to the Draft Surplus Plutonium Disposition Environmental Impact Statement ("draft EIS"). [64 *Federal Register* 16720, April 6, 1999]

We agree that DOE is required under NEPA to prepare a supplement to the draft EIS in order to provide more information on "the potential environmental impacts of using mixed oxide (MOX) fuel in six specific commercial nuclear power reactors at three sites…" in Virginia, North Carolina, and South Carolina. We find it unacceptable, however, that DOE plans only one public hearing on these issues, to be held in Washington, DC.

When the draft EIS was released last summer, some of us objected to the lack of plans to hold hearings in the communities around reactors that would irradiate weapons-plutonium MOX. At that time, we were informed by representatives of the Office of Fissile Materials Disposition (MD) that local hearings in reactor communities could not be scheduled because the MOX procurement process was still underway, and reactor sites had not yet been selected. After DOE's contract award on March 22, 1999, this is clearly no longer the case. The consortium that won the contract has announced that it plans to irradiate MOX fuel in Virginia Power's North Anna reactors (located near Charlottesville, VA), and in Duke Power's McGuire and Catawba reactors (located near Charlotte, NC, and Rock Hill, SC). 1

The communities around these reactor sites have a great deal at stake in these decisions, and deserve an opportunity to voice their opinions on the MOX proposal. It is also important that DOE solicit input from stakeholders most directly impacted by the MOX plan, and make it easy for them to be heard by holding hearings in their

MR013

MR013–1 General SPD EIS and NEPA Process

DOE acknowledges the commentors' request for additional public hearings in the communities near the potential reactor sites that would use the MOX fuel. After careful consideration of its public involvement opportunities, including the availability of information and mechanisms to submit comments, DOE decided not to hold additional hearings on the *Supplement to the SPD Draft EIS*. In addition to the public hearing on the *Supplement* held in Washington, D.C., DOE provided other means for the public to express their concerns and provide comments: mail, a toll-free telephone and fax line, and the MD Web site. Also, at the invitation of South Carolina State Senator Phil Leventis, DOE attended and participated in a public hearing held on June 24, 1999, in Columbia, South Carolina.

The *Supplement* was mailed to those stakeholders who requested it as well as to those specified in the DOE *Communications Plan* (i.e., Congressional representatives, State and local officials and agencies, and public interest groups around the United States) and the utilities' contact lists. The utilities, Duke Power Company and Virginia Power Company, would operate the proposed reactors (located in North Carolina, South Carolina, and Virginia) should the MOX approach be pursued per the SPD EIS ROD. Further, interested parties would likely have the opportunity to submit additional comments during the NRC reactor license amendment process.

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communities. We therefore urge DOE to schedule promptly additional hearings near each of the reactor sites. 1

We thank you for your attention to this urgent matter.

Sincerely,

Paul Leventhal
Nuclear Control Institute

Linda Pentz
Safe Energy
Communication Council

Ethan Brown
Carolina Peace Resource Center

Susan Gordon
Alliance for Nuclear Accountability

David Lochbaum
Union of Concerned Scientists

Robert K. Musil, Ph.D
Physicians for Social Responsibility

Anna Aurilio
U.S. Public Interest Research Group

Don Moniak
Serious Texans Against
Nuclear Dumping

CC: Laura Holgate

MR013

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Nuclear Control Institute Comments on the
Department of Energy's
Supplement to the Surplus Plutonium Disposition
Draft Environmental Impact Statement

June 28, 1999

Comments on the Environmental Impact Analysis (Section 5 and Appendix P)

The Nuclear Control Institute (NCI) has long urged the Department of Energy (DOE) to conduct a thorough, accurate and honest assessment of the environmental, safety and health risks associated with irradiating mixed-oxide (MOX) fuel derived from warhead plutonium in existing light-water reactors.[1] NCI believes it is essential that such information be given considerable weight in the development of DOE's strategies both for disposition of U.S. excess plutonium and for cooperation with Russia on their own disposition program. Reactor safety issues have not been given the consideration that they warrant in the formulation of disposition policy, as evidenced by the selection of the MOX-immobilization "dual track" in 1996 based on the rudimentary environmental analysis and flawed calculations of the 1996 *Storage and Disposition of Weapons-Usable Fissile Materials Programmatic Environmental Impact Statement* (S&D PEIS).[2] 1

The calculations of severe accident consequences contained in the *Supplement to the Surplus Plutonium Disposition Environmental Impact Statement* appear to be somewhat improved compared with those presented in the S&D PEIS. However, the overall analysis remains grossly incomplete and inadequate. DOE's final analysis must be strengthened to improve its credibility both with the public and with the Nuclear Regulatory Commission (NRC), which in spite of its relatively late start in examining the safety issues associated with DOE's MOX plan now appears

[1] Edwin S. Lyman, "Comments on the Department of Energy's Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement: Public and Occupational Health and Safety Issues," Nuclear Control Institute, Washington, DC, June 7, 1996 (revised October 9, 1996).

[2] Edwin S. Lyman, "Public Health Consequences of Substituting Mixed-Oxide for Uranium Fuel in Light-Water Reactors," Executive Summary, Nuclear Control Institute, January 1999.

MR022

MR022–1 **MOX Approach**

DOE believes that this SPD EIS does evaluate the potential impacts of fabricating and irradiating MOX fuel, including those associated with postulated design basis and severe accidents at the reactors proposed to use the MOX fuel. In addition to these evaluations, Duke Power Company and Virginia Power Company, the reactor licensees for the plants proposed for irradiation of MOX fuel, would provide analyses and documentation to NRC in support of the required operating license amendments. NRC would not issue a license amendment without the licensee fully demonstrating that the requested change would not compromise safety at the plant.

DOE believes that analyses contained in the *Storage and Disposition PEIS* are sufficient for programmatic decisionmaking. Based on decision made in the *Storage and Disposition PEIS* ROD, to pursue the "dual track" or hybrid approach to plutonium disposition, use of MOX fuel is analyzed in this SPD EIS along with the No Action Alternative and immobilization-only alternatives.

to be taking a more thoughtful approach than DOE.[3] If DOE continues to refuse to address seriously the full array of MOX safety issues, it will be inviting regulatory delays when license amendments to use MOX are sought by the Duke Cogema Stone and Webster (DCS) consortium in the future. 1

1) Beyond-Design-Basis Accident Analysis

The results of the beyond-design-basis accident analysis contained in the *Supplement* are substantially different from those provided by DOE in the S&D PEIS. This is apparent from the information provided in Table 4.28-9. Yet, there is no discussion in the text that explains the reasons for the different results of the two calculations. In addition, the table is misleading in not mentioning the fact that the S&D PEIS results were obtained for a full MOX core, while the *Supplement* calculations are based on a 40% MOX core.

The S&D PEIS calculations, which are cited in the Draft Surplus Plutonium Disposition EIS, indicate that for three out of four severe accident scenarios considered, the number of latent cancer fatalities (LCFs) that would result would be 3%-7% smaller for a full MOX core than for an LEU core. For the remaining accident scenario evaluated (late containment failure), the number of LCFs would be 8% higher for a MOX core.

The calculations in the *Supplement* give nearly diametrically opposite results. The three accident scenarios which were found originally to have less severe consequences for MOX cores than for LEU cores are now shown to have more severe consequences, with increases in LCFs of 1%-15% relative to LEU cores. In contrast, the one accident which was found in the S&D PEIS to have more severe consequences for MOX cores than for LEU cores, late containment failure, is now predicted to have less severe consequences for MOX cores at Catawba and McGuire, but more severe consequences for North Anna. 2

For North Anna, at first glance it appears that the result for late containment failure (a 9% increase in LCFs) is essentially unchanged from the S&D PEIS prediction of an 8% increase. However, taking into account the fact that the S&D PEIS results were obtained for a full MOX core, while the *Supplement* calculations are based on a 40% MOX core, it is clear that the new calculations indicate a MOX impact 2.5 times more severe than that implied by the S&D PEIS results.

The revised results provided in the *Supplement* are consistent with those estimated by NCI in a report released in January 1999 (attached), which found for a generic light-water reactor that the number of LCFs resulting from a severe accident with early containment failure or bypass would be approximately 28% greater for a 1/3-MOX core than for an LEU core as a result of

[3] U.S. Nuclear Regulatory Commission, "Mixed-Oxide Fuel in Commercial Light-Water Reactors," White Paper, 1999.

MR022–2 **Facility Accidents**

DOE agrees with the commentor that the accident consequences presented in Section 4.28 are closer to those postulated by the Nuclear Control Institute in February 1999. The results shown in this SPD EIS are related to the use of specific reactor information and a partial MOX core. It was always DOE's intention to update this section with reactor-specific information once the reactors that would use MOX fuel were identified as stated in the SPD Draft EIS. A footnote was added to the accident table referred to by the commentor to show that the *Storage and Disposition PEIS* evaluated the use of a full MOX core. The consequences of some of the accidents evaluated in this SPD EIS are greater than those presented in the PEIS. The analysis presented in Section 4.28 of this EIS used more precise data from the proposed reactors that have been selected to use MOX fuel.

This SPD EIS also analyzed several reactor accidents, including both design basis and beyond-design-basis accidents. For MOX fuel, as compared to LEU fuel, there is an increase in risk, about 3 percent, for the large-break loss-of-coolant accident (the bounding design basis accident). The largest increase in risk for beyond-design-basis accidents is approximately 14 percent for an interfacing systems loss-of-coolant accident at North Anna. Both of these accidents have an extremely low probability of occurrence. In the unlikely event this beyond-design-basis accident were to occur, the expected number of LCFs would increase from 2,980 to 3,390 with a partial MOX core and prompt fatalities would increase from 54 to 60. At North Anna, the likelihood of a large-break loss-of-coolant accident occurring is 1 chance in 48 thousand per year and the likelihood of an interfacing systems loss-of-coolant accident occurring is 1 chance in 4.2 million per year.

radiation exposures incurred within one week after the accident.[4] The chief difference between the NCI calculation and that of the *Supplement* is that the latter assumed that americium-241 (Am-241) would be removed from the plutonium via an aqueous separation process (so-called "plutonium polishing") prior to its fabrication into MOX fuel. However, at the time the NCI report was written, the baseline plan was to use only dry processing of plutonium feed, which would not remove the americium. NCI is revising its analysis to consider the effect of americium removal on its results. Preliminary results indicate that for a 40% MOX core with americium removal, the predicted number of excess LCFs is about 25% smaller than that originally estimated (for a 33% core without americium removal) or an increase of about 21% compared to an LEU core. Therefore, NCI's estimate and DOE's upper bound estimate are moving closer together. 2

However, many problems remain with DOE's analysis and presentation of data. These will have to be corrected and/or explained more fully in the final document. These include:

a) The results of calculations of population doses resulting from severe accidents are presented in the *Supplement* without sufficient detail to permit verification by independent analysts. The modeling of population dose in computer codes like MACCS 2 depends strongly on assumptions such as the time period of exposure considered, the cleanup standards, details of the evacuation and a whole host of other parameters. In general, the uncertainties associated with these calculations grow larger as longer time periods are considered. DOE must provide all the input parameters used in the calculations to facilitate independent public review.

Such information may shed light on some of the divergent results between sites, such as the reason why the MOX/LEU LCF ratios are smaller for Catawba and McGuire following a late containment failure accident, but larger for North Anna. These differences may be due to the use of results of the Independent Plant Evaluation (IPE), which have not been thoroughly reviewed by NRC. Because different utilities used different assumptions in developing their IPE submissions, the results may not be consistent for different plants. For instance, the frequencies of early containment failure at Catawba and McGuire given in the *Supplement* are smaller than that of North Anna, despite the fact that Catawba and McGuire have ice-condenser containments which are inherently more prone to failure in severe accident conditions. 3

Also, the reasons for the wide variation in MOX/LEU ratios depending on the particular type of severe accident must be discussed. NCI's analysis did not find such a large difference between early containment failure and containment bypass accidents.

b) There is an obvious error in the calculations in the *Supplement* which must be corrected in the final version. It is apparent from a comparison of population doses and LCFs in Tables 4.21-10 to 4.21-12 that a risk coefficient of 5×10^{-4} LCF/person-rem was used for all the calculations. This is inappropriate because it assumes a dose and dose-rate effectiveness factor (DDREF) of 2 is applicable for the entire affected population. However, this is clearly not the case, because 4

[4] Edwin S. Lyman, January 1999, *op cit.*

3

MR022

MR022–3 **Facility Accidents**

The accident calculations are voluminous, and therefore, included in the Administrative Record for this SPD EIS rather than in the EIS proper. The calculations contain all of the input parameters including the MACCS2 computer files. Principal input parameters, such as accident source terms and population distributions, are included in the EIS.

To determine the consequences and risks of severe accidents, the EIS analysis included data from plant probabilistic risk assessments. Each plant's probabilistic risk assessment is based on plant specific parameters, systems, operating procedures, etc. This often results in different assumptions and conclusions even for similar plants. These probabilistic risk assessments are the best plant specific severe accident data available, and were therefore used in the EIS analysis.

The EIS accident analysis was performed to determine the largest increase in risks when comparing the MOX-fueled reactor to the LEU-fueled reactor for each plant. Therefore, only certain severe accident scenarios, those which would result in the highest risk, were presented in the EIS. This results in a range of bounding severe accident risks providing sufficient information for a NEPA analysis. A complete risk analysis would require a consequence evaluation of every possible release and then summing these risks for an overall risk.

The severe accident scenarios chosen for analysis were selected in the following manner. Containment bypass and failure scenarios were evaluated since these events would result in the highest consequences. The containment bypass and failure release categories from each plant's probabilistic risk assessment were screened to determine which would result in the highest risk to the surrounding population. The probabilistic risk assessments sometimes contain several release categories for a release classification such as early containment failure. Summing the frequencies of all the release categories within the early release classification would lead to the total early release frequency. However, the purpose of this analysis was not to determine the total risk, but to show the largest possible increase in risk as a result of converting to a partial MOX core. Thus, the early release containment failure release category resulting in the highest risk to the surrounding population was presented in the EIS.

many exposures following a severe accident will involve high doses delivered in short periods of time at rates far exceeding the threshold below which a DDREF of 2 is believed to be applicable (i.e. below 10 millirem per minute, according to UNSCEAR). DOE must revise its calculations so that the number of LCFs expected among those experiencing higher doses and/or dose rates are properly estimated using a DDREF of 1. 4

c) The calculations employ the MACCS 2 code developed by Sandia National Laboratories. NCI discovered a major error in this code which has a large impact on calculations of the consequences of severe accidents. Sandia altered the code and provided a corrected version to NCI. DOE should also use the corrected version for its final calculations. 5

d) The MOX/LEU ratios for fission product core inventories are remarkably similar to those used in the S&D PEIS, when adjusted for the different MOX core fraction. This leads one to surmise that Oak Ridge National Laboratory did not recalculate all fission product ratios for input into the *Supplement*, but only those for the actinides, and used the AP-600 ratios for the fission products. NCI has pointed out that the S&D PEIS ratios are not appropriate for use in the *Supplement* because they were obtained from an analysis of the Westinghouse AP-600 LWR, a reactor that has not been built and will not be used for plutonium disposition, rather than from an analysis of the designs of the existing reactors that will use MOX. Moreover, some of the fission product ratios are of questionable validity, such as that for Cs-134. The ratio of the inventory of Cs-134 in a 40% MOX core to that in a full LEU core is given as 0.85 in Table K-2 of the *Supplement*. This corresponds to a full MOX to full LEU ratio of 0.63, which is close to the value of 0.65 originally used in the S&D PEIS. NCI has been unable to reproduce such a low MOX/LEU ratio for Cs-134 in repeated ORIGEN-S runs. The value obtained by NCI is 0.96. (Incidentally, the value for this ratio given in the 1975 NRC Generic Environmental Impact Statement on the use of Mixed-Oxide Fuel in Light-Water Reactors [GESMO] is also 0.96.) 6

2) MOX Fuel Performance and Severe Accident Issues

The *Supplement* is silent on the question of MOX fuel performance, and in particular makes no mention of serious unresolved issues associated with the potentially inferior behavior of MOX fuel in certain severe accidents such as reactivity insertion accidents (RIAs) and loss-of-coolant accidents (LOCAs).[5] These issues will surely be prominent in MOX licensing proceedings.

The *Supplement* assumes that all accident frequencies will remain unchanged by the substitution of MOX for LEU in existing LWRs, and references statements to this effect in the 1995 plutonium disposition study by the National Academy of Sciences (NAS). However, the NAS discussion was very general and did not examine in detail the following issues. These questions must be addressed in the *Supplement* so that the public can be informed about the numerous unresolved issues associated with MOX fuel performance in severe accidents. 7

[5] NRC White Paper, *op cit.*

MR022

MR022–4 **Facility Accidents**

The risk coefficient was corrected and used in the SPD Final EIS analysis.

MR022–5 **Facility Accidents**

The correction to the MACCS2 code was performed and employed in the SPD Final EIS analysis.

MR022–6 **Facility Accidents**

ORNL recalculated MOX/LEU ratios for all radioisotopes, including fission products, for the *Supplement to the SPD Draft EIS* based on operation of a typical Westinghouse pressurized water reactor. These ratios are not based on the Westinghouse AP–600. The MOX/LEU ratios are based on specific fuel enrichments and reactor cycle characteristics. Independent analyses, which do not use identical parameters, would result in different ratios.

MR022–7 **Facility Accidents**

Two significant light-water reactor transients analyzed in safety analyses are the loss-of-coolant accident (LOCA) and the reactivity insertion accident (RIA). Differences between LEU and MOX fuel could affect both of these accidents.

The reduced thermal conductivity in MOX fuel causes the fuel pellets to operate at somewhat higher temperatures than in LEU fuel of the same linear power rating. While the higher operating temperatures would not be a problem for normal operation, the fuel temperatures determine the amount of stored heat present at the beginning of a LOCA. However, the increased energy released per plutonium fission, compared with uranium fission, and early decrease in decay heat for MOX fuel will tend to offset the increased stored energy.

For RIAs, the higher fission gas release associated with plutonium hot spots may increase the severity of the pellet-cladding interaction, and the higher gas inventory may also cause greater entrainment and expulsion of fuel particles after cladding failure. Although, the higher creep rate of MOX fuel may reduce the severity of the pellet-cladding interaction that causes cladding failure at higher burnups.

