ENERGY
RESOURCES
INTERNATIONAL, INC.

ERI-2142.07-1001

Quantification of the Potential Impact on Commercial Markets of DOE's Transfer of Natural Uranium Hexafluoride During Calendar Years 2011, 2012 and 2013

ENERGY
RESOURCES
INTERNATIONAL, INC.

ERI-2142.07-1001

Quantification of the Potential Impact on Commercial Markets of DOE's Transfer of Natural Uranium Hexafluoride During Calendar Years 2011, 2012 and 2013

Prepared For:

U.S. Department of Energy
Office of Nuclear Energy

Prepared By:

Michael H. Schwartz
Thomas B. Meade
Julian J. Steyn

December 2010

1015 18th Street, NW, Suite 650
Washington, DC 20036
USA
Telephone: (202) 785-8833
Facsimile: (202) 785-8834

NOTICE

This report was prepared for the Office of Uranium Management and Policy in the Office of Nuclear Energy, Department of Energy (DOE) under Task 7 under GSA FABS Contract No. GS-23F0242P and DOE Contract No. DE-DT0000752.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

LIST OF TABLES

LIST OF FIGURES

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*."

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, 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. The UPA has continued to press this point with Congress and the Administration up to the present time.

By way of background, it is interesting to note that during the period December 2009 through October 2010, there were five DOE transfers of natural uranium that resulted in spot market sales by the DOE contractors that received the uranium. The plan to transfer the DOE uranium was first announced by the DOE in July 2009 and then described in more detail by the Secretary in November 2009. The sales were in amounts of between approximately 520,000 pounds U_3O_8 equivalent and 650,000 pounds U_3O_8 equivalent. During the months in which two of these transfers occurred, the spot market price for uranium declined by $0.75 and $1.75 per pound. This decline in price is less than the average month-to-month change in spot market price that occurred during the past 12 months. During the other three months 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 then might have been expected in the absence of any other market activity. Furthermore, since November 2009, the published spot market price for U_3O_8 has increased by $15 per pound.

This report presents the results of a business analysis performed by Energy Resources International, Inc. (ERI) of the potential effect on the commercial markets of the transfer of DOE natural uranium hexafluoride (UF_6) to DOE contractors in exchange for services during calendar years 2011, 2012 and 2013[i].

This analysis also takes into account other sales or transfers by DOE into the market during this period of time. The DOE National Nuclear Security Administration (NNSA) expects to be transferring into these same commercial markets additional low enriched uranium (LEU), which results from the down blending of highly enriched uranium (HEU). 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) Reliable Fuel Supply barter material for the NNSA contractor; (iii) Mixed Oxide Fuel (MOX) Inventory (12 MTU HEU) 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. Each of these elements, including the diluent, is accounted for in the DOE 2008 Plan.

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.

The transaction analyzed by ERI during 2011, 2012 and 2013 involves transfers of natural UF_6 to the DOE contractor(s) beginning in the first quarter of 2011 and continuing through the fourth quarter of 2013. The UF_6 is expected to be transferred by DOE to the contractor(s) in approximately equal amounts during each of the 12 successive quarters during 2011, 2012 and 2013.

Once DOE delivers material to its contractor(s), DOE will no longer be able to exercise control over when (e.g., immediately or with some delay) or how (e.g., through spot market or long-term contracts) such material will enter the commercial market. Therefore, any potential impact that the DOE material has on a market is assumed to take place during the year in which it is originally delivered by DOE to the contractor(s).

The total amount of the transfer made by DOE to the contractor(s) each year during this three year period is determined assuming that the TVA quantities are based on time of

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

expected transfer to TVA, which is consistent with the assumptions made for other DOE transfers in the DOE 2008 Plan.

Approximately 79% of the total amount of natural uranium expected to be transferred by DOE during this period would be to the DOE contractor(s), with the other 21% being DOE/NNSA transfers.

The total DOE transfers under consideration are equivalent to 10% of U.S. requirements for natural UF_6 (i.e., uranium concentrates and conversion services) in 2011, 2012 and 2013. The DOE transfers would never exceed the equivalent of 3% of U.S. requirements for enrichment services in any single year, and would be equivalent to 2.6% of U.S. requirements for enrichment services over the entire period.

This analysis also confirms that the plans that are presently under consideration by DOE result in the total amount of material that would be transferred into the commercial markets on average and in any single year would not exceed the 10% of annual U.S. requirements guideline established in the Plan, when calculated using the approach dictated by the Plan.

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[ii] 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 November 2010 and has an R^2 = 90.5%, which is very good, particularly given the extreme volatility experienced in the spot market price during this period.

