ENERGY RESOURCES INTERNATIONAL, INC.

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Quantification of the Potential Impact on Commercial Markets of Introduction of DOE Excess Uranium Inventory in Various Forms and Quantities During Calendar Years 2012 through 2033

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NOTICE

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Executive Summary

On March 11, 2008 the Secretary of the U.S. Department of Energy (DOE) issued a policy statement on management of the DOE's excess uranium inventory. It stated that

> *"To the extent practicable, the Department will manage its uranium inventories in a manner that is consistent with and supportive of the maintenance of a strong domestic nuclear industry. Consistent with this principle, the Department believes that, as a general matter, the introduction into the domestic market of uranium from Departmental inventories in amounts that do not exceed ten percent of the total annual fuel requirements of all licensed nuclear power plants should not have an adverse material impact on the domestic uranium industry."*

In support of the Secretary's policy statement, DOE published its "Excess Uranium Inventory Management Plan" (DOE 2008 Plan) on December 16, 2008.

It may be noted that the various segments of the U.S. nuclear industry (e.g., owners and operators of nuclear power plants as well as nuclear fuel suppliers and their trade associations) have stated their support for the DOE 2008 Plan. Among its comments, the Uranium Producers of America (UPA) stated that *"market analysts can now assume very predictable and transparent limits to the impacts of government supplies going forward*."

In September 2011, the U.S. Government Accountability Office (GAO) issued a report to Congress on the subject of excess uranium inventories.[i] In its report GAO stated that

> *"According to domestic uranium industry officials we interviewed, DOE's departure from its 2008 plan has created anxiety about how much further DOE might deviate from its plan in the future. In particular, industry officials were concerned that uncertainties about the quantities of uranium DOE might suddenly decide to sell or transfer could cause a fall in future uranium prices. Industry officials told us that this fear of declining prices discouraged potential investment in the industry, particularly in newer mining companies seeking to start production. Industry officials also said they feared that uncertainties about DOE's future plans would raise the costs of borrowing and of insurance coverage."*

By way of background, it is interesting to note that between December 2009 and March 2011, there were six DOE transfers of natural uranium that resulted in spot market sales by the DOE contractors that received the uranium. The sales were in amounts of between

[i] U.S. Government Accountability Office, "Excess Uranium Inventories – Clarifying DOE's Disposition Options Could Help Avoid Further Legal Violations," GAO-11-846, September 2011.

approximately 520,000 pounds U_3O_8 equivalent and 915,000 pounds U_3O_8 equivalent. During the months in which three of these transfers occurred, the spot market price for uranium declined by $0.75, $1.75 and $11.00 per pound. With the exception of the March 2011 price change, which can be largely attributed to the events at Fukushima Daiichi, these declines in price are less than the average month-to-month change in spot market price that has occurred during the past three years. During the other three months in which these transfers occurred, the uranium spot market price either did not change or increased by $1.00 and $1.25 per pound U_3O_8. Such upward price movements were in the opposite direction than might have been expected in the absence of any other market activity.

This report presents the results of a business analysis performed by Energy Resources International, Inc. (ERI) of the potential impact on the commercial markets of the introduction of DOE excess uranium inventories in various forms and quantities during the period 2012 through 2033[ii].

The transactions analyzed by ERI during this period involve the transfer of 9,156 MTU[iii] of high assay depleted uranium hexafluoride (DUF_6) to Energy Northwest (ENW), during calendar years 2012 and 2013. If completed, this transfer would be immediately followed by enrichment of the DUF_6 to LEU. At that point, there are several alternative paths under consideration by ENW for the disposition of this LEU during the period 2014 through 2033.

Under the proposed arrangement, USEC would receive 600 MTU of natural uranium feed upon completion of its enrichment contract, which it would use to meet a portion of its current contract obligations. If not for this material, USEC has stated that it would have taken 600 MTU of natural uranium feed from its existing inventory, without intending to replenish it. Accordingly, ERI views this part of the transaction as not having any market impact. There are several alternative paths under consideration by ENW for the disposition of this LEU during the 20 year period, 2014 through 2033. Each of these alternative paths include some amount of the natural uranium and enrichment services content of the remaining LEU being used to meet future reload requirements for the Columbia Generating Station, which is operated by ENW with all electricity output going to the Bonneville Power Administration. Under each of the alternative disposition paths, the balance of the natural uranium and enrichment services content would be sold under long-term contracts to one or more companies for use in the nuclear power plants that they operate.

This analysis also takes into account other sales or transfers by DOE into the market during this period of time. These include the ongoing quarterly transfers of natural uranium hexafluoride (UF_6) at the current rate to the DOE contractor, Fluor-B&W Portsmouth LLC (FBP), for services being provided to DOE in support of the environmental cleanup of the

[ii] Unless indicated otherwise, all years are calendar years.

[iii] Subsequent to this analysis being undertaken, the amount of DUF_6 under consideration was reduced to 9,075 MTU, which is bounded by the analysis.

Portsmouth gaseous diffusion plant (GDP). For the base case, transfers are assumed to continue at the current rate until all DOE Russian and U.S. origin UF_6 have been transferred to one or more DOE contractors, which would be in 2021. ERI also analyzed several alternative scenarios that reflect the transfer of the Russian and U.S. origin natural UF_6 at three higher annual transfer rates, until the transfer of all of this UF_6 has been completed, which would be in 2018 at the earliest.

In May 2011, Traxys North America LLC (Traxys) announced that it had entered into an agreement for the purchase of all natural UF_6 through 2013 that the DOE contractor, FBP, expects to receive from DOE under the arrangement referred to above. The Traxys announcement notes that *"FBP moved away from the previous practice of spot market auctions…wishing to avoid any impact upon the market"*. Therefore, it is no longer possible to explicitly identify when and how much of this DOE origin material is introduced into the commercial markets by Traxys at any point in time. ERI believes it is reasonable to assume that Traxys will introduce this material into the commercial markets through an equal mix (by volume of material) of spot market and term market transactions.

In addition, the DOE National Nuclear Security Administration (NNSA) expects to be transferring into these same commercial markets additional LEU, which results from the down blending of highly enriched uranium (HEU) under several programs. The four elements of down blended HEU that are presently expected by NNSA to be transferred to the commercial markets are: (i) Tennessee Valley Authority (TVA) off-spec material; (ii) American Fuel Supply barter material for the NNSA contractor; (iii) Mixed Oxide Fuel (MOX) LEU Backup Inventory Project barter material for the NNSA contractor; and (iv) Unallocated HEU down blended material. In addition, in order to perform the down blending of the HEU, diluent in the form of natural uranium is purchased from the commercial market. According to DOE/NNSA, based on information that is presently available, the last transfers to TVA and to the NNSA contractor that is down blending HEU for the American Fuel Supply occur during 2012; and the last transfer to the NNSA contractor that is down blending HEU for the MOX LEU Backup Inventory Project will occur during 2013. The presently unallocated HEU down blended material is assumed to be introduced into the market beginning in 2014.

It should be noted that the NNSA quantities identified and evaluated in this report do not include transfers of LEU that have a high assay (or enrichment) of uranium isotope 235 (U^{235}) – i.e., 19.75 weight percent U^{235} – derived from HEU to make fuel for research and isotope production reactors. Because the commercial sector cannot produce uranium of that assay, these transfers do not displace commercial activity and have absolutely no impact on the domestic nuclear fuel industry.

Twelve different scenarios result from the different combinations of these alternative transfer plans. In total, the transfer of natural uranium to the DOE contractor(s) accounts for about 72% of the total natural uranium equivalent that DOE is considering for transfer over the entire period. The natural uranium component of the LEU resulting from enrichment of the transferred high assay depleted UF_6 and the natural uranium component of the NNSA transfers account for about 16% and 12%, respectively, of the total natural uranium component of the DOE material under consideration.

Since the total amount of material that is assumed to be transferred by DOE over the entire period of 2012 through 2033 is identical at 20,639 MTU as UF_6 equivalent or 53.9 million pounds of U_3O_8 equivalent, the average annual quantity in each of the 12 scenarios is the same at 4.8% of annual U.S. requirements. In addition, the total amount of equivalent enrichment services that is assumed to be transferred by DOE over the entire period of 2012 through 2033 is identical at 5.8 million SWU. The average annual quantity in each of the 12 scenarios is the same at 0.3 million SWU, which is 1.7% of annual U.S. requirements. However, as expected, there are differences among the scenarios.

The (i) maximum annual quantities, (ii) average annual quantities over the first nine years (i.e., 2012 through 2020), which is the period during which all of the identified NNSA material and almost all of the Russian and U.S. origin natural uranium would be transferred, and (iii) average annual quantities over the entire period (i.e., 2012 through 2033) were compared with expected annual U.S. requirements in the corresponding period of time.

The results of this comparison are that in some years, the DOE transfers might reach values in the range of 12% to 15% of U.S. annual requirements for uranium and conversion services and not more than 7% of U.S. annual requirements for enrichment services. The average of the DOE transfers over the period 2012 through 2020 for uranium and conversion services is in the range of 10.3% to 10.8% of U.S. annual requirement. For enrichment services, the average of the DOE transfers is in the range of 3.2% to 3.5% of U.S. annual requirements. When examined over the entire period 2012 through 2033 the averages are 4.8% of U.S. annual requirements for uranium and conversion services and 1.7% of U.S. annual requirements for enrichment services.

It should be recognized that is very difficult, if not impossible, to accurately predict the specific change in spot market price that might result from a particular future event. The general inability of financial investors to accurately predict day-to-day movements in the markets for investment securities, including other commodities, provides a reasonable analogy. Furthermore, the market's expectations of future long-term market prices are believed to be more relevant to investment decisions than current spot market prices, since they are more likely to determine whether or not the investor will be able to earn an appropriate economic return over the life of the new projects. Nonetheless, recognizing that there is interest among some market participants in the potential impact of any DOE transfers on spot market prices, ERI has developed a multivariable correlation between the monthly spot market prices published by TradeTech[iv] and the monthly spot market values

[iv] TradeTech, LLC (TradeTech) is one of several companies that publish market price indicators for the nuclear fuel industry, and related supply and demand data.

of supply and demand, which are also published by TradeTech. This correlation covers the period from July 2004 through March 2012 and has an R^2 = 89%, which is good, particularly given the extreme volatility experienced in the spot market price during this period.

This correlation was then used to simulate the 2012 through 2021 spot market price for uranium concentrates, assuming monthly values of supply and demand consistent with the average monthly values that have been experienced over the last four years, with and without the DOE transfers that are presently under consideration. The results of applying this correlation are projections of a potential spot market price decrease of $2.96 per pound U_3O_8 based on an average of the scenarios over the period 2012 through 2021; and a decrease of $4.55 in the year of potential highest impact (2017) based on the highest of the scenarios. This represents a potential impact based on the spot market price during this period in the range of 5.8% to 8.9%. This is less than half the maximum month-to-month change experienced during the past three years in the spot market price; and about 1.5 to two months of average price volatility that has been experienced in this market over the last three years. This does not adjust for any other changes in market condition that may occur as a result of the announced transfer, such as an increase in market demand.

ERI also applied the results of its economic market clearing price analyses[v] to the average annual incremental addition of supply that would result from the DOE transfers that are presently under consideration. This allowed ERI to estimate the potential effect on economic market clearing price, which serves as the basis for long-term price, for the period 2012 through 2033.

The potential impact on the term price for uranium concentrates is $1.86 to $2.61 per pound, which is also less than about half the maximum month-to-month change experienced during the past year; and equivalent to about two to three times the average month-to-month volatility in term price for uranium concentrates over the last three years. The potential impact on the term price for conversion services is $0.69 to $0.97 per kgU as UF_6, which is also less then half the maximum month-to-month change experienced during the past three years; and equivalent to three to five months of the average month-to-month volatility in the term price for conversion services. The potential impact on the term price for enrichment services is $3.00 to $4.35 per SWU, which is less then the maximum month-to-month change experienced during the past three years, as well as the total change

[v] Such analyses require the creation of an annual supply curve, which in the case of uranium concentrates is constructed by stacking individual increments of supply (e.g., individual mines) in ascending order from low to high based on each increment's cost of production, until the total supply is equal in quantity to the projected demand for uranium concentrates in the year of interest. The market clearing price is the total cost of production for the last increment of supply that is required to meet demand during that year. The additional quantity of incremental supply added to the market during the year (e.g., by a DOE transfer), together with the slope of the supply curve (i.e., $\Delta\$$ per pound / Δ million pounds) at the point that total supply equals total demand, provide the basis for determining the potential impact (i.e., reduction) on the market clearing price.

in price over any of the last three years; and equivalent to four to seven months of the average month-to-month volatility in the term price for enrichment services. In summary, the potential impact on market price of the DOE material transfer is consistent with the historical volatility observed in the nuclear fuel markets.

Based on presently available information and the results of the analysis described in this report, ERI does not believe that either (i) the potential price effect of the presently proposed quantities of equivalent U_3O_8, conversion services and enrichment services that DOE is considering transferring during the period 2012 through 2033; or (ii) the quantities of domestic production, if any, that might be displaced due to the proposed DOE transfers are of a magnitude that they would constitute a material adverse impact on the domestic industries or any of the initiatives that are presently underway. These initiatives include uranium exploration and development, previously announced plans to license and construct new enrichment facilities, or the U.S.-Russian HEU Agreement, which is scheduled to end in 2013.

However, even if the potential impact of any individual transfer by DOE is not in itself significant, the nuclear fuel markets recognize that DOE controls a very large amount of material. The predictability of DOE's transfer of that material into the commercial markets over time is very important to the orderly functioning of these markets. In this regard, it is critical for long-term planning and investment decisions by the domestic industry that there can be confidence that DOE will adhere to what it presents as being established guidelines and plans.

Unless DOE can demonstrate to the domestic fuel supply industry that its transfer of material during any year(s) in an amount that is substantially larger than 10% of U.S. annual requirements will not establish a precedence by which DOE may make future transfers without any regard for the "*maintenance of a strong domestic nuclear industr*y", then DOE actions may, in fact, have an adverse material impact on the domestic industry. Most significantly, current and future plans for commercial uranium exploration, development, as well as new facility construction to increase long-term supply capacity, particularly in the domestic uranium supply industry, could be adversely impacted.

It is therefore important to note that in contrast to prior analyses of DOE transactions spanning three to seven years, DOE has identified all the material that is currently under consideration for transfer over a period of more than 20 years, i.e. from 2012 through 2033. This more comprehensive DOE plan enables the industry to better understand the significance of transfers during the next five to seven years that may exceed the 10% guideline and to adjust industry expectations and plans as is believed necessary.

1. Introduction

On March 11, 2008 the Secretary of the U.S. Department of Energy (DOE) issued a policy statement on management of the DOE's excess uranium inventory. It stated that

> *"To the extent practicable, the Department will manage its uranium inventories in a manner that is consistent with and supportive of the maintenance of a strong domestic nuclear industry. Consistent with this principle, the Department believes that, as a general matter, the introduction into the domestic market of uranium from Departmental inventories in amounts that do not exceed ten percent of the total annual fuel requirements of all licensed nuclear power plants should not have an adverse material impact on the domestic uranium industry."*

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The transactions analyzed by ERI during this period involve the transfer of depleted uranium hexafluoride (DUF_6) to Energy Northwest (ENW), a contractor of Bonneville Power Administration, during calendar years 2012 and 2013[1]. If completed, this transfer would be immediately followed by enrichment of the DUF_6 to LEU. At that point, there are several alternative paths under consideration by ENW for the disposition of this LEU during the period 2014 through 2033.

This analysis also takes into account other sales or transfers by DOE into the market during this period of time. These include the ongoing quarterly transfers of natural UF_6 at the current rate to the DOE contractor, Fluor-B&W Portsmouth LLC (FBP), for services being provided to DOE in support of the environmental cleanup of the Portsmouth gaseous diffusion plant (GDP). For the base case, transfers are assumed to continue at the current rate until all DOE Russian and U.S. origin UF_6 have been transferred to one or more DOE contractors, which would be in 2021. ERI also analyzed several alternative scenarios that reflect the transfer of the Russian and U.S. origin natural UF_6 at three higher annual transfer rates, until the transfer of all of this UF_6 has been completed, which would be in 2018 at the earliest.

In addition, the DOE National Nuclear Security Administration (NNSA) expects to be transferring into these same commercial markets additional LEU, which results from the down blending of highly enriched uranium (HEU) under several programs. It should be noted that the NNSA quantities identified and evaluated in this report do not include transfers of LEU that have a high assay (or enrichment) of uranium isotope 235 (U^{235}) –

[1] Unless indicated otherwise, all years are calendar years.

i.e., 19.75 weight percent U^{235} – derived from HEU to make fuel for research and isotope production reactors. DOE expects to transfer 82 MTU-equivalent as LEU with an assay of 19.75w/o U^{235} in each of 2012 and 2013. Because the commercial sector cannot produce uranium of that assay, these transfers do not displace commercial activity and have absolutely no impact on the domestic nuclear fuel industry. It will not be addressed further in this report.