MOX fuel produced via the MIMAS process, which will be the one used by the DCS consortium, is heterogeneous. It contains plutonium clusters (some of which have diameters of several hundred microns) which act as "hot spots," achieving much higher local burnups than occur in LEU fuel. For a fuel rod with an average burnup of 50 MWD/kg, the plutonium-rich clusters in MIMAS fuel achieve burnups of up to 200 MWD/kg.[6]

The locally high burnups in plutonium-rich clusters result in the formation of high-porosity regions which allow fission gas to escape from the interior of fuel pellets. In addition, MOX fuel has a thermal conductivity approximately 10% lower than LEU fuel, resulting in centerline temperatures about 50°C greater. These two effects cause greater fission gas releases to occur in MOX fuel than in LEU fuel at similar average burnups. Above about 35 MWD/kg, the fission gas release in MOX fuel rods rises to several times that of LEU fuel at the same burnup. Another troubling observation (from recent experiments at the Halden reactor in Norway) is that while fission gas release in LEU fuel ceases when the fuel temperature is lowered below the threshold of onset, the same is not true for MOX fuel.[7]

The increased fission gas release and higher temperature of MOX fuel rods can affect the severity of some accidents such as RIAs and LOCAs. The Rep-Na7 RIA test at the Cabri reactor in France, performed on a fuel rod that had been irradiated for four annual cycles and had a burnup of 55 MWD/kg, resulted in a "very severe failure" which caused the test channel to become almost completely blocked. This failure was unique because the fuel cladding did not have any important corrosion, unlike the LEU rods which failed in the same test series. As a result, according to those who conducted the experiment, "a MOX effect must be considered in this case."[8] 7

NCI acknowledges that the plan of DCS is initially to irradiate MOX fuel for only two 18-month cycles, whereas some LEU assemblies are now irradiated for three 18-month cycles. However, the *Supplement* should detail the exact fuel management scheme that will be used and specify the maximum MOX assembly and rod burnups that will occur under this scheme.

The maximum burnup to which DCS is initially seeking authorization to take MOX fuel, 50 MWD/kg, is above the maximum MOX rod burnup that is currently permitted in France (about 47 MWD/kg), and is in a region where the rods' resistance to RIAs is clearly in question. Moreover, DCS refuses to preclude eventually irradiating MOX fuel to the same maximum burnup to which it currently irradiating LEU (with maximum rod burnups well over 60

[6] "Reactivity Insertion Tests in Cabri with MOX Fuel," F. Schmitz, J. Papin and C. Gonnier, Institut de Protection et de Sûreté Nucléaire (IPSN), International Symposium on MOX Fuel Cycle Technologies for Medium and Long-Term Development, Vienna, Austria, 17-21 May 1999.

[7] W. Wiesenack, M. McGrath, "Performance of MOX Fuel --- An Overview of the Experimental Programme of the OECD Halden Reactor Project and Review of Selected Results," International Symposium on MOX Fuel Cycle Technology, IAEA, Vienna, 17-21 May 1999.

[8] F. Schmitz *et al*, op cit.

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The particular reactivity insertion accident scenario for a pressurized water reactor is a control rod ejection. The Cabri RIA test program was designed to challenge typical fuel rods under conditions that are more extreme than conditions that would be experienced during a real pressurized water reactor control rod ejection. Out of the nine Cabri tests (six with uranium fuel, three with MOX fuel), two uranium fuel rods and one MOX fuel rod experienced failures. The MOX failure occurred at an energy deposition rate that is greater than can realistically be reached by high burnup fuel, even after an extremely unlikely worst case control rod ejection.

These differences suggest that the behavior of MOX fuel during transients could be different than that of LEU fuel. These differences continue to be studied through several research programs. However, until definitive results are obtained, the best available data is the current reactor safety analyses. The offsite consequence analysis of these accidents was therefore based on LEU fuel behavior.

Both LOCA and RIAs were considered in preparing the *Supplement*. Because it was determined that RIAs would result in lower consequences and were of lower risk than the LOCAs, they were not presented in the *Supplement*.

Regarding whether the differences between LEU and MOX fuel affect the frequencies of accidents, an NRC White Paper (1999), *Mixed-Oxide Fuel Use in Commercial Light Water Reactors*, concluded that it appeared likely that the probability of severe accidents will not change and that consequence analyses, rather than full probabilistic risk assessments, may be sufficient to assess the changes due to the different inventory of radionuclides.

NRC believes that severe accident source terms would not be significantly different for MOX fuel than for LEU fuel. This conclusion was based on the assumption that a few percent additional plutonium in the core, with a reduction of only about 10ºC (50ºF) in melting temperature, will not have a significant effect on accident progression. Also, the processes that remove fission products will not be affected by the small change in composition of the core debris. Further, the source term itself is given in terms of fractions of initial inventory, so these fractions should not be changed significantly.

MWD/kg). It is acknowledged in France that the current generation of MIMAS fuel must be modified and improved before such high burnups can be achieved. DCS should specify in detail how it is going to take into account future fuel modifications in its fuel qualification program.

The issue of MOX fuel performance in LOCAs is one which NRC has highlighted as a concern. Increased fuel and cladding temperature due to the lower thermal conductivity and higher average linear power of MOX assemblies, as well as the possibility of fuel-clad gap reopening due to the increased fission gas release, could enhance the clad oxidation rate during a LOCA and increase the severity of the accident. DOE should address this concern and its proposed LOCA mitigation strategy in the *Supplement*. 7

There are also disturbing indications that the fission gas release dynamics of MOX fuel may lead to enhanced releases of volatile and semi-volatile radionuclides during the early stages of core degradation compared to LEU fuel.[9] This could have an effect on the consequences of some accidents, both design-basis and beyond design-basis.

3) Spent Fuel Management

The *Supplement* claims that the MOX program will not "impact spent fuel management" at the reactor sites, even though it predicts that additional spent fuel assemblies will be generated over the course of the campaign. However, the heat generation of spent MOX fuel will be greater than that of spent LEU fuel. NCI's calculations indicate that for two-cycle spent MOX fuel, the heat generation rate will be more than twice that of two-cycle LEU fuel soon after discharge and will remain at that level for many years. The *Supplement* should discuss how DCS can accommodate this incremental heat loading in their existing spent fuel storage facilities. 8

In summary, NCI believes that DOE cannot make credible or defensible decisions on a plutonium disposition strategy without a much more complete analysis of outstanding reactor safety issues associated with MOX use. Only then can the risks and benefits of various disposition strategies accurately be determined. In our view, the uncertainties and risks associated with reactor irradiation of MOX are significant enough to warrant a reevaluation of the "dual track" strategy. More serious consideration should be given to utilization of an all-immobilization approach to achieve the "spent fuel standard," so that the risks of MOX irradiation can be avoided. 1

Sincerely,

Ph.D.

Edwin S. Lyman, PhD
Scientific Director

[9] Advisory Committee on Reactor Safeguards, "Use of Mixed Oxide Fuel in Commercial Nuclear Power Plants," letter report to the Nuclear Regulatory Commission, May 17, 1999.

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NRC hypothesized that the gap release may marginally increase because of the elevated operating temperatures in MOX fuel compared to LEU fuel. The gap release is used in the analysis of design basis accidents and would not have a large effect on severe accident source terms. Once again, due to the lack of definitive information, for the offsite consequence analysis, the gap release was based on LEU fuel behavior. This possible difference is being evaluated by current research programs and any new information will be implemented in further safety analyses.

DCS proposes to continue the use of an 18-month fuel cycle. Specific fuel management schemes do vary during the life of a particular core life and setting a specific fuel management scheme would not be cost-effective. Maximum MOX fuel burnup levels will be approved by NRC only after thorough safety evaluations including information from current research programs.

MR022–8 **MOX Approach**

The DCS team reactor utility companies use a typical 18-month fuel cycle, replacing approximately 40 percent of the fuel assemblies in a reactor at each refueling. Some fuel assemblies are used for two cycles, some for three cycles. The utilities plan to maintain the current fuel management schemes and would use the MOX fuel assemblies for only two cycles.

Initially, when spent fuel is removed from the reactor, the MOX and LEU fuel would be about the same temperature and exhibit similar characteristics. After about a year out of the reactor, however, the temperature of MOX spent fuel would exceed that of LEU fuel of the same age. Therefore, storage of MOX spent fuel would increase the thermal loading in a spent fuel pool over that for only LEU fuel. However, thermal load limitations are based on the amount of cooling that the entire spent fuel pool can accommodate, not on individual fuel assemblies within the pool. Therefore, the additional heat load would be accounted for in the calculations for the reactor spent fuel management plans.

PUBLIC HEALTH CONSEQUENCES OF SUBSTITUTING MIXED-OXIDE FOR URANIUM FUEL IN LIGHT-WATER REACTORS

Edwin S. Lyman, PhD
Nuclear Control Institute
February 1999

Executive Summary

Background

In January 1997, the U.S. Department of Energy (DOE) decided to pursue a "dual track" policy for the disposition of approximately 50 metric tons (MT) of plutonium produced for weapons programs that have been declared excess to military needs. The two tracks of the "dual track" refer to two different approaches for converting separated plutonium into a dilute and highly radioactive form that is more difficult to return to weapons.

Under one approach, known as "can-in-canister" immobilization (CIC), plutonium will be incorporated into chemically stable ceramic discs. These discs will in turn be embedded in canisters of "vitrified" (glassified) high-level radioactive waste (VHLW) at the Defense Waste Processing Facility (DWPF) at the Savannah River Site in South Carolina. DOE is tentatively planning to use CIC for approximately 17 MT of excess plutonium in impure forms. The CIC facility will in all likelihood be sited at SRS adjacent to the DWPF.

Under the other approach, plutonium will be used to produce "mixed plutonium-uranium oxide" (MOX) fuel assemblies, which will be loaded and irradiated in a number of U.S. commercial nuclear reactors, displacing some or all of the low-enriched uranium oxide (LEU) fuel assemblies the reactors currently use. DOE is tentatively planning to utilize this option for approximately 33 MT of weapons-grade plutonium (WG-Pu). In 1998, DOE issued a Request for Proposals, seeking vendors interested in providing MOX fuel fabrication and irradiation services. Of the three proposals submitted, two have already been eliminated for failing to meet basic requirements. It is expected that DOE will sign a contract in February 1999 with the third party, a consortium including the French fuel fabricator Cogema and the U.S. utilities Duke Power and Virginia Power. It is also expected that Cogema will build and operate a MOX fuel fabrication plant at SRS, and that the fuel will be irradiated in Virginia Power's North Anna 1&2 plants and Duke Power's McGuire 1&2 plants in North Carolina and Catawba 1&2 plants in South Carolina.

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Both the immobilization and MOX tracks require large-scale handling and processing of plutonium, an extremely hazardous substance. Consequently, they will be expensive to carry out and will pose risks to human health and the environment. However, the costs and risks involved will be small compared to those experienced when the material was produced, and most arms-control advocates concur that the security benefits of plutonium disposition justify the risks.

Some analysts argue further that differences in cost and hazard associated with the two disposition approaches should not weigh heavily in policy decisions. However, this view is out of touch with both budgetary and political realities. Because Cold War-sized government coffers are not likely to be available to DOE for disarmament activities, the plutonium disposition program will be under pressure to minimize costs. Also, many environmental groups and citizens' groups near affected sites will likely oppose any disposition activities unless they clearly have low environmental and public health impacts. It is certainly sensible to reject an option with substantially greater economic and health risks, if it brings no additional benefits.

Cost and public health impact were major considerations in the process that DOE used to select MOX and immobilization from the large number of disposition options that were initially proposed. In deciding on the dual track policy, DOE argued that there are no decisive differences between the MOX and immobilization options with regard to any of its evaluation criteria, including public health impact. However, this report concludes that DOE's evaluation is inaccurate. We find that the public health risks associated with the MOX approach are significantly greater than those associated with CIC. This is due primarily to our findings that the consequences of severe accidents involving LWRs with MOX cores are likely to be greater than those involving LEU cores. 9

Our finding also has international implications. For instance, the U.S. and Russia are also pursuing a plan to utilize Russian excess WG-Pu in VVER-1000 light-water reactors located in Russia and Ukraine, which meet less stringent safety standards than nuclear plants in the U.S. Also, several nations, such as France, Switzerland and Japan, either use or are planning to use plutonium obtained in so-called "civil" reprocessing programs as fuel for LWRs. The "reactor-grade" plutonium (RG-Pu) used in these programs has different isotopic characteristics than WG-Pu and a different impact on reactor safety, including a greater increase in potential consequences. 10

In this report, the public health consequences of severe accidents at MOX-fueled pressurized water reactors (PWRs) are calculated and compared with the consequences of accidents at LEU-fueled PWRs. The acceptability of the increased risk associated with the change from LEU to MOX fuel in U.S. PWRs is then evaluated in the context of the "risk-informed" regulatory procedures now being implemented by the U.S. Nuclear Regulatory Commission (NRC).

Risks of MOX Use

The MOX approach consists of several stages, each of which can have a significant 2

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MR022–9 **MOX Approach**

DOE acknowledges the commentor's concern regarding increased public health risks associated with the MOX approach. DOE has identified as its preferred alternative the hybrid approach. Pursuing both immobilization and MOX fuel fabrication provides the United States important insurance against potential disadvantages of implementing either approach by itself. The hybrid approach also provides the best opportunity for U.S. leadership in working with Russia to implement similar options for reducing Russia's excess plutonium in parallel. Further, it sends the strongest possible signal to the world of U.S. determination to reduce stockpiles of surplus plutonium as quickly as possible and in a manner that would make it technically difficult to use the plutonium in nuclear weapons again.

As discussed in Section 4.28.2.4, the risks during normal operations using a partial MOX core are almost identical to risks using a full LEU core. As described in Section 4.28.2.5, the risks during accidents may be higher or lower for a partial MOX core, depending on the accident scenario.

The remainder of this comment is addressed in response MR022–2.

MR022–10 **Nonproliferation**

DOE acknowledges the commentor's concerns regarding the disposition of surplus Russian plutonium as MOX fuel, although programmatic and policy issues such as U.S. policies toward plutonium disposition in Russia are beyond the scope of this SPD EIS. Similarly, plutonium reprocessing programs conducted in France, Switzerland, and Japan are beyond the scope of this SPD EIS.

environmental and public health impact. A plant for fabrication of the fuel must be built and operated, the fuel must be shipped to reactor sites, and the fuel must be irradiated in reactors. By comparison, the environmental impacts of CIC immobilization are associated primarily with the operation of the ceramic immobilization plant. Because this plant will be very similar to the MOX fabrication plant in design and size, it will have similar impacts. Therefore, any risks associated with MOX transportation and irradiation increase the cumulative risk of the MOX approach to a level greater than that of immobilization.

In order to quantify and compare the public health impacts of the two options, it is necessary to understand how the risks of nuclear power plant operation change when WG-MOX is substituted for LEU. Risk is defined as the product of the probability and the consequences of a particular event, summed over all events. Nuclear power plants pose risks both as a result of routine operation (high probability and relatively low consequence events) and through the possibility of accidents (low probability and high consequence events). This report focuses on accident risk.

Carrying out a complete and accurate comparison of the accident risks of MOX and LEU cores is a difficult undertaking, for a number of reasons. Nuclear power plant accident safety analyses, or probabilistic risk assessments (PRAs), are extremely complex. In general, the substitution of WG-MOX for LEU fuel will affect both the probability of occurrence and the consequence of each accident sequence which can occur during reactor operation, so that existing PRAs will have to be extensively modified. The difficulty of doing so is compounded by the relative lack of experience with the use of WG-MOX fuel, as well as insufficient data on many technical aspects of MOX use. 2

Another complication results from the fact that almost every nuclear plant in the U.S. has unique features which are relevant to safety, so that the impacts of MOX use are highly reactor-specific. Also, the safety analysis will depend on details of the specific MOX irradiation plan, such as the amount of plutonium in the MOX fuel, the maximum burnup (amount of heat extracted) from each fuel assembly and the fraction of the core (from 33%-100%) that will be loaded with MOX fuel. These details have not been publicly released yet and may for the most part remain proprietary and unavailable to the public.

However, there are some safety-related problems with the use of MOX fuel which will apply to any LWR. For example, the total inventory of highly radiotoxic actinides, including plutonium-239 (Pu-239), americium-241 (Am-241) and curium-242 (Cm-242), is significantly greater in MOX cores than in LEU cores throughout the operating cycle. Our analysis shows that the public health consequences of some severe accidents will be greater for reactors fueled with MOX.

The exact quantities of plutonium and other actinides in MOX cores depend on parameters such as the concentration and isotopic content of the plutonium in the fresh fuel. For the case considered in this study we find that, compared to an LEU core, a full WG-MOX core will contain about three times the amount of Pu-239, seven times as much Am-241 and seven times as much Cm-242 at the end of an operating cycle (i.e. just before the reactor is shut down for reloading). For MOX fabricated with reactor-grade plutonium (RG-Pu), Am-241 and Cm-242 inventories are greater by additional factors of 4 and 3, respectively.

Since most of these radionuclides emit alpha particles, which are much more hazardous per decay than beta or gamma particles if inhaled or ingested, they will contribute significantly to public radiation exposures following severe reactor accidents, even if only a small fraction of the core inventory is released.

The initial draft of DOE's Storage and Disposition of Weapons-Usable Fissile Materials Draft Environmental Impact Statement (DPEIS) did not analyze the environmental impacts of accidents involving MOX-fueled LWRs. Instead, it only included an analysis of an LEU-fueled LWR. DOE justified this by claiming that

> "separate studies ... indicate that the use of MOX fuel in a ... LWR does not increase the risk and consequences of accidents. This results from the fact that the other radioisotopes that are released in an accident have more serious impacts on human health than the Pu used in the MOX fuel."[1]

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Another DOE study makes the stronger claim that the greater actinide inventories in a MOX core will not affect the consequences of an LWR accident because "plutonium and other insoluble fuel isotopes are not included in the releases to the environment."[2]

These statements are misleading, however. Certain severe accidents can result in the expulsion of significant quantities of actinides into the environment. Although such "beyond design-basis" accidents are expected to occur very infrequently, there are both historical precedents and regulatory requirements for considering them in safety analyses.

The best possible laboratory for loss-of-containment consequences, the Chernobyl accident, has demonstrated that significant and wide-ranging dispersal of actinides is possible. Recent reviews of the Chernobyl source term have concluded that approximately 3.5% of the core actinide inventory was released. Moreover, dispersal of these relatively heavy aerosols was not limited to the immediate vicinity of the plant; fuel fragments were discovered as far away as Greece and Germany, over one thousand kilometers away.[3]

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[1] U.S. Department of Energy, *Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement*, DOE/EIS/0229-D, February 1996, Volume II, p. 4-690.

[2] Oak Ridge National Laboratory, *FMDP LWR PEIS Data Report*, Rev.3, ORNL/MD/LTR-42, December 1995, p. B-22.

[3] L. Devell *et al.* "The Chernobyl Reactor Accident Source Term: Development of a Consensus View," OECD/NEA, OECD/GD(96)12, November 1995.