This correlation was then used to simulate the 2011 through 2013 spot market, assuming monthly values of supply and demand consistent the average monthly values that have been experienced over the last two years, with and without the DOE transfers that are presently under consideration. The result is an average potential spot market price decrease of $4.45 per pound U_3O_8 over the period 2011 through 2013 due to the DOE transfers. This represents an average potential impact on spot market price over this period of 7.4% relative to the November 31, 2010 spot market price of $60.25 per pound U_3O_8.

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

ERI also applied the results of its economic market clearing price analyses[iii] to the average annual incremental addition of supply that would result from the DOE transfers of 10% of U.S. annual requirements 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 2011 through 2013:

- the potential effect of DOE's transfer of the equivalent of 5.2 million pounds of U_3O_8 in a single year is a $1.24 per pound reduction in long-term price, which is equivalent to 1.9% of the term price;
- the potential effect of DOE's transfer of the equivalent of 5.2 million pounds of U_3O_8 in a single year is a $4.45 per pound reduction in spot market price, which is equivalent to 7.4% of the spot price
- the potential effect of DOE's transfer of the equivalent of 2.0 million kgU as UF_6 in conversion services in a single year is a $0.20 per kgU reduction in price, which is equivalent to 1.3% of the term price and 1.6% of the spot market prices for conversion services;
- the potential effect of DOE's transfer of the equivalent of 2.0 million kgU as UF_6 in natural uranium in a single year is a $3.44 per kgU reduction in price, which is equivalent to 1.9% of the term price and 2.0% of the spot market price; and
- the potential effect of DOE's transfer of the equivalent of 0.4 million SWU in enrichment services in a single year is a $1.62 per SWU reduction in price, which is equivalent to 1.0% of the term price and 1.0% of the spot market price for enrichment services.

These estimates of potential price impact do not reflect the fact that most of these equivalent DOE materials and services have already been anticipated by many market participants based upon the previously published DOE 2008 Plan and statements made by DOE during 2009 and 2010. It should also be noted that the fact that TVA was purchasing off-spec material from DOE under a long-term contract has been known to the market for many years, with first delivery to TVA in the form of finished fuel assemblies having occurred in March 2005. The potential long-term market impact of this arrangement has been included in market price forecasts since as far back as at least 2005.

Based on presently available information and the results of the analyses described in this report, ERI does not believe that either (i) the potential price effect of the presently

---

[iii] 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.

proposed quantities of equivalent U_3O_8, conversion services and enrichment services that DOE is considering transferring during the next several years beginning in the first quarter of 2011; 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, and the U.S.-Russian HEU Agreement.

However, the nuclear fuel markets recognize that DOE controls a very large amount of material and 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. If based upon DOE actions, the perception of domestic suppliers of uranium concentrates, for example, was that DOE might begin to transfer into the market quantities of uranium that are significantly larger than those quantities that DOE had previously indicated to the industry it may transfer (e.g., DOE 2008 Plan), then the potential adverse impact on uranium exploration and development could become significant for the domestic industry. 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.

The transfer by DOE of material during any year in an amount that is substantially larger than 10% of U.S. annual requirements is likely to be viewed by the industry as DOE establishing a precedent by which it may make future transfers without any regard for the "*maintenance of a strong domestic nuclear industry*."

If the industry believes that such a precedent is being established, then ERI expects that domestic suppliers within each of these markets may become concerned that (i) previously proposed schedules of transfers would be accelerated at some time in the future, resulting in a larger amount of DOE inventory being introduced into the market each year and/or (ii) additional U.S. inventory that has not yet been identified as surplus would be added to the transfer schedule. Either of these could result in a larger amount of equivalent nuclear fuel materials and services being introduced into the market, which, if of sufficient magnitude, could potentially have a material adverse effect on the markets.

It is the perceived uncertainty regarding DOE's potential future involvement in the commercial markets that ERI expects may have the greatest potential impact on the markets. 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. This adverse impact would be due to a perception of risk among suppliers and possibly external funding sources regarding the availability of as yet unknown amounts of excess materials and services that would lead to depressed prices, which would not support expenditures related to expansion of the present supply infrastructure.

Notwithstanding the above, it also should be recognized that there are (i) differences among each of the markets with regard to the relationship that exist between supply and requirements; (ii) differences among the various suppliers and purchasers in each of these markets with regard to existing inventories, production centers and facilities in operation; (iii) differences among the various commercial contracts with regard to their specific pricing mechanisms and duration; and (iv) differences in investments that either have been made or are being anticipated in the near future by any of these companies. These differences may result in different reactions among the various market participants to DOE announcements regarding transfers of its material.