In support of the Secretary's Policy Statement, DOE published its "Excess Uranium Inventory Management Plan" (DOE 2008 Plan) on December 16, 2008. According to the DOE 2008 Plan,

> *"The objectives of the Plan are to seek to: (1) enhance the value and usefulness of DOE's uranium by converting a portion of it into a low enriched uranium (LEU) inventory; (2) reduce DOE programmatic costs by decreasing uranium inventories; (3) meet key nonproliferation objectives; and (4) dispose of unmarketable material to facilitate the cleanup of DOE's gaseous diffusion plants (GDPs). DOE also anticipates that it will undertake to optimize the use and disposition of its excess uranium assets in a manner that also minimizes any material adverse impacts on the domestic uranium mining, conversion and enrichment industries.*
>
> *"The Plan addresses the disposition of DOE's excess uranium identified in this Plan through potential sales or transfers of uranium based on a combined annual quantity of no more than ten percent of the annual U.S. nuclear fuel requirements. The Department may exceed the ten percent in any given year for certain special purposes, such as initial core loads for new reactors. Uranium disposition decisions will be undertaken in a manner that is consistent with DOE's mission needs and the principles set forth in the Policy Statement. DOE sales or transfers would be conducted consistent with applicable legal requirements and will result in the U.S. Government's receipt of reasonable value."*

It should be noted that the various segments of the U.S. nuclear industry (e.g., owners and operators of nuclear power plants as well as nuclear fuel suppliers and their trade associations) have stated their support for the DOE 2008 Plan, together with DOE's proposed transfer of additional uranium "*for certain special purposes, such as initial core loads for new reactors*", even if such transfers are greater than 10% of U.S. requirements. Among its comments, the Uranium Producers of America (UPA) stated that *"market analysts can now assume very predictable and transparent limits to the impacts of government supplies going forward*."[2,3]

[2] Uranium Producers of America, News Release, "UPA Applauds the DOE Excess Uranium Inventory Management Plan", December 22, 2008.

[3] Nuclear Energy Institute, "Industry Position on Disposition of DOE's Nuclear Fuel Inventory vs. DOE Management Plan", December 16, 2008.

However, following the July 28, 2009 news release by DOE of its plans to expand and accelerate cleanup efforts at the Portsmouth site and of its intent to fund these efforts with its excess uranium[4], the UPA expressed concern regarding whether "*the sale or transfer of excess uranium from the Department's existing stockpiles [will] be within the sale or transfer amounts established by the December 2008 Excess Uranium Management Plan*" and the extent to which this new DOE initiative may impact the domestic uranium producers.[5] The UPA has continued to press this point within Congress and the Administration.[6] Subsequently, the nuclear industry expressed concern that DOE might increase the amount of uranium transferred above any guidelines previously presented in the DOE 2008 Plan[7].

In September 2011, the U.S. Government Accountability Office (GAO) issued a report to Congress on the subject of excess uranium inventories.[8] In its report GAO stated that

> *"According to domestic uranium industry officials we interviewed, DOE's departure from its 2008 plan has created anxiety about how much further DOE might deviate from its plan in the future. In particular, industry officials were concerned that uncertainties about the quantities of uranium DOE might suddenly decide to sell or transfer could cause a fall in future uranium prices. Industry officials told us that this fear of declining prices discouraged potential investment in the industry, particularly in newer mining companies seeking to start production. Industry officials also said they feared that uncertainties about DOE's future plans would raise the costs of borrowing and of insurance coverage."*

GAO also reported that DOE officials stated that *DOE "has begun work on updating the uranium management plan* [DOE 2008 Plan*], but officials were unable to provide a date by which the update would be completed."*

Section 2 provides background information on each of the nuclear fuel markets that would potentially be affected by the transfer of these DOE materials. They are the markets for uranium concentrates, conversion services, and enrichment services. For each of these markets, both spot and term price indicators, together with the observed volatility or change in these prices, are also presented. This information serves as a basis for

[4] U.S. Department of Energy, News Release, "800 to 1000 New Jobs Coming to Piketon", July 28, 2009.

[5] Uranium Producers of America, Letter from William P. Goranson, President of UPA, to Honorable Steven Chu, Secretary of the U.S. Department of Energy, August 4, 2009.

[6] Uranium Producers of America, Letter from William P. Goranson, President of UPA, to Honorable Steven Chu, Secretary of the U.S. Department of Energy, October 13, 2009.

[7] Fertel, M.S., Nuclear Energy Institute, Letter to Dr. Steven Chu, Secretary of Energy, U.S. Department of Energy, September 2, 2010.

[8] U.S. Government Accountability Office, "Excess Uranium Inventories – Clarifying DOE's Disposition Options Could Help Avoid Further Legal Violations," GAO-11-846, September 2011.

understanding the relative importance of the quantities of DOE material that might be transferred. It also provides additional perspective with regard to the potential impact of such transfers relative to published market prices.

Section 3 identifies and discusses the quantities of equivalent DOE natural uranium and enrichment services associated with the disposition of the enriched DUF_6, down blended HEU, as well the quantities of natural uranium that are currently being transferred to the DOE contractor, and the alternative scenarios under which it may be transferred in the future.

Section 4 presents quantitative and qualitative estimates of the potential effect of the above described transfers of DOE equivalent materials and services on the domestic uranium, conversion and enrichment industries, with particular attention to the potential effect of these transfers on market clearing prices[9], and also the spot market price for uranium concentrates. To provide perspective, comparisons are provided regarding the size of these potential price effects relative to changes in published spot and term market prices that have occurred in the past.

Finally, Section 5 provides a summary of potential market impact and the nature of the domestic industry's concerns in this regard.

[9] In any particular year, the market clearing price (or equilibrium price) for uranium concentrates, for example, is based on the cost of production of the last increment of uranium that must be supplied by the market in order to provide the total quantity of uranium concentrates that is demanded by the market during that year.

2. Background on Nuclear Fuel Supply Markets

In order to better understand the potential impact that DOE transfers could have on the commercial markets for nuclear fuel materials and services it is useful to have some background regarding the current status of each of these markets and the expectations that market participants have regarding the future. At a minimum, this allows one to better appreciate (i) the relative size of the DOE transfers in the context of each of these markets, (ii) the manner in which published market prices have behaved in the past, and (iii) how the potential price impacts of the DOE transfers relate in size to historical volatility in these market prices.

The ERI nuclear power requirements forecasts used in this analysis were developed on a plant-by-plant and country-by-country basis. These forecasts take into consideration social, political, and economic conditions in those countries implementing nuclear power. These forecasts also reflect both the near-term and expected long-term impact of the events at the Fukushima Daiichi Nuclear Power Plant in Japan, which were initiated by a massive earthquake and tsunami that struck off the East coast of Honshu, Japan in March 2011.

The nuclear power forecasts, nuclear fuel design, and management parameters for specific types of nuclear power plants are used to project future nuclear fuel material and services requirements. The requirements for each U.S. nuclear power plant now operating or under construction take into account plant specific discharge burn-up, reload fuel assays, fuel cycle lengths, first-core and reload lead times, and operating capacity factors. Generic plant type and country-specific operating and fuel cycle characteristics are used for nuclear power plants outside the U.S., and fuel recycle is included for specific countries in Western Europe, consistent with present and planned activities.

2.1 Uranium Concentrates

2.1.1 Uranium Market Price Activity

The spot market price of uranium was $9.75 per pound U_3O_8 in March 2002 and moved steadily upward, reaching $135 in June 2007, as reported by TradeTech.[10] This 14 fold increase in price over approximately five years was driven largely by a series of unexpected disruptions to supply, ongoing discussion of a worldwide resurgence in the use of nuclear power, and the entry of financial speculators into the market. As if it was

[10] TradeTech, LLC (TradeTech) is one of several companies that publish market price indicators for the nuclear fuel industry, and related supply and demand data. Unless otherwise noted, historical and current spot and term market prices for uranium, conversion and enrichment markets that are referred to in this report are based upon information that is published by Trade Tech in the March 2012 issue of its monthly publication, The Nuclear Review, and the March 31, 2012 issue of its weekly publication, Nuclear Market Review.

responding to an over reaction in market behavior, the spot price fell back to $85 per pound U_3O_8 by August 2007, $47 by January 2009, and continued in a downward direction, reaching a low of $40.50 per pound U_3O_8 in February 2010, before rebounding to $72.25 in January 2011. Following the accident at Fukushima Daiichi in March 2011, the price drifted down to $51.50 per pound U_3O_8 by June 2011, where it has held firm. The current spot market price of $51.10 per pound U_3O_8 as of March 31, 2012 represents more than a five-fold increase in the spot market price in 10 years.

The term (also referred to as long-term) contract price for uranium concentrates rose from $10.40 per pound U_3O_8 in March 2002 to $41 by March 2006 and finally up to $95 per pound U_3O_8 by May 2007. It remained unchanged at $95 through March 2008 and then declined slowly to $65 per pound by May 2009, where it remained through October 2009. Between November 2009 and August 2010, it held at $60 per pound U_3O_8; then began to drift upward, reaching $70 in January 2011. However, following the accident at Fukushima Daiichi, the term price drifted down to $68 per pound U_3O_8 in March 2011, where it held through July 2011, before continuing a very slow decline, reaching $60 per pound U_3O_8 in February 2012. As of March 31, 2012 the long-term price remains at $60 per pound U_3O_8.

The transition from the much higher prices for uranium that characterized the market in 2007 and 2008 – and which could not be justified on the basis of economic production cost-based market clearing price analysis – to current prices reflects a significant decline over the last several years. Even so, current prices, which are still much higher than they had been 10 years ago, have led to identification and development of new uranium projects worldwide. It also resulted in mining projects, which may have appeared to be viable during the short lived period – between 2006 and 2008 – when uranium prices spiked, being abandoned because they were no longer viewed as being competitive after prices declined from the peak. So, while the improved outlook for greater deployment of nuclear power plants around the world – in spite of the accident at Fukushima Daiichi – and the associated forecasts for increased requirements for uranium have contributed to the overall rise in price, the renewed outlook for increases in world uranium production during the coming years can be expected to moderate future price increases in this decade.

2.1.2 Uranium Requirements

ERI's Reference Nuclear Power Growth requirements forecast indicates that world nuclear power plant uranium requirements will increase from the present level of about 163 million pounds U_3O_8 per year to 200 million pounds in 2020, and about 250 million pounds in 2030. This is about a 53% increase over a period of almost 20 years. At the same time, U.S. requirements are forecast to increase from the present level of 50.4 million pounds U_3O_8 per year to 51.5 million pounds in 2020 and about 59.6 million pounds in 2030. This is an 18% increase in requirements over a period of almost 20 years.

2.1.3 Uranium Supply

The world U_3O_8 supply capacity to meet requirements during the next decades will be obtained from uranium mine production together with government and civilian LEU and U_3O_8 equivalent inventories, down blended material from U.S. and Russian government nuclear weapons stockpiles, upgraded enrichment tails, plutonium and uranium recycle, all of which are collectively referred to as secondary supply

ERI estimates that current worldwide uranium mine production capacity is approximately 134 million pounds U_3O_8 per year, representing about 82% of total world nuclear power plant requirements under ERI's Reference Nuclear Power Growth Scenario. In 2020 and 2030, world mine production capacity is projected to be 169 and 228 million pounds per year, respectively, which in combination with Russian HEU and other secondary supply, could meet all nuclear power plant requirements at that time under this same scenario. This is consistent with an average annual expansion rate in worldwide mine production capacity of about 3.5% between 2011 and 2030.

Six countries (i.e., Kazakhstan, Canada, Australia, Namibia, Niger and Russia) are expected to provide at least 80% of world mine production during the next 10 years.

In the U.S., there are several relatively low-cost in-situ recovery (ISR) projects that are currently operating. They include the Alta Mesa Project, Crow Butte Operation, LaPalangana, Smith Ranch-Highland Operation and most recently the Willow Creek Project. Total U.S. production in 2011 from these properties, and the White Mesa Mill was reported by DOE/Energy Information Administration (EIA) to have been 4.0 million pounds.[11] U.S. mine production has ranged between 3.7 and 4.5 million pounds annually over the past five years. It is expected that these centers will continue to collectively produce between 4 and 5 million pounds per year, during each of the next several years or more. ERI estimates that the total cost of production for each of these projects (including exploration, production and return on investment), is below present market prices.

However, even as the uranium mining industry in the U.S. is demonstrating resurgence, the potential for new and more onerous regulatory constraints is becoming increasingly apparent. These include proposed the U.S. government's January 2012 moratorium on new hard rock uranium mining claims on land surrounding the Grand Canyon in Arizona, Mining Law Reform legislation, Indian Country issues, and Sacred Land issues. The Sacred Land issues are reminiscent of the problems that prevented development of the Jabiluka uranium resources in Northern Australia and have obstructed some exploration in Canada's Thelon Basin.

[11] *Domestic Uranium Production Report,* data for 4th Quarter 2011, U.S. Energy Information Administration, February 2012.

2.1.4 Adequacy of Uranium Supply Relative to Requirements

Figure 2.1 presents the world mine and secondary supply capacity that is projected to be available to meet the ERI Reference Nuclear Power Growth requirements forecast during the time period 2012 through 2035, and the resulting excess/shortfall. The secondary supply projection assumes that there will be plutonium and uranium recycle in some Western European countries, and that some excess weapons plutonium will be consumed in the U.S. and Russia in the form of mixed oxide (MOX) fuel. This figure also explicitly shows the contribution from the Russian HEU-derived LEU during the period through 2013, after which that source of uranium supply will no longer be present through the U.S.-Russia HEU Agreement. However, it is assumed that Russia will continue to down blend HEU, but at a lower rate for its own use. Re-enrichment of tails in Russia and underfeeding by all enrichers is expected to increase.

Since some of the potential new mine production capacity could result in excess capacity, the new supply does not need to come on line as quickly as published plans may indicate. It is worth noting that published plans for planned and prospective new mines tend to be optimistic. For the ERI Reference requirements shown in Figure 2.1, an average delay of two years is assumed for mines under development, five years for planned mines, and 11 years for prospective mines. In addition to the delays, only about 50% of the prospective mines are assumed to proceed at all; together with 75% of the planned mines, and 90% of the mines under development.

It is apparent from this figure that the capacity of current mines, plus secondary supply, together with capacity under development, planned mines and prospective mine supply, assuming the delays indicated above, should adequately cover the amount of uranium that is necessary to meet requirements over at least the next 20 years for the ERI Reference Nuclear Power Growth forecast. The figure indicates a modest margin which allows for potential inventory building, particularly by China. If nuclear power growth is greater than this forecast implies, then new mines will need to begin operation with less delay; and a larger portion of prospective mine supply will need to be successfully brought into production

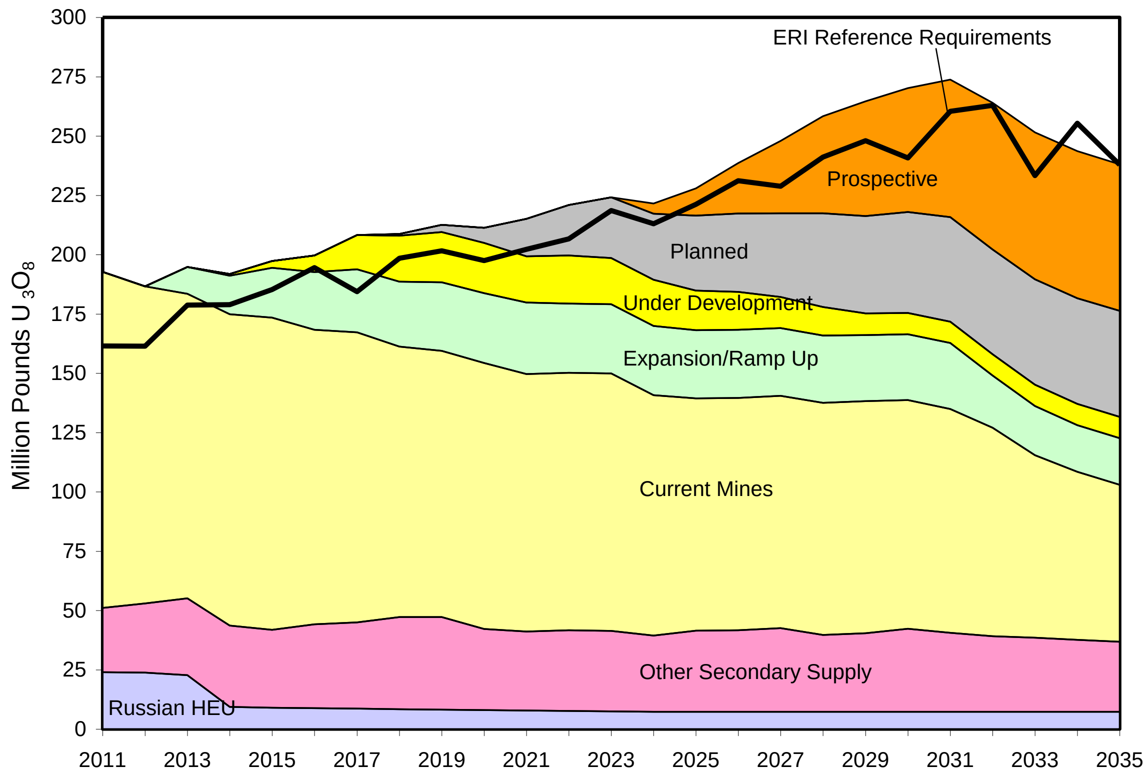

Figure 2.1 Forecast of World Supply and Requirements for Uranium Concentrates

2.1.5 Future Market Price for Uranium Concentrates

Present market prices are close to ERI's estimate of the economic market clearing price of about \$50 to \$55 per pound U_3O_8, based on the total cost of production – including return on investment. Long-term market prices are expected to be relatively stable during the next several years, even if there is some volatility and possible further movement in spot market prices during the coming months.

A current analysis of mine by mine production costs coupled with an economic market clearing price analysis[12] results in the conclusion that for each additional million pounds of uranium

[12] Such analyses require the creation of an annual supply curve, which in the case of uranium concentrates is constructed by stacking individual increments of supply (e.g., individual mines) in ascending order from low to high based on each increment's cost of production, until the total supply is equal in quantity to the projected demand for uranium concentrates in the year of interest. The market clearing price is the total cost of production for the last increment of supply that is required to meet demand during that year. The additional quantity of incremental supply added to the market during the year (e.g., by a DOE transfer), together with the slope of the supply curve (i.e., Δ\$ per pound / Δ million pounds) at the point that total supply equals total demand, provide the basis for determining the potential impact (i.e., reduction) on the market clearing price.

concentrates that are added to supply in a year, there is the potential for a reduction in the economic market clearing price that is on average approximately $0.31 per pound U_3O_8 during at least the next 10 years. It is important to note that this estimated impact is relative to projected economic market clearing prices, which serves as the basis for long-term price projections. More than 85% of all uranium requirements purchased by owners and operators of nuclear power plants during 2009, 2010 and 2011 were purchased under term contracts.[13] Typically 50% to 60% of the term contracts are market price based; and many of these include reference to the spot market price in their pricing provisions.