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It has often been claimed that a Chernobyl-type accident cannot happen in the West because Western reactors have robust containment structures. However, while the presence of containment domes reduces the risk of such accidents, it does not eliminate it entirely. Many accident sequences for U.S. LWRs have been identified which can lead either to massive failure or bypass of the containment, thereby allowing significant releases of core particles. In fact, the U.S. Nuclear Regulatory Commission (NRC) has estimated that actinide releases as high as several percent of the core inventory are possible in such accidents.[4]

In comments on the DPEIS in 1996, the Nuclear Control Institute (NCI) challenged DOE's assumption that there was no difference between LEU and MOX with regard to reactor safety.[5] In particular, NCI cited the possibility of accidents resulting in a relatively large release of actinides.

DOE responded to NCI's comments in the final PEIS on storage and disposition of weapons-usable fissile materials (FPEIS) by presenting the results of a calculation that took into account the different radionuclide inventories of WG-MOX and LEU cores. The FPEIS claimed that the change in accident consequences (defined as the resulting number of latent cancer fatalities) associated with the substitution of WG-MOX for LEU ranged from +8% to -7%: in other words, the number of cancer fatalities caused by some accidents could actually *decrease* as a result of switching to MOX fuel.[6] 2

A complete review of the FPEIS calculation is not possible because few details are provided. However, an analysis of the information that is provided reveals several obvious inconsistencies. For instance, the FPEIS calculation used a value of 0.65 for the ratio of the quantity of cesium-134 (Cs-134) in the WG-MOX core to that in the LEU core. When this ratio was "arbitrarily set to 1.0" in the FPEIS analysis, however, the observed reduction in cancer fatalities associated with switching to MOX fuel changed to an increase. The FPEIS fails to mention a fact that appears in one of its own reference documents --- namely, that various studies have calculated Cs-134 MOX/LEU ratios ranging up to 1.08, and that the value used by the FPEIS was based on a Westinghouse "advanced" PWR and not on an existing reactor type.[7] Our study, which was based on existing PWRs, found a value of 0.96 for the Cs-134 MOX/LEU ratio at the end-of-cycle.

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[4] U.S. Nuclear Regulatory Commission, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," NUREG-1150, 1990.

[5] Edwin S. Lyman, "Comments on the Department of Energy's Storage and Disposition of Weapons-Usable Fissile Materials Draft Programmatic Environmental Impact Statement: Public and Occupational Health and Safety Issues," Nuclear Control Institute, Washington, DC, June 7, 1996 (rev. Oct 9, 1996).

[6] U.S. Department of Energy, *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement*, DOE/EIS-0229, December 1996, p. S-37.

[7] Oak Ridge National Laboratory (1995), *op cit.*

Another factor that the FPEIS did not take into account is the sensitivity of the consequences of MOX accidents to the fraction of the actinides in the core that is assumed to be released. There are large uncertainties in predictions of the fraction of core actinides that can be released in severe accidents. The FPEIS assumed only very low values of the actinide release fractions.

Because of the flaws in the FPEIS risk calculation, NCI undertook its own study to evaluate the consequences of loss-of-containment accidents at PWRs with MOX cores and compare them to those at PWRs with LEU cores. The specific example of a four-loop PWR with an ice-condenser containment was chosen for analysis. Four of the six plants included in the sole bid now being evaluated by DOE --- Duke Power's Catawba 1&2 and McGuire 1&2 --- are of this type. 2

First, radionuclide inventories were computed for LEU and WG-MOX cores, using the Oak Ridge National Laboratory (ORNL) SCALE 4.3 code to simulate changes in the fuel composition during irradiation. Full WG-MOX cores were considered as the bounding case. Fuel management schemes were based on those in a 1996 Westinghouse report on plutonium disposition in which full-MOX cycles were developed that resembled LEU cycles as closely as possible.

Second, the accident consequences (acute fatalities, early commitment of latent cancer fatalities, and other indicators of risk) for LEU and MOX cores were evaluated for several different accidents, using NRC methodology and the NRC consequence calculation software MACCS2,[8] and ICRP 72 dose coefficients. Generic parameters were used for population and atmospheric data. While the absolute values of consequence measures depend strongly on these parameters, the relative consequences of MOX and LEU accidents are much less sensitive to them.

Finally, the calculated increases in risk associated with substituting MOX for LEU were compared to the acceptance guidelines contained in the recently issued NRC Regulatory Guide (RG) 1.174,[9] "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis." RG 1.174 describes a methodology for grading the intensity of NRC review of requested changes to the licensing basis (LB) of nuclear

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[8] D.I. Chanin and M.L. Young, *Code Manual for MACCS2: Volume 1, User's Guide*, SAND97-0594, Sandia National Laboratories, March 1997. In the course of generating data for the present paper, the author discovered an error in the MACCS2 software which resulted in the overcounting of cancer fatalities among individuals receiving committed effective doses (CEDs) greater than 10 sievert (Sv) and a consequent overestimate of population-averaged cancer risk. While the error will not be fixed until release of the next version of MACCS, an "unofficial" corrected version of the code was provided to the author. Although the corrected version has not been officially validated, the results agree well with calculations carried out by the author by hand. All data in this report has been generated with the corrected, unofficial version of MACCS2.

[9] U.S. Nuclear Regulatory Commission, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Regulatory Guide 1.174, July 1998.

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power plants according to their risk significance. RG 1.174 therefore provides a framework for evaluating the regulatory significance of the increased risk associated with use of MOX fuel.

Although not directly applicable to the WG-Pu disposition program, the inventory of a typical reactor-grade (RG) MOX core was also calculated for comparison. Because RG-MOX cores have larger quantities of heavy actinides, the consequences of RG-MOX accidents are even more severe than those of WG-MOX, especially at the relatively high plutonium loadings necessary to achieve adequate utilization of the fuel.

Findings

1. The number of latent cancer fatalities (LCFs) committed within one week after a severe reactor accident will be significantly greater for both full and partial WG-MOX cores than for LEU cores. For most accidents considered, the number of prompt fatalities that result will also be greater.

(a) Compared to a PWR using LEU fuel, the number of latent cancer fatalities (LCFs) that will result from exposures immediately following a severe accident with early containment failure or bypass will be significantly greater for a PWR loaded with weapons-grade (WG) MOX fuel, for both full and 1/3-cores of WG-MOX. This is primarily due to the increased concentrations of plutonium and heavier actinides in MOX cores.

For a set of typical severe accidents that result in the release of about 1% of the inventory of plutonium and other actinides (compared with a 3.5% release for the Chernobyl accident), the number of "early" LCFs that result (those due to exposures occurring within one week after the accident), averaged over an operating cycle, was found to be 81%-96% greater for a full MOX core. 2

For a 1/3-MOX core, the corresponding percent increase would be 29%-32%, a factor of three smaller than for a full core. However, because the increase in consequences is essentially linear with respect to the MOX core fraction, the overall excess *risk* (the product of probability and consequences) associated with the disposition program will be approximately the same for both full and partial MOX core loadings. Whether 33 MT of WG-Pu is processed in six plants with a 1/3-MOX core in 15 years, in six plants with a full MOX core in 5 years, or in two plants with a full MOX core in 15 years, the total average increase in risk to the U.S. public will be approximately the same in each case (although the risk to a particular individual may be different).

(b) These increases are considerably greater than the upper limit of the +8% to -7% range cited by the Department of Energy (DOE) in its environmental impact statements on surplus plutonium disposition for full-core MOX.

(c) The actual number of additional LCFs resulting from a MOX accident depends on details of the reactor site, such as population density and atmospheric conditions. For a generic site with a population density of 100 persons/square kilometer (which is very close to the actual density in the vicinity of the Catawba and McGuire plants) the number of additional LCFs within an area of 1000 miles radius, averaged over an operating cycle, was found to range from 1,440 to 6,165 for the set of accidents analyzed for a full-MOX core. For a 1/3-MOX core, the additional LCFs range from 495 to 2,385.

(d) The number of prompt fatalities resulting from acute radiation exposure is greater by around 40% for WG-MOX cores following early containment failure accidents. For containment bypass accidents, a 15% reduction was observed (from 33 to 28 cases) for a full-MOX core, and a 6% reduction for a 1/3-core. However, this reduction in prompt fatalities is tiny compared to the increase in LCFs observed.

2. The additional consequences of severe accidents involving MOX cores are sensitive to the fraction of actinides (i.e. plutonium, americium and curium) in the core that are released.

The increase in accident consequences associated with switching from LEU to MOX depends on the fraction of the actinide inventory that is released, which is a highly uncertain parameter. As the actinide release fraction is varied from 0.3% to 6%, the percent increase in LCFs resulting from an full-MOX core accident with early containment failure, averaged over an operating cycle, ranges from 39% to 131%, corresponding to an additional 1,730 to 18,185 LCFs for the generic reactor site. In the worst case, the number of *additional* cancers associated with a MOX accident is 60% as large as the *total* number of cases predicted to occur worldwide from the Chernobyl accident. For a 1/3-MOX core, the percent increases range from 14% to 44%, corresponding to an additional 610 to 6,135 LCFs. 2

3. The average latent cancer fatality accident risk to the population within ten miles of a nuclear plant is increased by approximately a factor of two when a full core of WG-MOX is substituted for LEU. This increase in risk is significant when compared to the risk limits in NRC's Safety Goal Policy Statement.[10] According to NRC's Regulatory Guide 1.174, a change in the licensing basis resulting in a doubling of risk <u>would not be allowed</u> for typical U.S. PWRs. The increase in risk associated with loading a 1/3-core of WG-MOX would also be unacceptably high.

When a full core of WG-MOX is substituted for LEU, the average increase in latent cancer fatality risk to the population near a reactor site nearly doubles. This is equivalent to the increase in risk that would occur if the probability of a severe accident with a large early release of radioactivity (the Large Early Release Frequency, or LERF) were doubled. For the PWR considered in this study, this would correspond to an increase in LERF of about seven in a million ($7x10^{-6}$) per year for a full MOX core, or more than two in a million ($2x10^{-6}$) per year

[10] U.S. Nuclear Regulatory Commission, "Safety Goals for the Operations of Nuclear Power Plants: Policy Statement," *Federal Register*, 51 FR 30028, August 4, 1986.

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for a 1/3-MOX core. In both cases, these exceed the threshold of one in a million ($1x10^{-6}$) per year established in NRC's Regulatory Guide 1.174 for allowable increases in LERF.

4. The use of WG-MOX in U.S. PWRs is not likely to lower the probability that a severe loss-of-containment accident may occur and may in fact increase it significantly.

Some reasons why this is the case are listed below.

(a) The ability of high-burnup MOX fuels in current use to withstand severe accident conditions is inferior to that of LEU fuel.

It has been observed that MOX fuel assemblies fabricated with current techniques are inferior to LEU fuel with regard to their integrity during abnormal events that cause rapid heating of the fuel, such as reactivity insertion accidents (RIAs) and loss-of-coolant accidents (LOCAs). Based on the results of a series of RIA tests at the Cabri test reactor in France, French regulators have concluded that "MOX fuel shows a higher failure potential than UO_2 at comparable burnup." In particular, a MOX fuel rod with a burnup of 55 gigawatt-days per metric ton (GWD/MT), which is typical of burnups achieved in U.S. PWRs today, experienced a violent rupture and dispersal of fuel particles, while two LEU rods of comparable and higher burnups were able to withstand similar conditions without rupture.[11] Based on this test, a French regulator recently concluded that this was a MOX-related phenomenon and that there is a "very high potential for rupture" of MOX fuel in RIA situations.[12]

(b) A MOX-fueled PWR may have a greater risk of experiencing pressurized thermal shock of the pressure vessel. 2

Due to a more rapid cooldown of the reactor vessel following a break in a main steam line, a MOX-fueled PWR may have a greater risk of experiencing pressurized thermal shock (PTS) than one fueled with LEU. PTS is a very severe event in which the reactor vessel becomes brittle at low temperature (below about 180°C or 350°F) and ruptures at high pressure, causing core debris to be expelled into the containment. Following such an event, it is nearly impossible to maintain cooling of the core and a meltdown becomes a virtual certainty. In addition, a sufficiently powerful rupture of the pressure vessel could damage the containment.

[11] DOE has recently claimed that the Cabri test is not relevant to the U.S. MOX program, arguing that (1) the burnup was higher than that which MOX rods will experience in U.S. reactors, and (2) the Cabri test rod was an obsolete fuel type with a high degree of heterogeneity. Both these statements are false. PWR fuel assemblies are authorized in the U.S. for burnups up to 62 GWD/t, and reactor operators expect that MOX and LEU fuel assemblies will be fully interchangeable. The Cabri rod was fabricated using the MIMAS process, which the French and Belgian industries have been using since 1984 and which is expected to be the process that a U.S. MOX fabrication plant will utilize. DOE is not encouraging the development of improved MOX fuel for the U.S. program because of the delays that would occur in its qualification.

[12] A. MacLachlan, "International Meeting Fails to Resolve Questions Surrounding Cabri Future," *NuclearFuel*, July 27, 1998, p. 6.

(c) Ice-condenser containments may be more vulnerable to early failure in a severe accident than large dry containments.

Four of the six PWRs that have been offered for MOX irradiation services in the sole remaining proposal being evaluated by DOE, Duke Power's Catawba 1&2 and McGuire 1&2, have ice-condenser containment structures. These containments are smaller in volume and have less structural strength than other types of PWR containments. In the event of a core melt, followed by failure of the reactor pressure vessel at high pressure, a phenomenon known as high-pressure melt ejection (HPME) can occur, resulting in a very rapid heating and pressurization of the containment atmosphere (direct containment heating, or DCH) which can cause containment failure. Ice-condenser containments "do not have the same inherent capacity to withstand the credible DCH loads from all scenarios as other Westinghouse plants," according to NRC.[13] The ability of ice-condensers to withstand hydrogen combustion events and steam explosions is also questionable.

Together, these facts raise the concern that if U.S. utilities plan to irradiate MOX fuel to a burnup comparable to that of LEU fuel, the risk of violent rupture and fuel dispersal that makes cooling of the core debris more difficult will be increased. Moreover, because such accidents can result in both dispersal of the core into the containment and early containment failure through the phenomenon of direct containment heating, they are also associated with release of solid core materials, such as actinides, into the environment. Therefore, both the consequences and the probability of this class of accidents may increase when MOX is substituted for LEU in PWRs. 2

5. A severe accident at a PWR with a reactor-grade MOX (RG-MOX) core would cause up to twice as many latent cancer fatalities (LCFs) as would an accident at a PWR with a WG-MOX core.

The number of LCFs resulting from a severe accident at a PWR fueled with a full core of RG-MOX, at the end of an operating cycle, was found to be 123%-486% greater than that resulting from an accident at a PWR fueled with LEU, depending on the actinide release fraction. This is more than twice as many cases as would result from an accident involving a WG-MOX core. This dramatic increase in risk should be taken into consideration by nations that are currently using or planning to introduce RG-MOX in their nuclear plants. Recently, some U.S. policy-makers who regret the U.S. decision not to pursue commercial spent fuel reprocessing and plutonium recycling have been seeking to take advantage of the current political difficulties of siting a geologic repository for spent fuel to revive the reprocessing option in the U.S. The results of this article provide an additional validation of the U.S. decision and another argument why reprocessing and recycle should be avoided.

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[13] U.S. NRC, "Status of the Integration Plan for Closure of Severe Accident Issues and the Status of Severe Accident Research," SECY-98-131, June 1998.

MR022

Conclusions

1. Licensing of U.S. reactors to use MOX will have to take place primarily on a site-specific level. In addition, an NRC finding that MOX use poses "no significant hazards" under 10 CFR 50.92 clearly would not be justified.

A key question in the procedure for licensing reactors to use MOX fuel will be whether NRC will rule, under the procedures outlined in 10 CFR 50.92, that the introduction of MOX fuel into existing reactors involves a "significant hazards consideration," which would obligate the NRC to conduct public hearings prior to issuance of a license amendment. Prospective industry participants in the MOX program have indicated that they intend to have the MOX reload core methodology licensed on a generic basis, thereby removing most MOX-related issues from consideration on a plant-specific level. In this way, they hope to facilitate an NRC finding of "no significant hazards" in individual plant license amendment proceedings and thus prevent the possibility of site-specific hearings that could lead to substantial delays in introducing MOX fuel into reactors.

However, the results of this study indicate that site-specific considerations, such as the public health impacts associated with changes in the licensing bases of existing plants to use MOX fuel, will indeed be substantial, and therefore it should not be possible for NRC to justify issuing a finding of "no significant hazards" on the plant-specific level.

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2. Limitations on MOX fuel burnup to below 36 GWD/MT should be imposed unless high burnup safety issues are resolved.

Concerns with the performance of high-burnup MOX fuel in the event of an accident have led the French nuclear safety authority DSIN to restrict the burnup of MOX fuel to 36 GWD/t, whereas LEU fuel is permitted to reach 47 GWD/MT. The French national utility Electricité de France (EdF) has concluded that to achieve burnup parity with LEU, a new MOX fuel type will have to be developed. Such an effort could cause substantial additional delays to the MOX mission. The U.S. should follow France's lead and restrict MOX burnup pending resolution of these safety issues, even though this will be a costly inconvenience for U.S. nuclear plants.

3. Licensees who wish to use WG-MOX will have to demonstrate to NRC that the Large Early Release Frequencies (LERFs) of their plants are below one in a million ($1x10^{-6}$) per year. Even if they can meet this requirement, the request will be subject to an intensive NRC technical and management review, and the underlying probabilistic risk assessment (PRA) calculation will have to undergo peer review and satisfy quality control requirements.

We have shown that the introduction of a full core of MOX fuel into PWRs will result on average in a doubling of the risk to the public from a large early release of radioactivity. This increase in risk is equivalent to that which would occur if the Large Early Release Frequency (LERF) of the plant were doubled. According to NRC's RG 1.174, a change to the plant licensing basis resulting in a doubling of the LERF would only be considered for plants with a

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MR022–11 **DOE Policy**

DCS does not intend to request licensing of MOX fuel use on a generic basis. Duke Power and Virginia Power, the reactor licensees, would submit individual reactor license amendment requests to NRC for each of their reactors in which the MOX fuel would be irradiated. Plant-specific core load and safety analyses would be performed, and an NRC license amendment approved, prior to MOX fuel being introduced into any reactor. All issues considered by NRC to be important to safety and the environment would be evaluated during the license amendment process.

MOX fuel burnup is proposed at 45 GWD/t with peak pin burnup of 50 GWD/t. Actual MOX fuel burnup limits will be established in concert with the NRC following a thorough safety review. It should be noted that reactors in Belgium and Germany typically use MOX fuel to burnups between 45 and 50 GWD/t and that while current French burnup limits are lower than that, French burnup limits for LEU fuel are also lower than those for U.S. reactors.

