DOE/EA-1172

Environmental Assessment

DOE Sale of Surplus Natural and Low Enriched Uranium

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1.0 Purpose and Need for Agency Action

This chapter discusses the underlying purpose and need for conducting the Proposed Action.

1.1 Purpose and Need for Action

The Department of Energy (DOE) owns substantial amounts of natural uranium and low enriched uranium (LEU) that have significant commercial value. The Department has declared about 21.5 million pounds of natural uranium equivalent (U_3O_8(e))[1], approximately 20.3 million pounds U_3O_8(e) and 1.2 million pounds of U_3O_8(e) in the form of 4.5 percent LEU, to be surplus. This surplus material is stored at the Department's gaseous diffusion plants in Piketon, Ohio, and Paducah, Kentucky.

Selling this uranium in a timely manner for commercial reactor fuel feed would allow the beneficial use of a valuable natural resource. In addition, storage costs and other liabilities associated with long-term storage of this material would be eliminated. Revenue obtained from the sales would be applied to help meet DOE's commitments to upgrade and maintain the gaseous diffusion plants.

Congress has authorized the Department to sell surplus uranium from its inventory by the recently enacted *USEC Privatization Act* (Public Law 104-134) as long as certain conditions are met. Furthermore, in the Department's Fiscal Year 1996 appropriations authorization, Congress anticipated that the Department would sell approximately $35 million of uranium in Fiscal Year 1996.

In addition to the surplus uranium in its inventory, the Department will receive by December 31, 1996, approximately 14.2 million pounds U_3O_8(e) of "Russian" uranium from the United States Enrichment Corporation (USEC) pursuant to the *USEC Privatization Act*.[2] The Act requires the Department to sell this material within seven years and specifies the means by which the Department may do so.

The proposed disposition of approximately 20.3 million pounds U_3O_8(e) and about 1.2 million pounds U_3O_8(e) in the form of 4.5 percent LEU from DOE's inventory, and approximately 14.2 million pounds U_3O_8(e) of "Russian" uranium that the Department will receive from USEC, is assessed in this one Environmental Assessment (EA) because (1) all of the material is located at the gaseous diffusion plants at Portsmouth, Ohio, and Paducah, Kentucky, (2) the prospective buyers

[1] While all of the uranium considered for sale in this EA is in the form of uranium hexafluoride (UF_6), it is referred to in terms of natural uranium equivalent, the term most commonly used in the uranium industry.

[2] Section 3112(b)(1) of the Act states, "Uranium hexafluoride transferred to the Secretary pursuant to this paragraph shall be deemed under United States law for all purposes to be of Russian origin."

for all of the material are the same, and (3) sales of all of the material would have similar impacts on the domestic uranium market.

1.2 Relationship to Other DOE NEPA Documents

The sales proposed and assessed in this EA would be in addition to sales evaluated in two other National Environmental Policy Act (NEPA) analyses: the *Environmental Assessment for the Purchase of Russian Low Enriched Uranium Derived from the Dismantlement of Nuclear Weapons in the Countries of the Former Soviet Union* (USEC/EA-94001; DOE/EA-0837), 1994, (Russian Purchase EA) and the *Disposition of Surplus Highly Enriched Uranium Final EIS* (DOE/EIS-0240), 1996, (HEU EIS). Each of these documents addresses uranium sales and includes analysis of economic impacts on the domestic nuclear fuel cycle industries and the domestic uranium market. Therefore, this EA considers the Russian purchase and the proposed disposition of DOE highly enriched uranium (HEU) in analyzing potential cumulative impacts of the Proposed Action.

1.2.1 Environmental Assessment for the Purchase of Russian Low Enriched Uranium Derived from the Dismantlement of Nuclear Weapons in the Countries of the Former Soviet Union

The Russian Purchase EA, which was issued in January, 1994, analyzes the impacts, including economic impacts on domestic nuclear fuel cycle industries, of the United States proposal to purchase 22,550 metric tons of low enriched UF_6 from the Russian Federation pursuant to the Russian HEU Agreement.[3] As described in the Russian Purchase EA, under this agreement 500 metric tons of HEU from dismantled nuclear weapons will be blended down in Russia and sent to the Portsmouth gaseous diffusion plant as 3-5 percent LEU to be sold by USEC for use as commercial nuclear reactor fuel. The Russian purchase will take place over a 20 year period from 1994 to 2013, which includes the time frame for the Proposed Action. Therefore, this EA considers the Russian purchase in analyzing the potential cumulative impacts of the proposed sale. The Russian Purchase EA is incorporated by reference in this EA.

1.2.2 Disposition of Surplus Highly Enriched Uranium Final EIS

In the Record of Decision for the HEU EIS[4], DOE has decided to blend down surplus HEU and sell as much of the resulting LEU as possible for use as reactor fuel. The Department decided to analyze separately the potential environmental impacts of selling the approximately 35.7 million pounds U_3O_8(e) of surplus uranium and LEU and the transferred "Russian" uranium for two reasons. First, the purpose and needs for the actions differ: the blending down of weapons-usable HEU serves an

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[3] The *Agreement between the Government of the United States and the Government of the Russian Federation Concerning the Disposition of Highly Enriched Uranium Extracted from Nuclear Weapons* (Russian HEU Agreement), signed January 14, 1994.

[4] The Record of Decision was issued on July 29, 1996.

important nonproliferation goal, whereas LEU and natural uranium are not suitable for use in weapons. Second, different environmental impacts are associated with the action proposed here and actions proposed in the HEU EIS. For example, the HEU will be blended down to reduce the risk of proliferation and in order to be sold as commercial fuel, whereas natural uranium would have to be enriched if it is to be used as fuel. Enrichment would occur at different facilities and would produce different quantities and types of waste than those produced by HEU blending. However, because there would be similar impacts from both actions on the domestic uranium industry, the Department included in this EA's cumulative impact analysis the HEU it has decided to blend down and sell.

1.3 Public Comments on the Draft EA

On August 12, 1996, DOE issued a notice of availability of the draft EA in the *Federal Register* [61 FR 41776-41777]. During the week prior to the publication of the notice of availability, DOE mailed copies of the draft EA to affected States; domestic uranium production, conversion, and enrichment companies; trade associations and environmental organizations; and other parties known to have an interest in the proposed action. In addition to the *Federal Register* notice, DOE provided notice of the availability of the draft EA through issuance of a *DOE Brief* on August 13, 1996.

The public comment period on the draft EA extended from August 12, 1996 through September 11, 1996. DOE considered all comments that were postmarked or sent electronically during the comment period in the development of this final EA.

The Department received 14 letters commenting on the draft EA via facsimile or public mail. No comments were submitted via telephone. Copies of the comment letters or summaries of them, where appropriate, and the Department's responses are provided in Appendix E of this final EA. Two of the letters are not reproduced in the Appendix because the commentors requested to remain anonymous.

Changes from the draft EA in response to public comment or to correct technical information are denoted by a change bar in the margin next to the affected text. If a public comment resulted in a change to the text of the EA, the section of the EA that was changed is identified in the response to the comment.

2.0 Proposed Action and Alternatives

This chapter describes the Proposed Action and alternatives to the Proposed Action.

2.1 Background

Uranium is a naturally occurring radioactive element that exists as several isotopes. The uranium-235 (^{235}U) isotope is of particular importance because it is capable of spontaneous fission. Natural deposits of uranium ore contain approximately 0.711 percent ^{235}U. The remainder (over 99 percent) is mostly ^{238}U. After the concentration of the ^{235}U isotope has been enriched to between three and five percent, uranium can be fabricated into fuel for commercial reactors. Such uranium (or any uranium enriched to 20 percent or less ^{235}U) is commonly referred to as LEU.[5]

DOE owns inventories of natural uranium and LEU in excess of the Department's current program needs, and therefore DOE has declared these inventories to be surplus. This surplus material amounts to approximately 1.2 million pounds U_3O_8(e) as LEU and 20.3 million pounds U_3O_8(e). All of this 21.5 million pounds U_3O_8(e) is in the form of uranium hexafluoride (UF_6), and is stored at the gaseous diffusion plants in Portsmouth, Ohio, and Paducah, Kentucky.

The gaseous diffusion plants are owned by DOE and are leased to and operated by USEC to enrich uranium for use as fuel in nuclear power plants. DOE retains ownership of and responsibility for certain assets located at the plants, and is obligated to make a number of modifications and upgrades to the plants. DOE will also be responsible for the decontamination and decommissioning of the plants once operations have ceased.

In DOE's appropriations for Fiscal Year 1996, Congress anticipated that DOE would sell approximately $35 million of its uranium inventory to help offset the cost of DOE's activities at the gaseous diffusion plants. Specifically, the Fiscal Year 1996 *Energy and Water Development Appropriations Act* (P.L. 104-46, November 13, 1996) provides "[t]hat revenues received by the Department for uranium programs [including sales of uranium] and estimated to total $34,903,000 in fiscal year 1996, shall be retained and used for the specific purpose of offsetting costs incurred by the Department for such activities [e.g., work at the gaseous diffusion plants] notwithstanding the provisions of 31 U.S.C. 3302 (b) and 42 U.S.C. 2296 (b) (2)."

The Department believes that it will need to sell additional amounts of uranium beginning in 1997 in order to continue financing the maintenance and improvement of the gaseous diffusion plants and

5 When enriched above 20 percent ^{235}U, uranium is referred to as HEU and additional management controls are required for security reasons and to prevent inadvertent nuclear criticality. As noted in Section 1, DOE has examined alternatives for the disposition of surplus, weapons-usable, United States-origin HEU in DOE/EIS - 0240, June 1996.

other activities. The Department is authorized in the *USEC Privatization Act* to sell natural and LEU from its inventory provided the following conditions are met:

(A) the President determines that the material is not necessary for national security needs;

(B) the Secretary determines that the sale of the material will not have an adverse material impact on the domestic mining, conversion, or enrichment industry, taking into account sales of uranium under the Russian HEU Agreement and the Suspension Agreement[6]; and |

(C) the price paid to the Secretary will not be less than the fair market value of the material.[7] |

In addition to the uranium already in its inventory, DOE will receive from USEC "an amount of uranium hexafluoride equivalent to the natural uranium component of LEU derived from at least 18 metric tons of HEU purchased from the Russian Executive Agent under the *Russian HEU Agreement*." (*USEC Privatization Act*, section 3112 (b)(1).). This represents approximately 14.2 million pounds U_3O_8(e). USEC is required to transfer title to this uranium to DOE by December 31, | 1996. The *USEC Privatization Act* requires the Secretary to sell this material within seven years of the date of enactment (April 26, 1996) by any one or a combination of the following means:

(A) at any time for use in the United States for the purpose of overfeeding[8]; |

(B) at any time for end use outside the United States;

(C) in 1995 and 1996 to the Russian Executive Agent at the purchase price for use in matched sales pursuant to the Suspension Agreement; or,

(D) in calendar year 2001 for consumption by end users in the United States not prior to January 1, 2002, in volumes not to exceed 3,000,000 pounds U_3O_8(e) per year.[9] |

Table 2.1 presents a brief overview of the alternatives which will be studied in this EA.

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[6] *The Suspension Agreement*, also referred to as the *Agreement to Suspend Investigation on Uranium from the Russian Federation, as amended*, settled an investigation into whether Russia was dumping uranium into the U.S. market. It established a mechanism known as "matched sales" in which imports of Russian uranium are linked with sales of uranium newly produced in the United States. In a matched sale, one-half of the uranium sold is Russian and the other one-half is new domestic production. There are annual quotas on the amount of matched sales through 2004, when the *Suspension Agreement* expires.

[7] Section 3112(d)(2). The Department is also authorized to sell or transfer uranium pursuant to other statutory authorities, including section 3112(e) of the *USEC Privatization Act*.

[8] Overfeeding is a process for enriching uranium that uses more uranium and less power to enrich the uranium to the desired concentration. This process results in increased levels of depleted uranium.

[9] Section 3112(b)(2).

Table 2.1
Overview of Alternatives Considered in this Environmental Assessment

Uranium Proposed for Sale	Proposed Action	No Action Alternative	Alternative 1: (Sell Only Transferred "Russian" Uranium)	Alternative 2: (For Domestic End Use Only)	Alternative 3: (For Use in Matched Sales, Overfeeding, or Foreign End Use)
DOE Surplus Natural Uranium (20.3 million pounds U_3O_8(e))	Sell all between 1996 and 2004 for domestic or foreign end use after Secretarial Determination	Hold in storage	Hold in storage	Sell all for domestic end use in a single year sometime between 1996 and 2004	Sell all for foreign end use over a number of years or in a single year between 1996 and 2004
DOE LEU (45 metric tons of 4.5% LEU; 1.2 million pounds U_3O_8(e))	Sell all in 1996, if possible, after Secretarial Determination	Hold in storage	Hold in storage	Sell all for domestic end use in the same year as DOE's surplus natural uranium sometime between 1996 and 2004	Sell all for foreign end use with DOE's surplus natural uranium over a number of years or in a single year between 1996 and 2004
Transferred "Russian" uranium (14.2 million pounds U_3O_8(e))	Sell about half to Russia for use in matched sales. Sell remaining material for overfeeding, foreign end use, or in 2001 for domestic end use after 2002	Hold in storage	Sell about half in 1996 to Russia for use in future matched sales. Sell remaining material for overfeeding, foreign end use, or in 2001 for domestic end use after 2002	Sell about half to Russia in 1996 for use in future matched sales. Sell remaining material in 2001 for domestic end use after 2002	Sell about half to Russia in 1996 for use in future matched sales. Sell remaining material for foreign end use at the same time as DOE's surplus natural uranium and LEU

2.2 Description of the Proposed Action

DOE proposes to sell approximately 35.7 million pounds U_3O_8(e) of uranium for subsequent enrichment and fabrication into commercial nuclear power reactor fuel. The uranium is in the forms of natural and LEU hexafluoride (UF_6), which is stored at the Portsmouth gaseous diffusion plant in Portsmouth, Ohio, and the Paducah gaseous diffusion plant in Paducah, Kentucky. The natural and low enriched UF_6 would be sold to various entities, which could include USEC, currently the only domestic provider of uranium enrichment services; over 60 utilities in the United States and abroad; converters; traders; and uranium producers.

Of the 35.7 million pounds U_3O_8(e) proposed for sale, 34.5 million pounds U_3O_8(e) are natural uranium[10] and 1.2 million pounds U_3O_8(e) are in the form of 4.5 percent LEU, as shown in Table 2.2. The 20.3 million pounds of natural uranium and the 1.2 million pounds U_3O_8(e) in the form of 4.5 percent LEU have been declared surplus to the Department's current needs through a process involving the Presidential Nuclear Weapons Council. The Nuclear Weapons Council determines (in documents that are classified) the amount of uranium necessary for national security needs. The uranium covered in this EA is not included in the amount deemed necessary, and is therefore excess to national security needs and available for sale, transfer, or other disposition.

Table 2.2
NATURAL AND LOW ENRICHED URANIUM PROPOSED FOR SALE
(Million pounds U_3O_8(e))

MATERIAL TYPE	**SOURCE**	**QUANTITY BY SITE**		**TOTAL**
		Portsmouth	**Paducah**	
Natural UF_6	DOE Stockpile	0.0	20.3	20.3
	Russian HEU Agreement	14.2	0.0	14.2
Low Enriched UF_6	DOE Stockpile	1.2	0.0	1.2
TOTAL		15.4	20.3	35.7

<u>Uranium Associated with the Russian HEU Agreement (Transferred "Russian" Uranium)</u>
The 14.2 million pounds U_3O_8(e) of "Russian" uranium stored at Portsmouth is associated with the *Russian HEU Agreement*. Under this Agreement, uranium from nuclear weapons of the former Soviet Union, is blended down in the Russian Federation and shipped to USEC, the United States Executive Agent, for use in satisfying its enrichment contracts. Under the terms of these contracts, utility companies send natural uranium to the gaseous diffusion plants to be enriched. Since USEC started receiving Russian LEU under the *Russian HEU Agreement*, some of its contracts have been and will continue to be filled with the already-enriched Russian material. As a result, some of the natural uranium supplied by the utilities remains unenriched. It is being held in storage by USEC and is deemed by law to be of "Russian" origin. As a result, this "Russian" uranium is subject to restrictions on its sale in the United States per the *USEC Privatization Act* and the *Suspension Agreement*.

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[10] Natural uranium is uranium in which the concentration of the ^{235}U isotope is about 0.7 percent. LEU has had the ^{235}U concentration increased to between 0.7 percent and 20 percent. For use as reactor fuel, natural uranium is typically enriched to between 3 percent and 5 percent ^{235}U.

Title to 14.2 million pounds U_3O_8(e) of this "Russian" uranium will be transferred from USEC to DOE as required by section 3112 of the *USEC Privatization Act.* (Thus, DOE will refer to the 14.2 million pounds U_3O_8(e) as "transferred 'Russian' uranium".) DOE proposes to sell the uranium it will receive from USEC, in accordance with the *USEC Privatization Act*, in the following manner. In 1996, DOE proposes to sell about half to the Russian Executive Agent for use in matched sales pursuant to the *Suspension Agreement*.[11] The Department would sell, to the extent feasible, the remaining 7.1 million pounds U_3O_8(e) for end use outside the United States or for overfeeding the gaseous diffusion plants during the period 1997 through 2000. Any material remaining unsold would be sold in 2001 for consumption by domestic end users beginning in 2002 at a rate not to exceed three million pounds U_3O_8(e) per year. The revenues from these sales would be deposited in the United States Treasury.

Inventory Uranium

As for the 21.5 million pounds U_3O_8(e) from DOE's stockpile, the Department proposes to sell the 1.2 million pounds U_3O_8(e) of LEU in 1996 to obtain the revenue from uranium sales that Congress anticipated in the Energy and Water Development Appropriations Act of 1996. DOE would sell the remaining 20.3 million pounds U_3O_8(e) sometime over the period 1997 through 2004 to continue financing the maintenance and improvement of the gaseous diffusion plants. All sales of inventory materials would be contingent on the Secretary making the determination required by section 3112(d)(2) of the *USEC Privatization Act*.

In selling the surplus uranium, DOE is required by section 3112(d) of the *USEC Privatization Act* to determine proposed sales will not have an "adverse material impact"[12] on the domestic uranium industry, taking into account the sales of uranium under the *Russian HEU Agreement* and the *Suspension Agreement*. While observing this requirement, DOE would also seek to maximize government revenues from any proposed sales.[13] The Department expects Congress to continue to anticipate that the Department will obtain revenues from the sale of uranium each fiscal year.[14] To balance the need to avoid adverse material impacts on the industry while maximizing government revenues, DOE would extend the sale of the surplus uranium to a mix of domestic and foreign customers over a number of years.

The proposed sale of this surplus natural uranium and LEU would not result in any new or different uses or management practices by enrichers, fabricators or reactor operators. While the LEU

[11] Because this uranium is considered to be "Russian" uranium, it would have to be matched with an equivalent amount of United States uranium.

[12] This phrase is not defined further in the legislation.

[13] Section 3112(d) also requires that the price paid to the Secretary not be less than the fair market value of the material.

[14] Draft appropriations language for Fiscal Year 1997 anticipates that the Department will sell additional uranium in that year.

proposed for sale is suitable for fuel fabrication, some blending at the gaseous diffusion plants may be required to meet customer specifications for ^{235}U concentrations. The natural uranium proposed for sale would require enrichment prior to fabrication. All of these activities would continue to be conducted as they are today by USEC and commercial entities. The only change would be that the natural uranium and LEU proposed for sale by DOE would replace an equivalent quantity of uranium that would otherwise have been mined, milled, and converted, (as shown in Figure 2.1.). For example, rather than buying U_3O_8, converting it to natural UF_6, and shipping it to one of the gaseous diffusion plants, a buyer might purchase some of the natural UF_6 proposed for sale, which is already at the gaseous diffusion plants and needs no conversion before enrichment. Or the buyer might purchase LEU that is stored at the Portsmouth plant rather than arranging for enrichment of natural uranium. (For additional information on the nuclear fuel cycle, see Appendix A.)

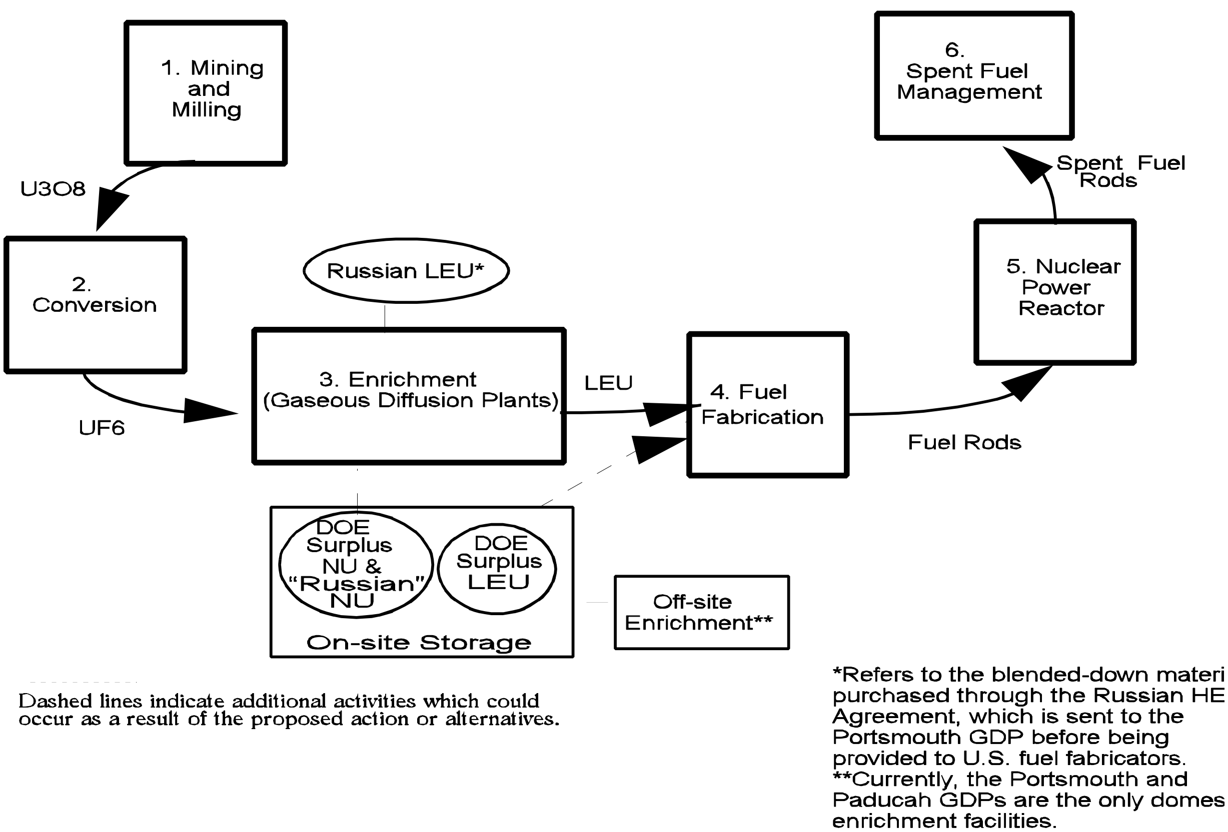


Figure 2.1
The Uranium Fuel Cycle

2.3 The No Action Alternative

Under the No Action Alternative, DOE would not sell either the surplus uranium or the transferred "Russian" uranium. DOE would maintain the uranium in storage at the gaseous diffusion plants or use the material for other DOE activities (e.g., blending down DOE-owned HEU) and not release it into the market. Under this alternative the Department's uranium would not displace other uranium needed by utilities, and uranium would have to be mined, milled, and converted to meet demand that the Department's uranium would have otherwise filled. The No Action Alternative would violate the *USEC Privatization Act's* requirement to sell the transferred "Russian" uranium within seven years. Furthermore, this alternative would not permit DOE to meet Congress' expectation that DOE would sell $34.9 million worth of surplus uranium in fiscal year 1996, and DOE would be required to seek an alternative source of funds for DOE activities at the gaseous diffusion plants.