It is very difficult, if not impossible, to correctly attribute a specific change in the spot market price to a single event. This is addressed further in Section 4.2. It should also be noted that during the last two years less than 40% of uranium purchased on the spot market was purchased by the owners and operators of nuclear power plants, with the balance (i.e., more than 60%) being transactions among producers, traders and others.[14] Therefore, spot market purchases by owners and operators of nuclear power plants during this period represent less than 15% of total market volume of uranium. The portion of annual operating requirements that owners and operators of nuclear power plants obtain through spot market transactions is also less than 15%, with more than 85% of their uranium requirements being acquired through term contract.

2.2 Conversion Services

2.2.1 Conversion Market Price Activity

Concerns associated with the uranium concentrate to uranium hexafluoride conversion services market began in 2003 when the operation of the Honeywell International, Inc. uranium conversion plant located in Metropolis, Illinois, was shutdown for almost six-months due to equipment problems. Early in 2001, the former British Nuclear Fuels Limited announced that it would no longer operate its Springfields plant in the United Kingdom (U.K.) after March 2006, but eventually agreed to operate it for Cameco under a ten-year agreement. These events resulted in a tightening of the market at the end of 2003 and an industry-wide realization that the nuclear fuel cycle, including conversion services, was vulnerable to serious interruption at any time.

In 2007, Cameco shutdown its Port Hope conversion plant for what eventually became about 15 months due to uranium bearing effluents leaking into the nearby city harbor. Shortly after it was restarted in Fall 2008 it was shutdown again for about six months due

[13] Based on annual volumes of uranium purchased under term contract arrangements, reported by Cameco Corporation in its February 9, 2012 "Management's Discussion and Analysis" that accompanied its financial statement and notes for the year ended December 31, 2011, and annual spot market volumes that are reported and attributed in that same document to The Ux Consulting Company, LLC.
[14] Based on data attributed to The Ux Consulting Company, LLC, as reported by Platts Nuclear News Flash, dated January 25, 2012,

to a price dispute with its fluorine supplier. During this period the consensus evolved that primary conversion capacity must be expanded in order to meet the industry's gradually expanding needs for uranium conversion services because of diminishing availability of secondary supply and thin supply margins with respect to production capacity. Following a 14 month labor strike at the Metropolis plant that began in June 2010, which clearly had an impact on production, even though it did not shut down the plant entirely, a three-year collective bargaining agreement was ratified by union employees in August 2011. The plant interruptions also highlighted the logistical issues associated with transport of conversion services supply, particularly between Europe and North America.

The succession of supply disruptions described above resulted in a significant increase in the conversion price. The North American conversion services spot market price reported by TradeTech rose from just under $5.25 per kgU as UF_6 in March 2003, a level that it had not exceeded during the previous six years, to $11.00 by January 2005. Between early 2005 and July 2007 it remained in the range of $11.00 and $12.00 per kgU. However, in August 2007 the conversion spot market price began to drift downward, reaching $8.00 per kgU by November 2007. Between then and May 2009 it fluctuated within a range of $8.00 to $9.00 per kgU; by July 2009 it had dropped to $6.50 per kgU and by February 2010 it reached a low of $5.00 per kgU. However, the price began to rise in June 2010 and by August 2010 it had reached $13.00 per kgU, and remained in a range of $12.00 to $13.00 through April 2011. During the last 12 months, the price has been slowly drifting down, reaching $6.75 per kgU as of March 31, 2012.

The North American long-term market price has remained in a range between $11.00 and $12.25 per kgU during the 6.5 year period between January 2005 and July 2010. In August 2010 it began to slowly increase, reaching $15.00 in November 2010 and $16.75 in September 2011, where it remains as of March 31, 2012, seven months later. It is interesting to note that two recent extended shut downs of the Cameco Port Hope facility had virtually no impact on the published long-term market price for conversion services. However, the more recent labor strike at the Metropolis plant followed by ConverDyn’s October 2010 announcement regarding its pricing in future contracts appears to have led to a significant increase in the long-term market price for conversion services.

2.2.2 Conversion Services Requirements

ERI's Reference Nuclear Power Growth forecast indicates world nuclear power plant requirements for conversion services will rise from the present level of 58 million kgU as UF_6 per year to 73 million kgU in 2020 and 92.2 million kgU in 2030. This is about a 59% increase over a period of almost 20 years. At the same time, U.S. requirements are forecast to increase from the current level of 19.1 million kgU per year to 19.3 million kgU in 2020 and about 22.6 million kgU in 2030, which is an 18% increase in requirements over a period of almost 20 years.

2.2.3 Conversion Services Supply

The world presently has four primary commercial suppliers of uranium conversion services. Two of these suppliers are located in North America, one in the U.S. and the other in Canada, with a supporting plant in the United Kingdom (U.K.); one in France; and one is located in Russia with two plants. These suppliers are: ConverDyn, Cameco Corporation, AREVA/Comurhex, and Rosatom, respectively. Rosatom does not typically sell conversion services alone, but has for some years been exporting enriched uranium product (EUP) containing equivalent conversion services to Western Europe, the U.S., and East Asia. Primary conversion production in 2012 of 45.6 million kgU as UF_6 is expected, which represents about 77% of the estimated 2012 world requirements of 59 million kgU. This indicates a gap between primary production and requirements of 13.4 million.

In addition to primary conversion capacity, there is a substantial amount of secondary supply in the form of commercial UF_6 equivalent (UF_6e) that is currently being held by nuclear power plant operators, fuel suppliers, and governments in the U.S. and the rest of the world that will provide various levels of supply well into the future. The amount of secondary supply available to meet market requirements is expected to amount to approximately 20 million kgU per year through 2013, after which it is expected to fall to between about 15 and 18 million kgU per year, following the conclusion of the U.S.-Russia HEU Agreement in 2013. The conversion component of the HEU-derived LEU, which ends in 2013, is approximately 9 million kgU per year and accounts for most of this decrease. However, it is anticipated that Russian HEU will continue to be down blended at a somewhat lower rate for internal use for the foreseeable future.

During the last few years, the conversion services industry has not significantly expanded existing capacity. The Honeywell Metropolis plant is the only conversion facility located in the U.S. In June 2007, ConverDyn reported that following expansion related process additions, the annualized production capacity of the Metropolis plant was 15 million kgU as UF_6. However, in October 2010, ConverDyn acknowledged that Honeywell has not operated consistently at production levels that are anywhere close to 15 million kgU per year during recent years; and, in fact, stated that annual production levels over the past four years have averaged about 10 million kgU. According to a recent statement made by ConverDyn President and CEO, Ganpat Mani, Metropolis' annual production as of 2010 was limited to no more than 12 million kgU as a result of equipment problems in one part of the plant.[15] With many of its problems behind it, it appears that annual Metropolis production may reach 12 million kgU this year and maintain this level in the foreseeable future.

[15] Mani, G., Presentation at the NEI International Uranium Fuel Seminar in Savannah, GA, October 18, 2010.

Cameco's Port Hope, Ontario conversion capacity is expected to maintain an annual conversion capacity of about 10 million kgU for the foreseeable future. However, the Springfields plant in the U.K., which is being operated by Westinghouse's Springfields Fuels, Ltd., and with which Cameco has been cooperating under a long-term sales agreement for about 5 million kgU per year, is expected to shut down following the completion of the Cameco sales agreement in 2016.

During 2007, AREVA announced that it was replacing its existing facilities in the south of France with new facilities that would go into operation in 2012 and, if required by the market, would eventually have an annual capacity that would 21 million kgU, which would be 50% greater than that of its current facilities. The new plant is currently expected to reach initial nameplate capacity of 15 million kgU by the end of 2015. However, in light of recent efforts by AREVA to control capital expenditures and its December 2011 announcement regarding its current plans for this new conversion facility, together with a number of its other capital intensive projects, expansion beyond 15 million kgU is not being assumed.

It is also expected that Rosatom's capacity that is available to meet nuclear power plant requirements will increase in the coming years as the Russian HEU down blending program ends.

2.2.4 Adequacy of Conversion Supply Relative to Requirements

Figure 2.2 illustrates the projected supply, which reflects ERI's most recent understanding of how these facilities are actually operating and how they may realistically be expected to operate during the next decade or more. ERI's assumptions regarding new facilities and expansion of existing facilities is consistent with recent announcements associated with these facilities and in some cases the behavior of various governments in their ongoing development of nuclear power and supporting fuel supply services, and also with the expected use of commercial and government inventories. This figure also explicitly shows the contribution from the Russian HEU-derived LEU under the U.S.-Russia HEU Agreement, during the period through 2013, after which it is anticipated that Russian HEU will continue to be down blended at a somewhat lower rate for internal use.

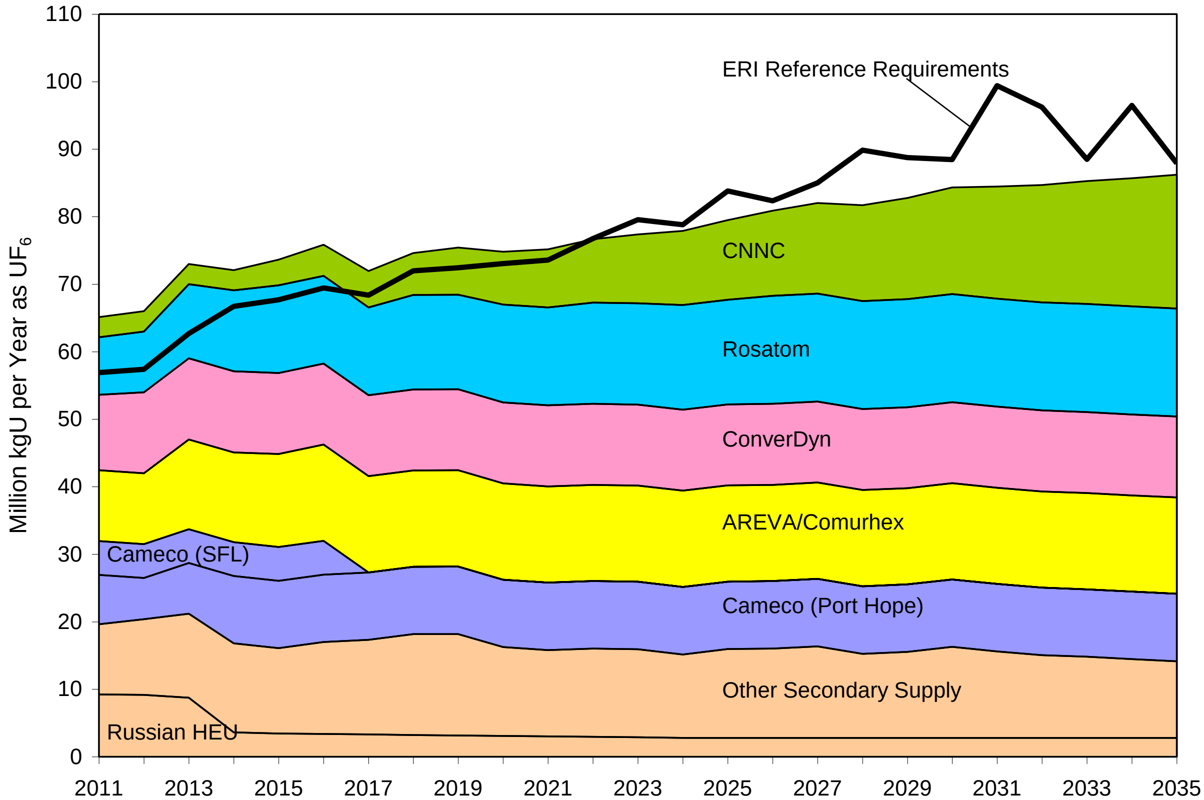

Figure 2.2 Forecast of World Supply and Requirements for Conversion Services

As shown in this figure, a reasonable margin between supply and requirements is expected for the next five years, but the margin steadily reduces after 2017 and there is a supply deficit starting in the year 2023 under the ERI Reference Nuclear Power Growth Forecast. This could become a problem during the next ten years if any of the presently operating facilities was unable to operate at its expected conversion capacity. After 2022 additional conversion capacity will need to be brought into operation. The lead time for a new plant is expected to be three to five years; while the lead time for expansion of an existing plant could be at the lower end of this range.

2.2.5 Future Market Price for Conversion Services

The industry recognizes the eventual need for expansion and/or replacement of existing facilities in order to meet the Reference Nuclear Power Growth forecast requirements for conversion services. As previously noted, the primary suppliers have already taken initial steps in that direction. Present long-term market prices appear to be adequate to support plant expansion activities, as well as construction of new conversion plants.

A production cost analysis of conversion facilities coupled with an economic market clearing price analysis results in the conclusion that for each additional million kgU of new conversion services that are added to supply in a year, there is the potential for a reduction in the market clearing price that is on average $0.30 per kgU as UF_6 during at least the next 10 years. It is important to note that this estimated impact is relative to the projected economic market clearing price, which serves as the basis for long-term price projections. More than 85% of the conversion services requirements purchased during the period 2009 through 2011 have been purchased under term contracts.[16]

2.3 Enrichment Services

2.3.1 Enrichment Market Price Activity

Following a stable period between 2002 and mid-2004, long-term prices for enrichment services began a steady rise from August 2004, with the long-term price indicator, as reported by TradeTech, reaching $165 per separative work unit (SWU) in May 2009. However, by April 2010 the price had declined to $160 per SWU, where it remained through October 2010, before declining to $158 in November 2010, where it remained through August 2011. Since then the price has continued to drift down, reaching $146 per SWU in March 2012.

The price increases that occurred between 2004 and 2009 were the result of a number of factors, which included the realization that the enrichment market supply and requirements relationship was very tight, requiring that significant new supply be brought into operation. In addition, rapidly increasing uranium prices led to lower enrichment tails assays as buyers substituted enrichment services for natural uranium, which also increased world requirements for enrichment services. As the importance of long-term supply security came to the forefront, contracting activity was quite high. Supplier costs increased as well. In particular, the cost of electric power for gaseous diffusion plant (GDP) operators experienced large increases. Additionally, the underlying cost of materials to build large new facilities has increased as well. Finally, currency exchange rates continued to have an unfavorable impact on U.S. dollar-denominated enrichment prices. However, during the past year, the market has come to believe that there will be adequate enrichment supply to meet future requirements over the next decade and the pace of contracting for future supply has eased off.

2.3.2 Enrichment Services Requirements

ERI's Reference Nuclear Power Growth requirements forecast indicates world requirements for enrichment services will increase from the present level of about 42 million SWU per

[16] Based on information published by The Ux Consulting Company, LLC in the Ux Weekly, to which DOE subscribes.

year to 55.7 million SWU in 2020, and 72.7 million in 2030. This is a 73% increase over a period of almost 20 years. At the same time, U.S. requirements are forecast to increase from the present level of 14 million SWU per year to 15.9 million SWU per year in 2020 and 18.1 in 2030, which is a 29% increase in requirements.

2.3.3 Enrichment Services Supply

Sources and quantities of uranium enrichment services include existing inventories of LEU, production from existing uranium enrichment plants, enrichment services obtained by blending down Russian weapons grade HEU, recycle materials, primarily the use of plutonium in the form of mixed oxide (MOX) fuel, as well as announced new enrichment plants and expansions at existing facilities, together with enrichment services that might be obtained by blending down U.S. HEU, to the extent that these have already been announced. The supply in this analysis also includes the annual amounts of Rosatom enrichment services that may be exported to the U.S. under the Amended Suspension Agreement directly to owners and/or operators of nuclear power plants or through USEC under the agreement that it executed last year with Tenex. The Amended Russian Suspension allows the import of EUP and SWU into the U.S. that is equivalent of up to 20% of nuclear power plant requirements starting in 2014.

Several sources of enrichment services, such as the Georges Besse (GB-I) gas diffusion plant (GDP) operated by AREVA and the Paducah GDP operated by USEC are expected to be removed from service during the next few years. Even though there are published schedules for several sources of future supply that are in various stages of the licensing and construction process, it can not be known with certainty when each will actually become operational; or whether one or more of these new facilities may encounter a problem of such significance that it may never be able to contribute to available supply. For example, (i) the construction and deployment schedule of the Eagle Rock Enrichment Facility (EREF) was placed on hold by AREVA in December 2011 as part of a corporate-wide reassessment of capital expenditures in reaction to significant budgetary pressures that had been building for several years; and the construction schedule for the USEC Advanced Centrifuge Plant (ACP) continues to be delayed due to problems revolving around USEC's ongoing difficulties in securing financing for the project.

Also, other presently operating facilities, such as Urenco's three operating enrichment facilities in Europe or its Urenco USA facility in the U.S., and Rosatom's four operating enrichment plants in Russia may be expanded in the future to meet projected, but as yet uncertain requirements, if they are needed. In addition, the smaller enrichment plants that are located in countries such as Japan, China, Brazil and Argentina must also be considered, as must China's apparent plan to rapidly increase enrichment capacity by utilizing indigenous centrifuge technology.

Also, while they are not expected to be a significant source of supply in the long term, government HEU inventories currently play a role in meeting commercial requirements.