There is a recognition that detailed analyses would need to be done to support the NRC license amendment process. This information would be prepared if the decision is made in the ROD to go forward with the MOX approach. The commentor's interpretation of NRC Regulatory Guide 1.174 is his opinion and may not be the interpretation adopted by NRC.

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baseline LERF of one in a million ($1x10^{-6}$) or below. For a 1/3-MOX core, the corresponding threshold would be three in a million ($3x10^{-6}$).

The guidelines in RG 1.174 are not absolute. In particular, an applicant may argue that quantitative increases in risk are offset by "unquantified benefits" and that a less strict NRC response is warranted. Even so, plants wishing to use MOX will have to undergo intensive site-specific reviews by NRC, and may have to conduct full-scope (Level 3) probabilistic risk assessments (PRAs), which very few plants have done to date because of the time and expense involved. These will be necessary to document that the Large Early Release Frequencies of the plants are sufficiently low that the increased risk associated with a large early release from a MOX-fueled plant are "small and consistent with the intent of the Commission's Safety Goal Policy Statement." Moreover, PRA documentation will have to be done more carefully and in more detail in the future. Because of the great variability in the content and quality of PRAs that have been carried out to date, NRC is in the process of developing a quality control standard for PRAs submitted in support of risk-informed regulatory proceedings. 11

4. The U.S. plan to encourage Russia to use WG-MOX in Russian and Ukrainian VVER-1000 LWRs poses even greater risks than the plan for U.S. domestic use of WG-MOX.

Russian VVER-1000s do not meet Western safety standards in such critical areas as fire protection and instrumentation and control systems. Although the U.S. is encouraging Russia to commence a program for using WG-MOX in VVER-1000s, and has provided a portion of the initial financing, there will be no simultaneous effort to upgrade these plants so that they fully meet Western safety standards, which would cost on the order of $150 million per unit, according to recent estimates. In fact, Russia has to date been reluctant to accept Western assistance for plant safety upgrades. Given that the use of MOX will increase risk even in plants that do meet Western standards, encouraging Russia to use MOX in its less robust plants without ensuring maximum possible adherence to safety is nothing short of reckless. 10

5. Risks associated with irradiation of WG-MOX in both U.S. LWRs and Russian VVER-1000s could be averted if both nations implemented an all-immobilization policy for the entire stockpile of excess WG-Pu. The use of MOX is unnecessary and should be avoided.

The significant additional public health risks of MOX use in existing nuclear plants cannot be justified in terms of the security benefits of plutonium disposition, because a less risky alternative exists --- immobilization. The insistence of the Russian Ministry of Atomic Energy (MINATOM), along with U.S. and European nuclear interests, that immobilization is not an acceptable approach for either the U.S. or Russia, is one of the driving forces behind the heavy emphasis on MOX in both countries. However, the U.S. should not be compelled by a handful of bureaucrats and industry lobbyists to adopt an outdated, shortsighted and technically flawed approach that will unnecessarily endanger the health of its citizens. Rather than proceeding with the MOX plan, the U.S. should recognize and highlight the environmental, economic and security advantages of immobilization and explore creative ways of enhancing its acceptability both at home and in Russia. 9

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NEI

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June 28, 1999

Ms. Laura S. H. Holgate
Director, Office of Fissile Materials Disposition
U.S. Department of Energy
Supplement to the SPD EIS
P.O. Box 23786
Washington, DC 20026-3786

Dear Ms. Holgate:

The Nuclear Energy Institute (NEI) has reviewed the Supplement to the Surplus Plutonium Disposition Draft Environmental Impact Statement. We did not identify any significant comments to submit.

NEI would like to take this opportunity to endorse the Department of Energy's (DOE's) hybrid approach to plutonium disposition, with the majority of the surplus plutonium dedicated for use in existing reactors as mixed oxide fuel. NEI notes that the environmental impacts of the preferred plutonium disposition alternative (hybrid approach) are relatively minor, and the nonproliferation benefits of the program make the preferred alternative far superior to the "no action" alternative. In addition, NEI commends DOE for its thorough efforts to provide for public input as a part of the Surplus Plutonium Disposition Environmental Impact Statement process. 1

Sincerely,

Felix M. Killar, Jr.

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MR019

MR019–1 **Alternatives**

DOE acknowledges the commentor's support for the hybrid approach and appreciates the recognition of its public outreach efforts.

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Comments on the Supplement to Surplus Plutonium Disposition Draft Environmental Impact Statement

Prepared by Mary Olson, Nix MOX Campaign Coordinator

We share the overall goal of this program: to render weapons plutonium unusable in weapons. We oppose the proposal to make plutonium fuel for nuclear power reactors in the United States, Russia, Canada or anywhere else for that matter.

This is an experimental program with extremely high stakes which are not justified under any circumstances. The assertion that the Russians are dictating the US program is simply not credible. The US would wage a reversal of our policies against plutonium in commerce, risk a major reactor accident here and in Russia for the minor benefit of isotopic alteration of plutonium in Russia since they propose nothing more than a delay in the reprocessing of the MOX fuel and moving ahead towards a plutonium cycle, at US tax payers expense. The fact that plutonium fuels increase the real hazard of US reactors is not justified by this marginal gain a the geo-political level. 1

Comments on the Process

We appreciate that the Department is finally providing site specific information about irradiation of MOX, and for this opportunity to comment. However, the Department has made a mockery of public participation in a decision making process, and the inclusion of those most impacted in the process. The fact that there is already a consortia under contract which includes the use of these reactors (Duke Power's McGuire and Catawba and Virginia Power's North Anna reactors) precludes the very consideration of whether to use them or not. Further, the fact that DOE has not seen fit to do any public education or solicitation of direct in-put from these host communities betrays any claim that DOE has conducted a fair process as described under the National Environmental Policy Act. 2

We (again) formally request that DOE hold hearings on this Supplement and draft EIS in the vicinity of Duke Power's McGuire and Catawba and Virginia Power's North Anna reactors. While the people of Columbia, SC appreciated the opportunity provided by 3

FR003

FR003–1 **MOX Approach**

DOE acknowledges the commentor's opposition to the MOX approach. DOE has identified as its preferred alternative the hybrid approach. Pursuing both immobilization and MOX fuel fabrication provides the United States important insurance against potential disadvantages of implementing either approach by itself. The hybrid approach also provides the best opportunity for U.S. leadership in working with Russia to implement similar options for reducing Russia's excess plutonium in parallel. Further, it sends the strongest possible signal to the world of U.S. determination to reduce stockpiles of surplus plutonium as quickly as possible and in a manner that would make it technically difficult to use the plutonium in nuclear weapons again. DOE will announce its decisions regarding the approach to surplus plutonium disposition in the SPD EIS ROD.

While it is true MOX fuel has not been produced commercially in the United States, it has been produced in Western Europe. MOX fuel fabrication is not a new technology. This experience would be used to benefit disposition of the U.S. surplus plutonium.

The *Joint Statement of Principles* signed by Presidents Clinton and Yeltsin in September 1998 provide general guidance for achieving the objectives of a future bilateral agreement to disposition surplus plutonium in the United States and Russia. Sensitive negotiations between the two countries have indicated that the Russian government accepts the technology of immobilization for low-concentration, plutonium-bearing materials, but that the MOX approach would be considered for higher-purity feed materials. DOE will continue to discourage Russia from reprocessing its spent nuclear fuel and starting a plutonium cycle but this issue is beyond the scope of this SPD EIS.

FR003–2 **General SPD EIS and NEPA Process**

DOE conducted a procurement process in accordance with DOE NEPA regulations 10 CFR 1021.216. The selected team, DCS, would design, request a license, construct, operate, and deactivate the MOX facility as well as irradiate the MOX fuel in domestic, commercial reactors. However, these activities are subject to the completion of the NEPA process. As stipulated in DOE's phased contract with DCS, until and depending on the decisions regarding facility siting and approach to surplus plutonium disposition are made and announced in the SPD EIS ROD, no substantive design work or construction can be started by DCS on the MOX facility. Should DOE decide to pursue the No Action Alternative or the immobilization-only approach, the contract with DCS would end. The contract is phased so that only nonsite-specific base contract studies and plans can be completed before the ROD is issued, and options that would allow construction and other work would be exercised by DOE if, and only if, the decision is made to pursue the MOX approach.

Efforts were made to contact persons living near the selected reactor sites and inform them of the proposed use of MOX fuel. The *Supplement to the SPD Draft EIS* was mailed to those stakeholders who requested it as well as to those specified in the DOE *Communications Plan* (i.e., Congressional representatives, State and local officials and agencies, and public interest groups around the United States) and the utilities' contact lists. The utilities, Duke Power Company and Virginia Power Company, would operate the proposed reactors (located in North Carolina, South Carolina, and Virginia) should the MOX approach be pursued per the SPD EIS ROD.

Since the inception of the fissile materials disposition program, DOE has supported a vigorous public participation policy. It has conducted public hearings in excess of the minimum required by NEPA regulations to engender a high level of public dialogue on the program. The office has also provided the public with substantial information in the form of fact sheets, reports, exhibits, visual aids, and videos related to fissile materials disposition issues. It hosts frequent workshops, and senior staff members make presentations to local and national civic and social organizations on request. For example, at the invitation of South Carolina State Senator Phil Leventis, DOE attended and participated in the public hearing that was held in Columbia, South Carolina, on June 24, 1999. Additionally, various means of communication—mail, a toll-free telephone and fax line, and a Web site (http://www.doe-md.com)—have been provided to facilitate the public dialogue. It is DOE policy to encourage public input into these matters of national and international importance.

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Senator Leventis, the June 24 event in Columbia cannot be construed as a substitute for hearings in the reactor communities. We also request an extension of the comment period. It is not appropriate to hold a single hearing and then close the comment period within a week. 3

Information Missing From the Supplement

In order to compare the 100% immobilization route to plutonium disposition with the hybrid approach that include making and using MOX plutonium fuel there are a number of direct comparisons which must be made. Most of these are in the department of contamination and waste.

Nowhere in the supplement or the draft EIS is there a compilation with radioisotopic profiles of the operating wastes and discharges. To get the full picture, reference must be given for each of the chosen reactors using LEU uranium fuel, projections using MOX fuel and the totals (including Pu processing and fuel fabrication) compared to the immobilization route.

Of particular interest is the air and water discharges and so-called "low-level" waste generated. It is not sufficient for the Department to simply say that the current regulation swill be met. The question remains whether the waste and discharges would bear more plutonium and total actinides and whether there would be more fission products and what the profile of tritium generation would be. Since we do recognize current regulations to be protective we are still interested in the net impact of shifting part of the fuel used in these reactors in such a way as to increase the plutonium in the system.

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While it is possible to assert, as the Department does, that regulations would be met, this does not guarantee that in fact, the regulations will be met. Nor does this assertion justify the practice of putting unique, untested plutonium fuel in existing, aging reactors. The International Committee on Radiological Protection (ICRP) explicitly states in publishing their guidelines that society must justify a practice which leads to radiation exposure, and the standard is then applied, not he other way where the assumption is that any practice that meets a standard is therefore justified. The ICRP guidelines are the basis on which national regulators establish existing national radiological standards.

Current waste standards allow the generator to simply prepackage and dilute to meet regulations. Further, the basis for regulation of discharges looks only at each year's discharge, with no reference to the loading of the environment with persistent radionuclides.

It is also not appropriate to look at only one year of discharge for each reactor. It would be more appropriate to average the discharge to air and to water, each over 5 years, since there is considerable variation between years in air and water discharge. These figures would then be compared to projections of discharges to air and water using MOX fuel,

FR003

FR003–3 **General SPD EIS and NEPA Process**

DOE acknowledges the commentor's request for additional public hearings in the communities near the proposed reactor sites. After careful consideration of its public involvement opportunities, including the availability of information and mechanisms to submit comments, DOE decided not to hold additional hearings on the *Supplement*. In addition to the public hearing on the *Supplement* held in Washington, D.C., DOE provided other means for the public to express their concerns and provide comments: mail, a toll-free telephone and fax line, and the MD Web site. Further, as discussed in response FR003–2, DOE attended and participated in a public hearing in Columbia, South Carolina at the invitation of Senator Phil Leventis. Moreover, interested parties would likely have the opportunity to submit additional comments during the NRC reactor license amendment process should the MOX approach be pursued per the SPD EIS ROD.

FR003–4 **Waste Management**

The commentor states that the radioisotopic inventories of emissions from the reactors need to be assessed using MOX fuel against using LEU fuel. For normal operating conditions, the emissions are the same. The only emission stream that might result from using MOX fuel that would result in a different radioisotopic mix than LEU fuel occurs in the event that there is a MOX fuel failure, in which there is a emission pathway from the core. Given the history and integrity of fuel, a fail failure may never occur during the limited fuel campaign to disposition surplus plutonium. Notwithstanding, if there were a MOX fuel failure, the effect on the radioisotopic inventory in emissions would be almost indistinguishable because: (1) the radionuclide inventories in MOX and LEU fuel are similar (as shown in Table K–27) and (2) the contribution of fuel failures to the total emissions from the reactor is small (other contributions to the site's effluents dominate).

Electricité de France reactors in France have seen little or no changes in radionuclide releases in effluents from the use of MOX fuel. All of the proposed reactors would continue to operate within stringent NRC 10 CFR 20 and 10 CFR 50 radionuclide release and dose requirements. Doses for hybrid alternatives and immobilization-only alternatives are given for each of the candidate sites in Appendix J and for each applicable alternative in Chapter 4 of Volume I.

While it is accepted that there are differences in fission product inventories and activation products between an LEU and MOX core during a fuel cycle, these differences are small enough that essentially no dose differential can be observed by members of the public during normal reactor operations. The only time significant quantities of fission products could be released to the environment would be in the event of a large-scale fuel leak. In regard to normal operations, FRAGEMA's (a subsidiary of COGEMA; one of the companies chosen to operate the proposed MOX facility) experience with fabricating MOX fuel indicates a leakage rate of less than one-tenth of 1 percent. FRAGEMA alone has provided 1,253 MOX fuel assemblies, with more than 300,000 fuel rods for commercial reactor use. There have been no failures and leaks have occurred in only 3 assemblies (a total of 4 rods). All leaks occurred as a result of debris in the reactor coolant system and occurred in 1997 or earlier. The French requirements for debris removal were changed in 1997 to alleviate these concerns. Since that time, there have been no leaks in MOX fuel rods.

In the event of a leaker, fission products are released into the primary containment and are ultimately either passed through a series of resins (for liquid releases) or through a HEPA filtration system (for releases to the atmosphere) that would capture approximately 99.99 percent of the radionuclides. In either case, the impact on dose would be expected to be small.

The use of MOX fuel would not be expected to result in any additional radioactive discharges to the air or water, or the production of additional LLW because the reactors would continue to operate on the same schedule as if they were using only LEU fuel. Any additional ionizing radiation would be limited to the containment and not reach the public. It is important to recognize that the quantities of "key" radionuclides (i.e., those radionuclides that typically account for the vast majority of public dose from normal reactor operations) are projected to remain about the same or in some cases decrease when a partial MOX core is used. These radionuclides include: iodine 131, cobalt 60, cesium 137, and tritium. By the end of core life, the presence of these radionuclides is expected to increase by 3 percent, decrease by 28 percent, decrease by 9 percent, and decrease by 5 percent, respectively, as presented in Table K–27 when a partial MOX core is used.

As described in Section 3.7, the waste generation rates are 5-year average waste generation rates. Since waste generation rates and isotopic composition are not expected to change appreciably, offsite municipal and commercial waste treatment and disposal facilities, and nuclear laundries should not be adversely affected. Likewise, activities of state regulators and the LLW disposal compacts should not be adversely affected.

The reactors for MOX fuel irradiation would not be operated by DOE. The reactors would continue to be operated by the utilities and regulated by NRC. Eventual D&D of the reactors, to include any recycling of metals, would be performed by the utilities in accordance with NRC regulations in force at that time. However, it is premature to assume that scrap metal at the reactors would be recycled as part of D&D. MOX fuel use is unlikely to impact reactor D&D since as described above, radionuclide inventories and contamination are unlikely to change significantly.

based on real data from the so-called experience of the consortia members, radionuclide by radionuclide.

The same would be repeated for so-called low-level waste.

The reason that this must be done is so that decision makers at all levels of the impacted communities can really weigh the MOX option against the no-MOX option where uranium fuels continue to be used. Municipal drinking water is at stake. Ground and surface water is at stake, state resources for dealing with so-called low level waste sites are also at question.

This analysis must be carried fully to all the extensions of reactor operations: nuclear laundries – on –site and off, nuclear decontamination and waste treatment facilities, incinerators of so-called low-level waste, brokers of this waste (off-site storage) and all transportation steps between these points. What is the radioisotopic profile compared to uranium and what are the doses that would be expected. 4

Finally, because of the Department's cavalier practice of releasing radioactively contaminated metals from decommissioning to the market place as if they were not radioactive, it is also necessary to compare the contamination of metals and other materials from LEU operations and MOX operations. We oppose the release of this material, but do not think that an analysis of the relative impact of MOX and LEU will be complete without it.

Inappropriate Risk Assessment

It is not credible to tie the current health effects analysis to the calculated risk associated with a single year of the operation of any of the 6 chosen reactors. If residents in the area of these reactors only lived there one year, there could be an argument made for this. For the most part they live there longer. Regulations should assume that someone is going to spend their life in this location. That is still a strong cultural tradition in the United States. When the risk factors given are multiplied by 70 year life span one arrives at the familiar, and still unacceptable 3.5 cancer fatalities in 1000 life time exposures given an annual dose on 100 millirems . This is nothing to brag about. 5

We appreciate that the Department has significantly altered their analysis of the impacts of MOX plutonium fuel on the health effects resulting from a major reactor accident.. However, the claim that the likelihood of such an accident occurring is only 1 chance in 4.2 million per year is not credible. The Chernobyl accident happened. It is an ongoing example of the type of core breach that plutonium fuel would complicate. Chernobyl happened in less than 3000 worldwide reactor years. It was the third, perhaps more, reactor accident, but the first core dump. To calculate probability on a model when we have direct data is folly. One can argue that the reactors are different and that containment is a factor. However, containment fails at US reactors regularly, we are simply lucky that this has not (yet) happened coupled with a major reactor problem. OF 6

FR003

FR003–5 **Human Health Risk**

The assertion of 3.5 cancer fatalities over 70 years for a population of 1,000 people is accurate when assuming that each of these persons incurs the maximum permissible public dose level (per 10 CFR 20) of 100 mrem/yr. However, it should be noted that this 100 mrem/yr dose is a limiting dose as established in the U.S. Code of Federal Regulations and that the three candidate reactor sites (Catawba, McGuire, and North Anna) do not come close to this dose value for even a hypothetical MEI. As shown in Section 4.28, the MEI at these sites would be expected to receive an annual dose of less than 1 mrem. Hence, over a 70-year timeframe, this actually equates to 0.035 fatal cancers in a population of 1,000 persons. It should also be noted that the probability of just one individual receiving this "hypothetical maximum exposure" of 1 mrem/yr is small; therefore, an annual exposure of 1 mrem to 1,000 persons is highly unlikely. A typical member of the public would receive an annual dose from natural background radiation which is roughly 300 times higher than the hypothetical 1 mrem dose received from MOX reactor operations.

