Appendix Q
Nuclear Infrastructure Nonproliferation Impact Assessment
Executive Summary

NUCLEAR INFRASTRUCTURE NONPROLIFERATION IMPACT ASSESSMENT

For Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility

September 2000

United States Department of Energy
Office of Arms Control and Nonproliferation

EXECUTIVE SUMMARY

ES-1 PURPOSE, SCOPE, AND OBJECTIVE

This document assesses the potential nonproliferation impacts that might result from U.S. Department of Energy (hereafter referred to as the Department or DOE) nuclear infrastructure improvements as proposed and described in the *Draft Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility* (DOE/EIS 0310D), July, 2000 (hereafter referred to as the Draft NI PEIS). The DOE Office of Arms Control and Nonproliferation has prepared this *Nuclear Infrastructure Nonproliferation Impact Assessment for Accomplishing Expanded Civilian Nuclear Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility* (hereafter referred to as the NI NIA). Together with the Draft NI PEIS and an associated cost report, both being prepared by the DOE Office of Nuclear Energy, this assessment is being made available to the public as part of the Department's decision-making process to evaluate nuclear infrastructure improvement alternatives.

The United States has an annual requirement for the production of radioisotopes needed for medical, industrial, and scientific applications. The Department has an obligation to supply Pu-238 thermal/power supplies to support currently scheduled and future NASA missions. Civil nuclear energy research and development (R&D) is also required to support future U.S. nuclear energy production, civil nuclear waste disposal, and possible nuclear science applications (*e.g.*, space reactors for future NASA missions). These programmatic needs, particularly those emanating from the projected growth rate in the use of medical isotopes and the continued requirement to produce isotopes for other applications (*e.g.*, Pu-238 for NASA missions), have led the Department to consider various infrastructure improvement alternatives, including the utilization of existing and new facilities.

The Department issued a Notice of Intent on September 15, 1999 to prepare a PEIS for specified alternatives to accomplish these nuclear infrastructure missions.[1] The Notice of Intent identified alternatives as follows: 1) resume Fast Flux Test Facility (FFTF) operation; 2) construct and operate a new research reactor at a generic DOE site; 3) construct and operate one or more new neutron-producing accelerators at a generic DOE site; or 4) meet these projected mission needs utilizing existing reactor and accelerator facilities (other than FFTF). The Draft NI PEIS assesses the environmental impact of all these alternatives, though not in precisely this order. Furthermore, the Draft NI PEIS also evaluates a No Action Alternative and a fifth alternative: permanently deactivate FFTF with no new missions at any U.S. facilities. This NI NIA will follow the same delineation of alternatives as the Draft NI PEIS to assess the nonproliferation impact of actions that are proposed in the Draft NI PEIS.

The objective of the NI NIA is to evaluate the relationship between the missions, facilities, alternatives and options as described in the Draft NI PEIS, and the body of U.S. Government nonproliferation policy, U.S. laws and regulations, and international agreements. Based on that evaluation, the NI NIA presents conclusions and recommendations regarding the nonproliferation merits and drawbacks of the various activities proposed in the Draft NI PEIS to assist the Secretary of Energy to render a Record of Decision following publication of the Final NI PEIS.

[1] "Notice of Intent To Prepare a Programmatic Environmental Impact Statement for Accomplishing Expanded Civilian Nuclear Energy Research and Development and Isotope Production Missions in the United States, Including the Role of the Fast Flux Test Facility," 64 *Fed. Reg.* 50064, 1999.

This assessment is limited to an evaluation of the direct and reasonably implied nonproliferation impact of the activities proposed in the Draft NI PEIS. Mission necessity, safety, environmental impact, effectiveness, costs, and life-cycle economics of activities described in the Draft NI PEIS are not considered to be central to the nonproliferation analysis reported in the NI NIA.

ES-2 FACILITIES, ALTERNATIVES, AND OPTIONS

The facilities identified by the Department in the Draft NI PEIS are presented in Table ES-1. The irradiation facilities are described and evaluated in Sections 4 and 5 and target fabrication and processing facilities are described and evaluated in Section 6. The facility type, name, location, acronym assigned in the NI NIA, and the operational status of each facility is shown in the table.