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."*

This report presents the results of a business analysis performed by Energy Resources International, Inc. (ERI) of the potential effect on the commercial markets of the transfer of DOE natural uranium hexafluoride (UF_6).

The transaction analyzed by ERI during this period involves quarterly transfers of natural UF_6 to the DOE contractor(s) beginning in calendar year 2011[1] and continuing through the fourth quarter of 2013. The natural uranium is assumed to be transferred to the DOE contractor(s) in approximately equal amounts during each of the 12 successive quarters in 2011, 2012 and 2013.

This analysis also takes into account other sales or transfers by DOE into the market during this period of time. The DOE National Nuclear Security Administration (NNSA) expects to be transferring into these same commercial markets additional low enriched uranium (LEU), which results from the down blending of highly enriched uranium (HEU). 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. DOE expects to transfer 82 MTU-equivalent as LEU with an assay of 19.75w/o U^{235} in each of 2011 through 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*

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

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]

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

[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.

[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

increase the amount of uranium transferred above any guidelines previously presented in the DOE 2008 Plan[7].

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 include 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 understanding the relative importance of the quantities of DOE material that might be transferred. It also provides some 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 from down blended HEU, as well the quantities of natural uranium that might be transferred to the DOE contractor(s) beginning in the first quarter of 2011 and continuing through the fourth quarter of 2013.

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[8], and also the spot market price for uranium concentrates. To provide perspective, comparisons are provided of the size of these potential price effects relative to changes in published spot and term market prices that have occurred during the last 12 months.

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

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] 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 forecast used in this analysis was developed on a plant-by-plant and country-by-country basis. The forecast takes into consideration social, political, and economic conditions in those countries implementing nuclear power. 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 and in Japan, consistent with their present and planned activities.

2.1 Uranium Concentrates

2.1.1 Uranium Market Price Activity

The spot market price of uranium was $6.40 per pound U_3O_8 at the beginning of 2001 and moved steadily upward, reaching $135 per pound U_3O_8 by June 30, 2007, as reported by TradeTech.[9] This 20 fold increase in price over approximately 6.5 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 responding to an over reaction in market behavior, the spot price fell back to $85 per pound U_3O_8 by August 31, 2007, $47 per pound U_3O_8 by January 31, 2009, and continued in an overall downward direction, reaching a low of $40.50 per pound U_3O_8 as of February 28, 2010, before rebounding to $52 per pound U_3O_8 as of October 31, 2010

[9] 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 November 2010 issue of its monthly publication, The Nuclear Review, and the November 30, 2010 issue of its weekly publication, Nuclear Market Review.

and then climbing to \$60.25 per pound U_3O_8 as of November 30, 2010, with traders and financial entities reported by TradeTech as having purchased the bulk of the material recently sold. Even with this \$75 per pound drop from its peak in June 2007, the current spot market price still represents more than an eight-fold spot market price increase in less than 10 years.

The term (also referred to as long-term) contract price for uranium concentrates rose from \$9.25 per pound U_3O_8 at the beginning of 2001 to \$85 per pound U_3O_8 by the end of February 2007, and finally up to \$95 by the end of May 2007. It remained unchanged at \$95 per pound U_3O_8 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 remained at \$60 per pound U_3O_8; then began to drift upward. As of November 30, 2010 it was at \$65 per pound U_3O_8.

Between early 1996 and early 2003 the term price was typically about \$1 greater than the spot price, plus or minus \$1, and averaged about \$0.90 greater than the spot price, for an average difference of less than 10%. While there was a significant relative difference between the spot and term market prices during the last four months of 2004 and the first four months of 2005 (\$4.80 or 23% above the spot market price in January 2005), this difference returned to its more typical one to three dollar range, where it remained until March 2007, at which point the spot market price increased by \$10 per pound over the term price and by July 2007 the spot market price was \$28 per pound greater than the term price. Over the next several months the relationship reversed and the long-term price began to increase relative to the spot market price. Between January 2008 and September 2010, the long-term price has been between \$14 and \$27 per pound higher than the spot market price. However, with the recent increase in spot market price, by October 31, 2010 long-term price was \$10 per pound U_3O_8 (19%) above the spot price; and as of November 30 the long-term price was only \$4.75 per pound higher than the spot market price (8%).

The transition from the much higher prices for uranium that characterized the market a few years ago – 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. So, while the improved outlook for greater deployment of nuclear power plants around the world 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.