FR003–6 **Facility Accidents**

The frequency of occurrence estimates were obtained from each plant's probabilistic risk assessment in response to NRC's request for individual plant examinations to assess each plant's vulnerability to severe accidents.

It should be noted that D.C. Cook has been shut down due to issues unrelated to its ice condenser. NRC has not considered it necessary to restrict operation of any of the other reactors in the United States that use ice condenser containments.

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real concern is the choice to use 4 Duke ice condenser model reactors,. where like DC Cook, the containment can be unusable. 6

Chances of an Accident Greater

The physics of plutonium fission are not the same using weapons plutonium as either MOX fuel from reprocessing or the consistent claim from industry that this is no different from the fissioning of the plutonium which reactors make towards the end of their fuel cycle.

A higher percentage of prompt neutrons a positive coefficient of heat reactivity and the tendency to accelerate the aging of reactors, as well as the possible degradation of fuel cladding by any possible residual gallium leads us to assert that a reactor accident is more likely to occur using MOX plutonium fuel. 7

The Department acknowledges that the consequences of a core-dump type accident will be worse than if LEU furl was used.. In making a comparison, one must assume the probability off the event occurring is 1. This means that there is an absolute increase in hazard, even if the probability is low.

Need For Site Specific High-Level Waste Analysis

Supplement needs to include a very detailed comparison of LU and plutonium MOX fuel and the type of issues that are currently being seen with dry cask storage challenges. These include metallurgical reactions between fuel and coolant and the gases as well as coatings on the inside of the casks. There are also thermal load issues with being able to unload these casks. 8

There needs to be a detailed analysis of potential impacts on a repository at Yucca Mountain. 9 What about comparative doses during transport? 10

Thermal load issues are of paramount concern for fuel pools and the reactor core in the case of extended loss of off-site power to the reactor . Turkey Point, Davis Besse and a Scottish reactor are all examples of the short fuse that LEU fuel has,. What is the impact of 40% MOX on these parameters? These are all site specific concerns. 11

If use of MOX is going to cause these 2 utilities to have more waste to handle, and need a fuel pool that is relatively open, then what about the impact on having to load more dry casks sooner, What about this in the context of current Department negotiations over high-level nuclear waste obligations? Who pays if the utility must go to dry casks sooner than otherwise? 12

No increased exposure to workers is not credible. 13

No plutonium contamination expected from plutonium activities at SRS is not credible. 14

FR003

FR003–7 **Facility Accidents**

Differences between MOX fuel and uranium fuel are well characterized and can be accommodated through fuel and core design. Initial evaluations indicate that partial MOX fuel cores have a more negative fuel Doppler coefficient at hot zero power and hot full power, relative to LEU fuel cores for all times during the full cycle. These evaluations also indicate that partial MOX cores have a more negative moderator coefficient at hot zero power and hot full power, relative to LEU fuel cores for all times during the full cycle. These more negative temperature coefficients would act to shut the reactor down more rapidly during a heatup transient.

All of the factors discussed by the commentor were evaluated by the proposed reactor licensees to ensure that the reactors can continue to operate safely using MOX fuel and will continue to be evaluated. Before any MOX fuel is used in the United States, NRC would have to perform a comprehensive safety review that would include information prepared by the reactor plant operators as part of their license amendment applications.

For MOX fuel, as compared to LEU fuel, there is an increase in accident risk for certain accident scenarios, about 3 percent, for the large-break loss-of-coolant accident (the bounding design basis accident). The largest increase in risk for beyond-design-basis accidents is approximately 14 percent for an interfacing systems loss-of-coolant accident at North Anna. In the unlikely event this beyond-design-basis accident were to occur, the expected number of LCFs would increase from 2,980 to 3,390 with a partial MOX core and prompt fatalities would increase from 54 to 60. Both of these accidents have an extremely low probability of occurrence. At North Anna, the likelihood of a large-break loss-of-coolant accident occurring is 1 chance in 48,000 per year and the likelihood of an interfacing systems loss-of-coolant accident occurring is 1 chance in 4.2 million per year.

FR003–8 **MOX Approach**

Initially, when spent fuel is removed from the reactor, the MOX and LEU fuel would be about the same temperature and exhibit similar characteristics. After about a year out of the reactor, however, the temperature of MOX spent fuel would exceed that of LEU fuel of the same age. By the time the decay heat from MOX spent fuel assemblies becomes significantly greater than that from LEU fuel, the total decay heat load in the spent fuel pool would have dropped to such a point that it is no longer limiting from a heat removal standpoint. Consequently, there would be minimal adverse impact on the cooling needed for irradiated fuel assembly storage due to substitution of MOX for LEU fuel assemblies. During the base contract period, the utilities would confirm the decay heat removal characteristics of the MOX fuel assemblies and would confirm what, if any, modifications may be needed to the spent fuel pool and dry storage cask cooling systems. If necessary, the MOX spent fuel could be preferentially retained in the spent fuel pools and only LEU spent fuel moved to dry cask storage. This would eliminate any concerns about storing MOX fuel in dry casks.

FR003–9 **Repositories**

This SPD EIS assumes, for the purposes of analysis, that Yucca Mountain, Nevada, would be the final disposal site for all immobilized plutonium and MOX spent fuel. As directed by the U.S. Congress through the NWPA, as amended, Yucca Mountain is the only candidate site currently being characterized as a potential geologic repository for HLW and spent fuel. DOE has prepared a separate EIS, *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE/EIS-0250D, July 1999), which analyzes the environmental impacts from construction, operation and monitoring, related transportation, and eventual closure of a potential geologic repository. The potential MOX spent fuel and/or immobilized plutonium are included in the inventory analyzed in that draft EIS should the decision be made to proceed with the hybrid or immobilization-only approaches.

FR003–10 **Transportation**

As described in Appendix L.5.4, all shipments (including MOX spent fuel shipments) were conservatively assumed to have a dose rate equal to the regulatory limit of 10 mrem/hr at 2 m (6.6 ft). The dose rate near a vehicle carrying spent nuclear fuel could be lower depending on factors such as the degree of fuel burn-up, the amount of post-irradiation cool-down time allowed before fuel shipment, and the amount of spent fuel being shipped. Because the dose rate can vary due to factors other than the fuel type, it is likely that shipments of MOX spent fuel and LEU spent fuel would have similar dose rates. Therefore, the impacts from shipping MOX and LEU spent fuel are expected to be similar under normal conditions. Accidents involving the shipment of spent fuel (which would reasonably represent the potential accident impacts from MOX spent fuel) are being considered in the *Yucca Mountain EIS* as described in response FR003–9.

FR003–11 **MOX RFP**

As discussed in response FR003–8, when spent fuel is initially removed from the reactor, the MOX and LEU fuel would be about the same temperature and exhibit similar characteristics. After about a year out of the reactor, however, the temperature of MOX spent fuel would exceed that of LEU fuel of the same age. Therefore, storage of MOX spent fuel would increase the thermal loading in a spent fuel pool over that for only LEU fuel. However, thermal load limitations are based on the amount of cooling that the entire spent fuel pool can accommodate, not on individual fuel assemblies within the pool. Therefore, the additional heat load would be accounted for in the calculations for the reactor spent fuel management plans.

The commentor has expressed a concern that MOX fuel in the reactor core might affect core cooling in the event of an extended loss of offsite power event. Each of the proposed nuclear units has two independent sources of offsite power capable of supplying power to the Engineered Safety Features, and two emergency onsite diesel generators as standby power sources should offsite power not be available. Each of the plant’s extended shutdown capabilities has been evaluated, including during loss of offsite power and station blackout scenarios. As part of the safety analyses supporting the license amendment request to use MOX fuel, each licensee would reevaluate these scenarios to account for MOX fuel in the core, to ensure that the reactors can be safely shutdown and maintained in that mode for an extended period. Rigorous safety analyses and operational parameter assessments would be conducted, and a license amendment approved by NRC, prior to the use of MOX fuel in any reactor. Differences in neutron flux, decay heat, temperature of the fuel assemblies and other parameters that could affect reactor operation and core cooling, both during normal operation and postulated transients and emergencies would be considered in these analyses, and factored into operating and emergency procedures, as necessary. Changes in the amount of moderator, neutron poisons and other reactor control mechanisms and emergency systems would be made as necessary to ensure continued safe operation of the proposed reactors.

Two examples of loss of offsite power in the United States were noted by the commentor. On August 24, 1992, winds from Hurricane Andrew caused extensive damage to southern Florida, including offsite power supplies to the Turkey Point Nuclear Generating Station. Offsite power to Turkey Point was unavailable for 6 days. During that time period, the emergency diesel generators operated and provided power for essential systems, including spent fuel pool cooling.

On June 24, 1998, a tornado struck the Davis-Besse Nuclear Power Plant and caused damage to the electrical switchyard. As a result, offsite power to Davis-Besse was lost for approximately 24 hours. The emergency diesel generators operated and provided power for essential systems, including spent fuel pool cooling. The ambient room temperature for one of the diesel generators slightly exceeded the design limit, but the generator continued to run and supply its load.

In both cases severe external phenomena caused a loss of offsite power for an extended period of time, but plant systems responded as designed to provide decay heat removal. It should be noted that all U.S. nuclear power plants, including the mission reactors, are required to demonstrate to NRC that they can withstand a station blackout (loss of all AC power, including onsite emergency power) for at least 4 hours. Therefore, there is substantial margin in the ability to provide adequate cooling for spent fuel. The impact of incorporating a limited number of MOX spent fuel assemblies on the ability to provide for spent fuel pool cooling is expected to be negligible and to be reviewed by NRC, as appropriate, as part of the reactor-license amendment process.

FR003–12 **Waste Management**

As described in Section 4.28, the amount of additional spent nuclear fuel generated is estimated to range from approximately 2 to 16 percent of the total amount of spent fuel that would be generated by the proposed reactors during the time period MOX fuel would be used. The amount of additional spent fuel is not expected to change spent fuel management practices at the reactor sites. Spent fuel from the reactors would be moved to the spent fuel pool and later, if needed, to onsite dry storage. Ultimately, the spent fuel would be moved to a potential geologic repository prepared in accordance with the NWPA. As is current practice, the utilities would pay for any spent fuel storage needed at the reactor sites.

As described in response FR003–9, DOE is preparing a separate EIS on a potential geologic repository for HLW and spent fuel.

FR003–13 **Health Human Risk**

Under normal operating conditions, it is not expected that the waste streams and handling characteristics would change significantly from those associated with LEU fuel. Electricité de France reactors in France have seen little or no increased impacts on workers from the use of MOX fuel; accordingly, little or no increases in worker exposure would be expected.

FR003–14 **Human Health Risk**

There are minute releases of plutonium to the environment expected from the proposed surplus plutonium disposition facilities at SRS. These releases are presented in Appendix J and factored into the analysis presented in Chapter 4 of Volume I.

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Physicians for Social Responsibility Comments
On the Supplement to the Surplus Plutonium Disposition
Draft Environmental Impact Statement
(DOE/EIS - 0283-DS, April 1999)

June 28, 1999

Physicians for Social Responsibility (PSR) is a national organization of approximately 15,000 members. We are the United States affiliate of the International Physicians for the Prevention of Nuclear War (IPPNW), winners of the 1985 Nobel Peace Prize. PSR was founded in the 1960's when we worked to end atmospheric nuclear testing by documenting the presence of Strontium 90 in children's teeth. PSR is committed to achieving the complete, verifiable elimination of nuclear weapons, and addressing the legacy of the Cold War. In that context, we urge the safe, secure disposition of plutonium. We oppose policies and efforts that would encourage the United States or other countries to use or proliferate this most lethal bomb material. 1

We support the stated goal of the Department of Energy's plutonium disposition program: *"[To] Reduce the threat of nuclear weapons proliferation worldwide."* We believe however, that the planned use of MOX in commercial reactors does not achieve this goal. Instead, we find that the MOX program fuels a worldwide plutonium economy, incurs unnecessary environment, safety, and health impacts and risks, wastes taxpayer money, and is not supported in the United States or worldwide. We are also concerned that DOE has not held public hearings in communities around the chosen reactor sites where citizens will be most directly impacted by this MOX program. 2

FR017

FR017–1 **Alternatives**

DOE acknowledges the commentor's concern that the MOX approach does not meet the surplus plutonium disposition program's goal. Use of MOX fuel in domestic, commercial reactors is proposed to safely and securely disposition surplus plutonium by meeting the Spent Fuel Standard. The Spent Fuel Standard, as identified by NAS and modified by DOE, is to make the surplus weapons-usable plutonium as inaccessible and unattractive for weapons use as the much larger and growing quantity of plutonium that exists in spent nuclear fuel from commercial power reactors. DOE is not advocating a plutonium economy. The use of U.S. surplus plutonium in existing domestic, commercial reactors does not involve reprocessing (reprocessing is a chemical separation of uranium, transuranic elements [including plutonium], and fission products from spent reactor fuel and the reuse of the plutonium and uranium to produce new fresh fuel) and therefore does not support building a plutonium economy.

FR017–2 **General SPD EIS and NEPA Process**

DOE acknowledges the commentor's request for extending the comment period and planning for additional public hearings in the three communities where the proposed reactors would use MOX fuel. After careful consideration of its public involvement opportunities, including the availability of information and mechanisms to submit comments, DOE decided not to hold additional hearings on the *Supplement to the SPD Draft EIS*. In addition to the public hearing on the *Supplement* held in Washington, D.C., DOE provided other means for the public to express their concerns and provide comments: mail, a toll-free telephone and fax line, and the MD Web site. Although it did not extend the comment period, DOE did consider all comments received after the close of that period. All comments were given equal consideration and responded to.

The *Supplement* was mailed to those stakeholders who requested it as well as to those specified in the DOE *Communications Plan* (i.e., Congressional representatives, State and local officials and agencies, and public interest groups around the United States) and the utilities' contact lists. The utilities, Duke Power Company and Virginia Power Company, would operate the

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MOX : Fueling a Plutonium Economy

We recognize the difficulty in negotiating with Russia on plutonium disposition issues. It is quite clear that Russia values plutonium as a fuel resource, intends to continue reprocessing activities, and would like to expand Russian use of breeder reactors. It seems however, that with our policy of pursuing a MOX program in parity with Russia, we have failed to exercise strong leadership. Real leadership on this issue would send a clear message to Russia and other countries that we are truly committed to our non-proliferation policies against reprocessing and could steer Russia and other countries away from reprocessing. Instead our policy has been a very confusing message, essentially saying to Russia and the world *"follow us, we're right behind you."*

While the DOE pays lip service to the United States policy on reprocessing (see box at right), in fact this current MOX program undermines that policy and supports a worldwide plutonium fuel economy.

"The United States does not encourage the civil use of plutonium and, accordingly, does not itself engage in plutonium reprocessing for either nuclear power or nuclear explosive purposes." (President Clinton 1993)

Examples of how MOX supports a worldwide plutonium economy:

- **"Aqueous Polishing" required for the U.S. weapons-grade plutonium to be used as MOX fuel is a reprocessing activity.** When we asked where there was experience with Aqueous Polishing, the answer from Cogema representatives was that Aqueous Polishing is part of the current reprocessing activities at La Hague. Thus, it seems that DOE's assertion that *"the MOX approach does not involve reprocessing,"* is incorrect. (DOE Fact Sheet, *Surplus Plutonium Disposition and the U.S. Policy of Reprocessing*, June 14, 1999). 3
- **The United States supports a Japanese effort to assist Russia in burning MOX at the BN-600, a breeder reactor.** Not only does this encourage the use of breeder reactors in Russia, it furthers Japan's understanding and use of similar fast reactors. DOE Under Secretary Moniz has reported that the United States is very supportive of this effort. (Under Secretary Moniz, spoke at the *Nuclear Weapons Exchange/ Monitor Publications' Sixth International Policy Forum on the Disposition of Plutonium and HEU* on June 7, 1999. Russian policymakers and Japanese contractors also made presentations.)
- Support of the BN-600 use is troubling especially given that Russia does not believe that enough MOX can be burned in the currently available VVER light water reactors to reach plutonium disposition goals. **Instead, Russia would like to build and operate the BN-800 -another new breeder reactor. Will the United States support that effort in order to enable Russian parity with the U.S. MOX program?**
- **Russia is committed to a "closed fuel cycle," and intends to reprocess MOX spent fuel at some point.**
- **Cogema, chosen as the MOX fabricator in the DCS consortium carrying out the U.S. MOX program, is well known throughout the world for its reprocessing operations, as well as related reactor-grade MOX use.**

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FR017

proposed reactors (located in North Carolina, South Carolina, and Virginia) should the MOX approach be pursued per the SPD EIS ROD. As pointed out by the commentor, interested parties would likely have the opportunity to submit additional comments during the NRC reactor license amendment process.

It is DOE policy to encourage public input into these matters of national and international importance. DOE has followed the spirit of NEPA and has not neglected its responsibilities to the public. Since the inception of the fissile materials disposition program, DOE has supported a vigorous public participation policy. It has conducted public hearings in excess of the minimum required by NEPA regulations to engender a high level of public dialogue on the program. The office has also provided the public with substantial information in the form of fact sheets, reports, exhibits, visual aids, and videos related to fissile materials disposition issues. It hosts frequent workshops, and senior staff members make presentations to local and national civic and social organizations on request. For example, at the invitation of South Carolina State Senator Phil Leventis, DOE attended and participated in a public hearing held on June 24, 1999, in Columbia, South Carolina.

FR017–3 **Nonproliferation**

As discussed in response FR017–1, DOE is not proposing to reprocess spent nuclear fuel or support a plutonium fuel economy. DOE acknowledges the commentor's concerns regarding the disposition of surplus Russian plutonium as MOX fuel. The *Joint Statement of Principles* signed by Presidents Clinton and Yeltsin in September 1998 provide general guidance for achieving the objectives of a future bilateral agreement to disposition surplus plutonium in the United States and Russia. Sensitive negotiations between the two countries have indicated that the Russian government accepts the technology of immobilization for low-concentration, plutonium-bearing materials, but that the MOX approach would be considered for higher-purity feed materials. The goal of surplus plutonium disposition program is to reduce the threat of nuclear weapons worldwide by conducting disposition of surplus plutonium in the United States in an environmentally safe and timely manner. Converting the surplus plutonium into MOX fuel and using it in domestic, commercial reactors is an effective way to accomplish this. This activity permanently removes nuclear materials from the military arena, and does not compromise the traditional separation between military and commercial uses of nuclear materials.