Table ES-1. Facilities Identified in the Draft NI PEIS

Type	Name	Acronym	Location	Status
Irradiation	Fast Flux Test Facility	FFTF	Hanford, WA	Standby
	Advanced Test Reactor	ATR	Idaho National Energy and Environmental Laboratory (INEEL), ID	Operational
	High Flux Isotope Reactor	HFIR	Oak Ridge National Laboratory (ORNL), TN	Operational
	Commercial Light Water Reactor	CLWR	Existing CLWR site to be determined	Operational
	New High-Energy Accelerator New Low-Energy Accelerator	- -	Existing DOE site to be determined	- -
	New Research Reactor	-	Existing DOE site to be determined	-
Target Fabrication and Processing	Radiochemical Engineering Development Center	REDC	Oak Ridge National Laboratory (ORNL), TN	Operational
	Fluorinel Dissolution Process Facility CPP-651	FDPF CPP-651	Idaho National Energy and Environmental Laboratory (INEEL), ID	FDPF: Non-operational Available CPP-651: Operational
	Fuels and Materials Examination Facility	FMEF	Hanford, WA	Non-operational Available
	Radiochemical Processing Laboratory Building 306-E	RPL 306-E	Hanford, WA	Operational
	New Support Facility	-	Existing DOE site to be determined	-

Using the facilities identified above, the Department has defined five potential alternatives and a No-Action Alternative to accomplish the missions described above. Table ES-2 defines the five alternatives and enumerates the options under each alternative (*i.e.*, the facility variations within each alternative). Each alternative and option is evaluated in Section 8. Under the No Action Alternative (all options) and Alternative 5, Pu-238 is purchased from Russia to meet NASA program requirements. Furthermore, under all options in Alternatives 2, 3, 4 and 5, FFTF is permanently deactivated. FFTF standby/deactivation is covered by a previous NEPA action that is not evaluated in this assessment, but the standby/deactivation activity is covered as a special case under the comprehensive FFTF nonproliferation assessment given in Section 4.[2]

[2] *Environmental Assessment – Shutdown of the Fast Flux Test Facility, Hanford Site, Richland, Washington*, DOE/EIA-0993, May, 1995.

Table ES-2. Alternatives and Options Defined in the Draft NI PEIS

Alternatives	Options	Irradiation Facility	Pu-238 Production Mission		Medical and Industrial Isotope Production and Nuclear Energy Research and Development Mission	
			Storage Facility	*Processing Facility*	*Storage Facility*	*Processing Facility*
No Action Alternative[d, e]	1	-	-	-	-	-
	2	-	REDC	-	-	-
	3	-	CPP-651	-	-	-
	4	-	FMEF	-	-	-
Alternative 1: *Restart FFTF*[g]	1	FFTF[a]	REDC	REDC	RPL/306-E	RPL/306-E
	2	FFTF[a]	FDPF/CPP-651	FDPF	RPL/306-E	RPL/306-E
	3	FFTF[a]	FMEF	FMEF	FMEF	FMEF
	4	FFTF[b]	REDC	REDC	RPL/306-E	RPL/306-E
	5	FFTF[b]	FDPF/CPP-651	FDPF	RPL/306-E	RPL/306-E
	6	FFTF[b]	FMEF	FMEF	FMEF	FMEF
Alternative 2: *Use Only Existing Operational Facilities*[f]	1	ATR	REDC	REDC	-	-
	2	ATR	FDPF/CPP-651	FDPF	-	-
	3	ATR	FMEF	FMEF	-	-
	4	CLWR	REDC	REDC	-	-
	5	CLWR	FDPF/CPP-651	FDPF	-	-
	6	CLWR	FMEF	FMEF	-	-
	7	HFIR/ATR	REDC	REDC	-	-
	8	HFIR/ATR	FDPF/CPP-651	FDPF	-	-
	9	HFIR/ATR	FMEF	FMEF	-	-
Alternative 3: *Construct New Accelerators*[f, g, h]	1	New	REDC	REDC	New[c]	New[c]
	2	New	FDPF/CPP-651	FDPF	New[c]	New[c]
	3	New	FMEF	FMEF	New[c]	New[c]
Alternative 4: *Construct New Research Reactor*[f]	1	New	REDC	REDC	New[c]	New[c]
	2	New	FDPF/CPP-651	FDPF	New[c]	New[c]
	3	New	FMEF	FMEF	New[c]	New[c]
Alternative 5: *Permanently Deactivate FFTF (with no new missions)*[d]	-	-	-	-	-	-

a) FFTF operates with MOX fuel for 21 years and uranium fuel for 14 years.
b) FFTF operates with MOX fuel for 6 years and uranium fuel for 29 years.
c) The New Support Facility would not be required if a DOE site with available support capability and infrastructure is selected.
d) Under the No Action Alternative (all options) and Alternative 5, Pu-238 is purchased from Russia to supply NASA programs.
e) Under the No Action Alternative, FFTF is maintained in standby mode indefinitely.
f) Under Alternatives 2, 3, and 4, the FFTF is permanently deactivated.
g) The ATW placeholder is not evaluated in this NI NIA. The ATW program will be the topic of a future ATW NIA.
h) A new low-energy accelerator might also be combined with reactor options under Alternative 2 to fulfill all proposed missions.