2.4 Other Alternatives Considered

In addition to the Proposed Action and the No Action Alternative, three other alternatives are also considered in this EA. They were selected for analysis in order to evaluate the widest possible range of potential impacts on the domestic uranium industry.[15] For example, selling all of the uranium for domestic end use would be expected to have the greatest impact on the domestic industry, while selling it as the Russian portion of matched sales, as stipulated in the *Suspension Agreement*, for overfeeding the enrichment plants, or for foreign end use would be expected to have a much smaller domestic impact. The alternative that calls for selling only the transferred "Russian" uranium has been included because the Department is required by the *USEC Privatization Act* to sell this material.

2.4.1 Sell Only Transferred "Russian" Uranium

Under this alternative, DOE would sell the 14.2 million pounds U_3O_8(e) of transferred "Russian" uranium as discussed in the Proposed Action, and the proceeds would be deposited in the United States Treasury. DOE would continue to store its surplus natural uranium and LEU at Portsmouth and Paducah rather than selling it, or would use it in other DOE activities. Because under this alternative the Department's surplus uranium would not displace other uranium needed by utilities, uranium would have to be mined, milled, and converted to meet demand that the Department's uranium would have otherwise filled. Under this alternative, DOE would fail to meet Congress' expectation that DOE would sell $34.9 million worth of its surplus uranium in Fiscal Year 1996. In addition, DOE would be required to seek an alternative source of funds for its activities at the gaseous diffusion plants.

2.4.2 Sell Transferred "Russian" Uranium and DOE Surplus Uranium for Domestic End Use

[15] For the purposes of this EA, in conformance with the *USEC Privatization Act*, the domestic uranium industry is considered to include producers, converters and enrichers.

Under this alternative, DOE would sell all of the 14.2 million pounds U_3O_8(e) of transferred "Russian" uranium for domestic end use. While about half of the transferred "Russian" uranium would be sold in 1996 for future use as the "Russian" component in matched sales, the remainder would be sold in 2001 as required by the *USEC Privatization Act* for domestic use in 2002 and later at a maximum level of three million pounds U_3O_8(e) per year. The DOE surplus natural uranium and LEU would be sold in a single year during the 1996-2004 time frame, for domestic end use only. As a result, up to 21.5 million pounds U_3O_8(e) could enter the domestic market in any single year between 1996 and 2001, or up to 24.5 million pounds U_3O_8(e) in any single year from 2002 to 2004. This alternative could expedite collection of, and maximize, government revenues. However, this alternative would likely have the greatest impact on the domestic uranium industry.

2.4.3 Sell Transferred "Russian" Uranium for Use in Matched Sales, Overfeeding, or with DOE Surplus Uranium for Foreign End Use

Under this alternative, DOE would sell the 14.2 million pounds U_3O_8(e) of transferred "Russian" uranium to the Russians for use in matched sales, use it for overfeeding domestic enrichment plants, or sell it with the DOE surplus uranium and LEU for foreign end use only. The transferred "Russian" uranium would be sold between 1996 and 2002, and the DOE surplus uranium could be sold at any time between 1996 and 2004. This alternative would likely have the least impact the domestic uranium industry. For example, by restricting the sales to foreign end use, the impact on the domestic uranium industry would be minimized, because foreign users of uranium are much less likely to buy domestic uranium or use domestic conversion or enrichment services than domestic users of uranium. However, this alternative may not maximize government revenues due to the relatively lower value of the material in the international market.

3.0 Affected Environment

This chapter describes the environments that may be affected by the various alternatives.

3.1 Portsmouth (Ohio) Gaseous Diffusion Plant

The Portsmouth gaseous diffusion plant is located immediately east of the Scioto River and three miles south of Piketon, Ohio. The plant has been in operation as a uranium enrichment facility since 1955. The plant site is in Pike County, Ohio, where the winters are moderately cold and the summers are moderately warm and humid. The area surrounding the site is generally sparsely populated, marginal farmland. The soils at the site are strongly acidic, and soil productivity varies from low on steep uplands to very high on terraces and flood plains; texturally, the soils are predominantly silt loams. The major source of groundwater in Pike County is the result of drainage from the Scioto River, which in turn flows into the Ohio River at Portsmouth, Ohio.

The terrestrial community consists of gently rolling hills, many of which have dry ridge tops, dry to moist slopes, and low-lying bottom lands. The vegetation is dominated by a tree cover consisting of white oak, red oak, and hickory. The animal species, their abundance, and their relative distributions are typical of those found in southern Ohio. The State of Ohio Department of Natural Resources identified two threatened mollusks that live in the Scioto River, near Piketon; neither lives on plant property. For additional information on the site, the reader is referred to ERDA-1555 (May 1977) *Final Environmental Impact Statement, Portsmouth Gaseous Diffusion Plant Site, Piketon, Ohio.*

Environmental monitoring systems at Portsmouth include emission monitoring networks for air and surface water discharges; waste sampling and characterization; and ambient sampling networks for air, surface water, groundwater, drinking water, vegetation (cattle forage), food crops, fish, soil, creek and river sediments, and direct (gamma) radiation levels. Additional details on Portsmouth's monitoring program are provided in *Portsmouth Site Annual Environmental Report for 1994*, Report No. ES/ESH-63, prepared by Lockheed Martin Energy Systems, Inc., Oak Ridge, TN.

The Portsmouth gaseous diffusion plant has an established radiological protection and surveillance program which monitors radiological doses received by employees and seeks to keep exposures as low as reasonably achievable. In 1995, approximately 4,485 employees at the Portsmouth site received a collective total effective dose equivalent of 25.971 person-rem. The maximum individual dose to a worker (measured in terms of total effective dose equivalent) was 636 millirem (0.636 rem). The DOE regulatory limit on occupation radiological exposure, established at 10 CFR Part 835, *Occupational Radiation Protection*, limits the annual exposure to workers to a dose of 5,000 millirem (5 rem) total effective dose equivalent.

3.2 Paducah (Kentucky) Gaseous Diffusion Plant

The Paducah gaseous diffusion plant, built in the early 1950s, occupies 748 acres of a 3,423-acre DOE reservation 10 miles west of Paducah, in McCracken County, Kentucky. It is surrounded by predominantly open fields and forested land with intermittent agricultural activities. Within seven miles of the plant, rural residential clusters form seven small communities. The immediate area of the site is underlain by 18 to 24 feet of fill excavated during the construction of the plant. The fill is composed of gray to brown silt with a trace of clay. The primary aquifers in the area include the lower Continental Deposits, the Eocene sands, and the sands of the McNairy Formation. The Paducah plant is located to the south of the Ohio River in an area of low geographic relief. Surface drainage from the site is to two small tributaries of the Ohio River-- the Big Bayou Creek on the west and the Little Bayou Creek on the east. Paducah is above the historical high water flood level of the Ohio River. The climate is temperate continental with warm humid summers and moderately cold winters. McCracken County is an attainment area with respect to National Ambient Air Quality Standards for most criteria pollutants.

The upland hardwoods are predominantly oak-hickory forests with numerous tree species. There are no extensive areas of upland hardwood forest on the site. Instead, small woodlots are common. The riparian hardwood forest along Big Bayou Creek and Little Bayou Creek is dominated by river birch, black willow, and eastern cottonwood. The bald eagle, arctic peregrine falcon, and interior least tern are listed as threatened or endangered in McCracken County. None of these birds is known to nest on the DOE land at Paducah. Several federally listed species of threatened mussel are known to exist in McCracken County but have not been reported in Big Bayou Creek or little Bayou Creek. No threatened or endangered plants are known to occur in the county, although two species listed by the state as threatened, the sweet cone flower and compass plant, are considered possible occurrences but are not afforded any special protection by the State of Kentucky. For a more detailed description of the Paducah plant site, the reader is referred to DOE/EA-0155 (August 1982) *Final Environmental Impact Assessment of the Paducah Gaseous Diffusion Plant Site*.

Environmental monitoring systems at the plant include emission monitoring networks for airborne and aqueous discharges, groundwater monitoring, solid waste characterization, and environmental surveillance networks for air, surface water, groundwater, vegetation, food crops, fish, wildlife, soil, and surface stream sediments. Additional information on site monitoring is provided in *Paducah Site Annual Environmental Report for 1994,* Report No. ES/ESH-60 prepared by Lockheed Martin Energy Systems, Inc., Oak Ridge, TN.

The Paducah gaseous diffusion plant has an established radiological protection and surveillance program which monitors radiological doses received by employees and seeks to keep exposures as low as reasonably achievable. In 1995, approximately 2,142 employees at the Paducah site received a collective total effective dose equivalent of 8.277 person-rem. The maximum individual dose to a worker (measured in terms of total effective dose equivalent) was 285 millirem (0.285 rem). The DOE regulatory limit on occupation radiological exposure, established in 10 CFR Part 835, *Occupational Radiation Protection*, limits the annual exposure to workers to a dose of 5,000 millirem (5 rem) total effective dose equivalent.

3.3 Socioeconomic Aspects of the Domestic Uranium Industry

This section examines the impacts that the Proposed Action and other alternatives may have on the domestic uranium industry. In conformance with the *USEC Privatization Act*, for the purposes of this assessment, DOE has defined the domestic uranium industry to include production, conversion, and enrichment activities. These activities take uranium as it is mined, convert it into UF6, the form currently required by domestic enrichers and nuclear fuel fabricators, and enrich it for use in nuclear fuel (See Appendix A for a more detailed discussion of the nuclear fuel cycle).

3.3.1 Background

From 1947 through 1970, the United States Government, through the Atomic Energy Commission, instituted a program to obtain uranium for nuclear weapons production. The commercial nuclear fuel cycle market evolved from this program as the uranium market gradually changed from one in which the government was the sole purchaser to one which was almost entirely commercial.

Early in the government's procurement program, the Atomic Energy Commission provided incentives for uranium ore exploration and production and agreed to buy all the uranium ore at a set price; uranium production flourished. However, by the 1960s, the Atomic Energy Commission had largely satisfied its needs, and the procurement program was phased out. In 1964, the *Private Ownership of Special Nuclear Materials Act* (Public Law 88-489) allowed private ownership of nuclear fuels.

Beginning in the mid 1960s, private ownership of nuclear fuels spurred exploration efforts and construction of mills so that, within a few years, available production capability exceeded the nascent nuclear energy industry's uranium oxide requirements. As a result, prices fell and the industry experienced a period of contraction.

However, after the rapid increase in oil prices in 1973 and 1974, the pace of new orders for nuclear power plants throughout the world accelerated. In the decade that followed, there was a dramatic increase in the quantities of uranium held in commercial inventories in the United States Beginning in 1974, fears of future uranium shortages led to a sharp increase in uranium oxide prices. Between 1974 and 1979, the average price of a pound of uranium almost quadrupled, peaking at over $43 per pound U_3O_8 (*The Nuclear Review*, December 1995, p. 27). The rapid increase in uranium prices stimulated new exploration and additional production. Once again, the market became unbalanced, with available supply exceeding the quantity demanded.

3.3.2 Current Domestic Uranium Production Industry

Over the past 15 years, the production of uranium in the United States declined sharply until very recently (EIA, Uranium Industry Annual 1992, Tables 19 and 30). Production peaked in 1980 at more than 40 million pounds U_3O_8(e); in 1993, it fell to just over three million pounds U_3O_8(e) (*EIA Uranium Industry Annual 1995*, Table H1). Likewise, the price of uranium declined throughout the 1980s and early 1990s, reaching a low in 1991 of less than $8 per pound U_3O_8 (*The Nuclear Review*, December 1995, p. 27). The result has been a serious contraction of the industry by every measure, including the number of uranium producing companies and active mines in the United States.

Contributing to the decline of uranium production in the United States has been domestic customers' increased reliance on foreign uranium; the entry into the market of the former Soviet Union; and the discovery of large, low-cost ore deposits in Canada, Australia, and Africa. Since 1980, when United States production peaked, uranium imports have increased significantly (See Figure 3.1).

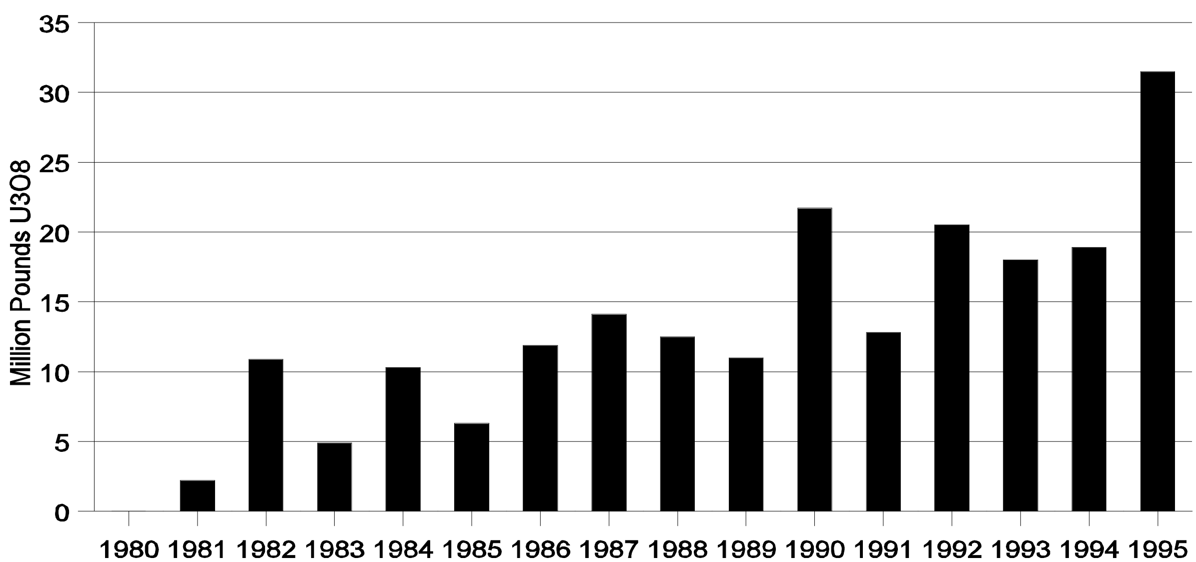


Figure 3.1
NET URANIUM IMPORTS, 1980 - 1995

Source: *EIA Uranium Industry Annuals, 1992- 1995.*

However, since 1993 there has been an increase in domestic production: it increased to 3.4 million pounds U_3O_8(e) in 1994, and to six million pounds U_3O_8(e) in 1995 (*EIA Uranium Industry Annual 1995*, Table H1). Today, there are eight active uranium production sites in the United States: five in-situ leaching operations, two phosphate by-product operations, and one operating conventional mill. The sites are located in Louisiana, Nebraska, Texas, Wyoming and Utah (See Table 3.1, Current United States Uranium Production Sites).

Virtually all of the uranium concentrate currently produced in the United States comes from in-situ leaching sites, or is recovered as a byproduct from the manufacture of phosphates for use as fertilizer. In-situ leaching involves leaching uranium from the host rock without removing the rock from the ground: a leaching solution is circulated through the rock; the uranium is dissolved; and the uranium-bearing solution is pumped to the surface, where it is washed and separated and the uranium is recovered.

Table 3.1
CURRENT UNITED STATES URANIUM PRODUCTION SITES

Site	County/ Parish and State	County/Parish Labor Force	Process	Rated Capacity in 000's of Pounds U_3O_8(e)/Year
Holiday-El Mesquite	Duval, TX	4,453	In-situ Leach	600
Christensen Ranch	Campbell, WY	15,327	In-situ Leach	650
Highland	Converse, WY	5,475	In-situ Leach	2,000
White Mesa	San Juan, UT	4,503	Conventional Mill	2,000 short tons ore per day
Crow Butte	Dawes, NE	4,243	In-situ Leach	1,000
Rosita	Duval, TX	4,453	In-situ Leach	1,000
Uncle Sam/Sunshine Bridge (two sites)	St. James, LA	8,414	Phosphate By-product Recovery	1,170

Source: 1990 U.S. Bureau of Census Data, and Energy Information Administration, *Uranium Industry Annual, 1995.*

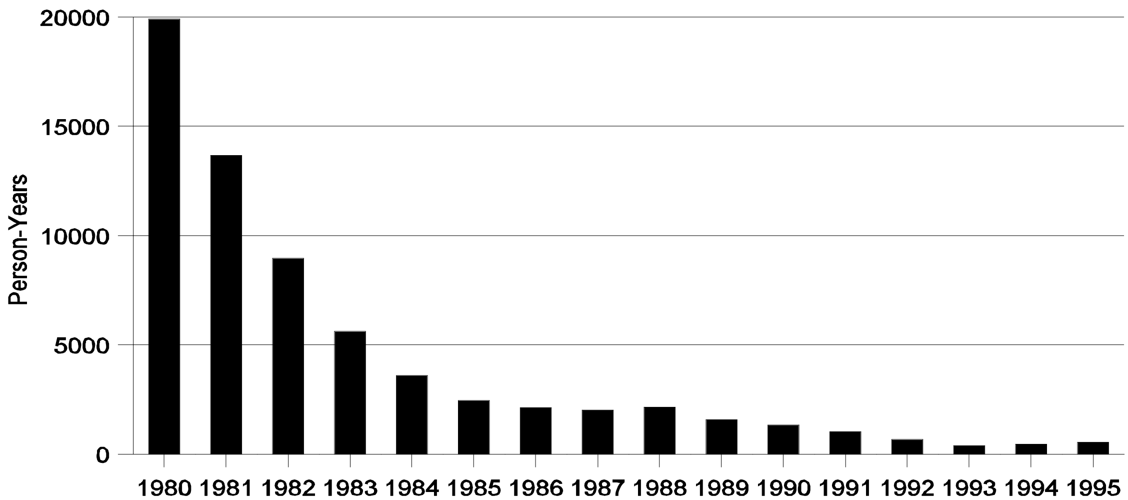
According to the Energy Information Administration's (EIA) *Uranium Industry Annual 1995*, domestic uranium concentrate production in 1995 was up 80 percent from 1994, from 3.4 million to six million pounds of U_3O_8. The uranium production sites in operation at the end of 1995 had a combined capacity of over eight million pounds U_3O_8(e) per year (including uranium concentrate produced at the White Mesa mill in 1995).

3.3.2.1 Employment

Employment in the domestic uranium industry fell dramatically from 1980 through 1993. (See Figure 3.2). However, the uranium production industry has seen increases in employment in the past two years. In 1994, employment in the uranium production segment of the industry, not including reclamation, increased 19 percent over 1993 levels to 452 workers; in 1995 employment increased another 18 percent to 534 workers (EIA, Uranium Industry Annual 1995, Table 8). The

1995 figures reflect a 44 percent increase in the mining sector; 15 percent increase in milling; and an eight percent increase in processing. Three states, Colorado, Texas, and Wyoming, accounted for 65 percent of the total employment in 1995 (EIA, Uranium Industry Annual 1995, Table 9). |

Figure 3.2 EMPLOYMENT IN THE DOMESTIC URANIUM PRODUCTION INDUSTRY 1980 - 1995



Source: *EIA Uranium Industry Annuals.*

As shown in Table 3.2, domestic uranium demand is expected to average about 47 million pounds U_3O_8(e) per year throughout the period of the Proposed Action. About 67 percent of this demand is expected to be satisfied with imported uranium. Another 15 percent is expected to be satisfied through inventory usage by the utilities, and almost 18 percent is expected to be satisfied with newly produced domestic uranium. In 1995, United States utilities received 43 million pounds of U_3O_8(e). Of that, 88 percent was from foreign sources and 12 percent was from the United States |

(EIA, Uranium Industry Annual 1995, p. 11). In 1995, purchases from foreign suppliers by domestic utilities and suppliers totaled 41.3 million pounds U_3O_8(e), up from 36.6 million pounds U_3O_8(e) in 1994 (EIA, Uranium Industry Annual 1995, Table 26).

Table 3.2
PROJECTED URANIUM DEMAND IN THE UNITED STATES 1996-2004
(Million Pounds U_3O_8(e))

Year	Projected U.S. Demand	Net Imports	Projected U.S. Production	Net Inventory Usage	% Demand Satisfied by Imports	% Demand Satisfied by U.S. Production	% Demand Satisfied by Inventory Usage
1996	46.9	29.7	7.2	10.0	63.3%	15.4%	21.3%
1997	46.9	30.4	8.0	8.5	64.8%	17.1%	18.1%
1998	48.2	29.4	8.2	10.6	61.0%	17.0%	22.0%
1999	45.4	30.0	8.2	7.2	66.1%	18.1%	15.8%
2000	47.5	30.8	8.2	8.5	64.8%	17.3%	17.9%
2001	46.6	32.5	8.4	5.7	69.7%	18.0%	12.0%
2002	47.0	33.0	8.4	5.6	70.2%	17.9%	11.9%
2003	46.2	33.4	8.7	4.1	72.3%	18.8%	8.9%
2004	47.2	33.5	8.8	4.9	71.0%	18.6%	10.4%
Average	46.9	31.4	8.2	7.2	67.0%	17.6%	15.4%

Source: Adapted from preliminary information from Energy Information Administration , *World Nuclear Outlook, 1996*, Table 14.

One factor contributing to the rise in production and subsequent increases in employment has been improved productivity at domestic facilities. As shown in Table 3.3, four of the top eight uranium-producing companies in the world, in terms of production per employee, were in the United States in 1994. This is important because the uranium market continues to be highly competitive.

Table 3.3
SUMMARY OF TOP URANIUM PRODUCERS -1994

Country	Production Center	Method	Productivity (lbs of U_3O_8 /person/year)
Canada	Key Lake	Underground Mining	33,058
Canada	Rabbit Lake	Underground Mining	31,863
United States	Crow Butte	In-Situ Leaching	20,057
Australia	Ranger #1	Underground Mining	16,699
United States	Highland	In-Situ Leaching	15,302
Canada	Cluff Lake	Underground Mining	11,080
United States	Holiday-El Mesquite	In-Situ Leaching	10,455
United States	Christensen Ranch-Irigaray	In-Situ Leaching	8,609

Source: *International Nuclear, Inc., October, 1995.*

Using the average 1995 domestic productivity rate of 11,235 pounds U_3O_8(e) per employee (i.e., six million pounds U_3O_8(e) divided by 534 workers) as a measure of the productivity, an increase in domestic production from six million pounds U_3O_8(e) to the projected average of 8.2 million p-ounds U_3O_8(e) over the time frame of this assessment could be expected to increase total production employment by about 195 workers for an average projected domestic employment level of about 730 workers.