On the basis of public comments received on the SPD Draft EIS, and the analysis performed as part of the MOX procurement, DOE has included plutonium polishing as a component of the MOX facility to ensure adequate impurity removal from the plutonium dioxide. Appendix N was deleted from the SPD Final EIS, and the impacts discussed therein were added to the impacts sections presented for the MOX facility in Chapter 4 of Volume I. Section 2.18.3 was also revised to include the impacts associated with plutonium polishing. Plutonium polishing is not a reprocessing activity (it is performed on plutonium dioxide made from pits, not on spent reactor fuel) but rather a process that is used to remove impurities, in particular gallium, in order to meet the required plutonium dioxide feed specifications for MOX fuel.

The United States and the other G–8 nations (Group of Eight industrialized nations: Canada, France, Germany, Great Britain, Italy, Japan, Russia, and United States) are supporting plutonium disposition efforts, both financially and by providing technical assistance, in Russia because these countries consider it vitally important to ensure that weapons-usable nuclear material does not fall into the hands of terrorists or rogue states. Russia considers the plutonium a valuable resource that can be used for energy production. DOE will continue to discourage Russia from reprocessing its spent nuclear fuel and starting a plutonium cycle, but this issue and the issue of Japan assisting Russia in building a reprocessing facility are beyond the scope of the SPD EIS.

Should the decision be made to proceed with the hybrid approach, COGEMA, part of the team that would design, request a license, construct, operate, and deactivate the MOX facility as well as irradiate the MOX fuel, would lend its expertise within the limits of the contract, which does not have any provisions for reprocessing.

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(Examples of MOX fueling a plutonium economy continued)

- **While DOE's stated intention is to shut down the MOX facility at the completion of the plutonium disposition mission, it would seem to be quite difficult to simply close down this large operation and infrastructure.** Thus, it is possible, if not probable, that the U.S. will continue to utilize the MOX process, eroding the once-through, no-reprocessing policy. 4

- **Use of MOX fuel in commercial reactors will forever blur to obliteration the line that the United States has maintained between military nuclear weapons processes and peaceful commercial nuclear power.**

Taken together these examples reveal the extent to which MOX and reprocessing are intrinsically related and serve to support the worldwide plutonium fuel economy, thereby undermining the non-proliferation goal of the plutonium disposition program. 3

MOX: A Public Safety & Health Risk

Plutonium is fairly characterized as one of the most lethal substances on earth. Any disposition method will pose inherent safety and health dangers to workers and the public. The DOE should make every effort to minimize those dangers.

> *"Plutonium . . . poses an extraordinarily dangerous threat to health as an emitter of alpha particles. Experiments in animals have demonstrated that plutonium is readily absorbed when inhaled as fine particles. Absorbed plutonium lingers in the body for decades. Major sites of retention include the lung, lymph nodes, liver, and bone, with relative distribution of the plutonium depending on its chemical form and entry route. Exposed animals develop high rates of cancer, primarily of the lung and bone, even when the dose of plutonium is small. Cell culture experiments suggest that such carcinogenesis may reflect a unique ability of alpha particles to cause inherited chromosomal defects from a minute amount of exposure."* Plutonium: Deadly Gold of the Nuclear Age, International Physicians for the Prevention of Nuclear War and The Institute for Energy and Environmental Research. 1992

Relative to the immobilization options, the MOX option presents additional risks and impacts. For example:

- **MOX requires more, transportation and multiple reactor locations.** Thus, more people and a broader environment are exposed to radiation and potential accidents in the fuel fabrication, transport, handling, and reactor use of plutonium. 5

- **Operation of MOX-fueled reactors risks greater harm than current uranium-fueled reactor operations.** The Nuclear Control Institute's recent study estimates that in the event of a severe loss of containment accident, releases from a reactor burning MOX fuel could cause from hundreds to thousands of additional cancer deaths among people exposed to the radioactive fallout. This is because MOX-fueled reactors contain greater quantities of radioisotopes including plutonium, americium, and curium than do reactors using uranium fuel. (*Public Health Consequences of Substituting Mixed-Oxide for Uranium Fuel in Light-Water Reactors*, Edwin S. Lyman, PhD, **Nuclear Control Institute,** January 21, 1999.) 6

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FR017–4 **DOE Policy**

Consistent with the U.S. policy of discouraging the civilian use of plutonium, a MOX facility would be built and operated subject to the following strict conditions: construction would take place at a secure DOE site, it would be owned by the U.S. Government, operations would be limited exclusively to the disposition of surplus plutonium, and the MOX facility would be shut down at the completion of the surplus plutonium disposition program. DOE will evaluate options for D&D or reuse of the proposed facilities at the end of the surplus plutonium disposition program. However, none of the current plans include using the facility to continue to manufacture MOX fuel.

Use of MOX fuel in domestic, commercial reactors is not proposed in order to subsidize the commercial nuclear power industry. Rather, the purpose of this proposed action is to safely and securely disposition surplus plutonium by meeting the Spent Fuel Standard as discussed in response FR017–1. Although cost will be a factor in the decisionmaking process, this SPD EIS contains environmental impact data and does not address the costs associated with the various alternatives. A separate cost report, *Cost Analysis in Support of Site Selection for Surplus Weapons-Usable Plutonium Disposition* (DOE/MD-0009, July 1998), which analyzes the site-specific cost estimates for each alternative, was made available around the same time as the SPD Draft EIS. This report and the *Plutonium Disposition Life-Cycle Costs and Cost-Related Comment Resolution Document* (DOE/MD-0013, November 1999), which covers recent life-cycle cost analyses associated with the preferred alternative, are available on the MD Web site at http://www.doe-md.com and in the public reading rooms at the following locations: Hanford, INEEL, Pantex, SRS, and Washington, D.C.

FR017–5 **MOX Approach**

The health and safety of workers and the public is a priority of the surplus plutonium disposition program, regardless of which approach is chosen. Operation of the proposed surplus plutonium disposition facilities would comply with applicable Federal, State, and local laws and regulations governing radiological and hazardous chemical limits. Within these limits, the level of exposure would be kept as low as is reasonably achievable. Chapter 5 summarizes the environmental statutes, regulations, and permits that cover emissions, waste, and ALARA standards.

DOE has considered the inherent risks, including terrorist concerns, associated with transporting plutonium materials. While DOE prefers to minimize the transportation of plutonium that is still desirable for weapons use, plutonium is routinely and safely transported in the United States. As described in Appendix L.3.3, transportation of nuclear materials would be performed in accordance with all applicable DOT and NRC transportation requirements. Interstate highways would be used, and population centers avoided, to the extent possible.

All shipments of surplus plutonium that have not been converted to a proliferation-resistant form would be made by DOE's SST/SGT system, as described in Appendix L.3.2. Since the establishment of the DOE Transportation Safeguards Division in 1975, the SST/SGT system has transported DOE-owned cargo over more than 151 million km (94 million mi) with no accidents causing a fatality or release of radioactive material. While it is true the MOX approach requires more transportation with regard to shipping the MOX fuel from the fabrication facility to the reactors, and then eventually shipping the MOX spent fuel to the potential geologic repository, each shipment would follow strict procedures using licensed equipment and in compliance with applicable requirements. A quantification of the risks associated with the various transportation scenarios is presented in Chapter 4 of Volume I by alternative and summarized in Section 2.18.

FR017–6 **Facility Accidents**

Section 4.28.2.5 provides a discussion of the analysis of several reactor accidents including both design basis and beyond-design-basis accidents. For MOX fuel, as compared to LEU fuel, there is an increase in risk, about 3 percent, for the large-break loss-of-coolant accident (the bounding design basis accident). The largest increase in risk for beyond-design-basis accidents is approximately 14 percent for an interfacing systems loss-of-coolant accident at North Anna. In the unlikely event this beyond-design-basis accident were to occur, the expected number of LCFs would increase from 2,980 to 3,390 with a partial MOX core and prompt fatalities would increase from 54 to 60. Both of these accidents have an extremely low probability of occurrence. At North Anna, the likelihood of a large-break loss-of-coolant accident occurring is 1 chance in 48,000 per year and the likelihood of an interfacing systems loss-of-coolant accident occurring is 1 chance in 4.2 million per year.

(MOX: A Public Safety & Health Risk continued)

- **While much is made of the operational experience with MOX reactors in Europe, these reactors abroad are using reactor-grade MOX fuel with much more plutonium-239.** U.S. weapons-grade plutonium fuel is different and unique, and even requires the additional Aqueous Polishing step. 7

- **The operational experience in Europe is irrelevant without adequate information about the health, safety and environment records of those operations.** The record of Cogema's operations should be disclosed to the public. We were pleased to note at the June 15 Public Meeting that at least some of this information will be posted on the web. The full environment, safety and health record of Cogema's reprocessing activities, along with its MOX experience, should be made available to the public. 8

MOX: An Expensive Option

- **Subsidies to Russia.** Achieving Russian plutonium disposition is a goal that we support. Thus we do not object to funding for this effort, and indeed have communicated our support to Congress in the past. We wonder however, why the U.S. cannot be more persuasive in directing the Russian programs. Instead, the U.S. approach is to fund and pursue MOX which seems to lead inevitably to reprocessing and breeder reactor use in Russia. Lawmakers including Jesse Helms (R-NC), Chair of the Senate Foreign Relations Committee, have raised serious concerns about the MOX program in Russia. Any program that does not have the clear support of Congress risks losing needed financial support. PSR cannot support funding for a plutonium disposition program with Russia that so heedlessly pursues MOX in the face of crucial non-proliferation concerns. 3

- **Subsidies to U.S. Utilities.** *"There will be small savings to the utility company's customers for the use of partial MOX fuel reloads."* (DOE Fact Sheet *"The Economics of the Plutonium Disposition Contractual Arrangement,"* June 14, 1999). The same fact sheet lists the costs covered by the DOE (which is funded by taxpayers), including the licensing expenses of the Nuclear Regulatory Commission and all modifications to the MOX mission reactors. While funding assistance to Russia may be needed even with other plutonium disposition options, taxpayer subsidies to the utilities and their customers is a unique cost of the U.S. MOX program. It is impossible to tell how "small" this subsidy is without full disclosure of the cost figures. The full costs of the entire MOX program should be disclosed to the public. We were pleased to note that access to at least a redacted form of the DOE- DCS MOX contract was made available at the June 15 Public Meeting, and hope that further cost information will be disclosed throughout the process. 4

- **Exclusive focus on the MOX option may endanger Congressional funding and support for plutonium disposition. Sufficient funding for the immobilization option is critically important.** In the political, competitive budget atmosphere of the U.S. Congress, it is important that steady plutonium disposition progress is made in order to maintain solid funding support for the program. Even proponents of MOX realize that MOX is not an option for all of the surplus plutonium. Some plutonium wastes will have to be immobilized. Moreover, especially because MOX is a new process in the U.S., delays and glitches are to be expected, and complete failure is a possibility. We are concerned that if money is poured into MOX, there may not be sufficient funding in later years to pursue immobilization or other options. 9

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FR017–7 **MOX Approach**

Reactor fuel in Europe is fabricated to similar enrichment levels (about 5 percent plutonium 239) to the levels being proposed for the U.S. reactors that would be used to irradiate MOX fuel.

Fabricating MOX fuel from surplus weapons-usable plutonium should have less impact than fabricating MOX fuel from spent nuclear fuel. At the La Hague Plant in France, COGEMA is reprocessing spent nuclear fuel to recover the plutonium. Because spent fuel is highly radioactive, it presents a series of unique hazards that need to be carefully dealt with. The La Hague Plant includes a series of processes to remove highly radioactive fission and activation products from the spent fuel. The MOX process being evaluated in this SPD EIS does not involve reprocessing. The proposed U.S. MOX facility would handle plutonium that is unirradiated. Therefore, the radiation exposures and emissions normally associated with reprocessing spent nuclear fuel would not be present in the proposed MOX facility.

The remainder of this comment regarding plutonium polishing is addressed in response FR017–3.

FR017–8 **MOX RFP**

European reactors of various designs use MOX fuel. European nuclear regulatory authorities in France, Germany, Belgium, the Netherlands, and Switzerland have reviewed MOX fuel use in reactors of varying designs. Recent reports prepared by the French Government have concluded that the radioactive releases from the La Hague Plant are not the cause of an excess childhood leukemia in the area of the plant between 1978 and 1996. As discussed in response FR017–7, the La Hague Plant is a spent fuel reprocessing plant. The use of U.S. surplus plutonium in existing domestic, commercial reactors does not involve reprocessing so a plant like La Hague would not be needed for the MOX approach.

In this regard, questions on environment, safety and health records of COGEMA can be directed to Ms. Christi A. Byerly. Her address is: 7401 Wisconsin Avenue; Bethesda, MD 20814. She may also be contacted by telephone at (301) 941-8367. Her fax number is (301) 652-5690, and

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MOX: Unsupported by Citizens Worldwide

As we push for nuclear disarmament progress, PSR believes that it is especially important that plutonium disposition efforts be supported by citizens worldwide. If people feel that plutonium disposition methods are dangerous and waste money, they may be less willing to support nuclear disarmament efforts in the first place. There is much opposition to MOX in Russia, the United States 9
and other countries. The ***"Statement of Non-Governmental Organizations on Plutonium Disposition"*** submitted at the June 15 Public Meeting, was signed by over 160 citizen's groups worldwide. This is the latest evidence that there is opposition to MOX throughout the world.

Public hearings should be held in the reactor communities.

DOE officials have stated that they would *"consider public hearings"* in the reactor communities. (Office of Fissile Materials Disposition (MD) Director Laura Holgate stated this at the *Nuclear Weapons Exchange/ Monitor Publications' Sixth International Policy Forum on the Disposition of Plutonium and HEU* on June 8, 1999, and MD Reactor Group Director Dave Nulton echoed this at the Public Meeting on June 15.) We strongly urge DOE to extend the comment period and ***plan*** hearings in the three communities where reactors will use MOX fuel.

PSR does recognize that the DOE has held a number of hearings throughout this Environmental Impact Statement process, and many of our members have participated in these hearings. We strongly believe, however, that DOE has an obligation to hold hearings in the communities where reactors have 2
been identified. Hearings have not been held in these communities. The citizens in these areas feel that failure to hold hearings in their communities is a gratuitous slap in the face. DOE is asking them to carry the largest burden of risk and impact for its disposition program, but does not even have the courtesy to go hear directly the concerns and questions people have.

While it is true that the Nuclear Regulatory Commission will license the reactors, and public hearings will likely be held by the NRC, this does not discharge DOE's responsibility. It is DOE's plutonium disposition mission, DOE has the contract with DCS, and it is DOE that is paying for the NRC licensing processes. Therefore, it is DOE's responsibility to hold hearings in the most affected communities at this time. We look forward to knowing when and where those hearings are planned.

Thank you very much for considering our written comments, and we do appreciate the efforts of the DOE Office of Fissile Materials Disposition at the June 15, 1999 Washington DC Public Meeting.

Comments prepared for Physicians for Social Responsibility by
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FR017

her email address is cbyerly@cogema-inc.com. You can also visit their Web site linked from the MD Web site at http://www.doe-md.com or directly at http://www.cogema.com.

FR017–9 **DOE Policy**

DOE acknowledges the commentor's observation that there is worldwide opposition to the MOX approach given the statement signed by over 160 citizen's groups. As discussed in response FR017–3, the disposition actions proposed are reasonable alternatives developed and analyzed to address the goals of the surplus plutonium disposition program. One of the advantages of pursuing the hybrid approach, which involves both immobilization and MOX fuel, is flexibility in meeting program goals and agreements reached with Russia should one of the approaches run into schedule delays. Decisions on the surplus plutonium disposition program will be based on environmental analyses, technical and cost reports, national policy and nonproliferation considerations, and public input. Should the decision be to proceed with the hybrid approach, construction and operation of the pit disassembly, immobilization, and MOX facilities would effectively occur simultaneously so there would be no threat of running out of funds to pursue immobilization. As shown in Appendix E, the immobilization would begin operating a year before the MOX facility was to begin cold startup operations.

ASHEVILLE
CITIZEN-TIMES

Tuesday, March 23, 1999

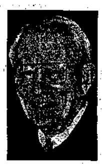
GUEST COLUMN

A global plutonium economy flourishes at our doorstep

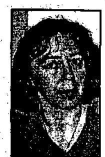
By Lewis Patrie
and Olga Pitsunova

We are writing to express our dismay about the proposed use of plutonium fuel both in the United States and Russia. Many U.S. citizens don't realize that environmental activists have been operating in Russia at their peril since before the break up of U.S.S.R. Recently, we took part in a lively discussion among six courageous Russian activists and many local community members who discussed nuclear issues on the UNCA campus.

Last December Secretary of Energy Bill Richardson identified the Savannah River Site in South Carolina as the preferred location to receive 50 tons of surplus plutonium from nuclear warheads from various locations around the country where most of it would be converted into plutonium fuel for use as fuel in nuclear power plants. Any day now the U.S. Department of Energy expects to contract with a consortium which includes French fabricator, Cogema, Virginia Power and Duke Power; the latter would accept MOX for use in its McGuire and Catawba reactors near Charlotte.



Lewis Patrie



Olga Pitsunova

Concurrently, the United States is promoting the use of plutonium fuel in Russian nuclear reactors. It would be U.S. money offered to conduct an initial experiment in the use of weapons grade plutonium fuel at the Balakovskaya Nuclear Power Station along the bank of the Volga River near Balakovo. The United States is promoting use of this fuel in many other Russian locations. Russian activists want U.S. citizens to know that plutonium plants in both countries are connected and that this movement signals the beginning of a global plutonium economy.

Our concerns about plutonium fuel include the billions of dollars for fabricating this fuel, transporting it to nuclear plants, offering it at no cost to power companies, future inestimable subsidies to the industry and the costs of promoting Russian fuel use. We dread even more that the characteristics of this fuel make it less stable than current fuel for reactor use, increasing the risk of a sever reactor accident and increasing the anticipated effects on human health should one occur. Such an event could ultimately result in many cancer deaths within 1000 miles of the accident.

Using pure plutonium fuel, the Nuclear Control Institute, a U.S. watchdog organization, estimates about doubles the cancer deaths from the radiation exposure within the first week of such an accident compared with nuclear fuel currently being used.

Although, DOE minimizes the risk of a disaster, reminiscent of Chernobyl, there are sufficient data to suggest that use of plutonium increases that risk.

Plutonium fuel substantially increases the waste management problem. Problems of security and nuclear proliferation are also increased with the use of plutonium fuel. Environmental problems from plutonium will linger for more than 200,000 years. For the sake of our world and that of our children, we should tell our governments that plutonium should never be used as fuel.