ES-3 NUCLEAR MATERIALS RELEVANT TO THIS ASSESSMENT

Mixed Oxide Reactor Fuel. Fresh and spent mixed oxide (MOX) fuel contains plutonium isotopes that are immediately useful as a fissile material in nuclear weapons following chemical separation from the uranium contained in the fuel matrix and metallurgical processing. MOX fuel (PuO_2 mixed with UO_2 in sintered pellet form) is intended as the initial fuel supply for the FFTF in the event that a Record of

Decision directs FFTF to restart. Two sources of fresh MOX fuel for FFTF have been identified in the Draft NI PEIS:

- FFTF MOX fuel currently stored at the Hanford site that was remaining when FFTF went into standby mode. There is enough Hanford MOX fuel to operate the reactor at 100 megawatts thermal (MWt) for about 6 years. This fuel is hereafter referred to as Hanford MOX fuel.
- Partially remanufactured German SNR-300 MOX fuel currently stored at Hanau, Germany and Dounreay, Scotland. This fuel would require some remanufacturing and would be imported to the United States for use in the FFTF. There is enough German SNR-300 MOX fuel to operate the FFTF at 100 MWt for about 15 years following the consumption of the Hanford MOX fuel. This fuel is hereafter referred to as German MOX fuel.

Highly Enriched Uranium Reactor Fuel. All uranium enriched in U-235 to or above 20% is called highly enriched uranium (HEU). HEU is special nuclear material (SNM). HEU fuel is required to operate two of the irradiation facilities proposed in the Draft NI PEIS: the High-Flux Isotope Reactor (HFIR) and the Advanced Test Reactor (ATR). Both research reactors use aluminum clad HEU plate fuel. The HEU contained in the HFIR and ATR plate fuel is 93% enriched such that it is immediately useful as a fissile material in nuclear weapons following chemical separation from the fuel matrix and metallurgical processing.

HEU fuel may be required to operate FFTF following the consumption of available MOX fuel supplies. FFTF can use HEU oxide fuel in the form of sintered pellets. The HEU contained in the FFTF oxide fuel is enriched to between 30 and 37%. International and domestic safeguards regulations treat uranium, that is enriched above 20%, as material that is usable as fissile material for nuclear weapons. However, higher assays are more readily usable than lower assays.

Low Enriched Uranium Reactor Fuel. Any uranium enriched in U-235 to less than 20% is called low enriched uranium (LEU). LEU is SNM. LEU fuel is required to operate two of the irradiation facilities proposed in the Draft NI PEIS: commercial light water reactor (CLWR) and new research reactor. A CLWR uses sintered LEU oxide fuel pellets enriched to between 3 and 4%. A new research reactor would use aluminum clad LEU oxide plate fuel enriched to slightly below 20%. In both cases, conversion to uranium hexafluoride, further enrichment and metallurgical processing would be required to obtain material that is readily usable for nuclear weapons.

In fiscal year 2001, the Department's RERTR program plans to study conversion of ATR to use LEU fuel. If a Record of Decision directs a restart of FFTF, the RERTR program will study the conversion of FFTF to LEU fuel. In both cases, If LEU fuel is found to be technically feasible, it would probably be enriched to slightly less than 20%. LEU fuel would require conversion to uranium hexafluoride, further enrichment and metallurgical processing to obtain material that is readily usable for nuclear weapons.

Neptunium. Neptunium is an alternate nuclear material (ANM). The utility of ANM in nuclear weapons is recognized by the U.S. Government and the international community. The Pu-238 production mission described in the Draft NI PEIS requires the production and irradiation of neptunium targets. Neptunium targets are typically made of purified, concentrated neptunium dioxide with an aluminum binder, canned or clad in aluminum. The production of Pu-238 requires the production of purified neptunium dioxide from neptunium solution followed by target fabrication, irradiation to build in Pu-238, chemical processing to separate and purify neptunium and Pu-238 from fission products and other waste products, and a repeat of the cycle to produce further Pu-238. Each cycle destroys neptunium since neptunium is converted to Pu-238 in the process.