Finally, General Electric Hitachi Nuclear Energy (GEH) has initiated work that may lead to commercialization of the Global Laser Enrichment (GLE) Technology, which is based on Silex laser enrichment technology, and depending upon the results of that work it may serve as a source of commercial supply at some point in the future.

2.3.4 Adequacy of Enrichment Supply Relative to Requirements

Figure 2.3 presents ERI's forecast of uranium enrichment supply and the ERI Reference Nuclear Power Growth requirements through 2035. Supply is consistent with the most recent schedules for the introduction of new centrifuge enrichment capacity that have been announced by each supplier as described above, together with the expected shut down of remaining GDP capacity. As shown in the figure, there is a modest margin in the expected supply relative to projected requirements throughout the study period, for the Reference Growth forecast.

This figure also explicitly shows the contribution from the Russian HEU-derived LEU during the period through 2013, after which that source of equivalent enrichment supply is no longer present.

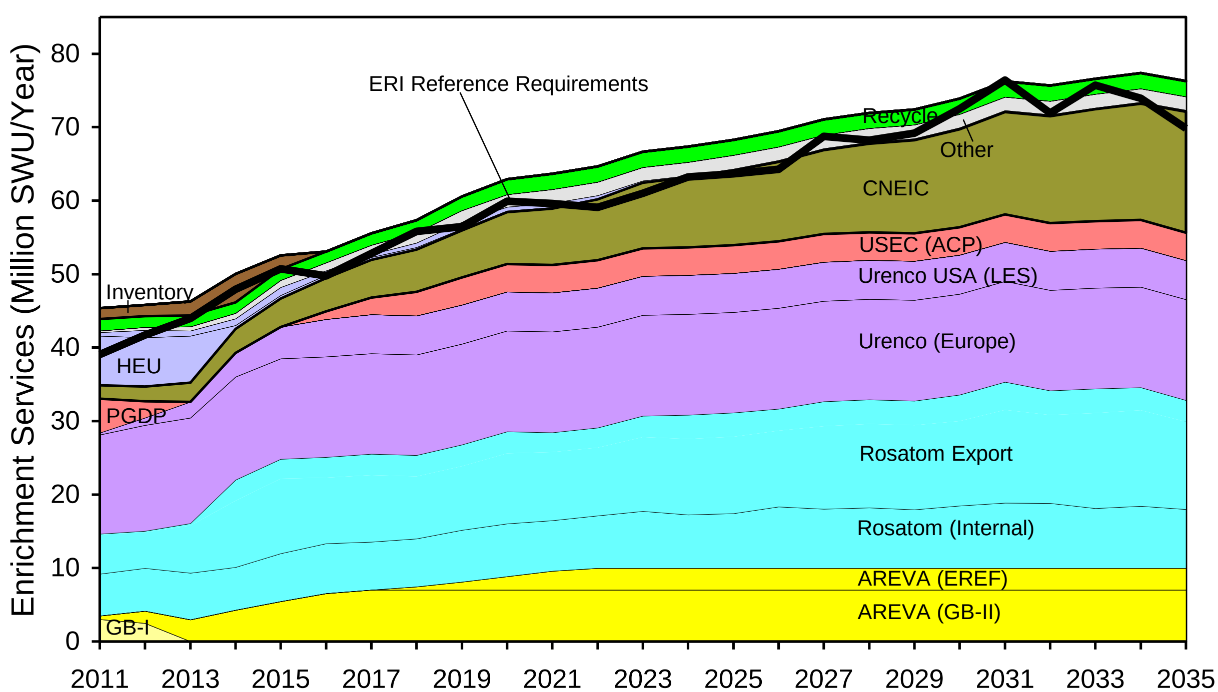

Figure 2.3 Forecast of World Supply and Requirements for Enrichment Services

During the 2012 to 2015 period, an average annual supply excess under the Reference Nuclear Power Growth forecast of just under 3 million SWU, which is about 6% of requirements, is projected by ERI. Between 2016 and 2020, if both the USEC ACP and AREVA EREF are built and begin to operate, then average annual supply would exceed the Reference Nuclear Power Growth forecast by about 2.9 million SWU, which is about 5% of requirements during that period. Supply margins of 5% to 10% are consistent with historical enrichment market behavior. However, at present the prospects for these two projects are less than certain. Without them the modest margin between supply and requirements during the 2016 to 2020 period would disappear. Looking further out in time, a similar situation is observed. Supply margin ranges between 4% and 8% after 2020, gradually declining with time. A long-term supply deficit would occur if both the ACP and EREF do not go forward. It is important to note that there are a number of sources that could potentially fill any supply deficits in the long-term and even beginning during the next couple of years if grown in requirements is greater than expected under the Reference Nuclear Power Growth forecast.

In summary, the enrichment market is expected to remain relatively in balance for the long term. A number of suppliers are capable of adding new capacity as needed, and with shorter construction lead times than typical of new nuclear power plants. The capital-intensive nature of enrichment technology discourages oversupply, but the number of suppliers able to expand incrementally should foster a healthy level of competition.

2.3.5 Future Market Price for Enrichment Services

Present market prices are believed to provide sufficient stimulus for construction of new centrifuge plant capacity. Facility capital costs can be covered, financing guaranteed, and an adequate return on investment earned at these prices. However, world centrifuge manufacturing capability is expected to remain well in excess of long-term annual requirements growth and there is some prospect for the commercial deployment of a new laser-based enrichment technology; which together could lead to long-term price decreases. Therefore, under the Reference Nuclear Power Growth requirements forecast, long term prices for enrichment services are expected to remain relatively stable for the next several years. A production cost analysis of enrichment facilities coupled with an economic market clearing price analysis results in the conclusion that for each additional million SWU of enrichment services that are added to supply in a year, there is the potential for a reduction in the market clearing price that is on average $3.90 per SWU during at least the next 10 years. It is important to note that this estimated impact is relative to the projected economic market clearing price, which serves as the basis for long-term price projections. More than 95% of the enrichment services requirements purchased during the period 2009 through 2011 have been purchased under term contracts.[17]

[17] Based on information published by The Ux Consulting Company, LLC in the Ux Weekly, to which DOE subscribes.

2.4 Summary of U.S. Requirements for Nuclear Fuel

Figure 2.4 provides a summary of U.S. requirements for nuclear fuel materials and services over the period 2012 through 2035 that is based upon ERI's current Reference Nuclear Power Growth forecasts. The saw tooth nature of these annual requirements is a reflection of the preponderance of U.S. nuclear power plants that operate on 18 or 24 month refueling cycles.

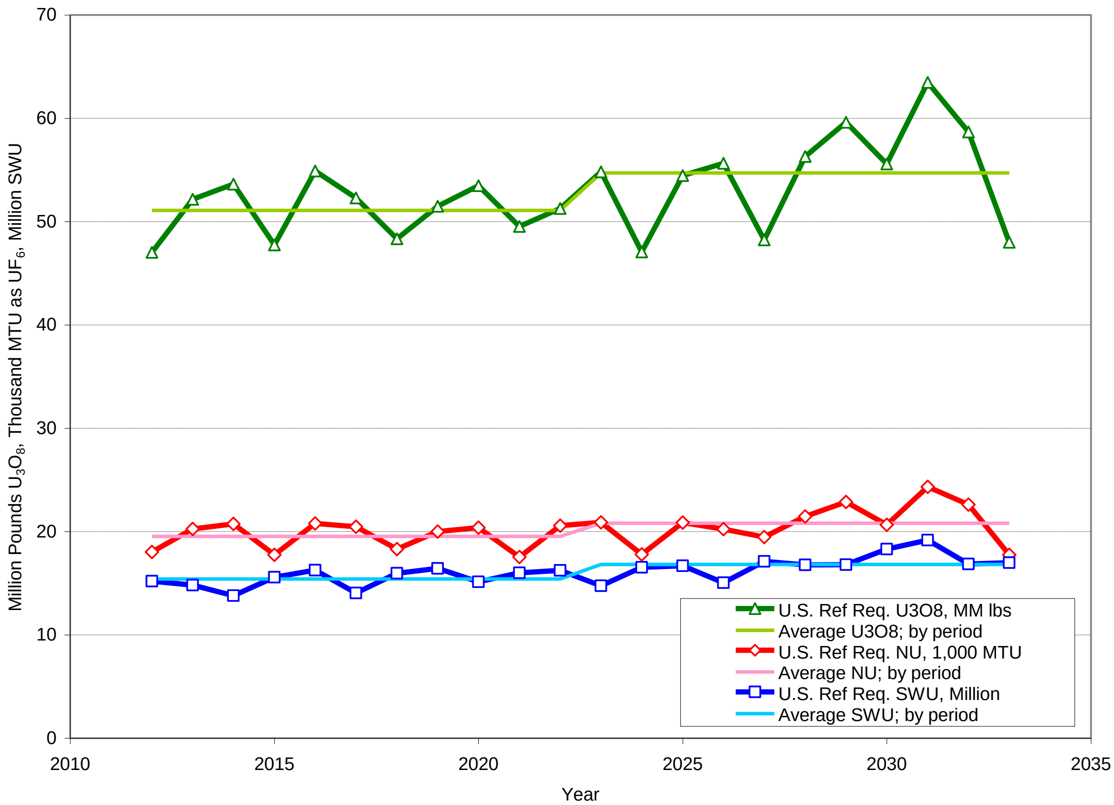

Figure 2.4 U.S. Requirements for Nuclear Fuel Materials and Services

Since the underlying change in average requirements over time is relatively small, but with significant year-to-year variation, average values that represent forecast years (i) 2012 through 2022 and (ii) 2023 through 2033, as presented in Table 2.1, are used in the analysis to provide perspective regarding the quantities of material that DOE is considering for transfer relative to the markets into which they would be introduced.

	Average over Period 2012 - 2022	Average over Period 2023 - 2033
U.S. Uranium Concentrates Requirements, Million Pounds of U_3O_8	51.1	54.7
U.S. Uranium Conversion Requirements, MTU of U as UF_6	19,529	20,813
U.S. Enrichment Services Requirements, Million SWU	15.4	16.8
Note: 1,000 MTU = 1 million kgU Source: Work in preparation for ERI "2012 Nuclear Fuel Cycle Supply and Price Report", Reference Nuclear Power Growth Forecast.		

Table 2.1 Summary of U.S. Requirements for Nuclear Fuel Materials and Services

As a point of comparison, the ERI requirements forecast shown in Table 2.1 is in general agreement with, but more conservative than the most recent analysis by the World Nuclear Association (WNA), which was published in September 2011 and is entitled "The Global Nuclear Fuel Market Supply and Demand, 2011 - 2030". It also provides projected U.S. requirements for nuclear fuel materials and services. Over the 2012 through 2030 period, the total U.S. nuclear fuel requirements forecasts published by WNA are 8% to 9% higher than those shown in Table 2.1. This is due to more optimistic assumptions made by WNA as compared to ERI regarding the number of new nuclear power plants that will be built in the U.S. during the next 20 years and the average fuel requirements for each of these units.

2.5 Summary of Published Market Prices

Current monthly spot and term market prices[18] (also referred to as "price indicators") are summarized in Table 2.2.

[18] TradeTech's spot prices "reflect the company's judgment of the price at which spot and near-term transactions for significant quantities [of that product or service] could be concluded as of the last day of the month". TradeTech's long-term price indicators are "TradeTech's judgment of the base price at which transactions for long-term delivery of that product or service could be concluded as of the last day of the month, for transaction in which the price at the time of delivery would be an escalation of the base price from a previous point in time."

	Spot Market Prices	Term Market Prices
U concentrates:$/lb U_3O_8	51.10	60.00
Conversion Services (North American): $/kgU as UF_6	6.75	16.75
Enrichment Services (Restricted): $/SWU	138.00	146.00
U as Nat UF6: $/kgU as UF_6	140.00	174.00
Market prices are as published by TradeTech in the March 31, 2012 issue of its weekly publication, Nuclear Market Review.		

Table 2.2 Recently Published Market Prices

2.6 Market Price Volatility

As is the situation with regard to published spot market prices for many publicly traded commodities and intra-day prices for various securities, as well as the broader financial market indices, the spot market price for uranium is extremely vulnerable to a broad range of factors at any point in time that include among other things: facts, rumors, and perceptions regarding: availability of both short-term and long-term supply – including excess DOE uranium inventory; expectations and changes in current and future requirements; the extent to which discretionary purchases are being made or are under consideration; short-term requirements for cash among individual suppliers and/or traders; and relative interest in alternative investments by speculative investors in uranium.

It is very difficult, if not impossible, to accurately predict the specific change in spot market price that might result from a particular future event. In addition, the effect is also highly dependent on the underlying direction in which the spot market price may be moving at the time of the event. For example, in a market in which prices are trending downward, news of additional supply being introduced into the market – such as the DOE natural uranium that is expected to be transferred to a D&D contractor – might lead to a further slide in spot market price that is greater than might otherwise be expected. In this same context, the early October 2009 announcement of an industrial accident at the large Olympic Dam mine in Australia, which resulted in that mine producing at only 25% of its full capacity for several months, was cited by several publishers of uranium spot market price indicators as the reason that a downward price movement reversed itself and increased by more than 15% during a two week period, before retreating 7% during the following two weeks. However, long-term investment decisions that are related to new or expanded uranium mines and fuel processing facilities are normally made based on the owners and/or investors expectations for what market prices will be in the longer term, as measured in years, not what they might be during the next several months.

Table 2.3 provides a summary of the total 12 month, and month-to-month volatility (i.e., absolute values of change), respectively, in published spot and term market prices for uranium concentrates, conversion services, natural UF_6, and enrichment services, during the previous three year period, ending March 31, 2012.

	Average, Minimum and Maximum of Absolute Value of Annual Change in Market Price During Past Three Years		Absolute Value of Largest Month to Month Change in Market Price During Past Three Years		Average of Absolute Values of Month to Month Change in Market Price During Past Three Years	
	Change,Dollar Basis	Change,Percent Basis	Maximum Monthly Change, Dollar Basis	Maximum Monthly Change, Percent Basis	Average Monthly Change, Dollar Basis	Average Monthly Change, Percent Basis
Uranium Concentrates, $ per pound U3O8						
Spot Market Price	$4.83 / $0.25 / $7.50	9.9% / 0.6% / 12.8%	$11.00	15.8%	$2.08	4.9%
Term Market Price	$8.33 / $8.00 / $9.00	12.7% / 11.8% / 13.0%	$5.00	7.7%	$0.81	1.2%
Conversion Services, $ per kgU as UF6						
Spot Market Price	$4.92 / $3.00 / $6.50	65.7% / 35.3% / 118.2%	$3.50	50.0%	$0.52	6.5%
Term Market Price	$2.33 / $1.25 / $4.50	19.7% / 8.1% / 40.9%	$2.00	15.4%	$0.19	1.5%
Natural Uranium, $ per kgU as UF6						
Spot Market Price	$17.55 / $3.65 / $24.85	13.1% / 3.1% / 15.1%	$29.74	15.3%	$6.94	4.8%
Term Market Price	$24.11 / $22.15 / $25.40	13.2% / 11.5% / 15.1%	$13.81	7.6%	$2.26	1.2%
Enrichment Services, $ per SWU						
Spot Market Price	$8.33 / $3.00 / $17.00	5.3% / 1.8% / 11.0%	$5.00	3.2%	$0.92	0.6%
Term Market Price	$6.33 / $2.00 / $12.00	4.0% / 1.2% / 7.6%	$5.00	3.3%	$0.64	0.4%
Source of market price data used to calculate volatility is Trade Tech. Natural uranium prices are calculated by ERI using the reported uranium concentrates and conversion services prices.						

Table 2.3 Summary of Nuclear Fuel Price Volatility

As shown in Table 2.3, the spot market price for uranium concentrates has shown significant volatility during the past three years. The average of the absolute value of the annual changes (i.e., independent of the direction in the change) during this period has been $4.83 per pound U_3O_8, which represents an average annual change of 9.9% in the underlying spot market price. However, the minimum and maximum values of annual change in the spot market price during this period have been $0.25 (0.6%) and $7.50 (12.8%) per pound U_3O_8, respectively. During this same period, the largest month to month change in spot market price is $11.00 per pound U_3O_8 – March 2011, which is 15.8% of the underlying spot market price and which can be largely attributed to the events at Fukushima Daiichi that month. The average month to month change in spot market price during these three years is $2.08 per pound U_3O_8, which is 4.9% of the average spot market price during this period. It is interesting to note that 12 months of this average month to month change in price would be $24.96 per pound U_3O_8, which is more than five times the average value of the annual changes during this period, suggesting a significant amount of up and down price movement throughout the period.

During the same three year period, the average of the absolute value of the annual changes (i.e., independent of the direction in the change) in the term price for uranium concentrates has been

\$8.33 per pound U_3O_8, which represents an average annual change of 12.7% in the underlying term market price. However, the minimum and maximum values of annual change in the term market price for uranium concentrates during this period have been \$8.00 (11.8%) and \$9.00 (13.0%) per pound U_3O_8, respectively. During this same period, the largest month to month change in term market price is \$5.00 per pound U_3O_8, which is 7.7% of the underlying term market price. The average month to month change in term market price for uranium concentrates during these three years is \$0.81 per pound U_3O_8, which is 1.2% of the average term market price during this period. A comparison of the average month to month volatility of the spot market and term market prices for uranium concentrates shows the spot market prices have been about four times as volatile as the term market prices on a percent basis over this three year period.

As also indicated in Table 2.3, the spot market price for conversion services has shown significant volatility during the past three years. The average value of the annual changes during this period has been \$4.92 per kgU as UF_6, which represents an average annual change of 66% in the underlying spot market price. However, the minimum and maximum values of annual change in the spot market price of conversion services during this period have been \$3.00 (35%) and \$6.50 (118%) per kgU as UF_6, respectively. During this same period, the largest month to month change in spot market price is \$3.50 per kgU as UF_6, which is 50% of the underlying spot market price. The average month to month change in spot market price during these three years is \$0.52 per kgU as UF_6, which is 6.5% of the average spot market price during this period.