Nevertheless, even with the projected increase in employment, the number of people involved in the production of domestic uranium will remain a small percentage of the labor force in the affected environment. An employment level of 730 workers is about 1.7 percent of the combined labor force of about 42,415 workers in those counties and parishes shown in Table 3.1.

3.3.2.2 Pricing

The market price of uranium oxide has recently begun to increase. In 1993, the domestic uranium market began to react to the Uranium Antidumping Suspension Agreements, which restricted the ability of nations of the former Soviet Union to export uranium to the United States. A "restricted market" price was developed, which acted as an indicator of uranium prices in the United States and other "restricted" markets.[16]

When first announced in late 1993, the restricted price was over \$10 per pound U_3O_8. The restricted price quickly dropped to less than \$10 per pound U_3O_8 and remained between \$9-\$10 per pound U_3O_8 throughout 1994. In 1995, the restricted price of uranium rose quickly to almost \$12 per pound U_3O_8 (*The Nuclear Review*, December 1995, p. 27). Price increases continued in 1996, at times exceeding \$16.50 per pound U_3O_8, but have recently begun to drop. The current restricted spot market price is estimated to be in the range of \$15.90 to \$16.20 per pound U_3O_8 (*NuclearFuel*, September 23, 1996, p. 16).

3.3.3 Current Domestic Uranium Conversion Industry

Utilities purchase conversion services to convert uranium concentrate from U_3O_8 to uranium hexafluoride (UF_6) before sending it to enrichment plants. All of the uranium proposed for disposition under the Proposed Action and the other alternatives considered in this EA is already in the form of UF_6. Therefore, disposition of these inventories could potentially impact domestic conversion activities.

Since 1993, ConverDyn has operated the only conversion facility in the United States The facility has an approximate conversion capacity of 14,000 metric tons of uranium (MTU) per year, or the

[16] The “restricted price” refers to the price currently paid for uranium in markets where the import of uranium from countries of the former Soviet Union has been restricted. These markets include the United States and signatories of the EURATOM Agreement. As a result of these restrictions, there is a premium charged for uranium bought in these markets. This premium has been as high as 50 percent and is currently about six percent. (*NuclearFuel*, September 23, 1996)

equivalent of 36 million pounds U_3O_8(e). ConverDyn is currently one of the top four converters in the world with an estimated 1995 production level of 12,000 MTU, or the equivalent of 31 million pounds U_3O_8(e), at its Metropolis plant in Massac County, Illinois, [discussion with TradeTech (E. Rutkowski) of 7/1/96]. This plant currently employs about 380 people (DOE/EIS-0240, p. 4-150). This compares to the Massac County total labor force of 6,356 at the time of the last census (1990 U.S. Bureau of the Census).

3.3.4 Current Domestic Uranium Enrichment Industry

The *Energy Policy Act of 1992* established USEC as a wholly-owned government corporation to operate the Department's gaseous diffusion plants in Piketon, Ohio, and Paducah, Kentucky, and, eventually, to operate them as a private corporation. These plants, currently the only uranium enrichment plants in the United States, satisfy over 70 percent of domestic demand. In addition, USEC is the world's largest provider of enrichment services, satisfying over one-third of world demand. USEC is the largest supplier to the Far East and a smaller supplier to western Europe. USEC reports that about 37 percent of its sales are to foreign customers (USEC Annual Report 1995, p. 28).

USEC employs approximately 4,350 people at its two plants. (*USEC Annual Report*, 1995, p. 10) The plants are the largest employers in southern Ohio and western Kentucky. In Ohio, the Portsmouth gaseous diffusion plant draws 90-95 percent of its employees from four counties: Pike, Ross, Scioto, and Jackson. The Paducah gaseous diffusion plant draws 90-95 percent of its employees from six counties: Ballard, Graves, and McCracken counties in Kentucky; and Johnson, Massac, and Pulaski counties in Illinois. As a result, USEC directly employs over three percent of the labor force in these counties (See Table 3.4).

Table 3.4
LABOR FORCE IN THE AREA SURROUNDING THE DOMESTIC ENRICHMENT PLANTS

Portsmouth Gaseous Diffusion Plant		Paducah Gaseous Diffusion Plant	
County	**Labor Force**	**County**	**Labor Force**
Jackson, OH	11,964	Ballard, KY	3,643
Pike, OH	9,190	Graves, KY	14,687
Ross, OH	28,942	McCracken, KY	29,353
Scioto, OH	28,780	Johnson, IL	1,540
		Massac, IL	6,356
		Pulaski, IL	2,806
Total	78,876	Total	60,860

Source: U.S. Bureau of Census, 1990.

4.0 Environmental Impacts

This chapter describes the potential environmental impacts associated with the Proposed Action and the various alternatives.

4.1 Radiation Exposure under Normal Operations

The potential for decreases in production in domestic uranium industries resulting from the Proposed Action and the alternatives, as discussed in Section 2, could potentially result in minor decreases in the radiological effects on workers or the public. The substitution of the natural uranium and LEU proposed for sale by DOE for an equivalent quantity of newly produced uranium would affect the “front end” of the fuel cycle; that is, at the mining, milling, and conversion facilities (and, for the LEU only, the enrichment facilities) (see Figure 2.1). Fuel fabrication and reactor operations would not be affected by the proposed sale, because the same quantities of UF_6 would be used in fabricating nuclear fuel, regardless of what action is taken. Likewise, the sale of natural uranium would not affect enrichment facilities because the uranium would still need to be enriched regardless of its source. The potential radiological effects from the Proposed Action and alternatives at the mining, milling, conversion, and enrichment facilities are discussed below.

4.1.1 Proposed Action

At the front end of the fuel cycle, the proposed sale could result in some reduction in the quantity of uranium ore that would be mined and milled and in the quantity of U_3O_8 that would be converted into natural UF_6. As discussed in Section 4.3, there could be a reduction of an average of seven percent per year in domestic uranium industry production over the 1996 - 2004 time frame as a result of the Proposed Action. If so, there could be a negligible reduction in collective radiological dose to workers in the mining and conversion industry and also a negligible reduction in collective dose to the public in the vicinity of those industries.

Also, the proposed sale of LEU could result in an estimated reduction in production of up to four percent in one year at the Portsmouth gaseous diffusion plant, where the LEU is stored, if all of the material were used in one year.[17] As a result, there could be a small decrease in collective dose to those workers handling natural uranium cylinders, and a similar decrease in the collective dose to the public in the vicinity of the plant.

4.1.2 No Action Alternative

[17] While the projected annual production at Portsmouth could drop by about four percent as a result of this LEU sale, the overall impact on both domestic enrichment plants would be expected to be less than two percent as shown in Section 4.3.3.

Under the No Action Alternative, there would continue to be very minor radiological effects to workers due to routine monitoring and maintenance of the storage canisters. There would be no routine radiological exposure to the public as a result of these storage activities. While data are not available on the specific dose to workers due to these activities, it is estimated that a worker would receive an annual dose of approximately 10 millirem (mrem) while conducting routine monitoring of cylinders in storage, based on discussions with technical plant personnel. Routine monitoring is conducted on approximately half of the cylinders each year. There are 1,200 cylinders at Paducah gaseous diffusion plant and 850 cylinders at Portsmouth gaseous diffusion plant. Typically, three-person teams conduct the monitoring, which requires about five minutes per cylinder inspected, and two of the three workers would receive a dose. The occupational dose to the maximally exposed individual from all plant operations was 285 mrem total effective dose equivalent (TEDE) in 1995 at Paducah and 636 mrem TEDE in 1995 at Portsmouth.

Under the No Action Alternative, it is possible that some of the uranium proposed for sale could be used for blending DOE HEU. The radiological effects of blending are addressed in the HEU EIS.

4.1.3 Sell Only Transferred "Russian" Uranium

Under this alternative, the sale of the 14.2 million pounds U_3O_8(e) of transferred "Russian" uranium could result in a slight reduction in mining, milling and conversion. As discussed in Section 4.3, there could be a reduction of an average of five percent per year in domestic uranium production under this alternative over the 2002 - 2004 time frame. If so, there could be a similar reduction in collective radiological dose to workers in the mining and conversion industries, and also a negligible reduction in collective dose to the public in the vicinity of those industries.

Because the LEU would not be sold under this alternative, the existing radiological effects on workers at the Portsmouth gaseous diffusion plant and the public near the plant would continue, without change. The effects of continued storage or other uses of this surplus uranium would be essentially the same as effects of the No Action Alternative, as discussed in Section 4.1.2.

4.1.4 Sell Transferred "Russian" Uranium and DOE Surplus Uranium for Domestic End Use

Under this alternative, the sale of the surplus natural uranium and LEU in a single year could result in a reduction of up to 53 percent in domestic uranium production and up to 52 percent in projected conversion production, as discussed in Section 4.3. Relative to the Proposed Action and the other alternatives, this alternative could result in a substantial reduction in the collective radiological dose to workers in the mining and conversion industries, and possibly to the public in the vicinity of those industries, because domestic mines and conversion facilities would be expected to significantly cut back production.

Like the Proposed Action, this alternative could also result in an estimated reduction in production of four percent in one year at the Portsmouth gaseous diffusion plant, where the LEU is stored. As a result, there could be a slight decrease in collective dose to those workers handling natural uranium cylinders, and possibly to the public in the vicinity of the plant.

4.1.5 Sell Transferred "Russian" Uranium for Use in Matched Sales, Overfeeding, or with DOE Surplus Uranium for Foreign End Use

Under this alternative, the sale of natural uranium and LEU would be expected to have a relatively small effect on the domestic uranium production industry: on average, a reduction of about two percent per year in projected production. However, if all of the material except that sold to the Russians for use in matched sales were to be sold in a single year, the reduction in domestic uranium production could be as high as 20 percent, and as high as 19 percent in projected conversion activity. The reduced production and conversion could result in a substantial reduction in the collective radiological dose to workers in the mining and conversion industries, and possibly to the public in the vicinity of those industries, because there would likely be a large drop in production in the year the material is sold.

Like the Proposed Action, this alternative could also result in an estimated reduction in production of four percent in one year at the Portsmouth gaseous diffusion plant, where the LEU is stored, if the material were used by foreign customers to supply the requirements of their enrichment services contract with USEC. In addition, if the majority of United States uranium were sold for foreign end use, it would be more likely to be enriched overseas. This could result in a reduction of up to five percent in USEC's production over the 1996-2004 time frame. As a result, there could be a slight decrease in the collective dose to workers handling natural uranium cylinders, and a negligible reduction in the collective dose to the public in the vicinity of the plant.

4.2 Transportation Impacts

As shown in Figure 2.1, "The Uranium Fuel Cycle," normal transportation to and from the gaseous diffusion plants involves the shipment of natural uranium feedstock in the form of UF_6 from conversion facilities to the gaseous diffusion plants and the shipment of low enriched UF_6 from the gaseous diffusion plants to fuel fabricators. All shipments are made in conformance with Nuclear Regulatory Commission and Department of Transportation (DOT) regulations (10 CFR Part 71 and 49 CFR Part 173, Subpart I), DOE Orders 460.1 and 460.2, and the International Atomic Energy Agency Safety Series No. 6. All uranium hexafluoride shipping containers are required to meet American National Standards Institute N14.1-1990 specifications.

Uranium hexafluoride is shipped in solid form in steel cylinders of various sizes, depending on the quantity and the concentration of ^{235}U. Natural uranium is typically shipped in cylinders having a 48 in. diameter and a capacity of 10 tons (the 48X Model) or 14 tons (the 48Y Model). LEU is shipped in 2.5-ton Model 30B cylinders, which meet DOT's definition of Type A packaging. In addition, uranium with a concentration of over 1 percent ^{235}U must be transported in overpacks.

No special permits or applications are required to transport UF_6 by train, truck, or ship. Department of Transportation regulations treat natural uranium or LEU as presenting a sufficiently minimal hazard that an “unlimited” quantity can be shipped in specified packaging. Currently, most overland shipments of UF_6 in North America are by truck.

Transportation is an issue only when there is a need to move uranium from point to point along the fuel cycle—e.g., from converter to enricher, or from enricher to fabricator—and these movements are determined by such factors as market demand and contractual arrangements between the utilities and their uranium suppliers. The sale of DOE’s surplus uranium and the transferred “Russian” uranium would be expected to decrease the amount of natural uranium transported to the gaseous diffusion plants. However, it would not be expected to increase the amount of enriched uranium leaving the gaseous diffusion plants. Rather, it would replace natural uranium that would have been needed at the plants to fulfill expected demand. For purposes of the following analysis, a period of nine years, from 1996 - 2004, was assumed for completing transportation activities involving the subject uranium.

Currently, the two domestic enrichment plants receive approximately 22.2 million kilograms of natural UF_6 each year from conversion facilities; 17.7 million kilograms go to Paducah, and 4.5 million kilograms go to Portsmouth. Approximately 45 percent of the total amount comes from converters outside the United States, principally from Cameco in Canada; the remaining 55 percent comes mainly from the ConverDyn plant in Metropolis, Illinois. Cameco typically sends its UF_6 in 10-ton Model 48X cylinders, with two cylinders per truckload. Each shipment, therefore, consists of about 19,000 kilograms of UF_6. (If all shipments were in this configuration, there would be a total of 1170 shipments a year.) ConverDyn, which accounts for approximately 55 percent of the gaseous diffusion plants’ feedstock, typically ships its natural UF_6 in 14-ton Model 48Y cylinders, with one cylinder per truckload. Each shipment consists of 12,500 kilograms of UF_6, and if all shipments were made this way, a total of about 1780 shipments per year would result.

In an average year, Paducah ships about 5.1 million kilograms of slightly enriched UF_6 to Portsmouth for further enrichment. Portsmouth ships out about 3.0 million kilograms of low enriched UF_6 per year, in about 1,300 Model 30B cylinders. The Model 30B cylinders are usually shipped four or five per truckload.

4.2.1 Proposed Action

<u>Incoming Shipments</u>

It is expected that, under the Proposed Action, the transferred “Russian” uranium and DOE surplus natural UF_6 would remain at the gaseous diffusion plants for enrichment. In the case of the surplus LEU stored at Portsmouth, the purchaser would have it sent to the fuel fabricators as needed, possibly after having the level of enrichment adjusted at the plant. The 35.7 million pounds U_3O_8(e) of DOE surplus and the transferred “Russian” uranium would, in effect, replace about 20 million kilograms of natural UF_6[18] that would otherwise be shipped into the plants from the converters in the United States, Canada, and elsewhere. Assuming approximately 12,500 to 19,000 kilograms of UF_6 per shipment, the Proposed Action would, therefore, reduce total natural uranium shipments to Paducah by 600 to 900 shipments and to the Portsmouth GDP by 500 to 700 shipments. Over a nine-year period, this would be about 120-180 shipments per year—approximately 7-15 percent of the annual shipments at present rates. Because of the reduced number of shipments and the associated reduction in the number of feed cylinders arriving at the gaseous diffusion plants, the Proposed Action would be expected to result in some reduction in radiological impacts to workers involved in handling and inspecting cylinders, to transportation workers, and possibly to the public along the transportation routes.

It should be noted that the overall probability of a transportation accident would also be reduced by the Proposed Action because fewer cylinders would be transported to the plants.

Outgoing Shipments

The number of outgoing shipments of LEU and the amount of related handling activity would remain unchanged under the Proposed Action; therefore no change in the current level of radiological impacts due to transportation of LEU from the gaseous diffusion plants is expected to occur.

4.2.2 No Action Alternative

Under the No Action Alternative, both incoming and outgoing shipments of UF_6 would continue as at present. Since the number of shipments and the amount of transportation-related handling activity would remain unchanged, no change in the radiological impacts due to either incoming or outgoing transportation would be expected to occur under this alternative.

4.2.3 Sell Only Transferred "Russian" Uranium

Incoming Shipments

Under this alternative, 14.2 million pounds U_3O_8(e) of transferred "Russian" uranium (approximately 8 million kilograms of UF_6) currently stored at Portsmouth would be sold. As with the Proposed Action, it is assumed that this material would replace feed that would otherwise have to be shipped from converters. If a shipment is between 12,500 and 19,000 kilograms of UF_6, this alternative would reduce total incoming shipments by 420 to 640, or about 50 to 70 shipments per year, over a nine-year period. Because of the reduced number of shipments, and the associated reduction in the number of feed cylinders arriving at the gaseous diffusion plants, this alternative would be expected to result in some reduction in radiological impacts to workers involved in handling and inspecting cylinders, to transportation workers, and possibly to the public along the

[18] To convert DOE's proposed sales from pounds of U_3O_8 to kilograms of UF_6, divide 35.7 million pounds of U_3O_8(e) by 2.6 to get 13.73 million kilograms of uranium. Each kilogram of uranium is equal to 1.479 kilograms of UF_6. So, 13.73 million is multiplied by 1.479 to equal about 20.3 million kilograms of UF_6.

transportation routes. As with the Proposed Action, the overall probability of a transportation accident would be also reduced by this alternative because fewer cylinders would be transported to the plants.

Outgoing Shipments

The number of outgoing shipments of LEU and the amount of related handling activity would remain unchanged under this alternative; therefore no change in radiological impacts due to outgoing transportation of LEU from the gaseous diffusion plants is expected to occur.

4.2.4 Sell Transferred "Russian" Uranium and DOE Surplus Uranium for Domestic End Use

Incoming Shipments

Like the Proposed Action, this alternative would reduce the amount of feedstock sent to the gaseous diffusion plants by a total of 1,100 to 1,600 shipments. Because all the material would become available at once, most of this reduction could occur in a single year, during which there might be no shipments to the gaseous diffusion plants from converters. In this case, radiological impacts and accident risks related to incoming transportation of feed would potentially be reduced to zero for that year. However, this scenario is considered highly unlikely because of the potential adverse impacts to the domestic uranium industry (discussed under the socioeconomic impacts of this alternative), and because of schedules previously arranged between the utilities and their uranium suppliers. Thus, it is expected that the reduction in shipments would take place over one to nine years, in which case, the reduction in impacts would be similar to that under the Proposed Action. In addition, the overall probability of a transportation accident would be reduced by this alternative because fewer cylinders would be transported to the plants.

Outgoing Shipments

If the sale were to proceed under the conditions in this alternative, the utilities would probably leave the UF_6 in storage as it is now and release it for enrichment and use as needed. Therefore, the number of outgoing shipments of LEU and the amount of related handling activity would remain unchanged under this alternative, and no change in radiological impacts due to outgoing transportation would be expected to occur.

4.2.5 Sell Transferred "Russian" Uranium for Use in Matched Sales, Overfeeding, or with DOE Surplus Uranium for Foreign End Use

Incoming Shipments

Under this alternative, the purchasers may decide to have the natural uranium enriched at the gaseous diffusion plants even though it would be used overseas, or to send it abroad for enrichment. In the former case, the potential reduction in the number of incoming feed shipments and in the associated impacts and accidents would be similar to the reductions under the Proposed Action. In the latter case, the number of incoming feed shipments and associated impacts for this alternative would be the same as under the No Action Alternative.

Outgoing Shipments
If the purchasers elect to have their uranium enriched at the gaseous diffusion plants, this alternative should have no effect on the number of outgoing shipments of LEU and the amount of related handling activity; therefore no change in radiological impacts due to outgoing transportation would be expected to occur.

A change in outgoing transportation might occur, however, if the purchasers choose to have their natural uranium shipped abroad for enrichment. In this case, in addition to the ongoing shipments of LEU enriched at the gaseous diffusion plants to meet enrichment contracts, all of the uranium proposed for sale in this EA, with the exception of the transferred "Russian" uranium used in matched sales or overfed to the enrichment plants, would be transported to foreign enrichment facilities. The most likely destinations would be one or more of the four enrichment plants in Europe: Eurodif operates a plant in France, and Urenco, a consortium of British, Dutch, and German interests, operates plants in Capenhurst, United Kingdom, Almelo, the Netherlands, and Gronau, Germany.

This section presents the potential impacts associated with the estimated 800-1,200 shipments of natural UF_6 that could be sent from Paducah and Portsmouth through any one of seven ports of egress in the United States and across the Atlantic Ocean to a northern European port. Much of this analysis is based on the recent Russian Purchase EA, which discusses the shipment of 22.5 million kilograms of low enriched UF_6 from Russia to Piketon, Ohio. Although none of the natural uranium considered in this EA would, in fact, be shipped to Russia, the marine, port, and domestic overland phases of the shipments would be similar (in reverse order). As previously stated, the Russian Purchase EA is incorporated by reference in this EA. |

The natural UF_6 would be transported in the 10- and 14-ton cylinders currently in use (Models 48X and 48Y), which would be packed one apiece into SEAPAKs at the plants and loaded onto special steamship container trailers. Container trailers, carrying one SEAPAK per shipment, would be hooked up to trucks for the overland trip by interstate highways to the selected port of debarkation. Assuming one SEAPAK per ship hold or defined deck area and eight holds or defined deck areas per ship, eight cylinders of UF_6 could be transported in each ocean shipment. |

Impacts
The Russian Purchase EA analyzes the total public and worker radiological risks (incident-free plus accident conditions) for the overland and port phases of transportation for the proposed purchase of Russian LEU.[19] A number of conservative assumptions that would tend to overestimate the risks were used in the Russian Purchase EA; for example; the incident-free annual exposure scenario assumes that all shipments go through one port; that one worker would be exposed to one-third of all shipments; and that one member of the public would be exposed to every highway shipment. The most severe accident considered was one in which four cylinders of LEU were subjected to a |

[19] The risks associated with transporting natural uranium are less than those described in the Russian Purchase EA because natural uranium is less radioactive than LEU.

fire, causing all cylinders to rupture and release their entire contents of UF_6. It was concluded that although the health effects of this scenario would be lethal for an individual located within 100 feet of the accident who is also stationary for the duration of the plume (a very unlikely situation), the probability of the event is so low that the risk is minimal.

For port workers and inspectors, the Russian Purchase EA estimated an exposure time of 10 minutes per SEAPAK and an exposure rate of 0.5 millirem (mrem)/hr for enriched UF_6 in overpacks (Type B packaging). The current EA assumes the same occupational exposure time, but, in accordance with estimates provided in Appendix C of the Russian Purchase EA, substitutes an exposure rate of 0.2 mrem/hr for natural UF_6. Therefore, total worker and public dose (including normal operations and accidents) for this activity would range between 20 and 25 person-rem, depending on the specific port chosen. This means that in the entire worker/public population there would be 0.01-0.012 additional cancer fatalities which could be attributed to this transportation activity, over and above the number of cancer fatalities which would occur independent of this activity. In a practical sense, this means that no excess cancers would be expected in the affected population.