Plutonium-238. Pu-238 is special nuclear material (SNM). However, isotopically concentrated Pu-238 (above 80%) is generally recognized to not constitute a nuclear proliferation threat. The IAEA exempts plutonium that contains more than 80% Pu-238 from international safeguards and DOE assigns this material to the lowest DOE safeguards grade. However, this material is rigorously protected against loss, theft and sabotage (through physical protection and accounting) and is strictly contained (to prevent accidental release) as a result of the health and safety risks presented by the material.

Target and Product Materials Associated with Isotope Production Missions. A wide variety of materials (radioactive and nonradioactive) are described in the Draft NI PEIS to produce targets for the production of medical and industrial isotopes. None of the materials listed as targets or products are materials of nuclear nonproliferation concern. As such, these materials are not relevant to this NI NIA.

Civil Nuclear Energy Research and Development Materials. The nuclear materials that might be involved in civil nuclear energy R&D are not described, or listed in detail in the Draft NI PEIS. However, example missions are described. This NI NIA focuses on the use of materials of nonproliferation concern (nuclear weapons-usable fissile materials: plutonium,[3] HEU and ANM) in facilities, alternatives, and options described in the Draft NI PEIS. Civil nuclear energy R&D studies on materials other than the materials of concern are not germane to this NI NIA.

ES-4 NONPROLIFERATION POLICY CONTEXT

In broad terms, the analysis performed in this assessment focuses on four major proliferation concerns that may be raised by the nuclear facilities and operations reviewed in the Draft NI PEIS:

- The concern that, pursuant to the Draft NI PEIS, the construction or operation of a facility in the United States that uses weapons-usable nuclear materials might encourage the development of similar facilities abroad, to the detriment of U.S. non-proliferation efforts aimed at discouraging the development of such facilities;
- The risk that weapons-usable nuclear material might be stolen from a U.S. nuclear facility constructed or operated pursuant to the Draft NI PEIS by agents of a country of proliferation concern or by a subnational organization or terrorist group;
- The risk that restrictions on voluntary or legally mandated international monitoring of certain U.S. facilities operated pursuant to the Draft NI PEIS might reduce confidence in U.S. pledges that it will never use for nuclear weapons certain weapons-usable nuclear materials that it has declared to be excess to defense needs; and
- The risk that activities proposed under the Draft NI PEIS might interfere with the implementation of anticipated future treaties, such as the Fissile Material Cutoff Treaty (FMCT).

The three weapons-usable nuclear materials whose use and processing are analyzed in this assessment, and which are discussed below, are HEU, plutonium,[4] and neptunium. Although HEU and plutonium have long been the subject of U.S. and international nonproliferation controls, neptunium, which to date has been separated in significant quantities only in nuclear-weapon states, became the subject of international regulation only in 1999.

The United States has long led global efforts to prevent the proliferation of nuclear weapons and to safeguard weapons-usable fissile materials against the risk of theft or diversion. Because the knowledge needed to make at least a crude nuclear weapon is now widespread, limited access to these essential

[3] The term "plutonium" is understood in this context to mean isotopic mixtures of plutonium other than isotopically concentrated Pu-238.
[4] Ibid.

ingredients of nuclear weapons is the principal technical barrier to nuclear proliferation in the world today. Hence, the United States has placed heavy emphasis on efforts to help monitor, protect, control, account for, and, ultimately, dispose of weapons-usable fissile materials worldwide.

Because of its pivotal role in preventing the proliferation of nuclear weapons and its own extensive nuclear programs and activities, the manner in which the United States manages its nuclear activities has a significant influence on other states. U.S. technical and policy choices frequently affect similar choices in other countries both by example and in the way these choices support U.S. diplomatic efforts. Thus, decisions of the type analyzed in the Draft NI PEIS that are taken in the United States can positively or negatively affect efforts to enhance the global nonproliferation regime and bolster the international norm against the acquisition of nuclear weapons. In recent years, the United States has sought to make its nuclear activities increasingly transparent in order to increase international confidence in the global arms control and nonproliferation regime and to encourage similar actions by other countries.