During the same three year period, the average value of the annual changes of the term price for conversion services has been \$2.33 per kgU as UF_6, which represents an average annual change of 19.7% in the underlying term market price. However, the minimum and maximum values of annual change in the term market price of conversion services during this period have been \$1.25 (8.1%) and \$4.50 (41%) per kgU as UF_6, respectively. During this same period, the largest month to month change in term market price is \$2.00 per kgU as UF_6, which is 15.4% of the underlying term market price for conversion services. The average month to month change in term market price during these three years is \$0.19 per kgU as UF_6, which is 1.5% of the average term market price during this period. As was the situation with regard to uranium concentrates, a comparison of the average month to month volatility of the spot market and term market prices for conversion services shows the spot market prices have been about four times as volatile as the term market prices on a percent basis over this three year period.

As shown in Table 2.3, the change in spot and term market prices for natural UF_6, which reflects the impacts of changes in market prices for both uranium concentrates and conversion services, have been most consistent with the changes identified above for the prices of uranium concentrates, as would be expected.

Finally, as shown in Table 2.3, the spot market price for enrichment services has shown relatively little volatility during the past three years. The average value of the annual changes during this period has been \$8.33 per SWU, which represents an average annual change of 5.3%

in the underlying spot market price. However, the minimum and maximum values of annual change in the spot market price of enrichment services during this period have been \$3.00 (1.8%) and \$17.00 (11.0%) per SWU, respectively. During this same period, the largest month to month change in spot market price is \$5.00 per SWU, which is 3.2% of the underlying spot market price. The average month to month change in spot market price during these three years is \$0.92 per SWU, which is 0.6% of the average spot market price during this period.

During this same period, the term price for enrichment services has behaved in a similar manner, showing even less volatility than that of the spot market price, as illustrated in Table 2.3.

It is also interesting to note that between December 2009 and March 2011 there have been six DOE transfers of natural UF_6 that resulted in immediate spot market sales by the DOE contractors that received the uranium. The sales were in amounts of between 520,000 pounds U_3O_8 equivalent and 915,000 pounds U_3O_8 equivalent. During the individual months in which three of these transfers occurred (December 2009, end of February 2010 and March 2011), the spot market price for uranium declined by \$0.75, \$1.75 and \$11.00 per pound, respectively. With the exception of the March 2011 price change, which can be largely attributed to the events at Fukushima Daiichi, these declines in price are less than the average month-to-month change in spot market price that has occurred during the past three years. During the other three months (end of April 2010, end of June 2010 and end of September 2010) in which these transfers occurred, the spot market price for uranium either did not change or increased by \$1.00 and \$1.25 per pound U_3O_8. Such upward price movements were in the opposite direction than might have been expected in the absence of any other market activity. This behavior further demonstrates the difficulty in attributing changes in spot market price to any single event.

In May 2011, Traxys North America LLC (Traxys)[19] announced that it had entered into an agreement for the purchase of all natural UF_6 through 2013 that the DOE contractor, FBP, expects to receive from DOE under the arrangement referred to in Section 1. The Traxys announcement notes that *"FBP moved away from the previous practice of spot market auctions…wishing to avoid any impact upon the market".* Therefore, it is no longer possible to explicitly identify when and how much of this DOE origin material is introduced into the commercial markets by Traxys at any point in time. ERI believes it is reasonable to assume that Traxys will introduce this material into the commercial markets through an equal mix (by volume of material) of spot market and term market transactions.

Further highlighting the nature of price volatility in the uranium market, Jerry Grandey, retired President and CEO of Cameco Corporation, which is a major supplier of uranium concentrates and owns two presently operating uranium properties in the U.S. (i.e., Crow Butte, and Highland/Smith ranch), made the following statement at the RBC Capital Markets Global

[19] Traxys is a global leader in financing, marketing, distribution and financial services for the mining, metals and minerals industries.

Mining and Materials Conference in June 2009, which accurately addressed spot market price volatility and the longer term expectation for uranium prices.

> *"For those who follow the market, this volatility is not surprising. The spot market is thinly traded, and minor quantities can result in large price movements. The short-term requirements of most utilities are well covered. Utilities evaluate their positions as prices rise and fall. Over time, they will step in and out of the spot market, depending on their need to contract for uncovered requirements and/or their desire to build inventories.*
>
> *"In addition, the spot market will be influenced by producers needing to sell uncommitted material or cover shortages, and by speculators. Given the financial crisis and the pressure on cash, we expect that prices will remain volatile in 2009 as well as over the next few years. When demand is weak, prices will moderate, while any significant hiccup in planned production or inventory building could cause spot prices to spike upwards.*
>
> *"Of course, prices will eventually stabilize within a range that supports exploration and the new mine development necessary to meet future demand and ensure a viable production industry."*

3. DOE Material Being Considered for Transfer

There are three broad categories of material for which DOE is presently considering transfer plans during the period of time that is addressed by this analysis (i.e., 2012 through 2033); they are (i) the depleted UF_6 being considered for transfer and disposition, (ii) the natural UF_6 that may be used for barter with the DOE contractor(s), and (iii) the NNSA down blended HEU. Each is addressed separately and then they are combined for further evaluation.

3.1 DOE Depleted UF_6 Being Considered for Transfer and Disposition

DOE is considering the transfer of 9,075 MTU of high assay DUF_6 to ENW during the period 2012 and 2013. If completed, this transfer would be immediately followed by enrichment of the DUF_6 to LEU by USEC through a contract with ENW. The resulting LEU would contain the equivalent of 4,087 MTU of natural uranium (10.7 million pounds U_3O_8 equivalent).[20] A discussion of alternative paths that are presently under consideration by ENW and other parties for the introduction of this material into the commercial markets is provided below.

Under the proposed arrangement, USEC would receive 600 MTU of natural uranium feed upon completion of its enrichment contract, which it would use to meet a portion of its current contract obligations. If not for this material, USEC has stated that it would have taken 600 MTU of natural uranium feed from its existing inventory, without intending to replenish it. Accordingly, ERI views this part of the transaction as not having any market impact.

There are several alternative paths under consideration by ENW for the disposition of this LEU during the 20 year period, 2014 through 2033. Each of these alternative paths include some amount of the natural uranium and enrichment services content of the remaining LEU being used to meet future reload requirements for the Columbia Generating Station, which is operated by ENW with all electricity output going to the Bonneville Power Administration. Under each of the alternative paths, the balance of the natural uranium and enrichment services content would be sold under long-term contracts to one or more companies for use in the nuclear power plants that they operate. The timing for use of the quantities of the natural uranium and enrichment services content of the LEU that will be produced are different under each of the alternative paths.

[20] The analysis described in this report is based upon a transfer of 9,156 MTU of high assay DUF_6 and 4,338 MTU of natural uranium (11.3 million pounds U_3O_8 equivalent) that would result from this slightly higher amount of DUF_6. Subsequent to this analysis being undertaken, the amount of DUF_6 was reduced to 9,075 MTU, which is bounded by the analysis.

For modeling purposes, ERI has assumed that the potential market impact of the natural uranium and enrichment services component of the LEU would occur 12 months and six months prior to loading of the fuel, respectively. Table 3.1 presents a summary of the year and quantities of natural uranium, equivalent uranium concentrates, and enrichment services that are assumed for each of the three alternative disposition paths presently under consideration.

Year	Path 1 MTU as UF6	Path 2 MTU as UF6	Path 3 MTU as UF6	Path 1 Equiv. Million Pounds of U3O8 (a)	Path 2 Equiv. Million Pounds of U3O8 (a)	Path 3 Equiv. Million Pounds of U3O8 (a)	Path 1 Equiv. Million SWU	Path 2 Equiv. Million SWU	Path 3 Equiv. Million SWU
2012	-	-	-	-	-	-	-	-	-
2013	-	-	-	-	-	-	-	-	-
2014	-	-	105	-	-	0.3	-	-	0.1
2015	-	-	105	-	-	0.3	0.4	0.4	0.5
2016	-	-	105	-	-	0.3	0.2	0.2	0.2
2017	-	-	105	-	-	0.3	0.2	0.2	0.2
2018	624	624	624	1.6	1.6	1.6	0.2	0.7	0.2
2019	1,051	1,051	1,051	2.8	2.8	2.8	0.8	0.3	0.8
2020	-	-	-	-	-	-	0.2	0.7	0.2
2021	76	76	76	0.2	0.2	0.2	0.7	0.2	0.7
2022	-	-	-	-	-	-	0.4	0.4	0.4
2023	381	381	381	1.0	1.0	1.0	0.3	0.3	0.0
2024	-	-	-	-	-	-	-	-	-
2025	381	381	381	1.0	1.0	1.0	-	-	-
2026	-	-	-	-	-	-	-	-	-
2027	381	381	381	1.0	1.0	1.0	-	-	-
2028	-	-	-	-	-	-	-	-	-
2029	381	381	381	1.0	1.0	1.0	-	-	-
2030	-	-	-	-	-	-	-	-	-
2031	381	381	43	1.0	1.0	0.1	-	-	-
2032	-	-	-	-	-	-	-	-	-
2033	82	82	-	0.2	0.2	-	-	-	-
Total	3,738	3,738	3,738	9.8	9.8	9.8	3.2	3.2	3.2

(a) Calculated by multiplying the MTU as UF6 value by a conversion factor of 0.0026184.
(b) Totals may not add due to rounding.

Table 3.1 Summary of Alternative Disposition Paths for DOE's High Assay DUF_6

3.2 DOE Natural Uranium Being Considered for Transfer in Exchange for Services

DOE is presently making quarterly transfers of natural UF_6 at an annualized rate of approximately 1,605 MTU per year to its contractor, FBP, for services being provided to DOE in support of the environmental cleanup of the Portsmouth GDP. For the Base Case, transfers are assumed to continue at the current rate until all DOE Russian and U.S. origin UF_6 has been transferred to one or more DOE contractors. DOE also requested that ERI analyze alternative scenarios that reflect the transfer of the Russian and U.S. origin natural UF_6 at several higher annual transfer rates, until the transfer of all of this UF_6 has been completed. Since this is natural UF_6, there is no enrichment services component. The material transfers to the DOE contractor(s), which are presently under consideration by DOE, are summarized in Table 3.2.

Year	Base Case MTU as UF6	Alternate 1 MTU as UF6	Alternate 2 MTU as UF6	Alternate 3 MTU as UF6	Base Case Equiv. Million Pounds of U3O8 (a)	Alternate 1 Equiv. Million Pounds of U3O8 (a)	Alternate 2 Equiv. Million Pounds of U3O8 (a)	Alternate 3 Equiv. Million Pounds of U3O8 (a)
2012	1,605	1,605	1,605	1,605	4.2	4.2	4.2	4.2
2013	1,605	1,888	2,088	2,288	4.2	4.9	5.5	6.0
2014	1,605	1,980	2,180	2,380	4.2	5.2	5.7	6.2
2015	1,605	1,980	2,180	2,380	4.2	5.2	5.7	6.2
2016	1,605	1,980	2,180	2,380	4.2	5.2	5.7	6.2
2017	1,605	1,980	2,180	2,380	4.2	5.2	5.7	6.2
2018	1,605	1,980	2,180	1,441	4.2	5.2	5.7	3.8
2019	1,605	1,461	261	-	4.2	3.8	0.7	-
2020	1,605	-	-	-	4.2	-	-	-
2021	409	-	-	-	1.1	-	-	-
Total	14,854	14,854	14,854	14,854	38.8	38.8	38.8	38.8

(a) Calculated by multiplying the MTU as UF6 value by a conversion factor of 0.00261284
(b) Totals may not add due to rounding.

Table 3.2 Summary of Transfers Under Consideration by DOE to the Contractor(s) During the Period, 2012 – 2021

Since the total amount of natural uranium to be transferred over the entire 10 year period is identical in each case, the annual average of 1,485 MTU as UF_6 (3.9 million pounds U_3O_8 is also the same for each case, even though the maximum amount of material transferred in any one year is different. As previously noted, since natural UF_6 would be transferred, there is no enrichment component.

As discussed in Section 2.6, FBP has entered into an agreement with Traxys for the purchase of all natural UF_6 through 2013 that FBP expects to receive from DOE. The announcement notes that *"FBP moved away from the previous practice of spot market auctions…wishing to avoid any impact upon the market"*. ERI believes it is reasonable to assume that Traxys will introduce this material into the commercial markets through an equal mix (by volume of material) of spot market and term market transactions.

3.3 DOE/NNSA Down Blended HEU Material

The four elements of down blended HEU that are presently expected by NNSA to be transferred to the commercial markets are:

- Tennessee Valley Authority (TVA) off-spec material;
- American Fuel Supply barter material for the NNSA contractor;
- Mixed Oxide (MOX) LEU Backup Inventory Project barter material for the NNSA contractor; and
- Unallocated HEU down blended material.

In addition, in order to perform the down blending of the HEU, diluent in the form of natural uranium is purchased by DOE from the commercial market. Each of these elements, including the diluent, is accounted for in the DOE 2008 Plan.

Table 3.3 presents a summary of the annual and total NNSA equivalent quantities of nuclear fuel materials and services that DOE/NNSA expects to transfer through 2020. According to DOE/NNSA, based on information that is presently available, the last transfers to TVA and to the NNSA contractor that is down blending HEU for the American Fuel Supply occur during 2012; and the last transfer to the NNSA contractor that is down blending HEU for the MOX LEU Backup Inventory Project will occur during 2013. The presently unallocated HEU down blended material is assumed to be introduced into the market beginning in 2014.

In addition to showing the annual and total equivalent net amounts of uranium as natural UF_6, which is also the quantity of equivalent conversion services, the corresponding equivalent net amount of uranium concentrates is shown, as is the net equivalent amount of enrichment services.[21]

Year	Equiv. Net MTU as UF6	Equiv. Net Million Pounds of U3O8 (a)	Equiv. Net Million SWU
2012	251	0.7	0.4
2013	312	0.8	0.4
2014	220	0.6	0.3
2015	220	0.6	0.3
2016	220	0.6	0.3
2017	220	0.6	0.3
2018	220	0.6	0.3
2019	210	0.5	0.3
2020	174	0.5	0.2

(a) Calculated by multiplying the MTU as UF6 value by a conversion factor of 0.00261284.

Table 3.3 Summary of Presently Expected NNSA Transfers

For consistency with the approach taken by DOE in preparing the DOE 2008 Plan, the information presented in Table 3.3 is based on when the material is transferred, including

[21] These are referred to as being "net" amounts of materials and services since they account for (i) any natural uranium diluent that would be purchased in the commercial market to support the down blending of HEU and (ii) the enrichment services that would be required to be purchased to enrich the depleted uranium tails that are identified in the DOE 2008 Plan, if they are to be characterized as natural uranium equivalent material.

the off-spec material transfers to TVA. However, ERI believes that any potential market impact of the DOE transfers to TVA would be most appropriately viewed as occurring during the year prior to such materials being loaded in the TVA nuclear power plants.[22] Table 3.4 has been prepared to reflect the NNSA material, as adjusted to more appropriately represent the timing of potential impact on the commercial markets.

Year	Equiv. Net MTU as UF6	Equiv. Net Million Pounds of U3O8 (a)	Equiv. Net Million SWU
2012	520	1.4	1.0
2013	939	2.5	0.7
2014	538	1.4	0.9
2015	538	1.4	0.6
2016	325	0.8	0.4
2017	220	0.6	0.3
2018	220	0.6	0.3
2019	210	0.5	0.3
2020	174	0.5	0.2

(a) Calculated by multiplying the MTU as UF6 value by a conversion factor of 0.00261284.

Table 3.4 Summary of Presently Expected NNSA Transfers at Year of Potential Impact

The quantities of nuclear fuel materials and services presented in Table 3.3 may be used to compare with the 10% guideline discussed in Section 1; and those in Table 3.4 will serve as the basis for ERI estimating potential market impact.

3.4 Summary of All DOE Material Presently Being Considered for Transfer

As described in the previous sections, there are three broad categories of material for which DOE or ENW are presently considering alternative transfer plans. They include (i) three alternative paths for transfer and disposition of the LEU that will result from enrichment of the high assay depleted UF_6 during the period 2014 through 2033, as presented in Table 3.1; (ii) four alternative approaches for transfer and disposition of the natural UF_6 that may be used for barter with the DOE contractor(s) during the period 2012 through 2021, as presented in Table 3.2; and (iii) the NNSA down blended HEU, with the TVA off-spec material being represented at both time of transfer and time of potential market impact during the period 2012 through 2020, as presented in Tables 3.3 and 3.4, respectively.

[22] This is a long-term contract between DOE and TVA under which the first fuel assemblies that contained the NNSA off-spec material were loaded into a TVA nuclear power plant in March 2005.

The transfer of natural uranium to the DOE contractor(s) accounts for about 72% of the total natural uranium equivalent that DOE is considering for transfer over the entire period. The natural uranium component of the LEU resulting from enrichment of the transferred high assay depleted UF_6 and the natural uranium component of the NNSA transfers account for about 16% and 12%, respectively, of the total natural uranium component of the DOE material under consideration.

As previously stated, ERI assumes that 50% of the natural uranium that DOE transfers to the contractor(s) is introduced through spot market contracts and 50% through term market contracts. In addition, 54% of the natural uranium component of the NNSA transfers is assumed to be through the spot market, with the remaining 46% -- the off-spec material that is transferred to TVA -- being through term market contracts. In total, this represents a total of 42% of the natural uranium equivalent component of the DOE material under consideration over this entire time period that is expected to be introduced through spot market contracts, with the 58% remaining being introduced through term market contracts.