Occupational exposures for workers at the Portsmouth and Paducah gaseous diffusion plants who would be involved in cylinder loading activities would potentially be slightly increased over current levels. Assuming the same workers loaded all the cylinders in SEAPAKs, two workers at each plant could receive a dose of about 40 mrem apiece at Portsmouth and 60 mrem apiece at Paducah. If other workers assisted in the loading of the SEAPAKs, the dose to any worker would be reduced.

Global Commons Analysis

In accordance with the Department's Implementation Guidance for Executive Order 12114, (46 FR 1007), the Russian Purchase EA analyzed impacts on the global commons.[20] Informal consultation with the National Marine Fisheries Service indicated that, under normal transport conditions, shipment of LEU by commercial vessel would be indistinguishable from any other commercial shipment and that there would be no impact on the marine environment, since marine flora and fauna would not be exposed to UF_6. Ship crews are shielded from packages and would receive no significant dose during transit.

The oceans contain significant quantities of uranium and its daughter products due to naturally occurring processes. Since uranium has not been found to bioamplify in fish (and only slightly in other marine organisms) an accidental gradual release would result in only slight increases in the exposure of marine organisms, which tend to be more radiation resistant than terrestrial mammals and which are already exposed to similar concentrations of uranium. Sudden accidental releases were also analyzed for both the radiological and the chemical hazards. Assuming the complete hydrolysis of the entire contents of a single cylinder, the resulting concentrations were estimated to be below toxic levels.

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[20] Again, since the majority of uranium covered by this EA is natural uranium, the risks are even lower than in the Russian Purchase EA.

4.3 Socioeconomic Impacts

Before it may sell uranium pursuant to the *USEC Privatization Act*, DOE is required by section 3112(d)(2)(B) of the Act to make a determination that such sales will not have an adverse material impact on the domestic uranium mining, conversion, or enrichment industries, taking into account other DOE sales of uranium and uranium sales under the *Russian HEU Agreement* and the *Suspension Agreement*. Such determinations may be made on a periodic basis (for example, for all contemplated sales over a certain period), as opposed to on a sale-by-sale basis. Under any of the alternatives that involve the sale of DOE's surplus uranium, the Department would make a determination prior to initiating such sales.

4.3.1 Socioeconomic Impacts on the Domestic Uranium Production Industry

The impacts of the Department's disposition alternatives for surplus uranium on the domestic uranium industry will depend in large part on the degree to which supply and demand are balanced during the period of delivery to the market because they are the major determinants of production and employment in the uranium industry. Domestic utilities could also be affected by the sale of this material because DOE would become an additional source of uranium supply under some of the alternatives.

To address the greatest potential impacts on the domestic uranium industry from the Proposed Action and the other alternatives, the analyses in this EA are based on conservative assumptions (e.g., in alternatives that allow for sales in both the United States and overseas, it is assumed that all sales will be for domestic end users even though some of the material may be sold for foreign end use.) Table 4.1 provides a brief overview of the impacts of the various alternatives on the domestic uranium production industry.

Table 4.1
IMPACTS OF ALTERNATIVES ON DOMESTIC URANIUM PRODUCTION INDUSTRY

Alternative	Est. Impact on Domestic Uranium Prod. (Million lbs U_3O_8(e))	Est. Impact as a Percent of Projected Production	Period of Impacts	Domestic Utilities Benefit from Alternative
No Action	0	0 %	1996-2004	No
Proposed Action	< 0.6	7%	1996-2004	Yes
Sell Only "Russian" NU	< 0.5	5%	2002-2004	Yes
Sell All in One Year	3.3 - 4.6	46 - 53%	one year within the period 1996 - 2004	Yes
Sell All for Foreign End Use	0.0 - 1.7	0 - 20%	1996-2004 or one year	No

4.3.1.1 Impact of the No Action Alternative

If the decision is made to continue to store the uranium rather than sell it, (including the transferred "Russian" uranium), there would be no effect on domestic production or employment

4.3.1.2 Impact of the Proposed Action

If DOE offered for sale its surplus uranium, as well as the "Russian" uranium transferred to the Department under the *USEC Privatization Act*, over a number of years beginning in 1996, it is expected that the impact on domestic uranium production would be minimal. As discussed earlier, about 67 percent of the uranium demand projected in the United States between 1996 and 2005 is expected to be supplied by foreign producers. Another 15 percent of projected demand is expected to be filled from existing inventories. Only about 18 percent of the United States demand is expected to be filled by domestic production.[21]

Average annual input into the market under the Proposed Action would be approximately 3.2 million pounds U_3O_8(e) based on the following: total material for sale (35.7 million pounds U_3O_8(e)), less about half of the transferred "Russian" uranium expected to be sold to the Russians for use in matched sales (7.1 million pounds U_3O_8(e)), divided by 9 years, the time frame (1996-2004) the material is expected to enter the market (i.e., (35.7 minus 7.1 divided by 9 years equals approximately 3.2). During the last three years of this period (i.e., 2002-2004), the majority of the

[21] While some of the new domestic uranium production could be used to fill foreign demand, for the purposes of determining the maximum impact on the domestic uranium production industry as a result of DOE taking the Proposed Action, all of this material is assumed to be applied to satisfying domestic demand.

material entering the market would be the remaining transferred "Russian" uranium. This could enter the market at a maximum of three million pounds per year beginning in 2002.

As noted above, only about 18 percent of domestic demand is expected to be filled by domestic production. Thus, DOE assumes that its uranium would displace domestic uranium by that same fraction which means that each year, 3.2 million pounds U_3O_8(e) would displace 576,000 pounds U_3O_8(e) of domestic production. The sale of transferred "Russian" uranium to the Russians would not be expected to impact the domestic uranium production industry, because the uranium would displace other Russian uranium that could have come into the country under the *Suspension Agreement*.

The Department intends to sell, to the extent feasible, a portion of its uranium overseas or for overfeeding the gaseous diffusion plants. This would further mitigate the impact of this material on the domestic uranium industry. However, for the purposes of this conservative analysis, all of the uranium is assumed to be sold for use in the United States.

Table 4.2
PROJECTED DOMESTIC PRODUCTION LEVELS AND ESTIMATED EMPLOYMENT LEVELS

Year	Projected Domestic Production Level (million lbs U_3O_8(e))[(1)]	Est. Percentage of Domestic Demand Satisfied by Domestic Production[(2)]	Estimated Domestic Employment Level[(2)]
1996	7.2	15.4%	641
1997	8.0	17.1%	712
1998	8.2	17.0%	730
1999	8.2	18.1%	730
2000	8.2	17.3%	730
2001	8.4	18.0%	748
2002	8.4	17.9%	748
2003	8.7	18.8%	774
2004	8.8	18.6%	783
Average	8.2	17.6%	733

Source: [(1)]Adapted from Preliminary Information from Energy Information Administration , *World Nuclear Outlook, 1996*, Table 14; [(2)]estimated using projected domestic production level divided by average domestic productivity rate per employee for 1995 as calculated from information in Energy Information Administration, *Uranium Industry Annual, 1995.*

Based on the conservative assumption that all of the Department's surplus uranium and about half of the transferred "Russian" uranium would be sold in the United States for domestic end use, the projected annual displacement of about 576,000 pounds U_3O_8(e) of new domestic production represents approximately seven percent of projected domestic production during the period from

1996 - 2004 (see Table 4.2). Using the 1995 average domestic uranium productivity rate of 11,235 pounds U_3O_8(e)/employee, discussed in Section 3.3.2.1, the sale of this uranium by DOE could impact average employment in the domestic uranium production industry by approximately 51 persons annually, a potential decrease to 682 persons from the projected average industry employment level of 733 persons. This reduced number is still 28 percent higher than 1995 employment level of 534 persons.

Because other jobs in the affected communities may also be impacted by a loss of employment in the uranium mining industry, a review of these projected impacts is also warranted. Using information from the Bureau of Economic Analysis, it is possible to determine an average multiplier for the states with active uranium production facilities. From this data, it was determined that the average employment multiplier was about 2.5.[22] With regard to the total labor force of approximately 42,415 in the affected communities, a drop in employment of 51 uranium production workers would be expected to decrease employment in the affected communities by about 128 workers (51X2.5=128) or about three-tenths of one percent of the total labor force.

4.3.1.3 Impact of the Sell Only Transferred "Russian" Uranium Alternative

If this alternative is selected and DOE offers for sale only the "Russian" uranium transferred to the Department under the *USEC Privatization Act*, it is expected that there would be no impact or a minimal impact on domestic uranium production. It is expected that about half (i.e., approximately seven million pounds) of the transferred "Russian" uranium would be sold to the Russians for use in matched sales as allowed in the *USEC Privatization Act*. This material would be used as the Russian component in matched sales and would have no impact on the domestic uranium industry beyond that already allowed under the *Suspension Agreement* (See Table 4.3).

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[22] The average employment multiplier for the "miscellaneous mining" industry (uranium mining is not broken out separately) in the states of Louisiana, Nebraska, Texas, Wyoming, and Utah is 2.539. This figure represents a measure of the flowdown of the impact of adding one job in a specific industry. In this example, if one job were added to the mining industry in these states it would be expected to generate a total change of about 2.5 jobs in all industries. (Source: Bureau of Economic Analysis, *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II) Second Edition,* May 1992)

Table 4.3
SALES QUOTAS FOR RUSSIAN MATCHED SALES ALLOWED UNDER THE SUSPENSION AGREEMENT

Year	Russian Uranium Allowed to be Imported for Use in Matched Sales Under Antidumping Suspension Agreement
1996	1,930,000
1997	2,710,000
1998	3,600,000
1999	4,040,000
2000	4,230,000
2001	4,040,000
2002	4,890,000
2003	4,300,000

The remainder of the transferred "Russian" uranium would be sold, to the extent possible, outside the United States or for use in overfeeding the gaseous diffusion plants. Sale of the transferred "Russian" uranium for either or both purposes would not impact the domestic uranium production industry. If such sales do not materialize, the Department would sell the remaining "Russian" uranium in 2001 for domestic use beginning in 2002, at a maximum rate of three million pounds U_3O_8(e) per year.

Assuming conservatively that all of the remaining transferred "Russian" uranium is sold in 2001 for domestic use beginning in 2002 at a rate not to exceed three million pounds U_3O_8(e) per year, 7.1 million pounds U_3O_8(e) would be placed into the domestic market between 2002 and 2004. The average annual domestic production during this period is expected to be 8.6 million pounds U_3O_8(e) and is expected to satisfy about 18 percent of domestic demand.

Using the average 1995 productivity rate per employee of 11,235 pounds U_3O_8(e), this alternative would lead to an expected average employment level of 768 workers. The impact of the Department selling the remaining transferred "Russian" uranium in this manner would be an expected annual displacement of about 432,000 pounds U_3O_8(e) of new domestic uranium production. This represents approximately five percent of projected domestic production during the period from 2002 - 2004. The sale of this uranium by DOE could, therefore, be expected to decrease employment in the domestic uranium production industry by approximately 38 workers, to 730 workers from the projected average employment level of 768 workers, 37 percent higher than the 1995 employment level.

As discussed in Section 4.3.1.2, the average employment multiplier for the mining in the states with active uranium production facilities is about 2.5. With regard to the total labor force of approximately 42,415 in the affected communities, a drop in employment of 38 uranium production workers would be expected to decrease employment in the affected communities by 95 workers (38X2.5=95) or about two-tenths of one percent of the total labor force.

4.3.1.4 Impact of the Sell Transferred "Russian" Uranium and DOE Surplus Uranium for Domestic End Use Alternative

If this alternative is selected, it is expected to impact the domestic uranium production industry. The release of 21.5 million pounds U_3O_8(e) into the domestic market in a single year sometime in the period 1996-2001, or up to 24.5 million pounds U_3O_8(e) in 2002, 2003, or 2004, would be significant, notwithstanding that the impact of the transferred "Russian" uranium would continue to be mitigated by the sale of almost half of it to the Russian Executive Agent for use in matched sales, and the stipulation that the remaining transferred "Russian" uranium sold in 2001 would be placed into domestic use beginning in 2002 at a maximum level of three million pounds U_3O_8(e) per year.

Depending on the year the uranium is sold, it would have a slightly larger or smaller impact on the domestic uranium production industry. Releasing 21.5 - 24.5 million pounds U_3O_8(e) in the domestic market in a single year would be expected to displace between 3.3 million and 4.6 million pounds U_3O_8(e) of domestic uranium production, or between 46 percent and 53 percent of the projected production for any given year between 1996 and 2004. As a result, it is possible that there could be a similar, 46 percent to 53 percent impact on uranium production industry employment in that year, reducing projected nationwide employment by between 295 and 410 workers.

As discussed in Section 4.3.1.2, the average employment multiplier for the mining industry in the states with active uranium production facilities is about 2.5. With regard to the total labor force of approximately 42,415 in the affected communities, a drop in employment of between 295 and 410 uranium production workers would be expected to decrease employment in the affected communities by between 738 and 1,025 workers or between 1.7 and 2.4 percent of the total labor force. Thus, while the impact of such a one time occurrence would be small in terms of the impact on the total labor force in the affected communities, it would likely affect the domestic uranium industry.

4.3.1.5 Impact of the Sell Transferred "Russian" Uranium for Use in Matched Sales, Overfeeding, or with DOE Surplus Uranium for Foreign End Use Alternative

Selling all of the transferred "Russian" uranium for use in matched sales, overfeeding the enrichment plants, or with the DOE surplus uranium for foreign end use would minimize the impact of the sale on the domestic uranium production industry. However, this alternative may not be feasible, because of trade restrictions and political considerations.

The United States is by far the largest user of uranium in the world, larger than any other single region, such as western Europe, which is the next largest user of uranium. There are also limits placed on the amount of foreign origin uranium allowed in some overseas markets. For example, EURATOM signatory countries, through the EURATOM Supply Agreement, seek to limit their dependence on any one supplier to 20 percent of demand. Similarly, Japan, another major importer of uranium, has been reluctant to accept Russian origin uranium due to longstanding political issues; consequently the Japanese may not want to buy any of the transferred "Russian" uranium from DOE.

Assuming the Department were able to sell its uranium for foreign end use, the sales could still affect the domestic uranium production industry. However, the impact would be expected to be much smaller than the impact from the sale of this material for domestic end use, because the vast majority of the uranium produced in the United States is purchased for domestic end use.[23] Nevertheless, uranium is a fungible commodity in the world market, and, therefore, any sale by DOE, even if it were restricted to foreign end use, might have the potential to impact the domestic uranium production industry.

Table 4.4.
PROJECTED WORLDWIDE URANIUM DEMAND AND DOMESTIC PRODUCTION LEVELS

Year	Projected World Demand (million lbs U_3O_8(e))	Projected U.S. Production (million lbs U_3O_8(e))	% Demand Satisfied by U.S. Production
1996	151.5	7.2	4.8%
1997	157.5	8.0	5.1%
1998	157.3	8.2	5.2%
1999	148.6	8.2	5.5%
2000	154.1	8.2	5.3%
2001	158.4	8.4	5.3%
2002	149.5	8.4	5.6%
2003	157.7	8.7	5.5%
2004	151.1	8.8	5.8%
Average	154.0	8.2	5.3%

Source: *EIA World Nuclear Outlook, 1995*, Tables 11 for Projected World Demand and Preliminary Information from Table 14 for Projected United States Production from the *EIA World Nuclear Outlook, 1996*.

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[23] In 1995, 6.0 million pounds of U_3O_8 were produced in the United States: domestic producers delivered 5.3 million pounds to domestic utilities, and producers added 0.6 million pounds to their inventories. (Source: EIA Uranium Industry Annual 1995, Tables 5 and 33.) The remaining 0.1 million pounds was not accounted for and may have been delivered to foreign users.

Domestic production is expected to satisfy about 5.3 percent of the world's demand for uranium over the next several years. (See Table 4.4) As discussed in Section 4.3.1.2, DOE's average annual input into the uranium market would be the equivalent of 3.2 million pounds U_3O_8(e). DOE assumes that its uranium would displace domestic uranium in the world market in the same proportion that domestic uranium fills the world market. (That is, 5.3 percent of DOE's uranium would displace domestic uranium that would otherwise have been sold abroad.) An annual average input of 3.2 million pounds U_3O_8(e) of DOE uranium would be expected to displace about 170,000 pounds U_3O_8(e), or about two percent of annual domestic production. If all the remaining uranium except that set aside for use in matched sales were sold in a single year for foreign end use, its expected impact on domestic uranium production could be as high as 1.7 million pounds U_3O_8(e), or about 20 percent of projected production in any given year. In terms of employment, the impact of selling this material for foreign end use would be expected to range from no impact to a projected decrease of about 150 workers.

As discussed in Section 4.3.1.2, the average employment multiplier for the mining industry in the states with active uranium production facilities is about 2.5. With regard to the total labor force of approximately 42,415 in the affected communities, a maximum drop in employment of up to 150 uranium production workers would be expected to decrease employment in the affected communities by 375 workers or about nine-tenths of one percent of the total labor force.

This alternative could also result in the lowest return to the United States Government. If sold overseas, DOE's uranium may have to be sold at the "unrestricted" rather than the "restricted" price. (As discussed earlier, the restricted price reflects a premium paid for uranium that can be used in the United States or Europe without any of the restrictions associated with uranium from countries of the former Soviet Union.) Although this premium has been as high as 50 percent[24], recent quotes place it at about 6 percent.[25] Disregarding the transferred "Russian" uranium set aside for use in matched sales, which must by law be sold to the Russians at its purchase price, a six percent difference in price could mean a loss of over $25 million at today's prices.[26] Finally, selling all the uranium for foreign end use would eliminate the potential benefit to domestic utilities from the sale of this material. In a time of diminished supply, the DOE material would offer an additional source of supply.

4.3.2 Socioeconomic Impact on the Domestic Uranium Conversion Industry

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[24] In April and May 1995, the quoted restricted price was over 50 percent higher than the unrestricted price as quoted in *The NUCLEAR Review*, December, 1995, p. 27.

[25] As quoted in the September 23, 1996 issue of *NuclearFuel*, the average restricted market price of $16.05 per pound of U_3O_8 was 5.9 percent higher than the unrestricted price of $15.15 per pound of U_3O_8 for Commonwealth of Independent States uranium.

[26] When this difference is applied to the proposed sale of 28.7 million pounds of U_3O_8, the material remaining after subtracting about half of the transferred "Russian" uranium which will be sold back to the Russian Executive Agent for use in matched sales, the difference in revenues is estimated to be $25,830,000.

Table 4.5
IMPACTS OF ALTERNATIVES ON DOMESTIC URANIUM CONVERSION INDUSTRY

Alternative	Est. Impact on Domestic Conversion Industry (million lbs U_3O_8(e))	Est. Impact as a percent of Projected Production	Period of Impacts	Domestic Utilities Benefit from Alternative
No Action	0.0	0%	1996-2004	No
Proposed Action	2.0	7%	1996-2004	Yes
Sell Only "Russian" NU	1.5	5%	2002-2004	Yes
Sell All in One Year	13.8 to 15.7	46 - 52%	one year, 1996 - 2004	Yes
Sell All for Foreign End Use	0.0 - 5.7	0 - 19%	1996-2004 or in any one year	No

The conversion market is probably the tightest of all of the nuclear fuel cycle components in terms of supply versus demand. As reported in *NuclearFuel*, "The main United States and European suppliers of conversion are thought to be operating their plants at or near capacity, and production is considered by market analysts to be barely keeping pace with consumption. Some sources close to the conversion supply world hold that nameplate capacity of United States and European converters may be falling short of consumption by up to 10 percent annually" (*NuclearFuel*, Oct. 9, 1995, p. 4). Unlike U_3O_8, there are no large inventories of UF_6. Table 4.5 provides a brief overview of the impacts of the various alternatives being considered on the domestic uranium conversion industry.

Table 4.6
CONVERDYN PRODUCTION VS. DOMESTIC/WORLD MARKETS
(millions pound U_3O_8(e))

Year	ConverDyn Production[1]	Domestic Utilities Deliveries to Enrichment Plants[2]	ConverDyn Production as a % of Domestic Market	World Market for Conversion Services[1]	ConverDyn Production as a % of World Market
1993	22.1	35.1	63.0%	111.0	19.9%
1994	21.6	37.6	57.4%	118.3	18.2%
1995	31.2	44.3	70.4%	107.1	29.1%
Average	25.0	39.0	64.1%	112.1	22.3%

Source: (1) *NUEXCO Review* 1993 and 1994 Annuals and discussions with E. Rutkowski (TradeTech) on 7/1/96; (2) EIA *Uranium Industry Annual, 1995*, Table 23.

As shown in Table 4.6, ConverDyn's production over the last three years has represented approximately 64 percent of the conversion services required by domestic utilities and over 22 percent of the world market. From 1996 to 2004, the average projected deliveries by utilities to enrichment plants around the world are estimated to be 148.5 million pounds U_3O_8(e). This would exceed by about 32 percent the average of 112.1 million pounds U_3O_8(e) delivered from 1993-1995 as shown in Table 4.6.[27] Because EIA does not project domestic conversion or enrichment production levels as it projects domestic uranium production, for the purposes of this analysis an average of the past three years has been used to project future production levels. By taking a three-year average, a year that may not be representative of the plant's normal production level will not unduly affect the analysis.

4.3.2.1 Impact of the No Action Alternative

If the decision is made to continue to hold the DOE surplus uranium in storage rather than sell it (including the transferred "Russian" uranium), there would be no effect on domestic conversion production or employment.

4.3.2.2 Impact of the Proposed Action

Assuming that ConverDyn continues to satisfy about 20 percent of the world's conversion market, production would be expected to average about 30 million pounds U_3O_8(e) annually during the 1996-2005 time frame, 20 percent more than the 1993-1995 average production level. Therefore, if the Proposed Action is selected and DOE offers for sale its surplus uranium as well as the "Russian" uranium transferred to the Department under the *USEC Privatization Act* over a number of years beginning in 1996, it is expected that the impact on domestic uranium conversion industry would be minimal.

As explained in Section 4.3.1.2, DOE's average annual release of uranium into the market would amount to 3.2 million pounds U_3O_8(e). DOE assumes that its uranium would displace domestic conversion services in the same proportion as domestic conversion services currently supply the domestic market. If ConverDyn's production continues to equal about 64 percent the domestic market (as shown in Table 4.6), DOE's uranium sales would be expected to displace about 2.0 million pounds U_3O_8(e) in domestic conversion services (i.e., 64 percent of 3.2 million is about 2.0 million). As a result, ConverDyn's production could be expected to drop by about seven percent from its projected level (i.e., ConverDyn's projected production would drop from 30 million pounds U_3O_8(e) to 28 million pounds U_3O_8(e), a reduction of 2 million pounds U_3O_8(e); about a seven percent drop). The impact on employment would be expected to be minimal, because the projected production level of 28 million pounds U_3O_8(e) would continue to be higher than the average production level from 1993-1995, of 25 million pounds U_3O_8(e).