In order to practically evaluate the nonproliferation merits and drawbacks of the activities proposed in the Draft NI PEIS, this NI NIA analyzes the proposed missions, facilities, alternatives, and options within the context of U.S. nonproliferation policy. This body of policy is articulated in President Clinton's 1993 Nonproliferation and Export Control Policy Statement (see Appendix 10.2), other relevant U.S. laws and regulations, and international agreements. Most central to this assessment are policies concerning:

- Plutonium reprocessing;
- Civil use of HEU;
- Monitoring of ANM; and
- Support of anticipated FMCT negotiations.

ES-5 NONPROLIFERATION ASSESSMENT METHODS

Technical and Policy Factors. This NI NIA evaluates the nonproliferation impact of the activities proposed in the Draft NI PEIS by analyzing the various missions, facilities, alternatives, and options against three technical factors and four policy factors. The technical evaluation factors focus on assuring that weapons-usable fissile materials are physically difficult to either steal or divert, and that this material and associated processes are appropriately safeguarded. The three technical factors assess the degree to which an activity would be:

- Assuring against theft or diversion;
- Facilitating cost-effective international monitoring; and
- Resulting in final material forms from which retrieval is more difficult than from original material forms.

The four policy factors used in this assessment focus on the ability of the United States to maintain and strengthen international efforts to stem the spread of nuclear weapons, including the overall approach to limit, restrict, and minimize the use of weapons-usable fissile material in civilian applications. Furthermore, the policy factors also address the continued transparency of the U.S. domestic moratorium on fissile material production for nuclear weapons. The four policy factors include the degree to which an activity would be:

- Maintaining consistency with U.S. nonproliferation policy;
- Avoiding encouragement of plutonium reprocessing;
- Building confidence that the United States is not producing material for nuclear weapons; and

- Supporting negotiation of a verifiable Fissile Material Cutoff Treaty.

Evaluation Grading Scale. A qualitative grading scale on three levels is defined to indicate the degree to which particular missions, facilities, alternatives, or options meet U.S. nonproliferation objectives. The three levels in the grading scale are:

● *Fully Meets Nonproliferation Objectives.* A mission, facility, alternative, or option under a factor assessment *fully meets nonproliferation objectives* if: there *are no significant identified concerns* that can be raised demonstrating how the use of the facility or implementation of the alternative is contrary to U.S. nonproliferation objectives as defined by the assessment factor.

◑ *Might Raise Nonproliferation Concerns.* A mission, facility, alternative, or option under a factor assessment *might raise nonproliferation concerns* if: there *is significant uncertainty* as to whether the use of the facility or implementation of the alternative *might have an adverse effect* on U.S. nonproliferation objectives as defined by the assessment factor.

○ *Raises Nonproliferation Concerns.* A mission, facility, alternative, or option under a factor assessment *raises nonproliferation concerns* if: there *are significant identified concerns* that can be raised demonstrating how the use of the facility or implementation of the alternative is contrary to U.S. nonproliferation objectives as defined by the assessment factor.

ES-6 SUMMARY OF NONPROLIFERATION ASSESSMENTS

Table ES-3 shows the summary of the detailed facility assessment scores. Facilities and mission cases (*e.g.*, FFTF standby/deactivation, neptunium storage) are shown across rows and nonproliferation assessment technical and policy factors are shown down columns. *There are currently no U.S. nonproliferation policies, laws, regulations or international agreements that preclude the use of any of the facilities in the manner described in the Draft NI PEIS.* However, there are a few instances of nonproliferation concerns and uncertainties.

These concerns and uncertainties are associated with the use of processing facilities to recover Pu-238 and neptunium from irradiated neptunium targets as part of the Pu-238 production mission. In all facility cases (REDC, FDPF, and FMEF), the repeated separation and purification of neptunium (which is an unavoidable part of the process) raises *significant uncertainty* under the third technical factor associated with reduction in material attractiveness. This is always the case and is technically unavoidable (even if Pu-238 is purchased from Russia, this process is required in a Russian nuclear facility).

Other concerns and uncertainties surrounding the use of FDPF stem from concerns about transparency measures that could be required as part of an FMCT verification regime. The extent to which FDPF, as a former defense nuclear material production facility, would be available for international monitoring under an FMCT is currently unknown.

Irradiation facilities and missions, as described in the Draft NI PEIS, do not have any identified nonproliferation concerns or uncertainties. Although the intended fuel supply for FFTF includes two different sources for existing MOX fuel, an analysis of these MOX supply options identified significant mitigating factors that indicated substantial nonproliferation benefits to disposing of that attractive material as highly radioactive spent fuel (see Section 4). If HEU fuel is required for either FFTF (30 to 37% enriched) or ATR (93% enriched) it will be procured in strict accordance with U.S. nonproliferation policy following the principles outlined in the Schumer Amendment (see Appendix 10.3). The Schumer

amendment places restrictions on the export of HEU, requiring that facilities pursue conversion to LEU fuels and targets.