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 2010 level of 171 million pounds U_3O_8 per year to 200 million pounds in 2015 and 218 million pounds in 2020. This is a 27% increase over a period of 10 years, or an average increase of about 2.5% per year. At the same time, U.S. requirements are forecast to increase from 50.2 million pounds U_3O_8 per year in 2010 to 53.7 million pounds in 2015 and 56.3 million pounds in 2020. This is a 12.2% increase in requirements over a period of 10 years, representing an average increase of only 1.2% per year, which is about one half the rate of increase forecast for the world.

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 already mined uranium (AMU).

ERI estimates that current worldwide uranium mine production capacity is approximately 141 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 2015 and 2020, world mine production capacity is projected to be 202 and 234 million pounds per year, respectively, which 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 5.2% between 2010 and 2020.

Six countries (i.e., Kazakhstan, Canada, Australia, Namibia, Niger and Russia) are expected to provide at least 80% of world mine production during each of 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 and Smith Ranch-Highland Operation. Total U.S. production in 2009 from these properties (together with Kingsville Dome, which was operating at that time), and the White Mesa Mill was reported by DOE/Energy Information Administration (EIA) to have been 4.1 million pounds U_3O_8.[10] It is expected that these centers will continue to collectively produce between 4 and 5 million pounds per year, during each of the next 5 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. These, together with

[10] *Domestic Uranium Production Report*, data for 2009, page 1, U.S. Energy Information Administration, July 15, 2010.

several other projects, could result in U.S. annual uranium production climbing to about 8 million pounds per year by 2012.

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 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.

2.1.4 Adequacy of Uranium Supply Relative to Requirements

Figure 2.1 presents the world mine and AMU supply capacity that is projected to be available, if needed, to meet the ERI Reference and High Nuclear Power Growth requirements forecasts during the time period 2010 through 2030, and the resulting excess/shortfall. The AMU projection assumes that there will be plutonium and uranium recycle in some Western European countries and Japan, and that some excess weapons plutonium will be consumed in the U.S. and Russia in the form of mixed oxide (MOX) fuel. It is apparent from this figure that current mine capacity, together with capacity under development, plus AMU exceed the amount of uranium that is necessary to meet requirements through 2023 for the ERI Reference Nuclear Power Growth forecast and 2017 years under the ERI High Nuclear Power Growth forecast. If prospective mine supply is added, than uranium supply should be adequate for at least the next 20 years for the ERI Reference forecast and the next 14 years for the ERI High forecast. 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 is no longer present.

As illustrated in this figure, some of the projected future mine production capacity could result in excess capacity. This would lead to either a buildup of inventory or a displacement of that capacity to a point in the future when it will be needed.