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[27] From 1996-2004, the annual average deliveries by domestic utilities to enrichment plants is expected to be 42.2 million pounds U_3O_8(e) versus the annual average of 39.0 million pounds U_3O_8(e) delivered in 1993-1995. Source: EIA *Uranium Industry Annual, 1995*, Table 24.

The sale of transferred "Russian" uranium to the Russians for use in matched sales would not be expected to impact the domestic uranium conversion industry because the uranium would displace other Russian uranium that could have come into the country under the *Suspension Agreement*. Under the terms of the *Suspension Agreement*, the form of the uranium in the matched sales must be matched with a like form (e.g., UF_6 with UF_6 or U_3O_8 with U_3O_8); any Russian UF_6 sold by the Russians in a matched sale would be have to be matched with new domestic production, which most likely would have been converted in the United States. Therefore, the use of the transferred "Russian" uranium in matched sales guarantees that an equivalent amount of domestic uranium would be converted in the United States.

The Department intends to try to sell, to the extent possible, the remainder of the transferred "Russian" uranium overseas or for overfeeding the gaseous diffusion plants. This would further mitigate the impact of this material on the domestic uranium conversion industry. However, for the purposes of this conservative analysis, all of the remaining "Russian" uranium is assumed to be sold in 2001 for delivery in 2002-2004 as required by the *USEC Privatization Act*.

4.3.2.3 Impact of the Sell Only Transferred "Russian" Uranium Alternative

If this alternative is selected and DOE offers for sale only the "Russian" uranium transferred to the Department under the *USEC Privatization Act*, it is expected that there would be no impact or a minimal impact on domestic conversion operations. It is expected that about half (i.e., approximately 7 million pounds U_3O_8(e)) of the transferred "Russian" uranium will be sold by the Department to the Russians for use in matched sales as allowed in the *USEC Privatization Act*. This material would be used as the "Russian" component in matched sales and would have no impact on the domestic conversion industry beyond that already allowed under the *Suspension Agreement*. The remainder of the transferred "Russian" uranium would be sold, to the extent possible, outside the United States or for use in overfeeding the gaseous diffusion plants. Sale of the transferred "Russian" uranium for either or both purposes would not be expected to impact domestic conversion capabilities.

If such sales are not possible, the Department will sell the remaining "Russian" uranium in 2001 for domestic use beginning in 2002, at a maximum rate of 3 million pounds U_3O_8(e) per year. As a result, 7.2 million pounds U_3O_8(e) would be placed into the domestic market between 2002 and 2004, an annual average of 2.4 million pounds U_3O_8(e). Assuming domestic conversion services continue to satisfy about 20 percent of the annual world demand during these years, ConverDyn would be expected to operate at an annual production level of about 29 million pounds U_3O_8(e) during these years. Based on ConverDyn continuing to supply about 64 percent of the domestic demand for conversion services, sale of the transferred "Russian" uranium for domestic use would be expected to reduce ConverDyn's projected production level by 1.5 million pounds U_3O_8(e) (i.e., 64 percent of 2.4 million pounds U_3O_8(e) is about 1.5 million pounds U_3O_8(e)), for a revised production level of 27.5 million pounds U_3O_8(e). This reduction in projected production would not be expected to affect ConverDyn's current employment level because this projected production level is about 10 percent higher than the 1993-1995 average production level of 25 million pounds U_3O_8(e).

4.3.2.4 Impact of the Sell Transferred "Russian" Uranium and DOE Surplus Uranium for Domestic End Use Alternative

If this alternative is selected and DOE offers for sale all of its natural uranium equivalent in a single year for domestic use, it is expected to impact domestic uranium conversion operations. The impact of the transferred "Russian" uranium would continue to be mitigated by the sale of almost half of the material back to the Russian Executive Agent for use in matched sales, and by the stipulation that the remaining transferred "Russian" uranium be placed into domestic use beginning in 2002 at a maximum level of three million pounds U_3O_8(e) per year. However, the release of 21.5 million pounds U_3O_8(e) in the domestic market in a single year between 1996-2001, or at a level of 24.5 million pounds U_3O_8(e) in 2002, 2003, or 2004, could be considered significant.

Depending on the year the DOE uranium is sold, it would have a slightly larger or smaller impact on the domestic uranium conversion industry. Releasing 21.5 - 24.5 million pounds U_3O_8(e) in the domestic market in a single year would be expected to displace between 13.8 and 15.7 million pounds U_3O_8(e) of domestic uranium conversion or between 46 and 52 percent of the projected production level of 30 million pounds U_3O_8(e) for any given year between 1996 and 2004.

4.3.2.5 Impact of the Sell Transferred "Russian" Uranium for Use in Matched Sales, Overfeeding, or with DOE Surplus Uranium for Foreign End Use Alternative

Selling all the uranium for use in matched sales, overfeeding, or foreign end use would likely minimize the impact of the sale of this material on domestic conversion facilities. However, as discussed in Section 4.3.1.5, this alternative may not be feasible. The United States is by far the largest user of uranium in the world, larger than any other single region such as Western Europe, the next largest user of uranium. While this alternative would likely lessen the impact of the sale of this material on the domestic conversion industry by displacing uranium more likely to be converted overseas, such an action would deprive domestic utilities of their ability to benefit from the sale of this material and likely result in the lowest return to the United States Government, as explained in Section 4.3.1.5.

If conversion services, like uranium, are considered fungible, the sale of DOE uranium even for foreign end use only could have an impact on the domestic conversion market. If domestic conversion services are assumed to continue to fulfill about 20 percent of the world's demand, the annual sale of an average of 3.2 million pounds U_3O_8(e) over the period 1996-2004 would be expected to impact domestic conversion services by a maximum of about 640,000 pounds U_3O_8(e) annually (i.e., 20 percent of 3.2 million equals 640,000 pounds U_3O_8(e)), or 2.1 percent of the projected annual production (i.e., 640,000 divided by 30 million is about 2.1 percent). If all the uranium that remains after the sale of material for use in matched sales (i.e., 28.7 million pounds U_3O_8(e)) is sold for foreign end use in a single year, the impact on the domestic uranium conversion industry could be as high as 5.7 million pounds (i.e., 20 percent of 28.7 million is about 5.7 million pounds U_3O_8(e)), or about 19 percent of the projected annual production in any given year (i.e., 5.7 million pounds U_3O_8(e) divided by the projected production rate of 30 million pounds U_3O_8(e) represents about a 19 percent drop in production).

4.3.3 Socioeconomic Impact on the Domestic Uranium Enrichment Industry

Table 4.7
DOMESTIC UTILITIES' PURCHASES OF ENRICHMENT SERVICES
(SWU in Millions)

Year	USEC Sales to Domestic Utilities	Domestic Utilities' SWU Purchases	Percent of Domestic Market
1993	8.1	8.8	92.0%
1994	7.5	9.2	81.5%
1995	6.7	9.5	70.5%
Average	7.4	9.2	81.1%

Source: EIA *Uranium Industry Annual*, 1993, 1994 and 1995.

The market for uranium enrichment services in the United States has become increasingly competitive in recent years (See Table 4.7). In 1995, just over 70 percent of domestic utilities' enrichment purchases were from USEC, the only domestic provider of enrichment services. This is a significant drop from the more than 90 percent share of the domestic market enjoyed by USEC as recently as 1993. Table 4.8 provides a brief overview of the impacts of the various alternatives on the domestic uranium enrichment industry.

Table 4.8
IMPACTS OF ALTERNATIVES ON DOMESTIC URANIUM ENRICHMENT INDUSTRY

Alternative	Est. Impact on Domestic Enrichment (SWU in millions)	Est. Impact as Percent of Projected Production	Time Frame of Impacts	Domestic Utilities Benefit from Alternative
No Action	0	0%	1996-2004	No
Proposed Action	<0.3	<2%	one year within 1996-2004	Yes
Sell Only "Russian" NU	0	0%	1996-2004	Yes
Sell All in One Year	0	0%	1996-2004	Yes
Sell All for Foreign End Use	3.8 to 4.6	3% to 5%	1996-2004	No

4.3.3.1 Impact of the No Action Alternative

If the decision is made to continue to hold DOE's excess uranium, including the transferred "Russian" uranium, in storage, there will be no effect on the domestic enrichment industry because the material will not be sold into the uranium market.

4.3.3.2 Impact of the Proposed Action

As discussed in Section 4.3, because EIA does not project domestic conversion or enrichment production levels as it projects domestic uranium production, for the purposes of this analysis an average of the past three years has been used to project baseline future production levels. By taking a three-year average, a year that may not be representative of the plant's normal production level will not unduly affect the analysis.

If the Proposed Action is selected and DOE offers for sale its surplus uranium, as well as the "Russian" uranium transferred to the Department under the *USEC Privatization Act,* over a number of years beginning in 1996, it is expected that the impact on the domestic uranium enrichment industry would be negligible. Only a small portion of the material DOE would offer for sale has been enriched. The material that is enriched is 45 metric tons of 4.5 percent LEU. It takes about 1.2 million pounds of natural uranium and 280,000 separative work units (SWU) to make 45 metric tons of 4.5 percent LEU.

The Proposed Action would be expected to reduce domestic SWU sales over the period by 280,000 SWU. Assuming USEC continues to capture about 80 percent of the domestic SWU sales, these 280,000 SWU could displace about 224,000 SWU of production from USEC. (See Table 4.8) In 1995, USEC produced an estimated 12 million SWU, a level consistent with its production levels in 1993 and 1994 (TradeTech discussion of 7/1/96). Assuming USEC production continues at this level, the sale of the DOE LEU could be expected to decrease USEC production by less than two percent in the year the material was sold. Such a small, one-time aberration is not expected to impact USEC or employment at the gaseous diffusion plants.

4.3.3.3 Impact of the Sell Only Transferred "Russian" Uranium Alternative

If this alternative is selected and DOE offers for sale only the "Russian" uranium transferred to the Department under the *USEC Privatization Act*, it is not expected to impact the domestic uranium enrichment industry. The uranium would still need to be enriched and since the assumption is that the material will be sold for domestic use, USEC will be the most likely enricher given its dominance of the domestic enrichment market. The material will most likely displace other natural uranium hexafluoride that would have been sent to USEC to be enriched during the time frame.

4.3.3.4 Impact of the Sell Transferred "Russian" Uranium and DOE Surplus Uranium for Domestic End Use Alternative

If this alternative is selected and DOE offers for sale all of its natural uranium equivalent in a single year for domestic use, it is not expected to impact the domestic uranium enrichment industry. As in the previous alternative, the majority of the uranium would most likely continue to be enriched by USEC, given USEC's dominance of the domestic market. Even if all of the uranium were sold in a single year, it would not necessarily have to be enriched in the same year. The material would probably continue to be stored at the gaseous diffusion plants until it needed to be enriched to meet the buyer's schedule. As a result, the uranium would not likely result in either an increase or a decrease in production at the gaseous diffusion plants.

4.3.3.5 Impact of the Sell Transferred "Russian" Uranium for Use in Matched Sales, Overfeeding, or with DOE Surplus Uranium for Foreign End Use Alternative

By selling all of the uranium, except the portion of the transferred "Russian" uranium that will be used in matched sales, for foreign end use, DOE may have a small impact on the domestic uranium enrichment industry. Because foreign buyers of the uranium are more likely to use foreign enrichers, the sale of 28.7 million pounds of natural uranium equivalent for foreign end use could have a somewhat greater effect than the Proposed Action on USEC's production levels from 1996 to 2006.

Whereas USEC dominates the domestic enrichment market, its hold on the foreign market is much smaller. USEC controls between 33 percent and 40 percent of the world's enrichment market.[28] From 1996 to 2004, the enrichment market is projected to average between 32.3 million and 33.1 million SWU (EIA, World Nuclear Outlook 1995, Table 16). From the same table, EIA estimates that domestic demand will average 9.8 million SWU during the same time frame. Assuming USEC continues to capture about 80 percent on average of domestic demand, USEC's annual domestic enrichment sales would average 7.8 million SWU. If USEC continues to control between 33 percent and 40 percent of the world market, USEC's average annual worldwide sales would be between 10.7 million and 13.2 million SWU during this time frame. As a result, it is estimated that annually, USEC would capture between 2.9 million and 5.4 million SWU outside the United States When compared to the average demand outside the United States of 22.5 million to 23.3 million SWU, USEC's foreign enrichment sales capture rate is projected to range between 12 percent and 24 percent.

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[28] In the *NUEXCO Review 1994 Annual*, NUEXCO reports that, "In 1994 USEC also maintained its dominant share of the world market by delivering about 40 percent of the world's enrichment requirement ...." (p. 16) In its 1995 Annual Report, USEC reports that, "USEC is the world's leading producer and marketer of uranium enrichment services with about four-fifths of the United States market and over one-third of the world market." (p. 10)

To determine the maximum impact of this alternative on USEC, the number of SWU needed to enrich the natural uranium to commercial enrichment levels must be estimated. For the purposes of this analysis, it is assumed that the natural uranium is enriched to 4.0 percent LEU at 0.3 percent tails.[29] (See Appendix A for a more complete explanation of the enrichment process.) This would result in a requirement for 6.5 million SWU, which includes the 280,000 associated with the LEU being offered for sale by DOE. Assuming USEC captured between 12 percent and 24 percent of this work, only 0.8 million to 1.6 million SWU would be captured by USEC. This should be compared to USEC's 80 percent expected capture rate of 5.4 million SWU if the uranium was sold for domestic end use. The difference is 3.8 million to 4.6 million SWU, or an average of between 3.2 percent and 4.8 percent of USEC's projected enrichment sales during this period.[30]

4.4 Accident Analysis

The analysis of bounding accident scenarios for the Proposed Action and alternatives is based on the safety analysis reports prepared by the USEC for its certification application to the U.S. Nuclear Regulatory Commission (NRC). [31]

4.4.1 Proposed Action

Under the Proposed Action, DOE would sell both natural and LEU as described in Section 2.0. Potential accidents associated with both the natural uranium and the LEU are described below.

4.4.1.1 Natural Uranium

The natural uranium proposed for sale would require enrichment by USEC at the Portsmouth and Paducah gaseous diffusion plants.[32] Because these enrichment actions would be conducted by USEC regardless of the action taken or not taken by DOE, the enrichment actions are not analyzed

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[29] Tails refers to the level of ^{235}U the uranium in the enrichment process is driven to before it is discarded as depleted uranium. In this example, natural uranium at 0.711 percent ^{235}U would be left in the enrichment process until it reached a level of 0.3 percent ^{235}U.

[30] Using USEC's projected annual sales of 10.7 - 13.2 SWU, its total sales for the 1996 - 2004 time frame would be between 96.3 million and 118.8 million SWU. A reduction in these amounts of between 3.8 million and 4.6 million SWU would result in a decrease in USEC sales of between 3.2 percent and 4.8 percent.

[31] The accident scenarios considered in this EA were obtained from the safety analysis report prepared by USEC as part of its application to the U.S. Nuclear Regulatory Commission (NRC): *Application for U.S. Nuclear Regulatory Commission Certification*, Volume 2, Portsmouth Gaseous Diffusion Plant Safety Analysis Report, Revision 3, May 1996; and *Application for United States Nuclear Regulatory Commission Certification*, Volume 2, "*Paducah Gaseous Diffusion Plant Safety Analysis Report*", Revision 2, January 19, 1996.

[32] The description of the actions and impacts are applicable to both sites unless otherwise noted.

in this EA. The following activities are components of the Proposed Action and form the basis for the accident analysis (see Appendix B for descriptions of these activities):

- interim storage of cylinders;
- cylinder maintenance and inspection;
- sampling and analysis of cylinder contents (liquefaction of the UF_6); and
- cylinder handling and transport to the enrichment cascade.

Most of the sampling activities would likely occur on the 14.2 million pounds U_3O_8(e) of transferred "Russian" uranium that would continue to arrive at Portsmouth between now and the end of 1996. (The 20.3 million pounds U_3O_8(e) at Paducah was received under DOE/USEC control and accountability and the contents of those cylinders would likely not need additional verification.) Approximately one in ten of the incoming cylinders would be subject to statistical selection for sampling.

The bounding accident scenario that could result from these activities is associated with sampling and analysis during movement of cylinders filled with liquid UF_6. Administrative and procedural controls have been established to protect against accidents. Such controls include moving the cylinders as low to the ground as possible, and prohibiting movement of liquid-filled cylinders over other liquid-filled cylinders. In absence of these controls, two bounding accident scenarios are postulated:

- liquid cylinder drop and puncture inside a building; and
- liquid cylinder drop and puncture outside a building in the interim storage yard.

These two accident scenarios are summarized in Table 4.9 and further described below with a discussion of the health effects that could be expected.

4.4.1.1.1 Bounding Accident Scenario Inside a Building

<u>Accident Scenario</u> - This accident scenario involves the drop and puncture of a cylinder filled with liquid UF_6 during the sampling and analysis activity. The UF_6 plume would be released inside the building housing the autoclave. In most scenarios, the drop and puncture of a UF_6 feed cylinder would not present a serious safety concern because the UF_6 in the cylinder is in a solid form. However, when the cylinder contents have been liquefied for sampling and analysis, a more serious safety concern exists. Such an accident scenario could result from dropping a liquid-filled UF_6 cylinder on a puncture point during removal from the autoclave. It is assumed that the cylinder would be dropped such that the autoclave is not able to close. (A closed autoclave provides additional containment.) The leakage rate from a cylinder puncture could range from minor leakage to an outrush of the complete contents of a full 14-ton cylinder (28,000 pounds UF_6).

Table 4.9
BOUNDING ACCIDENT SCENARIOS ASSOCIATED WITH THE PROPOSED ACTION

Accident Scenario	Source Term	Probability of Accident Occurring	Impact to Workers		Impacts to the General Public
			Involved Worker	Noninvolved Worker	
Liquid UF_6 cylinder drop inside autoclave, cylinder drop or puncture while removing from autoclave; full 14-ton cylinder release	28,000 lbs UF_6 released inside a building	Extremely Low Occurrence is expected to be less than once every 1,000 years. ($p < 1 \times 10^{-3}$ years)	Death to workers within 100 feet of release	Kidney damage and skin irritation to non-involved workers within 1,000 feet of release	Possible skin irritation and kidney damage to persons within 25,000 feet (4.5 miles) of release
Liquid UF_6 cylinder drop outside in interim storage or "cool-down" yard	28,000 lbs UF_6 released outside a building in an interim storage yard	Extremely Low Occurrence is expected to be less than once every 1,000 years. ($p < 1 \times 10^{-3}$ years)	Death to workers from 100 ft to 1,250 feet of release	Death to persons within 1,200 feet downwind with kidney damage to workers within 8,000 feet of release	Possible skin irritation and kidney damage to persons within 25,000 feet (4.5 miles) of release

The bounding accident is considered an extremely low probability event.[33] Procedural and administrative controls on lift heights, inspection and maintenance of cranes, and lifting fixtures have proven over the years to be effective steps to minimize the risks of this type of accident. In addition, the autoclaves are of the latest design and every effort has been made to remove puncture points. However, the possibility of such an accident does exist, and the consequences have therefore been analyzed.

It is important to note that under the Proposed Action, the overall likelihood of such an accident occurring would be further reduced because fewer cylinders would be received in the cylinder yards.

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[33] "Extremely low" means that the event is expected to occur less than once every 1,000 years, or $p < 1 \times 10^{-3}$ years.

As part of routine operations, a statistical number of incoming cylinders are selected for sampling and analysis to ensure uranium accountability and feed material specifications. Approximately one in ten cylinders is selected for sampling and analysis. Once a cylinder has been sampled, it is not heated again until the material is fed into the plant to be enriched. The existing cylinders in the storage yards were subjected to this sampling program; it is therefore not anticipated that they would require additional sampling because the contents have already been verified. Incoming cylinders would be subject to the sampling program. The accident probabilities and impacts therefore only apply to incoming cylinders subject to sampling or any existing cylinder that may require additional verification.

Health Effects - Health effects associated with this accident would be primarily chemical effects from exposure to hydrofluoric acid (HF). These chemical effects are discussed in Appendix C and include smelling HF, skin irritation, kidney damage, and possible death.

The release of up to 28,000 pounds of UF_6 would generate lethal quantities of uranyl fluoride (UO_2F_2) and hydrogen fluoride (HF) to involved workers in the immediate area (within 100 feet). However, not all involved workers would necessarily receive the full exposure level since it is assumed that personnel would immediately initiate evacuation procedures in response to the UF_6 release detection alarms. Administrative controls, standard operating procedures and plant warning systems would reduce effects to the other, noninvolved workers on the plant site. Health effects to workers located beyond 100 feet would range from smelling HF to possible kidney damage to possible death. Kidney damage to possible death could result within the area of the source release to approximately 100 feet downwind. Immediately adjoining this area would be the “renal injury” type health effect (kidney damage) ranging in a plume from 200 feet to 1,000 feet wide extending up to 25,000 feet (4.5 miles) downwind. Noninvolved workers in the area could experience effects from skin irritation to kidney damage. Off-site public within 25,000 feet (4.5 miles) from the drop site could experience effects from skin irritation to kidney damage if the release was not contained by the building. The total width of the plume would be 2,400 feet (USEC PAD: 4.7-20).

4.4.1.1.2 Bounding Accident Outside a Building

Accident Scenario - This bounding accident scenario would occur if the cylinder is dropped and punctured outside a building in an interim storage yard. Like the previous scenario, the full contents of the cylinder are assumed to be released, but in this scenario, the UF_6 plume would be released in the interim storage yard, outside the autoclave building. This bounding accident is likewise considered to be an extremely low probability event.

Health Effects - If this accident occurred, lethal doses of HF and UO_2F_2 could be released from 100 feet up to 1,250 feet away from the drop site. Noninvolved workers within 8,000 feet of the release site (depending on atmospheric conditions) could experience effects from skin irritation to kidney damage. Off-site public within 25,000 feet (4.5 miles) from the drop site could experience effects from possible skin irritation to kidney damage. At the periphery, “smell” to “possible irritation” type health effects would exist. The total plume width would be approximately 4,000 feet wide (USEC PAD 1995: 4.7-21; USEC PORTS 1996: 4.2-48a).

At Portsmouth, Ohio, as at Paducah, Kentucky, the plume would not be lethal off-site, but could cause kidney injury in persons within 25,000 feet. In Piketon, Ohio, two nursing homes are near the Portsmouth plant site. Residents of the nursing homes would be more susceptible to the off-site chemical effects, so additional analysis is provided. The nursing homes are about 1.5 miles southwest from a possible release point at the Portsmouth gaseous diffusion plant. Approximately 60 patients reside in these two nursing homes. The bounding effects to these residents would be kidney injury. Residents would have less than 45 minutes to be alerted and evacuated if the release occurred in a 2-mph wind, or less than 10 minutes in a 15-mph wind. If evacuation were not completed, the patients would receive some protection by remaining indoors with the doors and windows closed (USEC PORTS 1996: 4.2-48a).