It should be added that operation of the FFTF does not set a precedent that may encourage other states to build new high-flux test reactors using MOX or HEU fuels. The FFTF case is unique: it involves an existing, previously operated facility and the irradiation of previously fabricated MOX fuel now in storage, conditions that are highly unlikely to arise elsewhere. Possible future use of HEU at the facility will be subject to the same strict scrutiny that the United States would wish to have applied by other states considering the use of such fuel.

Table ES-3. Assessments of Facilities as Described in the Draft NI PEIS

		Irradiation Facilities								***Target Fabrication and Processing Facilities***						***Np-237 Storage***		
		FFTF Restarted	FFTF Standby/Deactivated	ATR	HFIR	CLWR	New Low-Energy Accelerator	New High-Energy Accelerator	New Research Reactor	REDC	FDPF	FMEF	RPL	306-E	New Support Facility	REDC	CPP-651	FMEF
Technical Factors	Assuring Against Theft or Diversion	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Facilitating Cost-Effective International Monitoring	●	●	●	●	●	●	●	●	●	○	●	●	●	●	●	●	●
	Resulting in Final Material Forms from which Retrieval is More Difficult than from Original Material Forms	●	●	●	●	●	●	●	●	◑	◑	◑	●	●	●	●	●	●
Policy Factors	Maintaining Consistency with U.S. Nonproliferation Policy	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Avoiding Encouragement of Plutonium Reprocessing	●	●	●	●	●	●	●	●	●	◑	●	●	●	●	●	●	●
	Building Confidence that the U.S. is not Producing Material for Nuclear Weapons	●	●	●	●	●	●	●	●	●	◑	●	●	●	●	●	●	●
	Supporting Negotiation of a Verifiable FMCT	●	●	●	●	●	●	●	●	●	○	●	●	●	●	●	●	●

● *Fully meets nonproliferation objectives*
◑ *Might raise nonproliferation concerns*
○ *Raises nonproliferation concerns*

It should also be noted that although the ATR's defense program mission precludes it from international monitoring, there are no U.S. nonproliferation policy directives, international agreements or regulations that generically prevent civil programs from being conducted in current or former defense facilities –

ATR is currently hosting civil radioisotope production programs. However, when comparable alternatives exist that allow civil programs to be hosted in facilities that are eligible for international monitoring, it is preferable to maintain a separation between defense and civil programs.

Table ES-4 shows the detailed assessment grades for each alternative and option described in the Draft NI PEIS (the alternatives and options are shown in Table ES-2). The alternative and option assessments are performed using the methods described in Section 3 (incorporating each of the facility assessments with a generic transportation assessment in a "weak link" analysis). The generic transportation assessment (see Section 8.3) found no significant nonproliferation impact associated with nuclear material transportation.

In Alternatives 1 through 4 (U.S. Pu-238 production alternatives) the assessments are fully determined by the Pu-238 processing facility assessment (REDC, FDPF, and FMEF). Furthermore, under the No Action Alternative and Alternative 5, the alternative assessments are determined by a generic assessment of the Russian Pu-238 purchase option (presented in Section 8.2). The Russian Pu-238 purchase option suffers from similar nonproliferation uncertainties and concerns as FDPF. In addition, the status of Russian domestic safeguards of ANM is largely unknown. Moreover, since there is currently no Russian moratorium on spent fuel reprocessing, and neptunium recovery is part of the Russian reprocessing flowsheet, the Russian inventory of separated weapons-usable neptunium could continue to increase, even if smaller quantities of neptunium were destroyed in the production of Pu-238.

ES-7 CONCLUSIONS AND RECOMMENDATIONS

ES-7.1 OVERALL ASSESSMENT OF MISSIONS PROPOSED IN THE DRAFT NI PEIS

There are currently no U.S. nonproliferation policies, laws, regulations or international agreements that preclude the use of any of the facilities in the manner described in the Draft NI PEIS. The overall missions (independent of selected facilities) proposed in the Draft NI PEIS are evaluated by using the methods presented in Section 3.