Olga Pitsunova is Program Director of the Center for Assistance to Environmental Initiatives in the Saratov region of Russia. The main goals of the organization are to encourage cooperation among environmental groups in the Saratov region and to encourage initiatives to protect and restore the environment.

Lewis Patrie is President of Western North Carolina of Physicians for Social Responsibility.

FR017

Viewpoint The Rock Hill Herald

Sunday, March 28, 1999

MOX Fuel

Should weapons-grade plutonium be used in nuclear reactors?

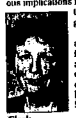
By Brita Larsen Clark and Kate C. Boniske
Special to The Herald

If you are like us, you may have no idea what MOX stands for. We have leaned only recently about this new development and what it means for our communities.

The U.S. Department of Energy (DOE) has developed a plan to combine surplus weapons-grade plutonium with uranium to produce fuel for civilian nuclear reactors. the fuel is called mixed oxide fuel, hence MOX. The Catawba II reactor, near Rock Hill, would be one of first to use this new and so far experimental fuel.

We all want to get rid of surplus plutonium, but is this a good way to do it? The more we learn, the more doubts surface.

When concerned groups asked the DOE to hold public hearings in communities such as Rock Hill, they were turned down. The public, however, has not only the right but also the responsibility to be involved in any policy decisions with such serious implications for our health and the health of future generations.



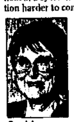
Clark

Our concerns about using MOX fuel are many. Here are some that directly affect those of us who make our homes in the Southeast:

◆ Weapons-grade plutonium never has been used in commercial reactors. They were not designed to use this fuel and would need extensive modifications.

◆ MOX fuel generates more high energy particles than uranium, and the rate of damage to key reactor parts would be accelerated.

◆ Increased energy also increases core temperatures, which increases fission, which in turn creates more heat in a cycle that makes the reaction harder to control.



Boniske

◆ Plutonium fission creates dangerous radioactive elements. Uranium "spent" fuel is about a million times more radioactive than fresh fuel (it is not "spent" at all; it becomes too highly irradiated to use) and MOX is even more dangerous

◆ A just-released study by the Nuclear Control Institute finds that a severe accident at a reactor fueled with MOX could cause twice as many fatal cancers as an identical accident

please see MOX, page 3E

MOX

from 1E

at a uranium-fueled reactor.

◆ Plutonium not only causes cancers, it also is highly likely to disrupt reproductive cells, causing mutations that can show up in future generations.

◆ Processing warhead plutonium pits into MOX (which would be done at the Savannah River Plant near Aiken) would create huge amounts of high-level nuclear waste.

◆ MOX means transporting plutonium by truck and/or rail to the Savannah River Plant for reprocessing. It then must be sent out again to the selected reactor sites. This presents serious security risks regarding the possibility of theft or diversion, as well as the potential for accidents en route.

◆ MOX will not use up our stockpiles of plutonium. Though a small amount will be expended in energy production, plutonium also will be created in the process, along with a host of other toxic elements. Of even greater concern, weapons still could be made from the irradiated "spent" fuel, undermining the point of using plutonium in the first place.

These are just a few of the issues regarding MOX that we believe need a public airing. As concerned parents and grandparents, we are distressed to think that Duke Energy, long known as a responsible member of the utility industry, would consider using MOX fuel in its Catawba and McGuire reactors.

We call on Duke Energy and the DOE to join with concerned citizens in organizing public forums where we can ask questions and give our input.

For more information on MOX in the southeast, contact the Blue Ridge Environmental Defense League (336) 982-2691, or Nuclear Information and Resource Service, (202) 328-0002. We have also relied on information published by the Institute for Energy and Environmental Research, whose e-mail is *http://www.ieer.org*, and the Nuclear Control Institute, *http://www.nci.org//nci/*.

Brita Clark and Kate Boniske both joined a roundtable discussion with members of The Herald's editorial board. Clark, of Candler, N.C., is active in the organization Physicians for Social Responsibility. Boniske, of Arden, N.C., is a longtime member of the Women's International League for Peace and Freedom.

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SAFE ENERGY COMMUNICATION COUNCIL
LINDA GUNTER
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The Herald

Viewpoint

Sunday, March 28, 1999

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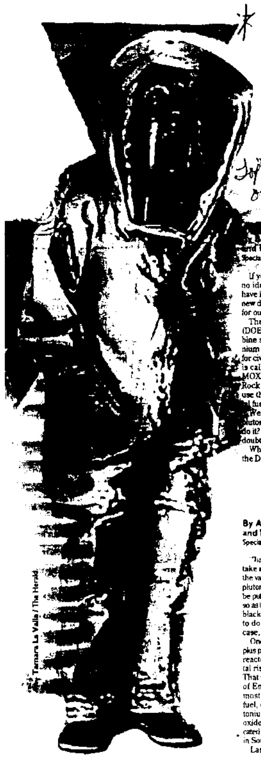
Opinion 2E
Classified 3E-14E



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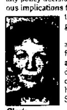

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Boniska

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- A just-released study by the Nuclear Control Institute finds that a severe accident at a reactor fueled with MOX could cause twice as many fatal cancers as an identical accident

please see MOX, page 3E

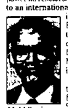
There's a better alternative

By Arjun Makhijani and Edwin Lyman
Special to The Herald

The United States and Russia must take action to reduce the risk from the vast surpluses of weapons-usable plutonium in both countries. It must be put into non-weapons-usable form, so as to keep it out of potential nuclear black markets. There are two ways to do this, and the jobs will, in any case, come to the Southeast.

One of the methods, the use of surplus plutonium as a fuel in commercial reactors, will increase environmental risks and proliferation dangers. That is the one that the Department of Energy (DOE) has chosen for most U.S. surplus plutonium. The fuel, consisting of a mixture of plutonium and uranium oxides (mixed oxide or MOX fuel), would be fabricated at the Savannah River Site (SRS) in South Carolina.

Last week, the DOE awarded a $130 million contract to design a nuclear power plant that can convert plutonium from decommissioned nuclear weapons into a fuel that would power its reactors. The contract went to an international consortium that includes Duke Energy, owner of the Catawba Nuclear Station in Lake Wylie and the McGuire reactors in North Carolina.



Makhijani

In recognition of the risks of MOX fuel use, the United States has, for more than two decades, had a bipartisan policy of not using plutonium as a fuel in commercial reactors. But the need to put the surplus plutonium into non-weapons-usable form has created a new opportunity for plutonium fuel advocates.

There is a simpler, faster and cheaper method for dealing with weapons plutonium: mixing it with radioactive wastes and encapsulating it in molten glass, which also could be carried out at SRS, without the risks attendant on the use of plutonium fuel. Yet, the DOE plans to use this only for plutonium not suitable for fabrication into fuel.

Lyman

Putting plutonium fuel into commercial circulation would require the militarization of commercial nuclear power plants to store the plutonium safely. It would require amending the licenses of the plants, which may need expensive modifications. It would make waste management more difficult and expensive. MOX fuel use also would require unnecessary plutonium transport.

Perhaps the most serious concerns

please see NUCLEAR, page 3E

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DCR003

DCR003–1 **Alternatives**

DOE acknowledges receipt of the commentaries that question the MOX approach.

The Herald
Sunday, March 28, 1999

MOX

from 1E

at a uranium-fueled reactor.

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Nuclear

from 1E

for people living downwind of the Catawba and McGuire reactors are the potential consequences of an accident in a reactor using MOX fuel. MOX-fueled reactors contain greater quantities of hazardous radioisotopes, including plutonium, americium and curium, than do plants using uranium fuel. A recent Nuclear Control Institute study estimates that in the event of a severe loss-of-containment accident, the higher releases of these isotopes from a plant using MOX could cause from hundreds to thousands of additional cancer deaths among people exposed to the radioactive fallout.

The DOE has tried to allay these concerns by pointing to countries such as France that use MOX fuel in some of their reactors. But the MOX experience abroad is not based on weapons-grade plutonium, which contains significantly more plutonium-239 and hence requires more stringent reactor control arrangements. The DOE also has failed to inform the public about the 1997 test in France in which a MOX fuel rod violently ruptured under simulated accident conditions while a uranium fuel rod with similar characteristics did not.

Finally, the MOX approach would mean that U.S. taxpayer dollars would be used to subsidize the creation of an infrastructure for commercial plutonium fuel use in this country and in Russia. Black-market dangers in Russia will only increase and proliferation problems will be aggravated by such a reversal of longstanding U.S. policy.

This poor plutonium policy is being accompanied by bad process. The DOE has not held hearings in the communities that host the reactors that would likely use the MOX fuel, nor even in Washington, D.C. Further, U.S. subsidiaries of two corporations, Cogema, owned by the French government, and British Nuclear Fuels, owned by the British government, would be intimately involved at SRS. The former is the likely contractor for the MOX plant; the latter is set to become part owner of Westinghouse, the SRS site contractor.

The DOE has not required these companies to make public their full operating safety, health and environmental records in their home countries. Yet they claim that extensive plutonium experience in their home countries especially qualifies them to do sensitive nuclear work in the United States.

Both Cogema and BNFL have polluted the environment in their home countries. Their plutonium separation operations are the subject of protest not only by environmentalists but also by other governments of the European Union, which have asked them to greatly reduce discharges of radioactivity, which are contaminating seafood.

Before letting a contract for MOX to Cogema or allowing BNFL to have a central role in operating SRS, the DOE should hold hearings in the Southeast and in Washington, D.C. on all relevant issues, including the home country records of Cogema and BNFL. All corporations that want public money, whether they are Cogema or Duke, should make all safety, health and environmental records public. (Much of Duke's record is already public via its disclosures to state and federal regulators.)

In the meantime, the region's public and policy-makers should withhold their support of the MOX program, which would introduce unnecessary environmental and proliferation risks and complicate the job of plutonium disposition. 1

Dr. Arjun Makhijani is president of the Institute for Energy and Environmental Research in Takoma Park, Md. Dr. Ed Lyman is scientific director of the Nuclear Control Institute in Washington, D.C. Both participated in a roundtable discussion with The Herald's editorial board regarding the use of MOX fuel.

DCR003

SAFE ENERGY COMMUNICATION COUNCIL
LINDA GUNTER
PAGE 3 OF 4

Opinion

The Herald
Sunday, March 28, 1999

2E

Our view

Let's take a closer look at MOX fuel proposal

In summary

◆ Opponents of plan raise disconcerting questions.

Last week, the U.S. Department of Energy gave the go-ahead to an international consortium led by Duke Energy to develop a plan for the use of weapons-grade plutonium in nuclear reactors. We worry that this plan is hurtling forward with virtually no attempt to educate the public about the potential hazards or to seek public reaction to the plan.

The use of what may be the most dangerous substance on the globe would occur at the Catawba Nuclear Station near Lake Wylie. It would be transported here overland from the Savannah River Site in Aiken County.

We have been reassured by Duke Energy officials and by others in the industry that the process is safe. They say it has been implemented successfully in Europe. And they point to an excellent safety record at Catawba and other nuclear plants in the consortium.

Proponents also maintain that providing a commercial use for plutonium will encourage other nations, notably Russia, with stockpiles of the material to use it in reactors. And, they say, unless plutonium is degraded in reactors, there is no way to keep it out of evil hands over its 100,000-year lifespan.

But others in the scientific community dispute both the safety claims and the efficacy of "burning" plutonium in nuclear plants to reduce stockpiles. These critics are not simply radical "anti-nuke" activists; they are doctors and scientists with the right credentials.

For example, Dr. Arjun Makhijani, who wrote a commentary that appears on the cover of today's Viewpoint section, is president of the Institute for Energy and Environmental Research. His Ph.D thesis was on controlled nuclear fusion, and he has served on an Environmental Protection Agency subcommittee on national radiation cleanup standards.

What both sides do agree on is the pressing need to render the nation's stockpile of plutonium to its least harmful state and keep it out of the hands of terrorists who could use it to build nuclear weapons. Where they disagree is over the best way to accomplish that.

The plan approved by the DOE last week calls for the plutonium to be turned into fuel that could be used in reactors. Mixed oxide fuel, commonly referred to as MOX, is made by mixing uranium oxide and plutonium oxide and placing the material in fuel "rods" for commercial use.

Rods would be shipped from the Savannah River Site by trucks or rail. Security details would be required to ensure the shipments weren't hijacked.

Industry officials say using MOX to generate electricity in nuclear plants would consume a significant portion of the plutonium and degrade the remainder, making it harder to use as a nuclear weapon. Eventually, they claim, this method would reduce the U.S. stockpile of surplus plutonium and help generate energy in the process.

Critics, however, claim, the conversion of plutonium to MOX fuel would produce hundreds of gallons of liquid radioactive waste. Furthermore, only a small portion of the plutonium is "burned" away in reactors and the fission process that occurs in the reactor actually creates more plutonium. And 1

DCR003

finally, used MOX fuel is much more radioactive and difficult to handle than normal uranium waste.

Opponents of the MOX program say the nation's weapons-grade plutonium should be encased in molten glass and stored in a secure area. Immobilization, they say, would be a quicker, less expensive and more efficient way to make this substance inaccessible.

Before buying industry claims that use of MOX fuel is both safe and economical, the public should demand answers to the concerns posed by opponents of this program. They claim that:

- An accident at a reactor using MOX fuel would pose a far greater danger of contamination and resulting cancer deaths of residents living near the plant.
- Transporting plutonium would be more difficult and dangerous than transporting uranium.
- Customers would enjoy no savings on fuel bills as a result of the use of MOX fuel.
- Workers at nuclear plants would be at higher risk.
- Commercial use of weapons-grade plutonium would encourage Russia and other nations to produce more plutonium.
- The bulk processing of plutonium would make it more difficult to account for the whereabouts of this dangerous material.
- An accident in which plutonium "went critical" would be more difficult to contain than one involving uranium fuel.
- The cost of refitting plants to accept MOX fuel would reduce or completely negate any savings in fuel costs.

These are just a few of the issues raised by opponents of the MOX fuel plan. Perhaps the Department of Energy and the nuclear power industry have answers for all of them.

To date, however, those answers have not been forthcoming. Nor has the industry offered to conduct forums to educate the public about its intention to use plutonium fuel. 1

Too much is at stake, especially for a community located so close to a nuclear power plant. The assurance that the Catawba Nuclear Station has a sterling safety record and that its engineers are convinced of the safety of this program is not enough.

The public needs to know more before it can endorse this controversial program.

DCR003

SAFE ENERGY COMMUNICATION COUNCIL
LINDA GUNTER
PAGE 1 OF 3

SECC

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FAX: (202) 234-9194
www.safeenergy.org

Statement of
Linda Gunter, Communications Director
Safe Energy Communication Council

Date: June 22, 1999
To: United States Department of Energy,
Office of Fissile Materials Disposition.

Overall, commercial nuclear power is already uneconomical, environmentally damaging and dangerous. Its future looks bleak. All new reactors ordered in the United States since 1974 have subsequently been canceled. No new reactors have been ordered since the accident at Three Mile Island 20 years ago. In fact, more than 100 reactors planned or under construction, have been canceled. In poll after poll, U.S. voters are clear: Americans want taxpayers' money spent on renewable energy options, not nuclear power, which already produces vast quantities of radioactive waste without a safe, permanent storage solution. This year, the Washington International Energy Group (WEIG), an industry think tank, released its **1999 Electric Industry Outlook** which found that 80 percent of utility CEOs and managers surveyed said no new nuclear power plants will be ordered in North America. In January, 1999, Steven Fleischman, Utilities Analyst for Merrill Lynch, predicted that no more nuclear reactors would be constructed in the U.S. Therefore, nuclear power has failed on Main Street, Wall Street and in the executive suites. 1

Using weapons plutonium – whose only purpose was supposed to be, and has hitherto been for bombs – in commercial reactors is even more uneconomical and even more dangerous. Furthermore, it is unnecessary. There is a safer, cheaper, faster alternative – immobilization – puts this dangerous material away forever. The U.S. Department of Energy (DOE) has agreed to immobilize up to 17 tons of surplus weapons plutonium, although we suspect the only reason is because it is unsuitable for Mixed Oxide fuel (MOX). However, the Supplement to the Surplus Plutonium Disposition Draft Environmental Impact Statement acknowledges that all of the surplus weapons plutonium could be immobilized. 2

So why pursue MOX at all? Why run such needless security, environmental and health risks to support a program that will prop up a 3

–more–

Safe Energy Communication Council

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MR011

MR011–1 **Other**

DOE acknowledges the commentor's view that commercial nuclear power has a bleak future in the United States.

MR011–2 **Alternatives**

DOE acknowledges the commentor's opposition to the use of weapons-grade plutonium in MOX fuel and irradiating it in commercial reactors. DOE has identified as its preferred alternative the hybrid approach. Pursuing both immobilization and MOX fuel fabrication provides the United States important insurance against potential disadvantages of implementing either approach by itself. The hybrid approach also provides the best opportunity for U.S. leadership in working with Russia to implement similar options for reducing Russia's excess plutonium in parallel. Further, it sends the strongest possible signal to the world of U.S. determination to reduce stockpiles of surplus plutonium as quickly as possible and in a manner that would make it technically difficult to use the plutonium in nuclear weapons again.

DOE does not agree that the MOX approach is inherently more dangerous than the immobilization approach. DOE and NAS have conducted studies to compare risks, including the nuclear material security and proliferation risks of alternatives analyzed in this SPD EIS. These studies include the *Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Materials Storage and Excess Plutonium Disposition Alternatives* (DOE/NN-0007, January 1997), *Proliferation Vulnerability Red Team Report* (SAND97-8203, October 1996), *Management and Disposition of Excess Weapons Plutonium* (NAS, 1994), and *Management and Disposition of Excess Weapons Plutonium, Reactor-Related Options* (NAS, 1995). As discussed in Section 4.28.2.5, studies by NAS have led it to the following conclusion: "no important overall adverse impact of MOX use on the accident probabilities of the LWRs involved will occur; if there are adequate reactivity and thermal margins in the fuel, as licensing review should ensure, the main remaining determinants of accident probabilities will involve factors not related to fuel composition and hence unaffected by the use of MOX rather than LEU fuel."

The environmental, safety and health consequences of the MOX approach at the proposed reactors are addressed in Section 4.28. In addition, NRC would evaluate license applications and monitor the operations of both the MOX facility and domestic, commercial reactors selected to use MOX fuel, to ensure adequate margins of safety.

As shown in the cost report, *Cost Analysis in Support of Site Selection for Surplus Weapons-Usable Plutonium Disposition* (DOE/MD-0009, July 1998), it is expected that the hybrid approach would be more expensive than the immobilization-only approach. However, as discussed, pursuing the hybrid approach provides the United States important insurance against potential disadvantages of implementing either approach by itself.