4.4.1.2 Low Enriched Uranium

The LEU is stored as UF_6 in 30 cylinders designed and manufactured for LEU storage. These cylinders are designated as Type 30B containers and are manufactured according to standards issued by the American National Standards Institute. Most likely, the LEU would be sent directly to fuel fabricators to satisfy orders for the LEU. Thus, the gaseous diffusion plants could reduce their production by up to two percent in any one year, and the Portsmouth plant would produce less LEU, and thus fill 30 fewer LEU cylinders. The overall probability of an accident would be slightly reduced by not filling these cylinders.

In addition, the feed represented by the LEU would be equivalent to enough natural uranium to fill 50 to 70 natural uranium cylinders. The probability of an accident would be slightly reduced because these cylinders would not need to be transported to the plants.

4.4.1.3 Ecological Impacts of the Bounding Accidents

Under these bounding accident scenarios, some effects might be observed in the flora and fauna surrounding the plant sites; however, wide-spread ecological impacts would not be anticipated. Smaller accidental releases of UF_6 have occurred in the past and no adverse ecological impacts were recorded in the annual site environmental monitoring reports as discussed in Appendix C. In 1993, 6,900 pounds of HF were released at Portsmouth from the production vents (DOE PORTS 1993: C-1). Vegetation sampling in 1993, like soil samples, revealed no statistically significant environmental contamination. No uranium was detected in any of the vegetation samples, and all fluoride concentrations were well below the 30 to 40 μg/g levels, levels at which vegetative fluorides may begin to discolor the teeth of foraging cattle (DOE PORTS 1993: 5-20).

4.4.1.4 Accident Response and Mitigation

Each of the gaseous diffusion plants has an established emergency response plan which is required as part of its application to the U.S. Nuclear Regulatory Commission.[34] These emergency response plans contain specific procedures for accident scenarios including the two bounding accident scenarios analyzed in this EA. A synopsis of the emergency response plan is provided in Appendix D.

4.4.2 No Action Alternative

Under the No Action Alternative, DOE would not sell either the surplus natural uranium and LEU or the transferred "Russian" uranium. DOE would maintain the existing uranium in storage at the gaseous diffusion plants or use the material for other DOE activities (e.g., blending of DOE-owned HEU) and would not release it into the uranium market. Workers at the two gaseous diffusion plants would be required periodically to inspect and maintain the UF_6 cylinders until another use for the material is proposed.

A study was conducted at Paducah in 1974 to evaluate the condition of several UF_6 storage cylinders. The wall thickness measurements of cylinders in service for 17 years suggested that the corrosion rate was about 2 millimeters per year. Thickness ranged from 0.289 to 0.308 inches. A minimum of 0.206 inches wall thickness and 0.218 inches head thickness is required for a cylinder to pass the 100 psi rating stipulated by the ASME Boiler and Pressure Vessel Code. Based on the results of this study, the oldest cylinders were predicted to have a remaining service life of about 30 years. (USEC 1996: 3.7-2). Given the results of this study, under the No Action Alternative, DOE would need to conduct additional verification of cylinder integrity between the years 2000 and 2002. The results of that study would determine whether the cylinders would remain in the storage yards or if the cylinders would need to be replaced or swapped out as new cylinders arrived in the plant.
If the UF_6 material were used in the blending of DOE-owned HEU, the impacts of that action have been analyzed in the *Final Environmental Impact Statement for the Disposition of Surplus Highly Enriched Uranium*. Otherwise, the UF_6 cylinders would remain in the storage yards at Portsmouth and Paducah and DOE would retain ownership and management responsibilities associated with the cylinders.

Ecological impacts associated with continued operations under the No Action alternative are discussed in Appendix C.

4.4.3 Sell Only Transferred "Russian" Uranium

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[34] Emergency response plans for the plants are part of the U.S. Nuclear Regulatory Commission (NRC) application prepared by USEC: "Application for U.S. Nuclear Regulatory Commission Certification," Volume 3, Portsmouth Gaseous Diffusion Plant Emergency Plan, Revision 6, August 12, 1996; and "Application for U.S. Nuclear Regulatory Commission Certification," Volume 3, Paducah Gaseous Diffusion Plant Emergency Plan, Revision 6, August 12, 1996.

Under this alternative, a reduced quantity of material would be sold and enriched. However, 14.2 million pounds of material would still be sold and, therefore, fewer cylinders would be required to be shipped into the plant, thereby avoiding cylinder handling, sampling and analysis. The likelihood of an accident due to these cylinder handling activities would therefore be reduced accordingly. The impacts, if an accident were to occur, would be the same as those described in the Proposed Action.

4.4.4 Sell Transferred "Russian" Uranium and DOE Surplus Uranium for Domestic End Use

Impacts from this alternative would be expected to be similar to those described for the Proposed Action.

4.4.5 Sell Transferred "Russian" Uranium for Use in Matched Sales, Overfeeding, or with DOE Surplus Uranium for Foreign End Use

Under this alternative, the majority of the uranium would be sold for foreign end use. Because this alternative could involve ocean transport, the environmental impacts on the global commons from transportation accidents are considered in accordance with Executive Order 12114. Under this Executive Order, DOE must analyze the impacts of actions in the global commons, but is not required to analyze the impacts of actions taken in other countries. Global commons impacts are addressed in this EA under transportation impacts.

4.5 Cumulative Impacts

This section examines the impact of the sale of natural and enriched uranium from a number of related activities that could potentially impact the domestic uranium industry. First, a large amount of LEU and natural uranium equivalent is entering the United States from Russia as a result of the *Russian HEU Agreement* and the *Suspension Agreement*. Second, as discussed in Section 1.2, DOE has completed an Environmental Impact Statement and issued a Record of Decision regarding the blending down of HEU that the Department no longer has a need for. As discussed in the HEU EIS, the Department began transferring about 13 metric tons of HEU to USEC in 1995 for blending down and eventual sale, and will transfer up to 50 metric tons of HEU and up to 7,000 metric tons of natural uranium to USEC under section 3112 of the *USEC Privatization Act*. Finally, in this EA, the Department is proposing to sell approximately 35.7 million pounds U_3O_8(e). A discussion of these activities and their potential impact on the domestic uranium industry follows.

4.5.1 Impacts on the Domestic Uranium Production Industry

Up to five million pounds U_3O_8(e) in the form of LEU blended down from DOE's HEU inventory, some of which has been or will be transferred to USEC, may enter the domestic market each year beginning in FY 1998, depending on blend down schedules and *USEC Privatization Act* requirements.[35] Other DOE uranium that will enter the market includes up to 7,000 metric tons of natural uranium (18.2 million pounds U_3O_8(e)) being transferred to USEC as required in and restricted by the *USEC Privatization Act*.

Based on the information provided in the HEU EIS, the Department could blend down up to 70 metric tons of HEU between 1998 and 2004. The first 50 metric tons are slated to be transferred to USEC (along with up to 7,000 metric tons of natural uranium), as provided in section 3112(c)(1) of the *USEC Privatization Act*. USEC will then determine when and how this material will enter the market. However, USEC is limited by section 3112(c)(2) of the Privatization Act as to the amounts of uranium and SWU it may deliver for domestic end use in any given year. Specifically, the Act states: "The Corporation shall not deliver for commercial end use in the United States -- (A) any of the uranium transferred under this subsection before January 1, 1998; (B) more than 10 percent of the uranium (by uranium hexafluoride equivalent content) transferred under this subsection or more than 4,000,000 pounds, whichever is less, in any calendar year after 1997; or (C) more than 800,000 separative work units contained in the LEU transferred under this subsection in any calendar year."

In addition to the 50 metric tons of HEU being transferred to USEC under the *Privatization Act*, 13 metric tons of HEU is currently being blended down at Portsmouth and transferred to USEC pursuant to the Energy Policy Act of 1992. This material represents the equivalent of about 6 million pounds U_3O_8(e). Its introduction into the market will be controlled by USEC and is limited by the speed at which the material can be blended down at Portsmouth. It is currently projected to take up to five years to complete this process.

By far the largest influx of uranium into the domestic market as a result of these various federal government actions is the natural uranium associated with the *Russian HEU Agreement*. The blending down of 500 metric tons of Russian HEU in Russia over 20 years for subsequent sale by USEC represents nearly 400 million pounds U_3O_8(e). To ease concerns about the impact of this material on the domestic uranium production industry, the flow of this uranium into the domestic market is restricted by the *USEC Privatization Act*. As shown in Table 4.10, in 1998, only two million pounds U_3O_8(e) of "Russian" uranium associated with the *Russian HEU Agreement* can be sold for domestic end use, with the allowable amount increasing each year until it reaches a maximum of 20 million pounds U_3O_8(e) in 2009.[36] (With regard to the time frame being considered in this EA, the maximum amount is 14 million pounds U_3O_8(e) in 2004.)

[35] Once the 13 MT of HEU (about 6 million pounds U_3O_8(e)) at Portsmouth have been completely blended down (around 1999), the amount of blended down LEU entering the market would drop to about four million pounds U_3O_8(e), as discussed in the HEU EIS and as limited by the *USEC Privatization Act*.

[36] The 14.2 million pounds U_3O_8(e) of transferred "Russian" uranium is not included in this delivery schedule; its sale and delivery is restricted by another section of the Act.

Table 4.10
ANNUAL MAXIMUM DELIVERIES OF NATURAL URANIUM EQUIVALENT TO DOMESTIC END USERS FROM THE RUSSIAN HEU AGREEMENT

Year	**Maximum Deliveries (million pounds U3O8(e))**
1996	0
1997	0
1998	2
1999	4
2000	6
2001	8
2002	10
2003	12
2004	14
2005	16
2006	17
2007	18
2008	19
2009 and thereafter	20

Note: Natural uranium associated with the *Russian HEU Agreement* could also enter the United States market at any time as part of matched sales allowed under the *Suspension Agreement*. Such sales are limited by annual quotas. See Table 4.3.

Other Russian uranium may enter the domestic market through the *Suspension Agreement* as part of matched sales. As shown in Table 4.3, an average of 3.7 million pounds U_3O_8(e) of Russian uranium may be sold in the United States between 1996 and 2003 if the matched sales are maximized. In order for these sales to be approved by the Department of Commerce, they must be matched with an equal amount of newly produced domestic uranium. Also, as allowed by the *USEC Privatization Act*, any or all of the "Russian" natural uranium associated with the *Russian HEU Agreement*, including the 14.2 million pounds U_3O_8(e) that will be transferred to DOE, could be bought by the Russians and used in matched sales. The sale of this material in matched sales would lessen the impact on the domestic uranium industry because it would displace other Russian uranium that would otherwise be allowed to enter the country. For example, if all 14.2 million pounds U_3O_8(e) of the transferred "Russian" uranium were used in matched sales, the annual average input of uranium that would be expected to impact the domestic uranium industry as a result of actions being considered in this EA would drop from 3.2 million pounds U_3O_8(e) to 2.4 million pounds U_3O_8(e).[37]

The amount of uranium that could enter the domestic market as a result of this EA is less than the amount of uranium that could enter the domestic market as a result of DOE or Russia blending down HEU, or under matched sales if they were maximized. The amount of uranium entering the domestic market as a result of blending down United States/Russian HEU and matched sales under the *Suspension Agreement* is less in the near term and grows over time as the level of Russian uranium from the HEU Agreement that is allowed to enter the domestic market under the *USEC Privatization Act* increases, and as DOE's HEU blending accelerates. While some of the uranium from all of these actions will enter the market during the period considered in this EA, a number of factors are expected to mitigate the impact on the domestic uranium production industry:

1. Over 80 percent of the uranium purchased by domestic utilities is expected to continue to come from foreign sources, so these sources would be expected to absorb the largest impact as a result of any of these actions.

2. The uranium market is starting to show the strain of years of low production and reliance on existing inventories to satisfy demand. Prices are up significantly since the end of 1994 and inventories are dropping rapidly. In the United States, commercial inventories have dropped by 18 percent and 19 percent over each of the last two years and are at a point where they may soon need to be replenished. As a result, 1996 EIA forecasts show an increase in projected domestic requirements of over 50 million pounds U_3O_8(e) over the next 15 years from 1995 forecast (EIA, *World Nuclear Outlook, 1996*, Preliminary United States Requirements).

3. Limits set in the *USEC Privatization Act* will control the amount of uranium that can enter the domestic market from the largest of these actions, the blending down of Russian HEU and the transfer of DOE's HEU and natural uranium to USEC.

4. The ability to blend down HEU will also affect the speed with which this material can enter the market. While the Department's HEU EIS states that up to 10 metric tons of material could begin to be blended down in 1998, it also acknowledges that it may not be able to make that amount available every year because some of the HEU will require further processing before it can be used commercially.

5. The Department's ability to sell some of its uranium to the Russians for use in matched sales, to USEC for overfeeding the enrichment plants, and to others for foreign end use would further mitigate the impact on the domestic uranium production industry. For matched sales, the Department's "Russian" uranium must be matched with an equivalent amount of newly produced domestic uranium.

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[37] This alternative was not considered because it is unlikely that the Russians would choose to fill their matched sales quotas over the next 5 years with this uranium as opposed to newly-mined Russian uranium.

6. Sale of the Department's surplus uranium is conditioned under the *USEC Privatization Act* in part on a Secretarial Determination of no adverse material impact on the domestic uranium industry. This Determination could limit the flow of DOE's uranium into the domestic market because it gives the Department the opportunity to reassess the market each time a sale is proposed.

4.5.2 Impacts on the Domestic Uranium Conversion Industry

Because all of the uranium DOE is proposing to sell in this EA and in the HEU EIS, and the uranium coming into the market as a result of the *Russian HEU Agreement*, is in the form of UF_6, the sale of this material could potentially affect the domestic conversion industry. However, the extent to which DOE's HEU and natural uranium being transferred to USEC can affect the conversion industry is limited by the *USEC Privatization Act* and the Department's ability to blend down the HEU to meet commercial specifications.

With regard to the natural uranium associated with the *Russian HEU Agreement*, the sale of the conversion component is not limited by the *USEC Privatization Act*. Section 3112(b)(8) provides that, "[n]othing in this subsection (b) shall restrict the sale of the conversion component of such uranium hexafluoride." As a result, the sale of the conversion component will be limited only by Russia's ability to deliver LEU from blended down HEU that meets commercial specifications. The current plans call for Russia to increase deliveries from 10 metric tons per year to 30 metric tons of HEU in 2000 and thereafter until all 500 metric tons of HEU have been blended down. Thirty metric tons of blended down HEU represent the equivalent of about 24 million pounds U_3O_8(e).

The *Suspension Agreement* will likely have little or no effect on the domestic conversion industry since the majority of matched sales under this Agreement involve U_3O_8 rather than UF_6 and, therefore, the uranium still needs to be converted. However, any sale by the Department of transferred "Russian" uranium back to the Russians for use in matched sales would be in the form of UF_6, which would then be required to be matched with newly produced domestic origin UF_6.[38] The impact on the domestic conversion industry would be positive because the this domestic-origin UF_6 would be converted in the United States.

The greatest impacts on the domestic conversion industry will likely result from the *Russian HEU Agreement* and the United States HEU blend down. The impact of all of these activities on the domestic conversion industry would be expected to be somewhat greater than that felt by the domestic uranium production industry, because the *USEC Privatization Act* does not limit the sale of the conversion component of the natural uranium associated with the *Russian HEU Agreement*. However, as with uranium production, a number of factors are expected to help mitigate the effect of this material on domestic converters:

[38] The *Suspension Agreement* states in Section IV, "Matched sales may be made only by matching spot contracts to spot contracts and long-term contracts to long-term contracts, as defined in Section II, and uranium-type (i.e., U_3O_8 to U_3O_8, UF_6 to UF_6)."

1. Demand for conversion services over the 1996-2004 time frame is expected to increase. EIA is projecting an increase in shipments of uranium by domestic utilities to enrichment suppliers over the number of shipments projected in 1995. Because this uranium will have to be converted before it can be enriched, there should be a similar increase in the demand for conversion services over this time frame. Based on responses to EIA's "Uranium Industry Annual Survey", EIA is projecting that an additional 12.5 million pounds U_3O_8(e) will be sent to enrichers by domestic utilities from 1996-2004 over what was projected in 1994 (EIA, Uranium Industry Annual 1995, Table 24). Since the domestic conversion industry is currently operating at or near capacity, to the extent that DOE's uranium satisfies demand above capacity, it will have no effect on the domestic conversion industry.

2. Limits set in the *USEC Privatization Act* will control the amount of conversion services which can enter the domestic market as a result of the transfer of United States HEU and natural uranium to USEC.

3. The Department's and Russia's ability to blend down HEU will affect the speed with which conversion services associated with this material can enter the market.

4. The Department's ability to sell some of its uranium to USEC for overfeeding enrichment plants and to others for foreign end use would also help mitigate the impact of the sale of this uranium on the domestic uranium conversion industry.

5. Any "Russian" uranium that the Department has for use in matched sales must be matched with an equivalent amount of domestic uranium. Since this "Russian" uranium is in the form of UF_6 and the Suspension Agreement requires that it must be matched in equivalent forms, the domestic uranium must also be UF_6. Therefore, the "Russian" uranium used in matched sales would not displace domestic conversion services but would create demand for such services.

6. Sale of the Department's surplus uranium is conditioned under the *USEC Privatization Act* in part on a Secretarial Determination of no adverse material impact on the domestic uranium industry. This Determination could limit the flow of DOE's uranium into the domestic market because it gives the Department the opportunity to reassess the market each time a sale is proposed.

4.5.3 Impacts on the Domestic Uranium Enrichment Industry

As discussed in Section 4.3.3, no lasting impact is expected on the domestic uranium enrichment industry as a result of the actions discussed in this EA. However, the introduction of blended down United States and Russian HEU into the domestic market could have an impact. While the *USEC Privatization Act* effectively meters the introduction of the natural uranium component associated with the *Russian HEU Agreement* into the market, it does not affect the introduction of the LEU and associated SWU. If the Russians are able to blend down 30 metric tons of HEU annually beginning in 2000 as currently planned, the resulting LEU would represent about 5.5 million SWU per year, up from the 1.8 million SWU expected annually from 1996-1999.

However, the *USEC Privatization Act* does limit the ability of the SWU associated with the 50 metric tons of United States HEU being blended down and transferred to USEC to enter the domestic market. As noted in Section 4.5.1, the *USEC Privatization Act* limits the number of SWU allowed into the domestic market from the 50 metric tons to 800,000 SWU per year beginning in 1998. The 13 metric tons of HEU previously transferred by the Department to USEC will be available to enter the market as it is blended down, approximately 300,000 - 400,000 SWU per year over the next several years.

The *Suspension Agreement* does not affect the domestic enrichment industry, because there are no longer any matched SWU sales allowable. In the first two years of the Agreement, the Russians and USEC were allowed to enter into matched SWU sales, but no SWUs are allowed in 1996 or later under the current terms of the Agreement.

To summarize, there are no long term impacts on the domestic uranium enrichment industry anticipated from the sale of the DOE's surplus natural uranium and LEU discussed in this EA. The 280,000 SWU associated with the LEU included in this EA is an extremely small amount compared to the SWU associated with the Russian and United States HEU being blended down.

Impacts to the domestic uranium enrichment industry that may result from the blending down and subsequent sale of United States and Russian HEU are mitigated by factors similar to those associated with the domestic conversion industry:

1. Demand for enriched uranium is expected to increase over 1996-2004. EIA is projecting an increase in shipments of uranium by domestic utilities to enrichment suppliers over the number projected last year. Based on responses to EIA's "Uranium Industry Annual Survey", EIA is projecting that an additional 12.5 million pounds U_3O_8(e) will be sent to enrichers by domestic utilities from 1996-2004 than were projected in 1995. (EIA, *Uranium Industry Annual, 1995*, Table 24) Assuming this uranium will be enriched to four percent, a standard enrichment level, the projection represents an increase of about 2.8 million SWU.

2. Limits set in the *USEC Privatization Act* will effectively meter the amount of enrichment services that can enter the domestic market as a result of the transfer of United States HEU to USEC. USEC will be limited to introducing a maximum of 800,000 SWU per year into the domestic enrichment market as a result of blending down excess HEU.

3. The Department's and Russia's ability to blend down HEU to meet commercial specifications will affect the speed with which enrichment services associated with this material can enter the market.

4. Sale of the Department's surplus uranium is conditioned under the *USEC Privatization Act* in part on a Secretarial Determination of no adverse material impact on the domestic uranium industry. This Determination could limit the flow of DOE's uranium into the domestic market because it gives the Department the opportunity to reassess the market each time a sale is proposed.

Finally, one additional factor must be considered as it relates to the impact of these activities on the domestic uranium enrichment industry. Currently, USEC operates the only two enrichment plants in the United States. Thus, USEC will effectively control all domestic enrichment services in the near term, (e.g., through 2003). As Executive Agent of the *Russian HEU Agreement* and the recipient of the first United States HEU blended down, USEC will control how this material impacts its operations. Thus, this LEU may not displace any enrichment production if USEC is able to attract enough customers to purchase both its full production quantities and the LEU.

4.6 Environmental Justice

On February 11, 1994, Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, was published in the Federal Register (59 FR 7629). The Executive Order requires each federal agency to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income communities.

As stated in previous sections of this EA, the potential environmental impacts calculated for activities associated with the Proposed Action and the alternatives due to planned operations or accident conditions present little, if any, risk to the surrounding environment and population. Therefore, there would not be disproportionately high and adverse impacts on any minority or low-income populations.

4.7 Avoided Environmental Impacts

The Proposed Action and alternatives, with the exception of the No Action alternative, would reduce the environmental impacts from uranium mining, milling, and conversion activities. This EA incorporates by reference the HEU EIS analysis of the environmental impacts avoided by replacing parts of the current uranium fuel cycle with the process of blending surplus HEU to LEU fuel. The HEU EIS provides data in Section 4.7 on the radiological effects of uranium mining, milling, conversion, and enrichment. The HEU EIS concludes that the adverse impacts on human health and the environment are greater from uranium mining, milling and conversion than from the other stages of the uranium fuel cycle, which are enrichment, fuel fabrication, and nuclear reactors (see Figure 2.1).

Similarly, substituting the natural uranium and LEU proposed for sale by DOE for an equivalent quantity of newly-produced uranium would avoid some environmental impacts from mining and milling, conversion, and enrichment.[39] Fuel fabrication and reactor operations would not be affected by the Proposed Action or any of the sale alternatives because the same quantities of UF_6 would be used in fabricating nuclear fuel, regardless of what action is taken. Decreases in domestic mining, milling, and production resulting from the Proposed Action and the other sale alternatives in this EA could result in decreases in the radiological effects on workers or the public, as discussed in Section 4.1. In addition, transportation effects could be avoided, as discussed in Section 4.2, and accident probabilities could be reduced, as discussed in Section 4.4.

[39] Because the bulk of the material considered in this EA is natural uranium, which will need to be enriched, most of the avoided environmental impacts are from mining, milling, and conversion.

5.0 Persons and Agencies Consulted

No federal or state agencies outside DOE or its contractors were consulted during the preparation of this draft EA. However, the draft EA has been distributed for review and comment by affected states and Native American tribes and members of the public known to be interested in the Proposed Action.