Medical, Industrial, and Research Isotope Production. There *are no significant identified concerns* demonstrating how, within the bounds of the description given in the Draft NI PEIS, the pursuit of the medical, industrial, and research isotope production mission is contrary to U.S. nonproliferation objectives as defined by any assessment factor. Therefore, this mission is graded as ● *fully meets nonproliferation objectives.*

Plutonium-238 Production. With the exception of the third technical assessment factor, *reduction in attractiveness of material forms* (see Section 3), there *are no significant identified concerns* demonstrating how, within the bounds of the description given in the Draft NI PEIS, the pursuit of the Pu-238 production mission is contrary to U.S. nonproliferation objectives as defined by the remaining technical and policy assessment factors. Therefore, these remaining factors are graded as ● *fully meets nonproliferation objectives.* In the case of the third technical assessment factor, the process of producing, recovering, and purifying Pu-238 requires that neptunium also be recovered, purified, and recycled. However, in the event that Pu-238 production is resumed in the United States, the total separated stocks of neptunium will be reduced over time in an irreversible manner since there is a moratorium on U.S. spent fuel reprocessing – the activity that could lead to the production of additional stocks of separated neptunium. This overall reduction in a weapons-usable material stock is a partial mitigation of the identified concern. Even so, *there is significant uncertainty* raised with respect to the third technical assessment factor, and that single factor is graded as ◑ *might raise nonproliferation concerns.* However, it should be pointed out that this issue is unavoidable (unless the United States elects to neither produce

Table ES-4. Assessments of Alternatives and Options as Defined in the Draft NI PEIS

		Technical Factors			***Policy Factors***			
Alternatives	***Options***	Assuring Against Theft or Diversion	Facilitating Cost-Effective International Monitoring	Resulting in Final Material Forms from which Retrieval is More Difficult than from Original Material Forms	Maintaining Consistency with U.S. Nonproliferation Policy	Avoiding Encouragement of Plutonium Reprocessing	Building Confidence that the U.S. (Russia)* is not Producing Material for Nuclear Weapons	Supporting Negotiation of a Verifiable FMCT
No Action Alternative*	1	◑	◑	○	●	●	●	◑
	2	◑	◑	○	●	●	●	◑
	3	◑	◑	○	●	●	●	◑
	4	◑	◑	○	●	●	●	◑
Alternative 1: *Restart FFTF*	1	●	●	◑	●	●	●	●
	2	●	○	◑	●	◑	◑	○
	3	●	●	◑	●	●	●	●
	4	●	●	◑	●	●	●	●
	5	●	○	◑	●	◑	◑	○
	6	●	●	◑	●	●	●	●
Alternative 2: *Use Only Existing Operational Facilities*	1	●	●	◑	●	●	●	●
	2	●	○	◑	●	◑	◑	○
	3	●	●	◑	●	●	●	●
	4	●	●	◑	●	●	●	●
	5	●	○	◑	●	◑	◑	○
	6	●	●	◑	●	●	●	●
	7	●	●	◑	●	●	●	●
	8	●	○	◑	●	◑	◑	○
	9	●	●	◑	●	●	●	●
Alternative 3: *Construct New Accelerator(s)*	1	●	●	◑	●	●	●	●
	2	●	○	◑	●	◑	◑	○
	3	●	●	◑	●	●	●	●
Alternative 4: *Construct New Research Reactor*	1	●	●	◑	●	●	●	●
	2	●	○	◑	●	◑	◑	○
	3	●	●	◑	●	●	●	●
Alternative 5: *Permanently Deactivate FFTF (with no new missions)**	-	◑	◑	○	●	●	●	◑

* Under the No Action Alternative (Options 1-4) and Alternative 5, the Russian Pu-238 purchase option is considered.

● *Fully meets nonproliferation objectives*

◑ *Might raise nonproliferation concerns*

○ *Raises nonproliferation concerns*

nor purchase Pu-238) and impacts all alternatives and options, including the No Action Alternative and Alternative 5: permanently deactivate FFTF with no new missions at U.S. facilities.