Operation of the proposed surplus plutonium disposition facilities is expected to take approximately the same amount of time for either the immobilization-only approach or the hybrid approach. The difference in timing for the hybrid approach is associated with the amount of time that MOX fuel would be irradiated in domestic, commercial reactors.

MR011–3 **Nonproliferation**

Use of MOX fuel in domestic, commercial reactors is not proposed in order to subsidize the commercial nuclear power industry. Rather, the purpose of this proposed action is to safely and securely disposition surplus plutonium by meeting the Spent Fuel Standard. The Spent Fuel Standard, as identified by NAS and modified by DOE, is to make the surplus weapons-usable plutonium as inaccessible and unattractive for weapons use as the much larger and growing quantity of plutonium that exists in spent nuclear fuel from commercial power reactors. The MOX facility would produce nuclear fuel that would displace LEU fuel that utilities would have otherwise purchased. If the effective value of the MOX fuel exceeds the cost of the LEU fuel that it displaced, then the contract provides that money would be paid back to the U.S. Government by DCS based on a formula included in the DCS contract. The commercial reactors selected for the MOX approach include only those reactors whose operational life is expected to last beyond the life of the surplus plutonium disposition program.

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June 22, 1999
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mature industry rapidly going the way of the dinosaurs? The DOE's response so far has been that we should address these concerns to the Nuclear Regulatory Commission (NRC). SECC asked questions specifically about security issues at a recent NRC public meeting. We were referred to a second NRC meeting the following week where, we were assured, security would be at the top of the agenda. But at that subsequent meeting we were told in no uncertain terms right at the start that we would not be allowed to ask questions, nor would we be permitted to make statements. Furthermore, not only was security not at the top of the agenda, it wasn't on the agenda at all. So much for the myth of an open, thorough public hearing process at the NRC. 4

Again we ask, why pursue the MOX option? Let us not be fooled by the Duke-Cogema-Stone & Webster (DCS) Consortium's assertions that it is for the good of the country and the noble cause of non-proliferation. Using MOX will end non-proliferation as we know it and increase the risk of nuclear-weapon proliferation by countries and, more seriously, by terrorist organizations. 3 In reality, DCS is endorsing the MOX program for the usual reason – money. Its utilities, Duke Power and Virginia Power, will be paid to use MOX, which is the only way it is financially feasible for them. And who will have to shoulder the burden of this handout? We, the people. The American taxpayer. 5

We urge the DOE to abandon this needless waste of government time and public money on the MOX program. The Department should instead focus on immobilization and safe storage while allowing the nuclear power industry to continue in the direction in which it is already appropriately proceeding, toward an orderly phaseout. 2

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MR011

In order to address security against terrorist-related incidents, all intersite shipments of plutonium for the surplus plutonium disposition program would be made using DOE's SST/SGT system. This involves having couriers that are armed Federal officers, an armored tractor to protect the crew from attack, and specially designed escort vehicles containing advanced communications equipment and additional couriers. Further, DOE does not anticipate the need for any additional security measures at reactor sites, other than for the additional security applied for the receipt of fresh fuel. Commercial reactors currently have armed security forces, primarily to protect against perimeter intrusion. There would be increased security for the receipt and storage of fresh MOX fuel, as compared with that for fresh LEU fuel, for additional vigilance inside the perimeter. However, the increased security surveillance would be a small increment to the plant's existing security plan. After irradiation, the MOX fuel would be removed from the reactor and managed with the rest of the spent fuel from the reactor, eventually being disposed of at a geologic repository built in accordance with the NWPA.

MR011–4 **General SPD EIS and NEPA Process**

NRC's public outreach policies are beyond the scope of this SPD EIS, however, since the inception of the U.S. fissile materials disposition program, DOE has supported a vigorous public participation policy. All interested parties would likely have the opportunity to submit comments during the NRC reactor license amendment process should the MOX approach be selected.

MR011–5 **MOX Approach**

The MOX approach is not intended to affect the viability of nuclear power generation at any particular reactor. DCS would not have to continue to use MOX fuel if it determined that it was uneconomical to operate the reactor. Furthermore, DCS would only be reimbursed for costs solely and exclusively related to the MOX fuel irradiation. This would ensure that the taxpayers were not underwriting otherwise uneconomical electricity-generating assets.
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Good Morning
My name is Ann with WAND -- Women's Action for New Directions, a national organization educating women to act politically. We also represent women state
legislators in all 50 states through our project Women Legislators Lobby (WiLL).

WAND was founded in 1980 as Women's Action for Nuclear Disarmament and has
worked toward nuclear arms reductions for nearly 20 years. We are encouraged
that at long last some nuclear weapons are being dismantled -- we hope there are many more to come. We also support the goals of the Clinton Administration
and the Department of Energy to dispose of the plutonium from these weapons in
such a way that they may never again be used in a weapon of mass destruction. 1

We are deeply concerned, however, with the DOE's approach to plutonium disposition and strongly disagree that converting some plutonium into fuel for
commercial power plants is the proper way to proceed. We feel the full balance
of the 50 tons of declared surplus plutonium should be immobilized and isolated
from the environment for safety, environmental, and proliferation reasons.

Fabricating MOX fuel and using it in commercial reactors in South Carolina, North Carolina and Virginia will require unnecessary and excess transportation
of plutonium, primiarly across the southeastern United States. WAND has active grassroots members and state legislators in these primary states. 2

While we hear repeated assurances that the plutonium will be transported "safely," it is important to remember that ANY shipment of plutonium involves
risk, and the MOX option maximizes that risk.

DCR009

DCR009–1 **Alternatives**

DOE acknowledges the commentor's opposition to converting some of the surplus plutonium into MOX fuel and irradiating it in commercial reactors. DOE has identified as its preferred alternative the hybrid approach. Pursuing both immobilization and MOX fuel fabrication provides the United States important insurance against potential disadvantages of implementing either approach by itself. The hybrid approach also provides the best opportunity for U.S. leadership in working with Russia to implement similar options for reducing Russia's excess plutonium in parallel. Further, it sends the strongest possible signal to the world of U.S. determination to reduce stockpiles of surplus plutonium as quickly as possible and in a manner that would make it technically difficult to use the plutonium in nuclear weapons again.

The safety, health, and environmental consequences of the MOX approach at the proposed reactors are addressed in Section 4.28. In addition, NRC would evaluate license applications and monitor the operations of both the MOX facility and domestic, commercial reactors selected to use MOX fuel, to ensure adequate margins of safety.

DOE and NAS have conducted studies to compare risks, including the nuclear material security and proliferation risks of alternatives analyzed in this SPD EIS. These studies include the *Nonproliferation and Arms Control Assessment of Weapons-Usable Fissile Materials Storage and Excess Plutonium Disposition Alternatives* (DOE/NN-0007, January 1997), *Proliferation Vulnerability Red Team Report* (SAND97-8203, October 1996), *Management and Disposition of Excess Weapons Plutonium* (NAS, 1994), and *Management and Disposition of Excess Weapons Plutonium, Reactor-Related Options* (NAS, 1995).

DCR009–2 **Transportation**

DOE has considered the inherent risks, including terrorist concerns, associated with transporting plutonium materials. While DOE prefers to minimize the transportation of plutonium that is still desirable for weapons use, plutonium is routinely and safely transported in the United States. As described in Appendix L.3.3, transportation of nuclear materials would be performed in accordance with all applicable DOT and NRC transportation requirements. Interstate highways would be used, and population centers avoided, to the extent possible.

All shipments of surplus plutonium that have not been converted to a proliferation-resistant form would be made by DOE's SST/SGT system, as described in Appendix L.3.2. Since the establishment of the DOE Transportation Safeguards Division in 1975, the SST/SGT system has transported DOE-owned cargo over more than 151 million km (94 million mi) with no accidents causing a fatality or release of radioactive material.

The MOX option also maximzes cost, waste generation, and potential worker
exposure to plutonium as it involves far more processing than the immobilization option. It will require the construction of a MOX Fabrication
Factility at the Savannah River Site, which is already highly contaminated and
has will take many decades to clean up, if it can, in fact, ever be cleaned up. 3

We are particularly concerned about the impact of the use of MOX in commercial
reactors on the surrounding communities. The people living near these reactors,
who will not have the benefit of speaking directly on this matter as DOE has refused to hold hearings in their communities, will bear the brunt of any accident involving MOX fuel. Yet they have not been adequately informed of the
risk they are being asked to take on. 4

WAND represents women legislators and grassroots activists living within 50 miles of these
reactors. [[[Kim: reactor locations are: McGuire reactor, 10 miles north of Charlotte, NC; the Catawba reactor, about 6 mi. south of Charlotte; and the North Anna reactor in Mineral, VA, kind of between Richmond and Fredericksberg. Can you find members in these areas?]]]

They are concerned, as we are, that:

* a severe accident at one of these reactor sites using MOX fuel, would result in far greater consequences with many more deaths and injuries than if such an accident
occurred with conventional uranium fuel.

* using MOX fuel in the reactor will cause embrittlement and premature
aging of the reactor, compromising safety 5

*since MOX fuel is made from WEAPONS plutonium (and not commercial

DCR009

DCR009–3 **MOX Approach**

As shown in the cost report, *Cost Analysis in Support of Site Selection for Surplus Weapons-Usable Plutonium Disposition* (DOE/MD-0009, July 1998), it is expected that the hybrid approach would be more expensive than the immobilization-only approach. However, pursuing the hybrid approach provides the United States important insurance against potential disadvantages of implementing either approach by itself as discussed in response DCR009–1.

Cleanup at SRS is a priority, will remain a priority, and can coexist with other DOE initiatives. The surplus plutonium disposition program would be conducted in a way which ensures that cleanup remains a priority at SRS and that the production of any additional waste is processed and disposed of in a timely and environmentally acceptable manner.

As described in Chapter 4 of Volume I and summarized in Section 2.18, potential impacts of any of the proposed activities during routine operations at any of the candidate sites would likely be minor. To avoid contamination that has occurred in the past at some DOE sites, DOE would design, build, and operate the proposed surplus plutonium disposition facilities in compliance with today's environmental, safety, and health requirements. Furthermore, any accidental releases would be promptly addressed following established policies and procedures by trained personnel.

DCR009–4 **General SPD EIS and NEPA Process**

DOE acknowledges the commentor's concern that the people living near the proposed reactors that would use MOX fuel are not getting to speak directly on this matter in a public hearing held in their community. After careful consideration of its public involvement opportunities, including the availability of information and mechanisms to submit comments, DOE decided not to hold additional hearings on the *Supplement to the SPD Draft EIS*. DOE provided other means for the public to express their concerns and provide comments. Also, at the invitation of South Carolina State Senator Phil Leventis, DOE attended and participated in a public hearing held on June 24, 1999, in Columbia, South Carolina.

The *Supplement* was mailed to those stakeholders who requested it as well as to those specified in the DOE *Communications Plan* (i.e., Congressional representatives, State and local officials and agencies, and public interest groups around the United States) and the utilities' contact lists. The utilities, Duke Power Company and Virginia Power Company, would operate the proposed reactors (located in North Carolina, South Carolina, and Virginia) should the MOX approach be pursued per the SPD EIS ROD. Further, interested parties would likely have the opportunity to submit additional comments during the NRC reactor license amendment process.

For those interested parties who could not attend the hearing on the *Supplement* held in Washington, D.C., on June 15, 1999, DOE provided various other means for the public to express their concerns and provide comments: mail, a toll-free telephone and fax line, and the MD Web site. Equal consideration was given to all comments, regardless of how or where they were received.

DCR009–5 **Facility Accidents**

While it is understood that there are differences from the use of MOX fuel versus LEU fuel, these differences are not expected to change the frequency of severe accidents in MOX-fueled reactors. Because differences between MOX fuel and uranium fuel are well characterized, they can be accommodated through fuel and core design. Before any MOX fuel is used in the United States, NRC would have to perform a comprehensive safety review that would include information prepared by the reactor plant operators as part of their license amendment applications.

Reactor vessel embrittlement is a condition in which the fast neutron fluence from the reactor core reduces the toughness (fracture resistance) of the reactor vessel metal. Analyses performed for DOE indicated that the core average fast flux in a partial MOX fuel core is comparable to (within 3 percent of) the core average fast flux for a uranium fuel core. All of the mission reactors have a comprehensive program of reactor vessel analysis and surveillance in place to ensure that NRC reactor vessel safety limits are not exceeded.

plutonium) it is therefore an experimental fuel --and neither DOE, Duke
Energy,
Virginia Power, Cogema, nor any other DOE subcontractor have a full
understanding of how this fuel will behave in a reactor. The fact is, it has
never before been used on a commercial scale and tests done at the
labroatory 5
scale indicate we have much, much more to learn about this volitile fuel.

* MOX fuel made from weapons plutlonium will make the reactor
harder to
control safely. We know "it can be done," but we also know the margin of
safety is narrowed with the use of MOX fuel.

* the nuclear industry will receive huge, as-yet undisclosed subsidies 6
and incentive fees for its participation in this program.

*storage of MOX fuel at reactor sites will be a security problem, as
plutonium in MOX fuel can be extracted fairly easily and used in a weapon,
making it very attractive to steal. Reactor sites are not set up to handle
this kind of security situation. 7

* We are also concerned about plutonium fuel transportation and the
impact on our communities and our children of heavily armored vehicles
carrying
plutonium fuel moving through our town's streets and highways.

At the very least, communities that must face these risks should have the
opportunity to speak for themselves and ask questions to you directly about 4
this risky program. We are dismayed that you have robbed them of that
chance.

We also feel the MOX program is costly and dangerous, puts people at risk
unnecessarily, and undermines the efforts of WAND and so many others to
reduce
the threat of nuclear weapons in the world. Your plan would provide the
funds 8
and infrastructure for a plutonium economy, which only worsens
environmental
and nuclear proliferation problems. It is particularly troubling that you are

DCR009

Section 4.28.2.5 provides a discussion of the analysis of several reactor accidents including both design basis and beyond-design-basis accidents. For MOX fuel, as compared to LEU fuel, there is an increase in risk, about 3 percent, for the large-break loss-of-coolant accident (the bounding design basis accident). The largest increase in risk for beyond-design-basis accidents is approximately 14 percent for an interfacing systems loss-of-coolant accident at North Anna. In the unlikely event this beyond-design-basis accident were to occur, the expected number of LCFs would increase from 2,980 to 3,390 with a partial MOX core and prompt fatalities would increase from 54 to 60. Both of these accidents have an extremely low probability of occurrence. At North Anna, the likelihood of a large-break loss-of-coolant accident occurring is 1 chance in 48,000 per year and the likelihood of an interfacing systems loss-of-coolant accident occurring is 1 chance in 4.2 million per year.

The fabrication of MOX fuel and its use in commercial reactors has been accomplished in Western Europe. This experience would be used for disposition of the U.S. surplus plutonium. Electricité de France reactors in France have seen little or no impact from the use of MOX fuel on radionuclide releases in effluents. No change would be expected from normal operations, given that MOX fuel performs as well as LEU fuel and the fission products are retained within the fuel cladding. FRAGEMA's (a subsidiary of COGEMA and FRAMATOME) experience with fabricating MOX fuel indicates a leakage rate of less than one-tenth of 1 percent. FRAGEMA has provided 1,253 MOX fuel assemblies, with more than 300,000 fuel rods for commercial reactor use. There have been no failures and leaks have occurred in only 3 assemblies (a total of 4 rods). All leaks occurred as a result of debris in the reactor coolant system and occurred in 1997 or earlier. French requirements for debris removal were changed in 1997 to alleviate these concerns. Since that time, there have been no leaks in MOX fuel rods. Further, as discussed in response DCR009–1, NRC would evaluate license applications and monitor the operations of the commercial reactors to ensure adequate margins of safety.

DCR009–6 **MOX Approach**

Use of MOX fuel in domestic, commercial reactors is not proposed in order to subsidize the commercial nuclear power industry. Rather, the purpose of this

pursusing this option when a cheaper, safer, more environmentally sound option
exists that does not encourage plutonium use and production in the US, Russia
and beyond. We implore [encourage? you to discard the MOX option and immobilize
all surplus plutonium as quickly and safely as possible. 8

Thank you for considering our comments.
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DCR009

proposed action is to safely and securely disposition surplus plutonium by meeting the Spent Fuel Standard. The Spent Fuel Standard, as identified by NAS and modified by DOE, is to make the surplus weapons-usable plutonium as inaccessible and unattractive for weapons use as the much larger and growing quantity of plutonium that exists in spent nuclear fuel from commercial power reactors. The MOX facility would produce nuclear fuel that would displace LEU fuel that utilities would have otherwise purchased. If the effective value of the MOX fuel exceeds the cost of the LEU fuel that it displaced, then the contract provides that money would be paid back to the U.S. Government by DCS based on a formula included in the DCS contract. The commercial reactors selected for the MOX approach include only those reactors whose operational life is expected to last beyond the life of the surplus plutonium disposition program.

DCR009–7 **Nonproliferation**

DOE does not anticipate the need for any additional security measures at reactor sites, other than for the additional security applied for the receipt and storage of fresh fuel. Commercial reactors currently have armed security forces, primarily to protect against perimeter intrusion. There would be increased security for the receipt and storage of fresh MOX fuel, as compared with that for fresh LEU fuel, for additional vigilance inside the perimeter. However, the increased security surveillance would be a small increment to the plant's existing security plan. After irradiation, the MOX fuel would be removed from the reactor and managed with the rest of the spent fuel from the reactor, eventually being disposed of at a geologic repository built in accordance with the NWPA.

In order to address security against terrorist-related incidents, all intersite shipments of plutonium for the surplus plutonium disposition program would be made using DOE's SST/SGT system. This involves having couriers that are armed Federal officers, an armored tractor to protect the crew from attack, and specially designed escort vehicles containing advanced communications equipment and additional couriers.

The dates and times that specific transportation routes would be used for special nuclear materials are classified information; however, the number of shipments that would be required, by location, has been included in Appendix L. Additional details are provided in *Fissile Materials Disposition Program SST/SGT Transportation Estimation* (SAND98-8244, June 1998), which is available on the MD Web site at http://www.doe-md.com.

DCR009–8 **DOE Policy**

DOE is not advocating a plutonium economy. Rather, as discussed in response DCR009–6, the purpose of this proposed action is to safely and securely disposition surplus plutonium by meeting the Spent Fuel Standard. The use of U.S. surplus plutonium in existing domestic, commercial reactors does not involve reprocessing (reprocessing is a chemical separation of uranium, transuranic elements [including plutonium], and fission products from spent reactor fuel and the reuse of the plutonium and uranium to produce new fresh fuel) and therefore does not support building a plutonium economy.

The remainder of this comment is addressed in response DCR009–1.