6.0 References

Bureau of Economic Analysis. 1992. *Regional Multipliers: A User Handbook for the Regional Input-Output Modeling System (RIMS II) Second Edition*. PB92-204262. U.S. Department of Commerce, Bureau of Economic Analysis. Washington, DC.

Energy Information Administration. 1995. *Decommissioning of U.S. Uranium Production Facilities*. DOE/EIA-0592. U.S. Department of Energy, Office of Coal, Nuclear, Electric and Alternate Fuels. Washington, DC.

Energy Information Administration. 1991. *Domestic Uranium Mining and Milling Industry, 1990, Viability Assessment.* DOE/EIA-0477(90). U.S. Department of Energy, Office of Coal, Nuclear, Electric and Alternate Fuels. Washington, DC.

Energy Information Administration. 1992. *Domestic Uranium Mining and Milling Industry, 1991, Viability Assessment.* DOE/EIA-0477(91). U.S. Department of Energy, Office of Coal, Nuclear, Electric and Alternate Fuels. Washington, DC.

Energy Information Administration. 1993. *Domestic Uranium Mining and Milling Industry, 1992, Viability Assessment.* DOE/EIA-0477(92). U.S. Department of Energy, Office of Coal, Nuclear, Electric and Alternate Fuels. Washington, DC.

Energy Information Administration. 1993. *Uranium Industry Annual 1992*. DOE/EIA-0478(92). U.S. Department of Energy, Office of Coal, Nuclear, Electric and Alternate Fuels. Washington, DC.

Energy Information Administration. 1994. *Uranium Industry Annual 1993.* DOE/EIA-0478(93). U.S. Department of Energy, Office of Coal, Nuclear, Electric and Alternate Fuels. Washington, DC.

Energy Information Administration. 1995. *Uranium Industry Annual 1994*. DOE/EIA-0478(94). U.S. Department of Energy, Office of Coal, Nuclear, Electric and Alternate Fuels. Washington, DC.

Energy Information Administration. 1996. *Uranium Industry Annual 1995*. DOE/EIA-0478(95). U.S. Department of Energy, Office of Coal, Nuclear, Electric and Alternate Fuels. Washington, DC.

Energy Information Administration. 1995. *World Nuclear Outlook 1995*. DOE/EIA-0436(95). U.S. Department of Energy, Office of Coal, Nuclear, Electric and Alternate Fuels. Washington, DC.

Energy Information Administration. 1996. Preliminary Information from *World Nuclear Outlook 1996.* U.S. Department of Energy, Office of Coal, Nuclear, Electric and Alternate Fuels. Washington, DC.

Lawrence Livermore National Laboratory. 1995. *This Is Gaseous Diffusion*. UCRL-AR-122154. Livermore, California.

Nuclear Assurance Corporation International. 1996. *Focus,* Winter. Atlanta.

NuclearFuel. 1995. McGraw Hill. October 9. New York.

NuclearFuel. 1996. McGraw Hill. September 23. New York.

Pool, Thomas (International Nuclear, Inc.). 1995. "U.S. Uranium Production. How Much? And at What Price?" Presentation given at the Nuclear Energy Institute's International Uranium Fuel Seminar, October 8-11.

Rutkowski, Edward (TradeTech). 1996. Telephone conversation, July 1.

TradeTech. 1995. *The Nuclear Review,* December. Denver, Colorado.

TradeTech. 1993. *NUEXCO Review 1993 Annual*. Denver, Colorado.

TradeTech. 1994. *NUEXCO Review 1994 Annual*. Denver, Colorado.

United States Congress. January 1996. Public Law 104-134, *USEC Privatization Act*. 104th Congress, Second Session. Washington, D.C.

United States Congress. November 1996. Public Law 104-46, Energy and Water Development Appropriations Act. 104th Congress. Washington, D.C.

U.S. Department of Commerce, Bureau of the Census 1990. Census Data for 1990. *County and City Data Book, Statistical Abstract.*

U.S. Department of Energy. 1996. *Disposition of Surplus Highly Enriched Uranium Final Environmental Impact Statement*. DOE/EIS-0240. Washington, DC.

U.S. Department of Energy. 1996. *Portsmouth Site Annual Environmental Report for 1994*. ES/ESH-63.

U.S. Department of Energy. 1996. *Paducah Site Annual Environmental Report for 1994*. ES/ESH-60.

U.S. Department of Energy. 1994. *Paducah Gaseous Diffusion Plant Annual Site Environmental Report for 1993*. ES/ESH-53.

U.S. Department of Energy. 1994. *Portsmouth Gaseous Diffusion Plant Annual Site Environmental Report for 1993.* ES/ESH-50.

U.S. Enrichment Corporation. 1996. *Annual Report 1995*. Bethesda, Maryland.

U.S. Enrichment Corporation. 1996 c. *Application for U.S. Nuclear Regulatory Commission Certification*, [Portsmouth Site]. Vol. 3, Portsmouth Gaseous Diffusion Plant Emergency Plan, Revision 6. [Individual sections may be dated separately.]

U.S. Enrichment Corporation. 1996a. *Application for U.S. Nuclear Regulatory Commission Certification*, [Paducah Site]. Vol. 3, Paducah Gaseous Diffusion Plant Emergency Plan, Revision 6. [Individual sections may be dated separately.]

U.S. Enrichment Corporation. 1996a. *Application for U.S. Nuclear Regulatory Commission Certification* [Paducah Site]. Vol. 2, Paducah Gaseous Diffusion Plant Safety Analysis Report, Revision 2. [Individual sections may be dated separately.]

U.S. Enrichment Corporation. 1996b. *Application for U.S. Nuclear Regulatory Commission Certification* [Portsmouth Site]. Vol. 2, Portsmouth Gaseous Diffusion Plant Safety Analysis Report, Revision 3. [Individual sections may be dated separately.]

U.S. Enrichment Corporation. 1993. *Amended Environmental Assessment for the Purchase of Low Enriched Uranium from the Russian Federation Pursuant to the Agreement Suspending the Antidumping Investigation of Uranium*. Bethesda, Maryland.

U.S. Enrichment Corporation. 1994. *Environmental Assessment for the Purchase of Russian Low Enriched Uranium Derived from the Dismantlement of Nuclear Weapons in the Countries of the Former Soviet Union*. USEC/EA-94001; DOE/EA-0837. Bethesda, Maryland.

U.S. Enrichment Corporation. 1995. *Uranium Hexafluoride: A Manual of Good Handling Practices*. USEC-651, Revision 7.

7.0 Glossary

Atomic Energy Act: This act, enacted in 1946 and amended in 1954, established a program for government control of the possession, use or production of atomic energy and special nuclear material, including highly enriched uranium.

Atomic Energy Commission: A five-member commission established by The Atomic Energy Act to supervise nuclear weapons design, development, manufacture, maintenance, modification, and dismantlement. It was abolished in 1974 and all functions transferred to the Nuclear Regulatory Commission and the Energy Research and Development Administration, whose functions were later transferred to the Department of Energy.

Baseline: A quantitative expression of conditions, costs, schedule, or technical progress to serve as a base or standard for measurement.

Bounding case: A case that represents the extreme (high or low) boundaries of a possible situation.

Conversion: The process by which uranium ore concentrate (U_3O_8), or yellowcake, is converted to uranium hexafluoride (UF_6).

Daughter products: Nuclides resulting from the radioactive decay of other nuclides; may be either stable or radioactive.

Domestic purchase: A uranium purchase from a firm located in the United States.

Domestic uranium industry: For the purposes of this analysis, the domestic uranium industry is defined as those businesses (whether domestic or foreign-based) that operate under the laws and regulations pertaining to the conduct of commerce within the United States and its territories and possessions and that engage in activities within the United States, its territories and possessions specifically directed toward uranium mining and milling; conversion and enrichment of uranium materials.

Dose equivalent: The product of the absorbed dose in rad and the effect of this type of radiation in tissue and a quality factor. Dose equivalent is expressed in units of rem or Sievert, where 1 rem equals 0.01 Sievert. The dose equivalent to an organ, tissue or whole body will be that received from the direct exposure plus 50-year committed dose equivalent received from radionuclides taken into the body during the year.

Endangered species: Animals, birds, fish, plants, or other organisms threatened with extinction by manmade or natural changes in their environment and declared "endangered" by law. Requirements for declaring species endangered are contained in the Endangered Species Act of 1973.

Endangered Species Act of 1973: This act requires federal agencies, with the consultation and assistance of the Secretaries of the Interior and Commerce, to ensure that their actions will not likely jeopardize the continued existence of any endangered or threatened species or adversely affect the habitat of such species.

Energy Information Administration (EIA): The independent statistical and analytical agency within the Department of Energy, which, as one of its responsibilities, collects and disseminates information related to the domestic nuclear power industry.

Energy Policy Act of 1992 (EPAct): This Public Law 102-486 created the U.S. Enrichment Corporation as a wholly-owned government corporation to take over uranium enrichment functions from DOE; made USEC the government's marketing agent for enriched uranium; and authorized DOE to sell uranium inventories not needed for national security purposes. Portions of it will be or have been repealed by the *USEC Privatization Act* (e.g., once USEC is privatized it will no longer serve as the government's exclusive marketing agent).

Enrichment: A process whereby the proportion of the fissile ^{235}U isotope is increased above its naturally occurring value of about 0.7% so that it can be used as fuel in nuclear power reactors.

Environmental Assessment (EA): A written environmental analysis prepared pursuant to the National Environmental Policy Act (NEPA) to determine whether a federal action would significantly affect the environment and thus require the preparation of a more detailed environmental impact statement. If the action does not significantly affect the environment, a Finding of No Significant Impact (FONSI) is prepared.

Environmental Impact Statement (EIS): A document required of federal agencies by the National Environmental Policy Act for major proposals significantly affecting the environment. It is a decision making tool that describes the positive and negative effects of the proposed action and alternatives.

Foreign end use: Uranium sales for foreign end use refers to those sales that require that the uranium sold must be used outside the United States. Initial sale could be to a foreign or domestic entity as long as the end user of the uranium is foreign.

Foreign sale: A uranium sale to a firm located outside the United States.

Fuel cycle: The series of steps involved in supplying fuel for nuclear reactors. It includes mining, converting, and enriching uranium; fabrication; using it in a reactor; and managing the resulting spent fuel and radioactive waste.

Gaseous diffusion plants (GDPs): Gaseous diffusion is the process used in the United States to enrich uranium so that it can be used as fuel in nuclear power plants. Two DOE-owned uranium gaseous diffusion plants are leased to and operated by the U.S. Enrichment Corporation.

Global Commons: Those resources shared by the nations of the world that are not under the jurisdiction of any nation.

Highly enriched uranium (HEU): Uranium with a content of the ^{235}U isotope of 20 percent or higher.

Low enriched uranium (LEU): Uranium with a content of the ^{235}U isotope greater than 0.7 percent and less than 20 percent.

Matched sales: These are uranium sales under the *Suspension Agreement* that must comprise an equal amount of Russian natural uranium and newly produced domestic uranium.

National Environmental Policy Act of 1969: This act is the basic national charter for the protection of the environment. It requires the preparation of an environmental impact statement for every major federal action that may significantly affect the quality of the human or natural environment. Its main purpose is to provide environmental information to decision makers so that their actions are based on an understanding of the potential environmental consequences of a proposed action and its reasonable alternatives.

Natural uranium: Uranium that has the same isotopic composition as naturally occurring uranium. The isotopic composition of natural uranium is approximately 99.3 percent ^{238}U and 0.7 percent ^{235}U.

Notice of Intent (NOI): A notice printed in the *Federal Register* announcing that a federal agency is going to prepare an environmental assessment or an environmental impact statement.

Occupational Safety and Health Administration (OSHA): Created by the Occupational Safety and Health Act of 1970, it oversees and regulates workplace health and safety.

Overfeeding: Introduction of additional uranium in the enrichment cascades at the gaseous diffusion plants for the purpose of reducing the amount of electricity needed or number of SWU required to enrich uranium to any desired assay.

Rad: The abbreviation for radiation absorbed dose. It refers to the amount, or dose, of ionizing radiation absorbed by any material, including human tissue.

Radiation: Particles or waves from atomic or nuclear processes; prolonged exposure to these particles and rays may be harmful.

Rem: The abbreviation for "roentgen equivalent man," which is the unit of radiation dose for biological absorption. It is equal to the product of the absorbed dose, in rads, and a quality factor that accounts for the variation in biological effectiveness of different types of radiation.

Russian HEU Agreement: An agreement between Russia and the United States under which USEC, as the United States Executive Agent, is purchasing LEU derived from 500 metric tons of HEU extracted from dismantled Russian nuclear weapons.

Russian Purchase EA: An EA written by USEC and DOE in January, 1994 to assess the environmental impacts associated with shipping approximately 22,500 metric tons of low enriched UF_6 from Russia to the United States for sale by USEC. This material is available as a result of Russia blending down 500 metric tons of HEU from dismantled nuclear weapons under the Russian HEU Agreement.

Separative Work Units (SWU): A measure of the separation achieved in a uranium enrichment plant after separating uranium of a given ^{235}U content into two components, one having a higher percentage of ^{235}U than the other component.

Spent nuclear fuel: Fuel that has been withdrawn from a nuclear reactor following irradiation, the constituent elements of which have not been separated.

Suspension Agreement: The Agreement to Suspend Investigation on Uranium from the Russian Federation, as amended in 1994, settled an investigation into whether Russia was selling uranium in the domestic (U.S.) market at less than fair market value, and established a mechanism known as matched sales in which imports from Russia are linked with sales of newly-produced domestic uranium. As currently written, the Agreement expires in 2004.

Threatened species: any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

U.S. Enrichment Corporation (USEC): A wholly-owned government corporation created by the Energy Policy Act of 1992 to take over DOE's uranium enrichment functions and eventually to be privatized; USEC is currently the only domestic provider of uranium enrichment services.

USEC Privatization Act: Public Law 104-134, enacted in 1996, set the groundwork for privatization of USEC. In addition, it authorized DOE to sell its surplus uranium as long as certain conditions are met.

Uranium: A heavy, silvery-white metallic element with an atomic number of 92, is the heaviest naturally occurring metallic element. It has three naturally occurring radioactive isotopes: uranium-234, which is less than .01 percent of natural uranium; uranium-235, which is about 0.7 percent of natural uranium and uranium-238, which comprises about 99.3 percent.

Uranium hexafluoride (UF_6): a white solid compound of uranium and fluorine obtained by chemical treatment of U_3O_8 and which forms a vapor at temperatures above 56 degrees Centigrade. UF_6 is the form of uranium required for the enrichment process.

Uranium oxide(U_3O_8): Uranium concentrate or yellowcake.

Uranium reserves: Estimated quantities of uranium in known mineral deposits of such size, grade, and configuration that the uranium could be recovered at or below a specific production cost with currently proven mining and processing technology and under current law and regulations.

Yellowcake: Term used to describe uranium oxide (U_3O_8).

Appendix A: The Nuclear Fuel Cycle

Uranium consists of two major isotopes: uranium-235 (^{235}U) and uranium-238 (^{238}U). In natural uranium, these isotopes are present in concentrations of 0.7 percent ^{235}U and 99.3 percent ^{238}U. Under the proper conditions, atoms of ^{235}U can fission, or split apart, to produce energy that can be used to generate electric power. However, as shown in Figure 2.1, "The Uranium Fuel Cycle," various steps must occur before uranium can become fuel for a nuclear power reactor. The basic steps in the uranium fuel cycle are (1) mining and milling, (2) conversion, (3) enrichment, (4) fuel fabrication, (5) use in a nuclear power reactor, and (6) spent fuel management.

1. Mining and Milling

To obtain the enriched uranium fuel for their power reactors, utility companies sign enrichment services contracts with an enrichment provider such as the U.S. Enrichment Corporation (USEC). Under the terms of their contracts, the utilities first obtain natural uranium ore concentrate, or "yellowcake" (in the chemical form U_3O_8), from a mining and milling company or other natural uranium supplier. Uranium ore was formerly mined using conventional methods, but today most uranium concentrate produced in the United States is either derived from in-situ leaching operations or recovered as a by-product from the manufacture of phosphates. In-situ leaching involves circulating a solution which leaches, or dissolves, uranium from the host rock and then carries it to the surface where it can be separated and dried to form uranium concentrate.

2. Conversion

Before natural uranium can be "enriched" for fabrication into fuel, the uranium ore concentrate (U_3O_8) must be converted to uranium hexafluoride (UF_6), a compound of uranium and fluorine. At normal temperatures and pressure, UF_6 is a white, crystalline solid. In this form, it is shipped in cylinders containing 10 or 14 tons of UF_6 from the conversion facility to one of the gaseous diffusion plants for enrichment. It should be noted that the chemical processes used to produce the U_3O_8 in the milling stage and the UF_6 in the conversion stage do not change the isotopic content of the uranium. Therefore, the UF_6 which is delivered from the converter to the enrichment facilities is "natural" UF_6—i.e., it continues to have a ^{235}U concentration of 0.7 percent.

3. Enrichment

For fuel, nuclear power reactors require uranium in which the concentration of ^{235}U, the fissionable isotope, has been increased to between 3 and 5 percent. In the United States, utility companies have their natural UF_6 sent to one of USEC's two enrichment plants: the Portsmouth gaseous diffusion plant near Piketon, Ohio, or the Paducah gaseous diffusion plant near Paducah, Kentucky. In addition to providing the natural UF_6, the utilities pay an enrichment fee based on separative work units (a measure of the effort required to separate uranium isotopes to produce the desired assay). For a description of the gaseous diffusion process, see *This Is Gaseous Diffusion - How a Gaseous Diffusion Plant Operates*, UCRL-AR-122154. As a result of this process, the initial UF_6 feed is divided into low enriched UF_6 (with a ^{235}U concentration higher than that of natural uranium, but less than 20 percent) and "depleted" UF_6 (with a ^{235}U concentration below that of natural uranium). The low enriched UF_6 is placed in Model 30B cylinders, which hold 2.5 tons of UF_6 each and allowed to cool, after which it can be shipped to a fuel fabricator. The depleted UF_6 is stored at the gaseous diffusion plants in steel cylinders which typically hold 14 tons of UF_6.

4. Fuel Fabrication

At a fuel fabrication plant, the enriched UF_6 is converted into uranium dioxide (UO_2) pellets, which are then stacked inside metal tubes. Bundles of these fuel rods form fuel elements or fuel assemblies, which can be used in power reactors.

5. Use in a Nuclear Power Reactor

Several hundred fuel elements joined together form the power reactor core, which is contained within the reactor vessel and a containment structure. Inside the reactor, the ^{235}U is allowed to fission, or split apart. This produces energy, which heats water and makes steam which in turn drives the electric turbines. Nuclear reactors in the United States and throughout the world use light water (i.e., regular water) to produce the steam and to moderate the energy of the neutrons produced in the fissioning of the ^{235}U so that additional fissions can occur under the controlled conditions inside the reactor. Control rods, which are also inserted into the reactor core, serve to regulate the rate of fissioning and the amount of heat produced.

6. Spent Fuel Management

After several years, nuclear fuel rods are no longer efficient and are removed from commercial reactors. In accordance with the Nuclear Waste Policy Act, as amended (42 U.S.C. 10101 et seq.) spent fuel rods are high-level radioactive waste that will ultimately be disposed of in a geologic repository. The Department of Energy is conducting characterization of Yucca Mountain, Nevada to determine its suitability as a site for a geologic repository for high level radioactive waste. Until the repository is constructed, spent fuel from commercial reactors continues to be stored in pools at reactor sites across the country. As storage pools become full, utilities are reracking the fuel rods or using NRC-licensed dry storage technologies.

Appendix B: Actions Forming the Basis for the Accident Analysis

The following actions are part of the Proposed Action and form the basis for the accident analysis.

Interim Storage - UF_6 feed cylinders are held in an interim storage yard until needed for feed into the enrichment process. In the storage yard, cylinders are secured by saddles that provide for proper spacing and restricted movement. The saddles also help to prevent corrosion by keeping the cylinders off the ground. Two saddles support each cylinder. Cylinder storage spaces are designed with sufficient spacing to reduce the possibility of cylinder damage during storage operations. Cylinders would remain in these saddles unless required to be moved for sampling and analysis or until ready to be moved to the enrichment operations.

Cylinder Maintenance and Inspection - Cylinders are visually inspected and maintained to ensure cylinder integrity before handling, heating, or shipping. About half the cylinders in the storage yard are inspected annually under a routine maintenance program. Thus, each cylinder is inspected about every two years. A UF_6 cylinder would be removed from service for repair or replacement if it has leaks, excessive corrosion, cracks, bulges, dents, gouges, defective valves, damaged stiffening rings or skirts, or other conditions that, in the judgment of the inspector, render it unsafe or unserviceable.

Cylinder Handling - The in-plant cylinder handling system includes scale carts, cranes, lifting fixtures, cylinder handlers, and trailers. Scale carts, along with some cranes and lifting fixtures, have been identified as design features for safety since they are involved in the handling of cylinders filled with liquid UF_6. Cylinders would be moved from interim storage to the autoclaves for heating and sampling the contents of the cylinder and/or for feeding to the enrichment cascade.

Cylinder Sampling and Analysis - As part of the cylinder maintenance program, the UF_6 contents of statistically selected cylinders are routinely sampled and analyzed upon arrival on-site to ensure uranium accountability and feed material specifications. Once a cylinder has been sampled, it is not heated again until the material is fed into the plant to be enriched. Not every cylinder is sampled upon arrival; a statistical number of cylinders are selected for sampling. Currently, about one of every ten cylinders is selected for sampling. Existing cylinders in the storage yards were received under an established sampling program and would likely not require additional sampling.

For the cylinders that are sampled, the contents of the cylinder must be heated in an autoclave to change the UF_6 from a solid to a liquid form. Once the solid UF_6 contents have been liquefied, a sample is extracted and sent to the in-plant laboratory for analysis. The cylinder would then be removed from the autoclave and returned to an interim storage area while the UF_6 cools and returns to a solid state. Approximately five days are required for the UF_6 in the cylinders to solidify. Upon receipt of acceptable analytical results, the cylinder would be transported to the cascade feed facilities to begin the enrichment process. Once the cylinder contents have been fed into the enrichment process, the empty cylinders are returned to the storage yard for shipment back to the customer or are moved to a withdrawal facility for filling with depleted tails material for storage.

Most of the sampling activities would likely occur on the 14.2 million-pound equivalent U_3O_8 that would be arriving at Portsmouth. The 20.3 million-pound equivalent U_3O_8 at Paducah has been under DOE/USEC control and accountability and the contents of these cylinders would likely not need additional verification.

Appendix C: Chemical Effects

Uranium hexafluoride (UF_6) reacts rapidly with moisture in the air, forming uranyl fluoride (UO_2F_2) and hydrogen fluoride or hydrofluoric acid (HF). Although uranium compounds such as UO_2F_2 and UF_6 exhibit both chemical toxicity and radiological effects, the primary health effect from actions analyzed in this Environmental Assessment (EA) would be from the chemical effects, not radiological effects. Once released into the atmosphere, these chemicals may remain airborne for various lengths of time depending on atmospheric conditions. The health effects postulated in this EA assume meteorological conditions that would result in bounding exposures and effects. Individuals exposed to the chemicals may suffer varying degrees of health effects depending on the concentration of the chemical, the duration of the exposure, and the sensitivity of the individual to the exposure.