The enrichment component of the LEU resulting from enrichment of transferred high assay depleted UF_6 and the enrichment component of the NNSA transfers of down blended HEU equivalent account for about 56% and 44%, respectively, of the enrichment component of total DOE material under consideration.

The 12 scenarios that result from the different combinations of these alternative transfer plans are identified in Table 3.5.

Scenario	Depleted UF6 Disposition Paths (a)	Natural UF6 Transfer Rates (b)	NNSA Downblended HEU Transfers (c)
1	Path 1	Base Case	Transfer/Impact
2	Path 2	Base Case	Transfer/Impact
3	Path 3	Base Case	Transfer/Impact
4	Path 1	Alternative 1	Transfer/Impact
5	Path 2	Alternative 1	Transfer/Impact
6	Path 3	Alternative 1	Transfer/Impact
7	Path 1	Alternative 2	Transfer/Impact
8	Path 2	Alternative 2	Transfer/Impact
9	Path 3	Alternative 2	Transfer/Impact
10	Path 1	Alternative 3	Transfer/Impact
11	Path 2	Alternative 3	Transfer/Impact
12	Path 3	Alternative 3	Transfer/Impact

(a) Table 3.1
(b) Table 3.2
(c) Tables 3.3 and 3.4

Table 3.5 Scenario Identification

Tables 3.6, 3.7 and 3.8 show the annual and total equivalent net natural UF_6, equivalent uranium concentrates, and enrichment services, respectively, for each of these 12 scenarios, based on when the material is transferred.

	Total Equivalent Net MTU as UF6 to be Transferred under each Scenario											
Year / Scenario	1	2	3	4	5	6	7	8	9	10	11	12
2012	1,856	1,856	1,856	1,856	1,856	1,856	1,856	1,856	1,856	1,856	1,856	1,856
2013	1,917	1,917	1,917	2,200	2,200	2,200	2,400	2,400	2,400	2,600	2,600	2,600
2014	1,825	1,825	1,930	2,200	2,200	2,305	2,400	2,400	2,505	2,600	2,600	2,705
2015	1,825	1,825	1,930	2,200	2,200	2,305	2,400	2,400	2,505	2,600	2,600	2,705
2016	1,825	1,825	1,930	2,200	2,200	2,305	2,400	2,400	2,505	2,600	2,600	2,705
2017	1,825	1,825	1,930	2,200	2,200	2,305	2,400	2,400	2,505	2,600	2,600	2,705
2018	2,449	2,449	2,449	2,824	2,824	2,824	3,024	3,024	3,024	2,285	2,285	2,285
2019	2,866	2,866	2,866	2,722	2,722	2,722	1,522	1,522	1,522	1,261	1,261	1,261
2020	1,779	1,779	1,779	174	174	174	174	174	174	174	174	174
2021	485	485	485	76	76	76	76	76	76	76	76	76
2022	-	-	-	-	-	-	-	-	-	-	-	-
2023	381	381	381	381	381	381	381	381	381	381	381	381
2024	-	-	-	-	-	-	-	-	-	-	-	-
2025	381	381	381	381	381	381	381	381	381	381	381	381
2026	-	-	-	-	-	-	-	-	-	-	-	-
2027	381	381	381	381	381	381	381	381	381	381	381	381
2028	-	-	-	-	-	-	-	-	-	-	-	-
2029	381	381	381	381	381	381	381	381	381	381	381	381
2030	-	-	-	-	-	-	-	-	-	-	-	-
2031	381	381	43	381	381	43	381	381	43	381	381	43
2032	-	-	-	-	-	-	-	-	-	-	-	-
2033	82	82	-	82	82	-	82	82	-	82	82	-
Total	20,639	20,639	20,639	20,639	20,639	20,639	20,639	20,639	20,639	20,639	20,639	20,639

(a) Totals may not add due to rounding.
(b) Quantities based on time of transfer.

Table 3.6 Total Equivalent Net MTU as UF_6 to be Transferred Under Each Scenario

	Total Equivalent Net Million Pounds U3O8 to be Transferred under each Scenario											
Year / Scenario	1	2	3	4	5	6	7	8	9	10	11	12
2012	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8	4.8
2013	5.0	5.0	5.0	5.7	5.7	5.7	6.3	6.3	6.3	6.8	6.8	6.8
2014	4.8	4.8	5.0	5.7	5.7	6.0	6.3	6.3	6.5	6.8	6.8	7.1
2015	4.8	4.8	5.0	5.7	5.7	6.0	6.3	6.3	6.5	6.8	6.8	7.1
2016	4.8	4.8	5.0	5.7	5.7	6.0	6.3	6.3	6.5	6.8	6.8	7.1
2017	4.8	4.8	5.0	5.7	5.7	6.0	6.3	6.3	6.5	6.8	6.8	7.1
2018	6.4	6.4	6.4	7.4	7.4	7.4	7.9	7.9	7.9	6.0	6.0	6.0
2019	7.5	7.5	7.5	7.1	7.1	7.1	4.0	4.0	4.0	3.3	3.3	3.3
2020	4.6	4.6	4.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
2021	1.3	1.3	1.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2022	-	-	-	-	-	-	-	-	-	-	-	-
2023	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2024	-	-	-	-	-	-	-	-	-	-	-	-
2025	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2026	-	-	-	-	-	-	-	-	-	-	-	-
2027	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2028	-	-	-	-	-	-	-	-	-	-	-	-
2029	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2030	-	-	-	-	-	-	-	-	-	-	-	-
2031	1.0	1.0	0.1	1.0	1.0	0.1	1.0	1.0	0.1	1.0	1.0	0.1
2032	-	-	-	-	-	-	-	-	-	-	-	-
2033	0.2	0.2	-	0.2	0.2	-	0.2	0.2	-	0.2	0.2	-
Total	53.9	53.9	53.9	53.9	53.9	53.9	53.9	53.9	53.9	53.9	53.9	53.9

(a) Totals may not add due to rounding.
(b) U3O8 values are calculated by multiplying the MTU as UF6 value by a conversion factor of 0.0026184.
(c) Quantities based on time of transfer.

Table 3.7 Total Equivalent Net Million Pounds of U_3O_8 to be Transferred Under Each Scenario

	Total Equivalent Net Million SWU to be Transferred under each Scenario											
Year / Scenario	1	2	3	4	5	6	7	8	9	10	11	12
2012	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2013	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2014	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
2015	0.7	0.7	0.8	0.7	0.7	0.8	0.7	0.7	0.8	0.7	0.7	0.8
2016	0.4	0.4	0.5	0.4	0.4	0.5	0.4	0.4	0.5	0.4	0.4	0.5
2017	0.4	0.4	0.5	0.4	0.4	0.5	0.4	0.4	0.5	0.4	0.4	0.5
2018	0.4	0.9	0.4	0.4	0.9	0.4	0.4	0.9	0.4	0.4	0.9	0.4
2019	1.0	0.5	1.0	1.0	0.5	1.0	1.0	0.5	1.0	1.0	0.5	1.0
2020	0.4	0.9	0.4	0.4	0.9	0.4	0.4	0.9	0.4	0.4	0.9	0.4
2021	0.7	0.2	0.7	0.7	0.2	0.7	0.7	0.2	0.7	0.7	0.2	0.7
2022	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2023	0.3	0.3	0.0	0.3	0.3	0.0	0.3	0.3	0.0	0.3	0.3	0.0
2024	-	-	-	-	-	-	-	-	-	-	-	-
2025	-	-	-	-	-	-	-	-	-	-	-	-
2026	-	-	-	-	-	-	-	-	-	-	-	-
2027	-	-	-	-	-	-	-	-	-	-	-	-
2028	-	-	-	-	-	-	-	-	-	-	-	-
2029	-	-	-	-	-	-	-	-	-	-	-	-
2030	-	-	-	-	-	-	-	-	-	-	-	-
2031	-	-	-	-	-	-	-	-	-	-	-	-
2032	-	-	-	-	-	-	-	-	-	-	-	-
2033	-	-	-	-	-	-	-	-	-	-	-	-
Total	5.8	5.8	5.7	5.8	5.8	5.7	5.8	5.8	5.7	5.8	5.8	5.7

(a) Totals may not add due to rounding.
(b) Quantities based on time of transfer.

Table 3.8 Total Equivalent Net Million SWU to be Transferred Under Each Scenario

Tables 3.9, 3.10 and 3.11 were prepared as a summary of the year by year quantities shown in the above tables. These next three tables identify (i) the maximum annual values that would be transferred at anytime during the 2012 to 2033, (ii) the average annual values over the entire period, which is the same for each scenario since the total amount of material to be transferred is the same in each scenario, and (iii) the average annual value over the first nine years (i.e., 2012 through 2020), which is the period during which all of the identified NNSA material and almost all of the Russian and U.S. origin natural uranium would be transferred.

	Total Equivalent Net MTU as UF6 to be Transferred under each Scenario											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	2,866	2,866	2,866	2,824	2,824	2,824	3,024	3,024	3,024	2,600	2,600	2,705
Avg. 2012-20	2,019	2,019	2,065	2,064	2,064	2,111	2,064	2,064	2,111	2,064	2,064	2,111
Avg. 2012-33	938	938	938	938	938	938	938	938	938	938	938	938

Table 3.9 Maximum and Average Annual Values of Total Equivalent Net MTU as UF_6 to be Transferred Under Each Scenario

	Total Equivalent Net Million Pounds U3O8 to be Transferred under each Scenario											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	7.5	7.5	7.5	7.4	7.4	7.4	7.9	7.9	7.9	6.8	6.8	7.1
Avg. 2012-20	5.3	5.3	5.4	5.4	5.4	5.5	5.4	5.4	5.5	5.4	5.4	5.5
Avg. 2012-33	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

Table 3.10 Maximum and Average Annual Values of Total Equivalent Net Million Pounds of U_3O_8 to be Transferred Under Each Scenario

	Total Equivalent Net Million SWU to be Transferred under each Scenario											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	1.0	0.9	1.0	1.0	0.9	1.0	1.0	0.9	1.0	1.0	0.9	1.0
Avg. 2012-20	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Avg. 2012-33	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Table 3.11 Maximum and Average Annual Values of Total Equivalent Net Million SWU to be Transferred Under Each Scenario

Tables 3.12, 3.13 and 3.14 show annually and in total equivalent net natural UF_6, equivalent uranium concentrates, and enrichment services, respectively, for each of these 12 scenarios, based on when the material is transferred, as a percent of annual U.S. nuclear fuel requirements.

	Total Quantities of Natural UF6 for each Scenario as a Percent of U.S. Annual Requirements											
Year / Scenario	1	2	3	4	5	6	7	8	9	10	11	12
2012	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%
2013	9.8%	9.8%	9.8%	11.3%	11.3%	11.3%	12.3%	12.3%	12.3%	13.3%	13.3%	13.3%
2014	9.3%	9.3%	9.9%	11.3%	11.3%	11.8%	12.3%	12.3%	12.8%	13.3%	13.3%	13.9%
2015	9.3%	9.3%	9.9%	11.3%	11.3%	11.8%	12.3%	12.3%	12.8%	13.3%	13.3%	13.9%
2016	9.3%	9.3%	9.9%	11.3%	11.3%	11.8%	12.3%	12.3%	12.8%	13.3%	13.3%	13.9%
2017	9.3%	9.3%	9.9%	11.3%	11.3%	11.8%	12.3%	12.3%	12.8%	13.3%	13.3%	13.9%
2018	12.5%	12.5%	12.5%	14.5%	14.5%	14.5%	15.5%	15.5%	15.5%	11.7%	11.7%	11.7%
2019	14.7%	14.7%	14.7%	13.9%	13.9%	13.9%	7.8%	7.8%	7.8%	6.5%	6.5%	6.5%
2020	9.1%	9.1%	9.1%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
2021	2.5%	2.5%	2.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
2022	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2023	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
2024	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2025	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
2026	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2027	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
2028	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2029	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
2030	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2031	1.8%	1.8%	0.2%	1.8%	1.8%	0.2%	1.8%	1.8%	0.2%	1.8%	1.8%	0.2%
2032	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2033	0.4%	0.4%	0.0%	0.4%	0.4%	0.0%	0.4%	0.4%	0.0%	0.4%	0.4%	0.0%

Table 3.12 Total Equivalent Net MTU as UF_6 to be Transferred Under Each Scenario as a Percent of Annual U.S. Requirements

	Total Quantities of Uranium Concentrates for each Scenario as a Percent of U.S. Annual Requirements											
Year / Scenario	1	2	3	4	5	6	7	8	9	10	11	12
2012	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%	9.5%
2013	9.8%	9.8%	9.8%	11.3%	11.3%	11.3%	12.3%	12.3%	12.3%	13.3%	13.3%	13.3%
2014	9.3%	9.3%	9.9%	11.3%	11.3%	11.8%	12.3%	12.3%	12.8%	13.3%	13.3%	13.8%
2015	9.3%	9.3%	9.9%	11.3%	11.3%	11.8%	12.3%	12.3%	12.8%	13.3%	13.3%	13.8%
2016	9.3%	9.3%	9.9%	11.3%	11.3%	11.8%	12.3%	12.3%	12.8%	13.3%	13.3%	13.8%
2017	9.3%	9.3%	9.9%	11.3%	11.3%	11.8%	12.3%	12.3%	12.8%	13.3%	13.3%	13.8%
2018	12.5%	12.5%	12.5%	14.4%	14.4%	14.4%	15.5%	15.5%	15.5%	11.7%	11.7%	11.7%
2019	14.7%	14.7%	14.7%	13.9%	13.9%	13.9%	7.8%	7.8%	7.8%	6.5%	6.5%	6.5%
2020	9.1%	9.1%	9.1%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
2021	2.5%	2.5%	2.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
2022	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2023	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
2024	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2025	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
2026	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2027	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
2028	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2029	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%
2030	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2031	1.8%	1.8%	0.2%	1.8%	1.8%	0.2%	1.8%	1.8%	0.2%	1.8%	1.8%	0.2%
2032	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2033	0.4%	0.4%	0.0%	0.4%	0.4%	0.0%	0.4%	0.4%	0.0%	0.4%	0.4%	0.0%

Table 3.13 Total Equivalent Net Million Pounds of U_3O_8 to be Transferred Under Each Scenario as a Percent of Annual U.S. Requirements

	Total Quantities of Enrichment Services for each Scenario as a Percent of U.S. Annual Requirements											
Year / Scenario	1	2	3	4	5	6	7	8	9	10	11	12
2012	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%
2013	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%	2.7%
2014	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%
2015	4.6%	4.6%	5.1%	4.6%	4.6%	5.1%	4.6%	4.6%	5.1%	4.6%	4.6%	5.1%
2016	2.7%	2.7%	3.2%	2.7%	2.7%	3.2%	2.7%	2.7%	3.2%	2.7%	2.7%	3.2%
2017	2.7%	2.7%	3.2%	2.7%	2.7%	3.2%	2.7%	2.7%	3.2%	2.7%	2.7%	3.2%
2018	2.7%	5.9%	2.7%	2.7%	5.9%	2.7%	2.7%	5.9%	2.7%	2.7%	5.9%	2.7%
2019	6.7%	3.4%	6.7%	6.7%	3.4%	6.7%	6.7%	3.4%	6.7%	6.7%	3.4%	6.7%
2020	2.3%	5.6%	2.3%	2.3%	5.6%	2.3%	2.3%	5.6%	2.3%	2.3%	5.6%	2.3%
2021	4.7%	1.4%	4.7%	4.7%	1.4%	4.7%	4.7%	1.4%	4.7%	4.7%	1.4%	4.7%
2022	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%	2.3%
2023	1.8%	1.8%	0.0%	1.8%	1.8%	0.0%	1.8%	1.8%	0.0%	1.8%	1.8%	0.0%
2024	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2025	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2026	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2027	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2028	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2029	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2030	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2031	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2032	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2033	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 3.14 Total Equivalent Net Million SWU to be Transferred Under Each Scenario as a Percent of Annual U.S. Requirements

Tables 3.15, 3.16 and 3.17 were prepared as a summary of the information in the above tables. These next three tables identify as a percent of annual requirements (i) the maximum annual values that would be transferred at anytime during the 2012 to 2033, (ii) the average annual values over the entire period, which is the same for each scenario since the total amount of material to be transferred is the same in each scenario, and (iii) the average annual value over the first nine years (i.e., 2012 through 2020), which is the period during which all of the identified NNSA material and almost all of the Russian and U.S. origin natural uranium would be transferred.

	Total Quantities of Natural UF6 for each Scenario as a Percent of U.S. Annual Requirements											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	14.7%	14.7%	14.7%	14.5%	14.5%	14.5%	15.5%	15.5%	15.5%	13.3%	13.3%	13.9%
Avg. 2012-20	10.3%	10.3%	10.6%	10.6%	10.6%	10.8%	10.6%	10.6%	10.8%	10.6%	10.6%	10.8%
Avg. 2012-33	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%

Table 3.15 Maximum and Average Annual Values of Total Equivalent Net MTU as UF_6 to be Transferred Under Each Scenario as a Percent of Annual U.S. Requirements

	Total Quantities of Uranium Concentrates for each Scenario as a Percent of U.S. Annual Requirements											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	14.7%	14.7%	14.7%	14.4%	14.4%	14.4%	15.5%	15.5%	15.5%	13.3%	13.3%	13.8%
Avg. 2012-20	10.3%	10.3%	10.6%	10.6%	10.6%	10.8%	10.6%	10.6%	10.8%	10.6%	10.6%	10.8%
Avg. 2012-33	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%	4.8%

Table 3.16 Maximum and Average Annual Values of Total Equivalent Net Million Pounds of U_3O_8 to be Transferred Under Each Scenario as a Percent of Annual U.S. Requirements

As might be expected, the values of natural uranium as UF_6 (Tables 3.12 and 3.15) and corresponding uranium concentrates as U_3O_8 (Tables 3.13 and 3.16) demonstrate virtually identical behavior. Since the total amount of material that is assumed to be transferred by DOE over the entire period of 2012 through 2033 is identical at 20,639 MTU as UF_6 equivalent or 53.9 million pounds of U_3O_8 equivalent, the average annual quantity in each of the 12 scenarios is the same at 4.8% of annual U.S. requirements. However, as expected, there are differences among the scenarios.