Civil Nuclear Energy Research and Development. The DOE Office of Nuclear Energy has included Accelerator Transmutation of Waste (ATW) as one of many possible future civil nuclear energy R&D missions as a placeholder in the event that the U.S. Government decides to pursue this technology. Currently, the Department is performing technical paper studies and planning studies (*e.g.*, the "ATW Road Map") to assist Congress with fiscal and program planning. These efforts are also being reviewed by the independent Nuclear Energy Advisory Committee (NERAC) Subcommittee on the Accelerator Transmutation of Waste, which, in its report of May 23, 2000, recommended that, a study should be launched to identify potential proliferation concerns associated with ATW and possible approaches to mitigate identified concerns. A comprehensive nonproliferation impact assessment of the ATW program plan will be performed by the Office of Arms Control and Nonproliferation prior to proceeding beyond paper studies with actual fuels materials testing in support of ATW (or other technologies that include or imply closed fuel cycle technologies). As such, the nonproliferation impact of a possible future ATW program is not considered in this NI NIA since it is not a well-defined, principal identified mission at this time. It will, however, be considered in a future nonproliferation impact assessment if the ATW Program moves forward. With respect to other identified civil nuclear energy R&D missions, there *are no significant identified concerns* demonstrating how, within the bounds of the description given in the Draft NI PEIS, the pursuit of these missions is contrary to U.S. nonproliferation objectives as defined by any assessment factor. In fact, the development of proliferation resistant nuclear fuels and technologies are a significant feature of the intended R&D program. Therefore, this mission is graded as ● *fully meets nonproliferation objectives.*

ES-7.2 NONPROLIFERATION MOST AND LEAST FAVORABLE ALTERNATIVES AND OPTIONS

Since the assessments of alternatives and options are largely determined by the Pu-238 processing facility assessments, the options that use the REDC and FMEF have the most favorable assessments, and the options that use the FDPF have the least favorable assessments. The No Action Alternative and Alternative 5 use the Russian Pu-238 purchase option. These alternatives score between most and least favorable. As a result, the *most favorable nonproliferation alternatives and options* are:

- Alternative 1: Restart FFTF, Options 1, 3, 4, and 6
- Alternative 2: Use Only Existing Facilities, Options 1, 3, 4, 6, 7, and 9
- Alternative 3: Construct New Accelerator(s), Options 1 and 3
- Alternative 4: Construct New Research Reactor, Options 1 and 3

The *least favorable nonproliferation alternatives and options* are:

- Alternative 1: Restart FFTF, Options 2 and 5
- Alternative 2: Use Only Existing Facilities, Options 2, 5, and 8
- Alternative 3: Construct New Accelerator(s), Option 2
- Alternative 4: Construct New Research Reactor, Option 2

ES-7.3 SPECIAL CONSIDERATIONS FOR ALTERNATIVE 1: RESTART FFTF

If the Nuclear Infrastructure Record of Decision elects to restart FFTF (under any option), there are some special considerations. To codify the assumptions underlying the conclusion that restart of the FFTF fully

meets U.S. nonproliferation policy objectives, the Nuclear Infrastructure Record of Decision should include the following commitments:

- The FFTF will not be configured to operate as a breeder reactor (breeding ratio equal to or greater than one) or to optimize the production of plutonium.
- Spent MOX fuel irradiated in the FFTF will not be reprocessed.
- During the period that the FFTF is fueled with Hanford MOX fuel, an analysis will be undertaken by the RERTR program to determine whether the reactor can be fueled with LEU fuel, and if this is shown to be technically feasible, the reactor will be fueled with LEU fuel following the consumption of existing MOX fuel (Hanford and, possibly, German MOX fuel).
- A nonproliferation impact assessment will be prepared on the ATW program prior to the test irradiation of ATW fuels materials in the FFTF.
- The FFTF will remain available for international monitoring.

ES-7.4 NONPROLIFERATION UNCERTAINTIES, CONCERNS, AND MITIGATION APPROACH

There are a limited number of nonproliferation concerns and uncertainties that might be mitigated to increase the number of alternatives and options that have optimum nonproliferation qualities for the missions described in the Draft NI PEIS. These concerns are associated with the U.S. and Russian facilities used to process and recover Pu-238.

- If managed access can be granted to the FDPF, sufficient for verification of an FMCT, the uncertainties and concerns associated with the use of FDPF for the Pu-238 processing mission would be effectively mitigated (with the exception of the material forms technical factor).
- If the United States had sufficient confidence concerning the rigor of Russian controls on ANM, this uncertainty would be effectively mitigated.
- If Russia were to implement a moratorium on spent nuclear fuel reprocessing, the material forms technical factor would be partially mitigated to "◑ might raise nonproliferation concerns" – similar to the U.S. Pu-238 program assessments, since Russia would no longer be able to add to its stocks of separated neptunium.
- If managed access can be granted to the Russian facility responsible for Pu-238 and neptunium recovery, sufficient for verification of an FMCT, the uncertainties associated with the use of a Russian facility for the Pu-238 processing mission would be effectively mitigated (with the exception of the material forms technical factor).