Human Chemical Toxicity of Uranium Hexafluoride and Uranyl Fluoride - Solid UF_6 is a white, crystalline substance that resembles rock salt; liquid UF_6 is clear, resembling water, and gaseous UF_6 is a colorless gas. Solid UF_6 volatilizes slowly at room temperature and pressure. Liquid or gaseous UF_6 reacts quickly with atmospheric moisture to produce uranium fluoride (UO_2F_2) and hydrogen fluoride or hydrofluoric acid (HF). For human exposure to these chemicals, four types of health effects have been established: no effect, possible mild health effects, renal (kidney) injury, and death. Mild health effects include observable biological effects that would not result in either a short-term or long-term impairment to the body's ability to function.

Human Chemical Toxicity of Hydrogen Fluoride - HF is a clear, colorless liquid that vaporizes readily when exposed to the atmosphere to produce corrosive vapors with an intolerable, pungent odor. When dissolved in water, such as moisture in the atmosphere, hydrogen fluoride becomes hydrofluoric acid. For human exposure to HF, five types of health effects have been established: no effect, smell/no health effects, smell/possible irritation, irritation/possible health effects, and lethality.

Ecological Toxicity Effects - The Portsmouth and Paducah gaseous diffusion plants conduct routine environmental monitoring of the flora and fauna surrounding the plants. Results are reported annually in the site's Annual Environmental Reports. In 1994, 1,600 pounds of HF were released accidentally from the Portsmouth site due to decontamination activities. During the same year, all of the measured gaseous fluoride concentrations in ambient air were within applicable Tennessee and Kentucky ambient air quality standards (DOE PORTS 1996: 7-1). In 1993, 6,900 pounds HF were released accidentally from Portsmouth through the production vents (DOE PORTS 1994: C-1). Vegetation sampling for 1993, like the soil samples, revealed no statistically significant environmental contamination. No uranium was detected in any of the vegetation samples, and all fluoride concentrations were well below the 30 to 40 μg/g levels, levels at which vegetative fluorides may begin to discolor the teeth of foraging cattle (DOE PORTS 1994: 5-20).

At Paducah, Kentucky, all ambient air measurements for fluorides were well below the Kentucky ambient air quality standards for fluorides for 1994. Samples of vegetation and fish and wildlife were collected but not analyzed for fluoride concentration levels (DOE Pad 1994: 8-7). In 1993 and 1994, no accidental releases of HF were reported through the Superfund Amendments and Reauthorization Act, Title III, Section 313 (SARA 313) chemical release reporting process (DOE Pad 1996:B-2) and (DOE Pad 1994: B-1).

Appendix D: Emergency Response Plans

Each of the gaseous diffusion plants has an established emergency response plan required to be prepared and maintained as part of it application to the U.S. Nuclear Regulatory Commission.[1]

In accordance with 10 CFR Part 76.91, and the Emergency Planning and Community Right-to-Know Act of 1986, the USEC has established and will maintain and follow the Paducah and Portsmouth gaseous diffusion plant Emergency Response Plans to ensure that plant personnel are adequately prepared for accidents or other emergencies. These plans are implemented by the Emergency Plan Implementing Procedures. The plans provide an overall description of the comprehensive site-wide emergency preparedness program, policies, procedures, and actions that will be implemented in an emergency to mitigate the consequences of the emergency and protect the health and safety of workers, the public, and the environment. The plans include specific accident response procedures for many scenarios, including a large uranium hexafluoride (UF_6) release.

For the purposes of emergency management, the entire DOE reservations at the gaseous diffusion plants are controlled by USEC. In this capacity, USEC prescribes protective actions for all persons on the DOE reservation. At Portsmouth, areas adjacent to the site are largely agricultural with a relatively low population density; agricultural and forested land account for approximately 90 percent of the area surrounding the plant (USEC PORTS 1996c: 1-5). An emergency planning area, established with agreement of Pike County and State of Ohio officials, extends approximately two miles from the center of the plant. Two nursing homes are located within this area. This entire area is covered by the Public Warning System. No other installations or facilities (such as schools, prisons, etc.) requiring special precautionary measures are located in the immediate areas surrounding the plant. At Paducah, agricultural and open-space land account for approximately 75 percent of the area surrounding the plant. There are no special facilities such as schools, nursing homes, or prisons located withing an 1-mile radius of the plant. The plant has established an Immediate Notification Area which extends approximately two miles from the center of the plant. A public warning system would be used to notify members of the public within this area in the event of a chemical release (USEC Pad 1995a:1-6). The public warning system at Paducah includes the Kentucky Wildlife Management area (USEC Pad 1995a:5-8).

In an emergency situation, the Plant Shift Superintendent Office and the Emergency Response Office take actions to ensure safety of plant personnel and the general public. Detailed actions for both workers and the public are described in the emergency plan and associated procedures. If the

[1] Emergency response plans for the plants are part of the U.S. Nuclear Regulatory Commission (NRC) application prepared by USEC: "Application for U.S. Nuclear Regulatory Commission Certification," Volume 3, Portsmouth Gaseous Diffusion Plant Emergency Plan, Revision 6, August 12, 1996; and "Application for U.S. Nuclear Regulatory Commission Certification," Volume 3, Paducah Gaseous Diffusion Plant Emergency Plan, Revision 6, August 12, 1996.

accident has potential for off-site releases, an assessment of off-site exposure is performed considering the release information and meteorological conditions, to determine appropriate sheltering and/or evacuation procedures. The best protective action is then communicated to the offsite local officials (USEC PORTS 1996c: 5-3). Agreements are in place with off-site organizations around each of the plants to coordinate emergency response efforts. Such coordination between the local, state, and plant emergency plans serves to better ensure the safety and health of the general public. These support services include medical assistance, fire control, evacuation, ambulance services and law enforcement. Plant protective forces provide site access control. Other safeguard and security systems, including material controls and accountability, are maintained as well (USEC Pad 1995a: 4-6).

Mitigation measures are pre-established as part of the emergency response plan. During an emergency, the primary concern is to minimize the impact on plant personnel and the general public. By initiating prompt protective actions such as personnel evacuation, consequences to workers, the public, and the environment are minimized. Other procedures have been established ensure a safe shutdown of operations, thereby limiting the release.

In an emergency, the immediate action is directed toward limiting the consequences of the incident in a manner that affords maximum protection to plant personnel, the public, and the environment. Once the corrective and protective actions have established an effective control over the situation and emergency conditions no longer exits, the emergency response moves into a recovery phase. Recovery includes those actions necessary to return an incident site and the surrounding environment to pre-emergency conditions to the maximum extent practicable. Specific recovery plans are developed in accordance with applicable emergency response implementation plans.

The emergency management plans and programs are maintained, updated, and audited. A formal training program is also conducted based on the plans. Both on- and off-site personnel are trained based on the plan. Emergency drills and exercise are also conducted to develop, maintain, and test the response capabilities of emergency personnel, facilities, procedures, and training. Audits are in accordance with Section 2.18 of the site quality assurance program to ensure adequate and effective program function.

Appendix E: Public Comments and Department of Energy Responses

I. Comments

On August 12, 1996, DOE issued a notice of availability of the draft EA in the *Federal Register* [61 FR 41776-41777]. During the week prior to the publication of the notice of availability, DOE mailed copies of the draft EA to affected States; domestic uranium production, conversion, and enrichment companies; trade associations and environmental organizations; and other parties known to have an interest in the proposed action.

The public comment period on the draft EA extended from August 12, 1996 through September 11, 1996. DOE considered all comments that were postmarked or transmitted electronically during the comment period in the development of this final EA.

The Department received 14 comment letters on the draft EA via facsimile or public mail. No comments were submitted via telephone. The following table lists the organizations that commented on the draft EA. Part I of this Appendix contains copies of the letters received by the Department from these organizations and the Department's responses to the comments in those letters. Two of the letters are not reproduced in Part I of this Appendix because the commentors requested to remain anonymous. Summaries of comments received from these commentors and the Department's responses are in Part II.

Table E-1. Organizations Commenting on the Draft EA

Letter	Organization	Representative
1	ConverDyn	James J. Graham
2	U.S. Department of State, Office of Nuclear Energy Affairs	Eleanor R. Busick
3	Virginia Power	H.H. Barker
4	Nuclear Fuel Resources, Inc.	Dustin J. Garrow
5	Uranium Producers of America	Crew Schmitt
6	Nuclear Energy Institute	Marvin S. Fertel
7	Wolf Creek Nuclear Power Plant	James E. Sammis
8	Canadian Embassy	Brian E. Morrisey
9	United States Enrichment Corporation	T. Michael Taimi
10	Yankee Atomic Electric Company	Francis X. Quinn
11	PECO Nuclear	G. A. Hunger, Jr.
12	State of Ohio, Office of Budget and Management	Larry W. Weaver

Changes to the draft EA, either in response to public comment or to correct technical information, are denoted by a change bar in the margin next to the affected text. If a comment resulted in a change to the text of the EA, the section of the EA that was changed is identified in DOE's response to the comment.

Letter 01 **Author:** James A. Graham, ConverDyn

Response to Comment Letter 01

1. DOE added a footnote in the final EA to clarify the definition of uranium as used in the EA. (See Section 1.1) DOE has also reviewed the EA to ensure consistency in the units of measurement used throughout the EA.

2. The 7.1 million pounds U_3O_8(e) estimated as the Russian portion of future matched sales was subtracted from the total sales likely to impact the domestic conversion industry because the matched sales would require a like amount of newly produced domestic uranium. Because the "Russian" uranium is in the form of UF_6, the domestic uranium used to match these sales would also have to be in the form of UF_6, as required by Section IV of the Amended Agreement Suspending the Antidumping Investigation of Uranium from the Russian Federation. Therefore, the use of the transferred "Russian" uranium in matched sales guarantees that an equivalent amount of domestic uranium would be converted in the United States. This would be the case if the uranium were sold overseas or in 2001 for domestic use in 2002 and later. On this basis, the Department feels it is appropriate to subtract the "Russian"uranium that will be used in matched sales from the total sales likely to have an impact on the domestic conversion industry.

3. The methodology used for calculating impacts shown in Table 4.5 has been clarified in the final EA. (See Section 4.3.2)

   The 7 percent figure cited in the draft EA was calculated based on the following assumptions:

   -- ConverDyn's annual production was assumed to average 30 million pounds U_3O_8(e) based on ConverDyn continuing to supply about 20 percent of the projected worldwide market requirements from 1996 - 2004.
   -- Under the Proposed Action, DOE's domestic sales would average 3.2 million pounds U_3O_8(e). Of this, as discussed in Section 4.3.2.2 of the draft EA, about 64 percent would normally be expected to be converted by ConverDyn; therefore, ConverDyn's impact would be expected to average 2 million U_3O_8(e) (i.e., $0.64 \times 3.2 \approx 2.0$).
   -- This average impact when divided by the assumed annual production equals 7 percent (i.e., $2/30 \approx 0.067$ rounded to 7 percent).

4. Even if ConverDyn's entire production went toward satisfying domestic conversion demand, it would only satisfy 64% of domestic demand. Accordingly, the Department believes it is logical to assume that sale of its already converted material to domestic customers would displace foreign conversion and not just domestic conversion. This is a conservative assumption because it is likely that some of ConverDyn's production is used to satisfy foreign needs. The remaining 36 percent would have been satisfied by foreign convertors.

Therefore, DOE assumed that future domestic sales would impact ConverDyn and foreign convertors by like percentages. For example, if, as discussed in the Proposed Action, DOE were to offer for sale an average of 3.2 million pounds U_3O_8(e), it would be expected to impact ConverDyn's annual production by 2 million pounds U_3O_8(e) and impact foreign convertors by 1.2 million pounds U_3O_8(e).

5. The Department agrees that the proposed sale of this uranium could have an impact on prices for conversion services. DOE recognizes that predicting the future of the uranium market has a large number of uncertainties associated with it. For the purpose of determining whether there is a significant environmental impact as a result of the actions proposed in the EA, NEPA socioeconomic analyses are generally confined to impacts on employment, production, etc.

6. ConverDyn's preference for an extended timetable is noted. The nine-year timetable in the EA was selected for purposes of the analyses in the environmental assessment; however, the amount of uranium DOE will sell over a given period of time will ultimately be determined in the Secretarial Determinations. These Determinations will allow the Department to factor in prevailing market conditions and the experience gained from previous sales.

7. The proposal to split or deconvert natural UF_6 so that the uranium and conversion components could be brought into the market on different timetables is noted. DOE will consider this proposal in developing its future sales strategy. Any decision related to separating the components would be included in any Secretarial Determinations that must be made prior to sales of the Department's excess uranium. As discussed in response to comment 6, the amount of uranium DOE will sell over a given period will be guided by analyses included in the Secretarial Determinations.

Letter 02 **Author:** Eleanor R. Busick, State Department

Response to Comment Letter 02

1. DOE agrees that uranium is a fungible commodity in a world market. However, recent data suggest that uranium produced in the United States is most likely going to be used in the United States. For example, in 1995, U.S. producers produced 6 million pounds of natural uranium and delivered almost 5.3 million pounds to U.S. utilities. Thus, the Department feels it is appropriate to judge the impact of domestic sales on domestic producers differently than foreign sales.

2. Production costs are proprietary information unavailable to the Department. In the draft EA, consideration of the likely impact on domestic producers included factors such as percentage of world production in the absence of definitive data as to domestic and foreign producers' marginal costs. The amount of uranium DOE will sell over a given period will depend on analyses included in any Secretarial Determination, as required by the USEC Privatization Act. These Determinations will allow the Department to factor in prevailing market conditions and the experience gained from previous sales.

Letter 03 **Author:** H.H. Barker, Virginia Power

Response to Comment Letter 03

1. Virginia Power's support of the Proposed Action is noted.

2. Virginia Power's support for a near-term loan program in addition to direct sales of surplus material by DOE is noted. The Department is currently assessing the feasibility of such a program.

3. Regarding possible acceleration of the Department's uranium sales program, the amount of uranium from its inventory that DOE sells over a given period will depend on analyses included in any Secretarial Determinations, as required by the USEC Privatization Act. These Determinations will allow the Department to factor in prevailing market conditions and the experience gained from previous sales.

Letter 04 **Author:** Dustin Garrow, Nuclear Fuel Resources, Inc.

Response to Comment Letter 04

1. DOE's proposed uranium sales are already subject to periodic review in the form of Secretarial Determinations that must be made prior to proposed sales of DOE uranium.

2. NFR's support of the Proposed Action is noted.

3. Regarding the process and procedures DOE will use in the sale of surplus uranium, the Department plans to develop the appropriate mechanisms for uranium sales as part of the Secretarial Determinations required by the USEC Privatization Act. These Determinations will allow the Department to factor in prevailing market conditions and the experience gained from previous sales.

Letter 05 **Author:** Crew Schmitt, Uranium Producers of America

Response to Comment Letter 05

1. In analyzing the potential cumulative impacts of the Proposed Action in the draft EA, DOE considered the proposed disposition of DOE's highly enriched uranium (Record of Decision issued July 29, 1996) and the Russian HEU Agreement. In addition, any Secretarial Determination will include consideration of prevailing and projected market conditions, uranium available as a result of natural and Russian HEU blending activities, and the impact of other government actions at the time of the proposed sales.

2. The observations regarding the impact of DOE's Proposed Action on the Russian HEU Agreement are noted. Regarding the market's ability to absorb the material, DOE will comply with the USEC Privatization Act's requirement to only sell uranium if the sale will not have an adverse material impact on the domestic uranium industry. In addition, prevailing market conditions at the time of proposed sales will be evaluated in any required Secretarial Determinations.

3. UPA's support for introducing DOE's surplus uranium in a manner consistent with the Proposed Action is noted. The amount of uranium DOE will sell over a given period will be guided by analyses included in any Secretarial Determinations required by the USEC Privatization Act. This will allow the Department to update its analysis of expected impacts of proposed sales based on prevailing market conditions and the experience gained from previous sales.

4. Comments on how best to determine impacts on the domestic uranium industry are noted and will be considered in preparing any Secretarial Determinations required prior to proposed sales of the Department's excess uranium. For the purpose of determining whether there is a significant environmental impact as a result of the actions proposed in the EA, NEPA socioeconomic analyses are generally confined to impacts on employment, production, etc. The Department continues to believe that the most accurate method of assessing impacts on the domestic uranium industry is by basing the analysis on historical data and conservative assumptions.

5. DOE recognizes the requirement for prior agreements with foreign users of U.S. uranium before the uranium can be sold but believes that this will not greatly impact its ability to sell its excess uranium to foreign buyers. The major foreign buyers of uranium are already parties to such agreements. This includes buyers of uranium in Japan, Korea, Taiwan, and western Europe. Also, in analyzing the impact of the Proposed Action on the domestic uranium industry, DOE made the conservative assumption that all of the uranium would be sold in the domestic market to maximize the potential adverse impact of these sales on the domestic uranium industry; thus, DOE's inability to sell its uranium to foreign buyers would not change the results of the EA.

6. While the Department agrees that the proposed sale of excess uranium could have an impact on uranium prices, DOE recognizes that predicting the future of the uranium market has a large number of uncertainties associated with it. DOE will further analyze the impact of proposed sales in any Secretarial Determinations required by the USEC Privatization Act. These Determinations will consider prevailing market conditions and the impacts experienced as a result of previous sales can be factored into future decisions.

7. As discussed in responses to earlier comments, DOE will consider the impact of its sales on the market in the Secretarial Determinations required prior to proposed sales. These Determinations will analyze the impact of proposed sales taking into consideration uranium that will be entering the U.S. market as a result of the Russian HEU Agreement, Suspension Agreement, and the blending down of domestic HEU.

8. UPA's opposition to the accelerated sale of DOE's surplus uranium is noted. As UPA noted on the first page of its comments, Congress may anticipate that DOE fund more of its program needs through uranium sales. Regarding possible acceleration of the program, the amount of uranium DOE will sell over a given period will be guided by analyses included in the Secretarial Determinations that are required by the USEC Privatization Act. As discussed in the responses to earlier comments, this will allow the Department to factor in prevailing market conditions and the impacts experienced as a result of previous sales into future decisions.

Letter 06 **Author:** Marvin S. Fertel, Nuclear Energy Institute

Response to Comment Letter 06

1. NEI's support of the Proposed Action and a finding of no significant impact is noted.

2. NEI's support of quarterly auctions is noted. DOE will consider this comment in developing the mechanisms it will use in future uranium sales.

3. NEI's proposal for a supplemental uranium loan program that would allow up to 4 million pounds of uranium to be made available only to U.S. utilities is noted and will be considered in the Department's sales strategy. The Department is currently assessing the feasibility of such a program and notes NEI's belief that such a program would not have an adverse material impact on the domestic uranium industry.

4. The proposal to split or deconvert natural UF_6 so that the uranium and conversion components could be brought into the market on different timetables and NEI's belief that the conversion services could be brought into the market without having an adverse material impact on the domestic conversion industry are noted. DOE will consider this proposal in developing its future sales strategy. Any decision related to separating the components would be included in any Secretarial Determinations that must be made prior to sales of the Department's excess uranium.

5. NEI's statement that the sale and loan of DOE material will not have adverse material impact on the U.S. uranium enrichment industry is noted.

Letter 07 **Author:** James E. Sammis, Wolf Creek Nuclear Operating Corporation

Response to Comment Letter 07

1. Wolf Creek's support of the Proposed Action is noted.

2. Wolf Creek's support for a uranium loan program is noted. The Department is currently assessing the feasibility of such a program.

Letter 08 **Author:** David McLellan, Canadian Embassy

Response to Comment Letter 08

1. Canada's support of the Proposed Action (if material is sold in equal annual quantities at the rate of about 2.5 million pounds U_3O_8(e) to ensure predictability) is noted. However, the 2.5 million pounds U_3O_8(e) noted by the commentor does not include the natural uranium equivalent included in the low enriched uranium DOE is considering for sale or the "Russian" natural uranium that will be sold in the open market. Including this uranium, the average sales will be about 3.2 million pounds per year as discussed in the draft EA.

2. Comment noted. DOE anticipates making its material available in an open process to all buyers including utilities, producers, converters and traders. For purposes of analyzing environmental impacts, DOE assumed that the material would enter the market in equal amounts each year. The amount of uranium DOE will sell over a given period of time, however, will ultimately be determined through any Secretarial Determinations required by the USEC Privatization Act. These Determinations will allow the Department to factor in prevailing market conditions and the experience gained from previous sales.

Letter 09 **Author:** T. Michael Taimi, United States Enrichment Corporation

Response to Comment Letter 09

1. USEC's suggested changes have been incorporated in the final EA. (See Section 4.2.5)

2. USEC's suggested changes have been incorporated in the final EA. (See Table 4.9)

3. USEC's suggested changes have been incorporated in the final EA. (See Section 7.0)

4. Although more recent data on HF releases than that cited in the draft EA are available, as noted by USEC, more recent environmental monitoring data is not publicly available. Therefore, in order to show a more direct cause and effect relationship between releases and environmental effects, DOE has retained the use of the like data sets used in the draft EA.

5. USEC's suggested changes have been incorporated in the final EA. (See Appendix D)

Letter 10 **Author:** Francis X. Quinn, Yankee Atomic Electric Company

Response to Comment Letter 10

1. Yankee Atomic's support of the Proposed Action is noted.

2. Yankee Atomic's support for a supplemental uranium loan program is noted. The Department is currently assessing the feasibility of such a program.

Letter 11 **Author:** G.A. Hunger, Jr., PECO Nuclear

Response to Comment Letter 11

1. PECO's support for the Proposed Action is noted.

2. PECO's recommendation of expedited sales over a shorter period of time is noted. The amount of uranium DOE will sell from its inventory over a given period of time will ultimately be determined through any Secretarial Determinations required by the USEC Privatization Act. These Determinations will allow the Department to factor in prevailing market conditions and the experience gained from previous sales.

Letter 12 **Author:** Larry W. Weaver, Ohio State Clearinghouse

Response to Comment Letter 12

1. DOE will provide the requested copies of the final EA.

II. Other Comments

The Department also received two comment letters substantially similar to comments of other organizations. Both expressed support for the Department's proposed action. One commentor supported consideration of an accelerated schedule for uranium sales. This commentor also supported the supplemental loan program proposed by the Nuclear Energy Institute. Both commentors advocated flexibility in selecting a mechanism for selling the uranium. One commentor specifically recommended an open bidding process. The second commentor also suggested requesting bids, as well as holding auctions and offering long-term contracts. The Department will conduct additional analysis on sales of uranium in any Secretarial Determinations as required by the USEC Privatization Act. The amount and timing of sales, and the mechanisms for conducting the sales, will depend on analyses included in these Determinations.