In Scenarios 1, 2 and 3, the annual quantities transferred exceed 10% only in years 2018 and 2019, at 12.5% and 14.7%, respectively, largely as a result of the high levels of equivalent natural uranium being considered for transfer in those two years by ENW that are in addition to the ongoing transfers of natural uranium by DOE to contractors. However, in these first three scenarios, the percent of U.S. annual requirements does not exceed 10% in any other years. Over the 2012 through 2020 period, the average would be 10.3% to 10.6% of annual U.S. requirements for uranium for these three scenarios.

In Scenarios 4, 5 and 6, the annual quantities during years 2013 through 2018 are higher then in Scenarios 1, 2 and 3 because of the higher transfer rates of natural uranium to the contractors, as shown in Table 3.2. The annual quantities of natural uranium transferred by DOE during years 2013 through 2017 would be 11.3% to 11.8% of annual U.S. requirements, and in years 2018 and 2019 they would be 14.5% and 13.9%, respectively. Over the 2012 through 2020 period, the average would be 10.6% to 10.8% of annual U.S. requirements for uranium for these three scenarios.

In Scenarios 7, 8 and 9, the annual quantities during years 2013 through 2018 are higher then in Scenarios 4, 5 and 6 because of the yet higher transfer rates of natural uranium to the contractors, as shown in Table 3.2. The annual quantities of natural uranium transferred by DOE during years 2013 through 2017 would be 12.3% to 12.8% of annual U.S. requirements, and in years 2018 and 2019 they would be 15.3% and 7.8%, respectively. The reduction in 2019 is due to most of the natural uranium having already been transferred to contractors during the prior years, assuming the higher annual transfer rate shown in Table 3.2 for Alternate 2. Over the 2012 through 2020 period, the average would be 10.6% to 10.8% of annual U.S. requirements for uranium for these three scenarios.

In Scenarios 10, 11 and 12, the annual quantities during years 2013 through 2018 are higher then in Scenarios 7, 8 and 9 because of the yet higher transfer rates of natural uranium to the contractors, as shown in Table 3.2. The annual quantities of natural uranium transferred by DOE during years 2013 through 2017 would be 13.3% to 13.9% of annual U.S. requirements, and in years 2018 and 2019 they would be 11.7% and 6.5%, respectively. The reductions in 2018 and 2019 relative to the previous scenarios is due to most of the natural uranium having already been transferred to contractors during the prior years, assuming the higher annual transfer rate shown in Table 3.2 for Alternate 3. Over the

2012 through 2020 period, the average would be 10.6% to 10.8% of annual U.S. requirements for uranium for these three scenarios.

	Total Quantities of Enrichment Services for each Scenario as a Percent of U.S. Annual Requirements											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	6.7%	5.9%	6.7%	6.7%	5.9%	6.7%	6.7%	5.9%	6.7%	6.7%	5.9%	6.7%
Avg. 2012-20	3.2%	3.5%	3.3%	3.2%	3.5%	3.3%	3.2%	3.5%	3.3%	3.2%	3.5%	3.3%
Avg. 2012-33	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%	1.7%

Table 3.17 Maximum and Average Annual Values of Total Equivalent Net Million SWU to be Transferred Under Each Scenario as a Percent of Annual U.S. Requirements

Since the total amount of equivalent enrichment services that is assumed to be transferred by DOE over the entire period of 2012 through 2033 is identical at 5.8 million SWU, the average annual quantity in each of the 12 scenarios is the same at 0.3 million SWU, which is 1.7% of annual U.S. requirements.

While there are differences among the scenarios, which are driven by the three different paths assumed for disposition of the enrichment services component of the LEU by BPA/ENW, as shown in Table 3.1, the annual quantities transferred never exceed 6.7% of annual U.S. requirements for enrichment services. Over the 2012 through 2020 period, the average would be 3.2% to 3.5% of annual U.S. requirements for uranium for these 12 scenarios.

4. Quantification of the Potential Effect of the Transfer of DOE Material

4.1 Potential Effect of Transfers on Market Prices

As previously stated, it is very difficult, if not impossible, to accurately attribute a specific change in spot market price to a single event. The general inability of financial investors to accurately assign cause to the often unpredictable day-to-day movements in the markets for investment securities, including other commodities, provides a reasonable analogy. However, since some market participants are sensitive to change in spot market price for uranium concentrates, ERI will address the potential effect of DOE transfers on spot market price. Furthermore, the market's expectations of future term market prices are believed to be more relevant to major investment decisions than current spot market prices, since the term market prices are more likely to determine whether or not the investor will be able to earn an appropriate economic return over the life of the new projects.

By applying the results of ERI's economic market clearing price analyses, which are summarized in Sections 2.1.5, 2.2.5 and 2.3.5, regarding the potential impact of an incremental addition of supply on the market clearing price of uranium concentrates, conversion services and enrichment services, respectively, to the incremental amount of equivalent nuclear fuel materials and services that would result from possible DOE's transfers of equivalent materials and services, the potential effect on term market price may be estimated as presented below.

4.1.1 Potential Market Price Impact of DOE Transfers Based on Market Clearing Price Analysis

For each of the 12 scenarios, Tables 4.1, 4.2, 4.3 and 4.4 show for uranium concentrates, conversion services, natural UF_6, and enrichment services, respectively, (i) the maximum potential negative impact on term market prices during the 2012 to 2033, (ii) the average potential negative impact on term market prices over the entire period, which is the same for each scenario since the total amount of material to be transferred is the same in each scenario, and (iii) the average potential negative impact on term market prices over the first nine years (i.e., 2012 through 2020), which is the period during which all of the identified NNSA material and almost all of the Russian and U.S. origin natural uranium would be transferred.

	Potential Impact on Term Market Price of Uranium Concentrates under each Scenario, $/pound U3O8											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	2.32	2.32	2.32	2.29	2.29	2.29	2.45	2.45	2.45	2.61	2.61	2.61
Avg. 2012-20	1.78	1.78	1.82	1.82	1.82	1.86	1.82	1.82	1.86	1.82	1.82	1.86
Avg. 2012-33	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82

Table 4.1 Maximum and Average Potential Negative Impact on Term Market Price of Uranium Concentrates of Net MTU as UF_6 to be Transferred Under Each Scenario

As shown in Table 4.1, across all scenarios the maximum potential impact on term market prices for uranium concentrates is between -\$2.29 and -\$2.61 per pound U_3O_8, while the average over the entire period is -\$0.82 per pound U_3O_8, and the average over the first nine years is between -\$1.78 and -\$1.86 per pound U_3O_8.

	Potential Impact on Term Market Price of Conversion Services under each Scenario, $/kgU as UF6											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	0.86	0.86	0.86	0.85	0.85	0.85	0.91	0.91	0.91	0.97	0.97	0.97
Avg. 2012-20	0.66	0.66	0.67	0.67	0.67	0.69	0.67	0.67	0.69	0.67	0.67	0.69
Avg. 2012-33	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30

Table 4.2 Maximum and Average Potential Negative Impact on Term Market Price of Conversion Services of Net MTU as UF_6 to be Transferred Under Each Scenario

As shown in Table 4.2, across all scenarios the maximum potential impact on term market prices for conversion services is between -\$0.85 and -\$0.97 per kgU as UF_6, while the average over the entire period is -\$0.30 per kgU as UF_6, and the average over the first nine years is between -\$0.66 and -\$0.69 per kgU as UF_6.

	Potential Impact on Term Market Price of Natural UF6 under each Scenario, $/kgU as UF6											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	6.93	6.93	6.93	6.83	6.83	6.83	7.32	7.32	7.32	7.80	7.80	7.80
Avg. 2012-20	5.32	5.32	5.43	5.43	5.43	5.54	5.43	5.43	5.54	5.43	5.43	5.54
Avg. 2012-33	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45

Table 4.3 Maximum and Average Potential Negative Impact on Term Market Price of Uranium as Natural UF_6 of Net MTU as UF_6 to be Transferred Under Each Scenario

As shown in Table 4.3, across all scenarios the maximum potential impact on term market prices for natural UF_6 is between -\$6.83 and -\$7.80 per kgU as UF_6, while the average over the entire period is -\$2.45 per kgU as UF_6, and the average over the first nine years is between -\$5.32 and -\$5.54 per kgU as UF_6.

	Potential Impact on Term Market Price of Enrichment Services under each Scenario, $/SWU											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	4.05	4.05	4.35	4.05	4.05	4.35	4.05	4.05	4.35	4.05	4.05	4.35
Avg. 2012-20	2.78	3.00	2.89	2.78	3.00	2.89	2.78	3.00	2.89	2.78	3.00	2.89
Avg. 2012-33	1.39	1.39	1.37	1.39	1.39	1.37	1.39	1.39	1.37	1.39	1.39	1.37

Table 4.4 Maximum and Average Potential Negative Impact on Term Market Price of Enrichment Services of Net Enrichment Services Component of Material to be Transferred Under Each Scenario

As shown in Table 4.4, across all scenarios the maximum potential impact on term market prices for enrichment services is between -\$4.05 and -\$4.35 per SWU, while the average over the entire period is between -\$1.37 and -\$1.39 per SWU, and the average over the first nine years is between -\$2.78 and -\$3.00 per SWU.

For each of the 12 scenarios, Tables 4.5, 4.6, 4.7 and 4.8 show for uranium concentrates, conversion services, natural UF_6, and enrichment services, respectively, (i) the maximum potential negative impact on term market prices during the 2012 to 2033 as a percent of the current term market price, as shown in Table 2.2, (ii) the average potential negative impact on term market prices over the entire period, which is the same for each scenario since the total amount of material to be transferred is the same in each scenario as a percent of the current term market price, and (iii) the average potential negative impact on term market prices over the first nine years (i.e., 2012 through 2020), which is the period during which all of the identified NNSA material and almost all of the Russian and U.S. origin natural uranium would be transferred, as a percent of current term market price.

	Potential Impact on Term Market Price as a Percent of Present Market Price of Uranium Concentrates											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	3.9%	3.9%	3.9%	3.8%	3.8%	3.8%	4.1%	4.1%	4.1%	4.4%	4.4%	4.4%
Avg. 2012-20	3.0%	3.0%	3.0%	3.0%	3.0%	3.1%	3.0%	3.0%	3.1%	3.0%	3.0%	3.1%
Avg. 2012-33	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%

Table 4.5 Maximum and Average Potential Negative Impact on Term Market Price of Uranium Concentrates of Net MTU as UF_6 to be Transferred Under Each Scenario as a Percent of the Current Term Market Price

As shown in Table 4.5, across all scenarios the maximum potential impact on term market prices for uranium concentrates is between -3.8% and -4.4% of current market price, while the average over the entire period is -1.4% of current market price, and the average over the first nine years is between -3.0% and -3.1% of current market price.

	Potential Impact on Term Market Price as a Percent of Present Market Price of Conversion Services											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	5.1%	5.1%	5.1%	5.1%	5.1%	5.1%	5.4%	5.4%	5.4%	5.8%	5.8%	5.8%
Avg. 2012-20	3.9%	3.9%	4.0%	4.0%	4.0%	4.1%	4.0%	4.0%	4.1%	4.0%	4.0%	4.1%
Avg. 2012-33	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%	1.8%

Table 4.6 Maximum and Average Potential Negative Impact on Term Market Price of Conversion Services of Net MTU as UF_6 to be Transferred Under Each Scenario as a Percent of the Current Term Market Price

As shown in Table 4.6, across all scenarios the maximum potential impact on term market prices for conversion services is between -5.1% and -5.8% of current market price, while the average over the entire period is -1.8% of current market price, and the average over the first nine years is between -3.9% and -4.1% of current market price.

	Potential Impact on Term Market Price as a Percent of Present Market Price of Natural UF6											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	4.0%	4.0%	4.0%	3.9%	3.9%	3.9%	4.2%	4.2%	4.2%	4.5%	4.5%	4.5%
Avg. 2012-20	3.1%	3.1%	3.1%	3.1%	3.1%	3.2%	3.1%	3.1%	3.2%	3.1%	3.1%	3.2%
Avg. 2012-33	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%

Table 4.7 Maximum and Average Potential Negative Impact on Term Market Price of Uranium as Natural UF_6 of Net MTU as UF_6 to be Transferred Under Each Scenario as a Percent of the Current Term Market Price

As shown in Table 4.7, across all scenarios the maximum potential impact on term market prices for natural UF_6 is between -3.9% and -4.5% of current market price, while the average over the entire period is -1.4% of current market price, and the average over the first nine years is between -3.1% and -3.2% of current market price.

	Potential Impact on Term Market Price as a Percent of Present Market Price of Enrichment Services											
Scenario	1	2	3	4	5	6	7	8	9	10	11	12
Maximum	2.8%	2.8%	3.0%	2.8%	2.8%	3.0%	2.8%	2.8%	3.0%	2.8%	2.8%	3.0%
Avg. 2012-20	1.9%	2.1%	2.0%	1.9%	2.1%	2.0%	1.9%	2.1%	2.0%	1.9%	2.1%	2.0%
Avg. 2012-33	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%

Table 4.8 Maximum and Average Potential Negative Impact on Term Market Price of Enrichment Services of Net Enrichment Services Component of Material to be Transferred Under Each Scenario as a Percent of the Current Term Market Price

As shown in Table 4.8, across all scenarios the maximum potential impact on term market prices for enrichment services is between -2.8% and -3.0% of current market price, while the average over the entire period is -0.9% of current market price, and the average over the first nine years is between -1.9% and -2.1% of current market price.

Tables 4.5 through 4.8 also provide some perspective for each of these potential effects on price by comparison to the current market price indicators. Independent of whether maximum or average values of potential impact on term market prices serve as the basis of these comparisons to current market price indicators, with maximum potential term market price impacts of less than 6.0% and with averages taken over the nine years of most significant transfers that are don't exceed 4.1% of the term market prices, the potential impact on term market price of the DOE transfers presently under consideration appears to be quite minimal.

4.1.2 Potential Impact of DOE Transfers Based on a Spot Market Price Analysis

As previously stated, it is very difficult, if not impossible, to accurately attribute a specific change in spot market price to a single event. As discussed in Section 2.6, in the context of market volatility, in three of the six months during the past year in which DOE material was sold by a DOE contractor into the spot market the spot market price either did not change or increased, which is opposite the direction one might expect an additional increment of supply being added to the market would have on market price. It is clear that other things were taking place during those months and/or the addition of that material to the market had already been anticipated. It is also possible, for example, that as a result of the DOE material being introduced into the market additional buyers became active – increasing demand – or other sellers withdrew from the market – reducing supply.

Nonetheless, recognizing that there is interest among some market participants in the potential impact of any DOE transfers on spot market prices, ERI has developed a multivariable correlation between the monthly spot market prices published by TradeTech and the monthly spot market values of supply and demand, which are also published by TradeTech. This correlation covers the period from July 2004 through March 2012 and has an R^2 = 89%, which is good, particularly given the extreme volatility experienced in the spot market price during this period. A comparison of the actual spot market prices with the correlation is provided in Figure 4.1

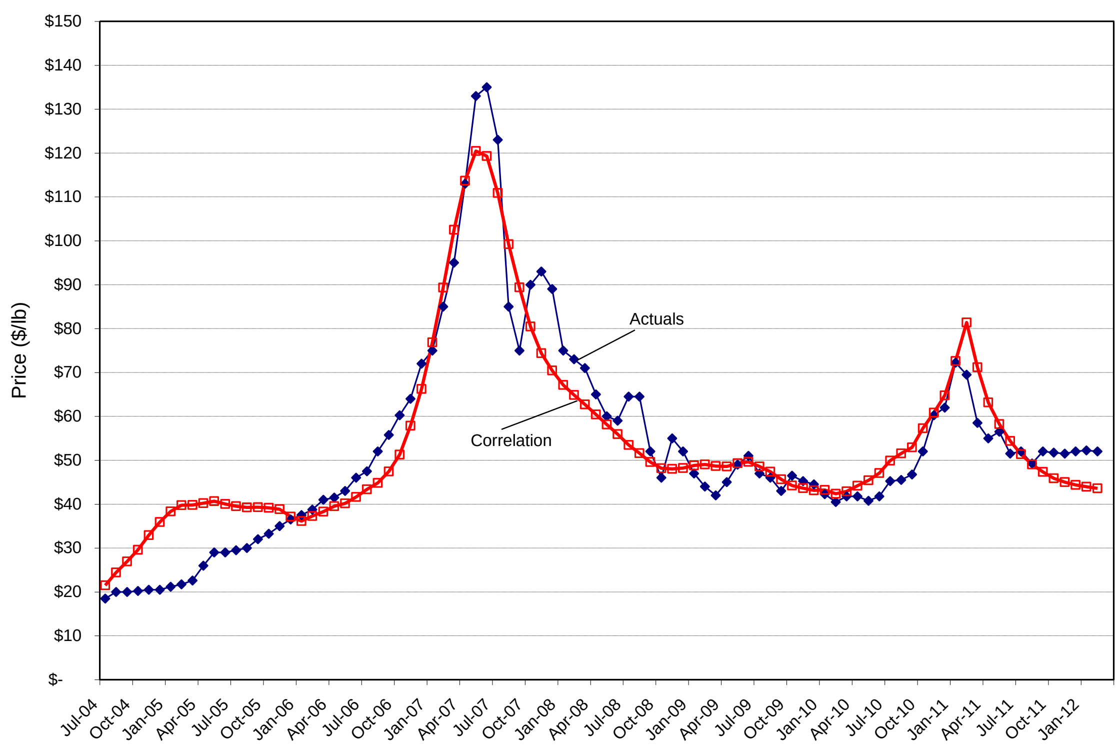

Figure 4.1 Spot Market Prices for Uranium – Actual versus Correlation

This correlation was then used to simulate the 2012 through 2021 spot market price for uranium concentrates, assuming monthly values of supply and demand consistent with the average monthly values that have been experienced over the last four years, with and without the DOE transfers that are presently under consideration.

The average and highest annual DOE total annual transfer rates of U_3O_8 equivalent among the 12 scenarios are shown in Table 4.9 during the period of time that such material would be introduced into the spot market. This includes the 50% of the natural uranium that would be transferred by DOE to its contractor(s) and all the NNSA natural uranium as U_3O_8 equivalent from down blended HEU, with the exception of the material associated with the TVA off-spec material.

	Total Equivalent Net U3O8 Transferred to the Spot Market, Under All Scenarios Million Pounds U3O8	
Year	Average	Highest
2012	2.6	2.6
2013	3.4	3.8
2014	3.2	3.7
2015	3.2	3.7
2016	3.2	3.7
2017	3.2	3.7
2018	2.9	2.5
2019	1.6	0.5
2020	1.0	0.5
2021	0.1	0.0

Table 4.9 Total Equivalent Net U_3O_8 Transferred to the Spot Market Under All Scenarios

DOE transfers during this period – are assumed to be distributed equally among the four quarters in each year, and then one quarter of each year's transfer is sold into the spot market in a single month in each quarter.

The results of applying this correlation are projections of a potential spot market price decrease of $2.96 per pound U_3O_8 based on an average of the scenarios over the period 2012 through 2021; and a decrease of $4.55 in the year of potential highest impact (2017) based on the highest of the scenarios. This represents a potential impact on spot market price during this period in the range of 5.8% to 8.9% relative to the March 31, 2012 spot market price of $51.10 per pound U_3O_8. This does not adjust for any other changes in market condition that may occur as a result of the announced transfer, such as an increase in market demand or reduction in market supply from other sources.

For instance, as previously noted, during period between December 2009 and March 2011, in three of the six months during which DOE material was transferred into the market, the spot market price either did not change or moved upward, not downward as might have been expected based upon the analysis described above. However, this is not entirely unexpected if one recognizes that the additional supply introduced by DOE could draw additional demand into the market that otherwise would not have been present; with the outcome being an offset to the downward pressure that any additional DOE supply might have on spot market price.

4.2 Comparison of Potential Market Price Impact with Market Volatility Data

In order to provide further perspective regarding the potential impact on market prices of the quantities of DOE material that might be transferred, Table 4.10 provides comparisons of the potential impacts on market prices relative to the month-to-month volatility in the published market price indicators, as had been previously shown in Table 2.3 over the last three years, for the transfers that are under consideration. The larger potential impact as calculated in Section 4.1.2 is used for the spot market price of uranium. However, ERI continues to believe that it is very difficult, if not impossible, to correctly and consistently attribute the impact of any single event on the spot market price for uranium concentrates.

	Absolute Value of Largest Month to Month Change in Market Price During Past Three Years		Average of Absolute Values of Month to Month Change in Market Price During Past Three Years		Potential Impact on Market Clearing Price and Spot Market Price of U3O8 of All DOE Transfers Under Consideration	
	Maximum Monthly Change, Dollar Basis	Maximum Monthly Change, Percent Basis	Average Monthly Change, Dollar Basis	Average Monthly Change, Percent Basis	Average and Maximum Change, Dollar Basis	Average and Maximum Change, Percent Basis
Uranium Concentrates, $ per pound U3O8						
Spot Market Price	$11.00	15.8%	$2.08	4.9%	$2.96 and $4.55	5.8% and 8.9%
Term Market Price	$5.00	7.7%	$0.81	1.2%	$1.86 and $2.61	3.1% and 4.4%
Conversion Services, $ per kgU as UF6						
Spot Market Price	$3.50	50.0%	$0.52	6.5%	-	-
Term Market Price	$2.00	15.4%	$0.19	1.5%	$0.69 and $0.97	4.1% and 5.8%
Natural Uranium, $ per kgU as UF6						
Spot Market Price	$29.74	15.3%	$6.94	4.8%	-	-
Term Market Price	$13.81	7.6%	$2.26	1.2%	$5.54 and $7.80	3.2% and 4.5%
Enrichment Services, $ per SWU						
Spot Market Price	$5.00	3.2%	$0.92	0.6%	-	-
Term Market Price	$5.00	3.3%	$0.64	0.4%	$3.00 and $4.35	2.1% and 3.0%
Source of market price data used to calculate volatility is Trade Tech. Natural uranium prices are calculated by ERI using the reported uranium concentrates and conversion services prices.						

Table 4.10 Comparison of Potential Effect on Market Prices of the DOE Material Transfer Relative to Monthly Market Price Volatility Data

As shown in Table 4.10, the potential impact on the spot market price for uranium concentrates is \$2.96 to \$4.55 per pound U_3O_8, which is less than half the maximum month-to-month change experienced during the past three years in the spot market price; and about 1.5 to two months of average price volatility that has been experienced in this market over the last three years. The potential impact on the term price for uranium concentrates is \$1.86 to \$2.61 per pound, which is also less than about half the maximum month-to-month change experienced during the past year; and equivalent to about two to three times the average month-to-month volatility in term price for uranium concentrates over the last three years.

The potential impact on the term price for conversion services is \$0.69 to \$0.97 per kgU as UF_6, as shown in Table 4.10, which is also less then half the maximum month-to-month change experienced during the past three years; and equivalent to three to five months of the average month-to-month volatility in the term price for conversion services. The potential impact on the spot market price for conversion services has not been calculated because sufficient industry data is not published to support such a calculation. However, it should be noted that (i) the total spot market volume for conversion services is reported to have been on average only about seven thousand MTU of UF_6 during the period 2009 through 2011[23], which represents only about 12% of annual world total requirements for conversion services; (ii) that it is uncommon for primary converters to sell conversion services to owners and operators of nuclear power plants under spot market-based contracts; (iii) that, unlike the situation with regard to the pricing provisions in term contracts for uranium concentrates that may include reference to spot market price indicators it is uncommon to include reference to the spot market price indicators for conversion services in term contracts for conversion services; and (iv) even while spot market prices for conversion services have dropped by more than 40% during the last 12 months, term market prices have increased by about 8% in the North American market and by 11% in Europe, based on prices reported by TradeTech, Therefore, the potential impact of DOE transfers on the spot market price for conversion services is not viewed as being an indicator of market impact on the conversion industry.

As also shown in Table 4.10, the potential impact on the term price for enrichment services is \$3.00 to \$4.35 per SWU, which is less then the maximum month-to-month change experienced during the past three years, as well as the total change in price over any of the last three years; and equivalent to four to seven months of the average month-to-month volatility in the term price for enrichment services. The potential impact on the spot market price for enrichment services has not been calculated because sufficient industry data is not published to support such a calculation. However, it should be noted that (i) the total spot market volume for enrichment services is reported to have been on average only

[23] Based on information published by The Ux Consulting Company, LLC in the Ux Weekly, to which DOE subscribes.

about 1.6 million SWU per year during the period 2009 through 2011[24], which represents only about 4% of annual world total requirements for enrichment services; and (ii) that, unlike the situation with regard to the pricing provisions in term contracts for uranium concentrates that may include reference to spot market price indicators, it is uncommon to include reference to the spot market price indicators for enrichment services in term contracts for enrichment services. Therefore, the potential impact of DOE transfers on the spot market price for enrichment services is not viewed as being an indicator of market impact on the enrichment industry.

In summary, the potential impact on market price of the DOE material transfer is consistent with the historical volatility observed in the nuclear fuel markets.

4.3 Potential Impact on Domestic Industries

The potential effect of the transfer of the equivalent DOE materials and services discussed above on each of these domestic industries is discussed further in the following sections.

4.3.1 Potential Impact on the Domestic Uranium Concentrates Industry

DOE transfers would not displace already committed sales by the domestic industry. In addition, based on ERI's analysis, the presently operating domestic producers, as well as several of those scheduled to begin operation within the next couple of years, are believed to have costs of production that are significantly below current market clearing prices and should be able to sell their annual production in a competitive market on a profitable basis, even with the addition of the DOE material to the available supply. It should be noted that current market prices already reflect a significant portion of the total annual quantities of DOE material that are under consideration for transfer.

Cameco, owner of the majority of currently operating U.S. uranium mine production, estimates the price sensitivity of its current contract portfolio for sales of uranium relative to change in future spot market price.[25] Cameco’s most recent estimate indicates that the projected change in realized price is about 40% of the change in spot market price during 2012 to 2016. For example, if the spot market price were to drop by $5.00 per pound, then this means that Cameco’s realized price would drop by $2.00 per pound. The overall effect on Cameco is further reduced by the fact that a portion of its uranium supply is obtained each year from purchases on the spot market; the purchase cost of which would mirror the change in spot price. A comparison of historical changes in Cameco’s realized prices from year to year relative to Cameco’s estimates indicates that the actual impact on changes in

[24] Ibid.

[25] Cameco Corporation in its February 9, 2012 “Management’s Discussion and Analysis” that accompanied its financial statement and notes for the year ended December 31, 2011.

spot price on Cameco's realized prices has been less than Cameco has been projecting for future years.

It is also worth noting that not all project revenues from U.S. uranium sales are obtained under spot market price based contracts. Some mining companies have chosen to sell on a spot market price basis with the objective of benefiting from anticipated increases in spot market prices, rather than locking in prices using a base price escalated approach. For example, Cameco has reported that it usually includes in its contracts a mix of fixed-price and market-price components, which reflect a target of 40% fixed-price and 60% market-price**.**

While uranium mining and production company stock values have been most sensitive to spot market price, major investments in uranium mining, either by banks or by larger mining companies looking for acquisitions, are most sensitive to realistic expectations for the subject uranium properties to earn a return on investment over the long-term, which is dependent on long-term expectations for uranium price. Thus, even if higher spot market prices can spur initial investment in a uranium property, the long-term viability of the project will necessarily depend upon it economic potential and long-term market price prospects.

It is also important to note that there will always be high cost, yet to be developed, prospective uranium properties, in the U.S. and elsewhere, that might be considered in jeopardy of not being developed under market conditions that do not require the additional capacity that such prospective properties might eventually be able to make available to the market. If, in fact, such prospective properties are not developed, it is usually because they have been determined to be higher cost resources that will not be needed to meet future market requirements on a long-term basis.

4.3.2 Potential Impact on the Domestic Conversion Services Industry

DOE transfers would not displace already committed sales. The potential impact on the market clearing price for conversion services has been estimated to be very small. Furthermore, virtually all contracting between primary suppliers and owners and operators of nuclear power plants to date has been done under base price escalated terms, so the supplier should not see an adverse impact from any potential decline in market price of conversion services in the near term. However, it is possible that future contracts may require price reopeners after three to five years of delivery. Finally, to the extent that a supplier must obtain spot market conversion services to meet contract commitments, which may exceed its production capacity during the period of interest, any downward impact on market price that may be associated with the DOE transfers should benefit the supplier since the purchase cost of the conversion services would mirror the change in spot price.

Nonetheless, it is also recognized that the greater the amount of secondary supply that is available to owners and operators of nuclear power plants to meet their operating requirements, particularly at the lower spot market prices, then this would have the potential of reducing contracting volumes under the higher priced term contracts. One might expect that this would lead to the decline in term market price. However, even with the current volume of secondary supply that is already available to the market for conversion services, the term market price has increased over the last 12 months. This would imply that the term market is not as sensitive to the availability of secondary market conversion services as one would otherwise believe and the potential adverse impact of the transfer of DOE material presently under consideration on the conversion services industry is not significant.

4.3.3 Potential Impact on the Domestic Enrichment Services Industry

Other than USEC, U.S. companies that could enrich uranium during the next five years have publicly stated that they have committed virtually all of their present enrichment capacity under term contracts. DOE transfers would not displace these already committed sales by the domestic industry. As for USEC, it is clear that it has the potential to benefit from the transfer of higher assay depleted UF_6 that is under consideration through the additional amount of enrichment services that it will be engaged to provide. Also, as noted in Section 3.1, the DOE transfers of uranium materials containing equivalent enrichment services to TVA have been known to the market for many years and are long-term contracts in nature.

Therefore, the potential adverse impact of the transfer of DOE material presently under consideration on the enrichment services industry is not significant.

5. Summary of Potential Market Implications and Nature of Industry Concern

Based on presently available information and the results of the analysis described in this report, ERI does not believe that either (i) the potential price effect of the presently proposed quantities of equivalent U_3O_8, conversion services and enrichment services that DOE is considering transferring during the period 2012 through 2033; or (ii) the quantities of domestic production, if any, that might be displaced due to the proposed DOE transfers are of a magnitude that they would constitute a material adverse impact on the domestic industries or any of the initiatives that are presently underway. These initiatives include uranium exploration and development, previously announced plans to license and construct new enrichment facilities, or the U.S.-Russian HEU Agreement, which is scheduled to end in 2013.

However, even if the potential impact of any individual transfer by DOE is not in itself significant, the nuclear fuel markets recognize that DOE controls a very large amount of material. The predictability of DOE's transfer of that material into the commercial markets over time is very important to the orderly functioning of these markets. In this regard, it is critical for long-term planning and investment decisions by the domestic industry that there can be confidence that DOE will adhere to what it presents as being established guidelines and plans.

Unless DOE can demonstrate to the domestic fuel supply industry that its transfer of material during any year(s) in an amount that is substantially larger than 10% of U.S. annual requirements will not establish a precedence by which DOE may make future transfers without any regard for the "*maintenance of a strong domestic nuclear industry*", then DOE actions may, in fact, have an adverse material impact on the domestic industry. Most significantly, current and future plans for commercial uranium exploration, development, as well as new facility construction to increase long-term supply capacity, particularly in the domestic uranium supply industry, could be adversely impacted.

It is therefore important to note that in contrast to prior analyses of DOE transactions spanning three to seven years, DOE has identified all the material that is currently under consideration for transfer over a period of more than 20 years, i.e. from 2012 through 2033. This more comprehensive DOE plan enables the industry to better understand the significance of transfers during the next five to seven years that may exceed the 10% guideline and to adjust expectations and plans as is believed necessary.

GLOSSARY

ACP – USEC's planned Advanced Centrifuge Plant.

centrifuge – A device that can spin at extremely high speeds and separate materials of different densities. For uranium, centrifuges are able to separate the uranium-235 isotopes from the uranium-238 isotopes based on their difference in atomic weight.

conversion – In the context of nuclear fuel, the process whereby natural uranium in the form of an oxide is converted to uranium hexafluoride.

depleted uranium – Uranium whose content of the fissile isotope uranium-235 is less than the 0.711 percent (by weight) found in natural uranium, so that it contains more uranium-238 than found in natural uranium.

down blending – The term used to describe the process whereby highly enriched uranium is mixed with depleted, natural, or low enriched uranium to create low enriched uranium.

enriched uranium – Uranium whose content of the fissile isotope uranium-235 is greater than the 0.711 percent (by weight) found in natural uranium. (See uranium, natural uranium, and highly enriched uranium.)

enrichment – In the context of nuclear fuel, the separation of the uranium-235 isotope from the more common uranium-238 isotope to create enriched uranium.

equivalent – In the context of uranium concentrates equivalent, conversion services equivalent, enrichment services equivalent, this refers to the equivalent amount of each of these materials and services that is included in the LEU that is derived from the blended down HEU. While the LEU is not physically subdivided into these components, from a commercial perspective the components can be transferred individually.

EREF – AREVA's planned Eagle Rock Enrichment Facility.

fissile material – Any material fissionable by thermal (slow) neutrons. The three primary fissile materials are uranium-233, uranium-235, and plutonium-239.

gaseous diffusion – A uranium enrichment process where uranium hexafluoride in gaseous form is forced through a series of semi-porous membranes to increase the concentration of uranium-235 isotopes.

highly enriched uranium or HEU – Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to 20 percent or more (by weight). (See natural uranium, enriched uranium, and depleted uranium.)

kgU – Kilograms of uranium.

long-term or term price – In the context of this report, refers to the price paid for nuclear fuel materials and services that will be delivered more than one year after the contract is signed.

low-enriched uranium or LEU – Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to more than 0.7 percent but less than 20 percent by weight. Most nuclear power reactor fuel contains low-enriched uranium containing 3 to 5 percent uranium-235.

MT and MTU – Metric tons and metric tons of uranium.

natural uranium – The material provided to a uranium enricher for producing enriched uranium and uranium tails.

reactor core – The fuel assemblies, fuel and target rods, control rods, blanket assemblies, and coolant/moderator of a nuclear power plant. Energy is produced in this part of the nuclear power plant.

separative work units or SWU – The unit of measurement for the effort needed to enrich uranium.

spot market price or spot price – In the context of this report, refers to the price paid for nuclear fuel materials and services that will be delivered soon (e.g., usually within 12 months) after the contract is signed.

tails – Refers to depleted uranium produced during the uranium enrichment process.

term or term market price – See **long-term price**.

uranium concentrates or U_3O_8 – The form of uranium that is the end product of the uranium milling process, which follows mining of the uranium ore. This compound can be converted through a uranium conversion process into uranium hexafluoride.

uranium hexafluoride or UF_6 – The form of uranium that is the end product of the uranium conversion process. This compound can be easily transformed into a gaseous state at relatively low temperatures to allow the uranium to feed through a uranium enrichment process, either gaseous diffusion or gas centrifuge.