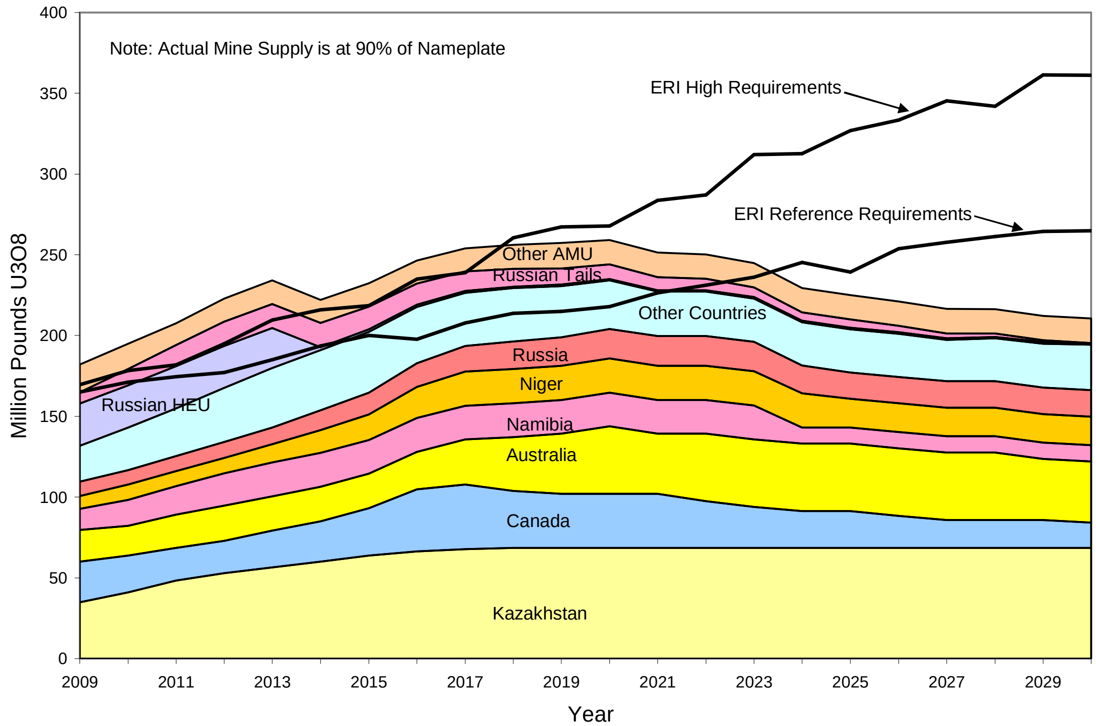

Figure 2.1 Forecast of World Supply and Requirements for Uranium Concentrates

2.1.5 Future Market Price for Uranium Concentrates

Even though there is not very much excess capacity in the market relative to nuclear power plant requirements today, adequate uranium is expected to be available to meet near term requirements and the Reference Nuclear Power Growth requirements forecast during at least the next 14 years, as illustrated in Figure 2.1. Present market prices are close to ERI's estimate of the economic market clearing price based on the total cost of production – including exploration, development and return on investment – of about $51 to $55 per pound U_3O_8 during the 2010 through 2015 period, in 2010 dollars. 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. However, substantial exploration and mine development still must be carried out in order to eventually provide fuel for the 60-year lifetimes of the nuclear plants that will be committed during the coming years.

A current analysis of mine by mine production costs coupled with an economic market clearing price analysis[11] results in the conclusion that for each additional million pounds of uranium

[11] Such analyses require the creation of an annual supply curve, which in the case of uranium concentrates is

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 $0.24 per pound U_3O_8 during the period 2010 through 2015. It is important to note that this estimated impact is relative to projected economic market clearing price, which serves as the basis for long-term price projections. 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. More than 70% of the uranium purchased during 2008 and 2009 was reported to have been purchased under term contracts.[12]

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 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. The plant interruptions also highlighted the logistical issues associated with transport of conversion services supply, particularly between Europe and North America. Earlier this year, a labor

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.

[12] The percent of uranium concentrates purchased under term and/or spot market contracts during 2008 and 2009 is based upon information that was published by The Ux Consulting Company, LLC.

strike at the Metropolis plant, which is still ongoing, has had an impact on production, even though it has not shut down the plant entirely.

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 about $5.00 per kgU as UF_6 in November 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 28, 2010 it reached a low of $5.00 per kgU. However, the price began to rise in June 2010 and by September 30, 2010 it had reached $13.00 per kgU, where it remained through October 31, 2010, before drifting down to $12.50 per kgU as of November 30, 2010.

The North American long-term market price has remained at about $12.00 kgU since January 2005; dropping to as low as $11.00 per kgU at the end of 2009, before recovering in the last several months. By October 31, 2010 it had increased to $13.00 per kgU; and as of November 30, 2010 it had climbed to $15.00 per kgU. 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 announcement regarding its pricing in future contracts appears to have led to a significant increase in conversion price.

2.2.2 Conversion Services Requirements

ERI's Reference Nuclear Power Growth forecast indicates that world nuclear power plant requirements for conversion services will rise from 60.3 million kgU as UF_6 per year to 72.1 million kgU in 2015 and 79.7 million kgU in 2020. This is a 32.2% increase over a period of 10 years, or an average increase of about 2.8% per year. At the same time, U.S. requirements are forecast to increase from 19.2 million kgU per year in 2010 to 20.5 million kgU in 2015 and 21.5 million kgU in 2020, which is a 12.0% increase in requirements over a period of 10 years, representing an average increase of about 1.1% per year, which is about 40% of the rate of increase forecast for the world.

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 capacity in 2010 is approximately 47.5 million kgU as UF_6, which represents about 79% of the estimated 2010 world requirements of 60.3 million kgU. This indicates a gap between primary production and requirements of 12.8 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 through the next decade or so. The contribution of secondary supply to meeting market requirements is estimated to have been about 20 million kgU as UF_6 in 2009 and is expected to amount to approximately 22 million kgU per year between 2010 and 2013, after which it is expected to fall to about 55% of this amount by 2015. 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.

During the last few years, the conversion services industry has not significantly expanded existing capacity. The Honeywell Metropolis 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 is presently limited to no more than 12 million kgU as a result of equipment problems in one part of the plant.[13] It is presently unknown whether Metropolis production will increase above this level in the foreseeable future.

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.

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

[13] At the NEI International Uranium Fuel Seminar in Savannah, GA, October 18, 2010.

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 during the period through 2013, after which that source of equivalent conversion supply is no longer present.

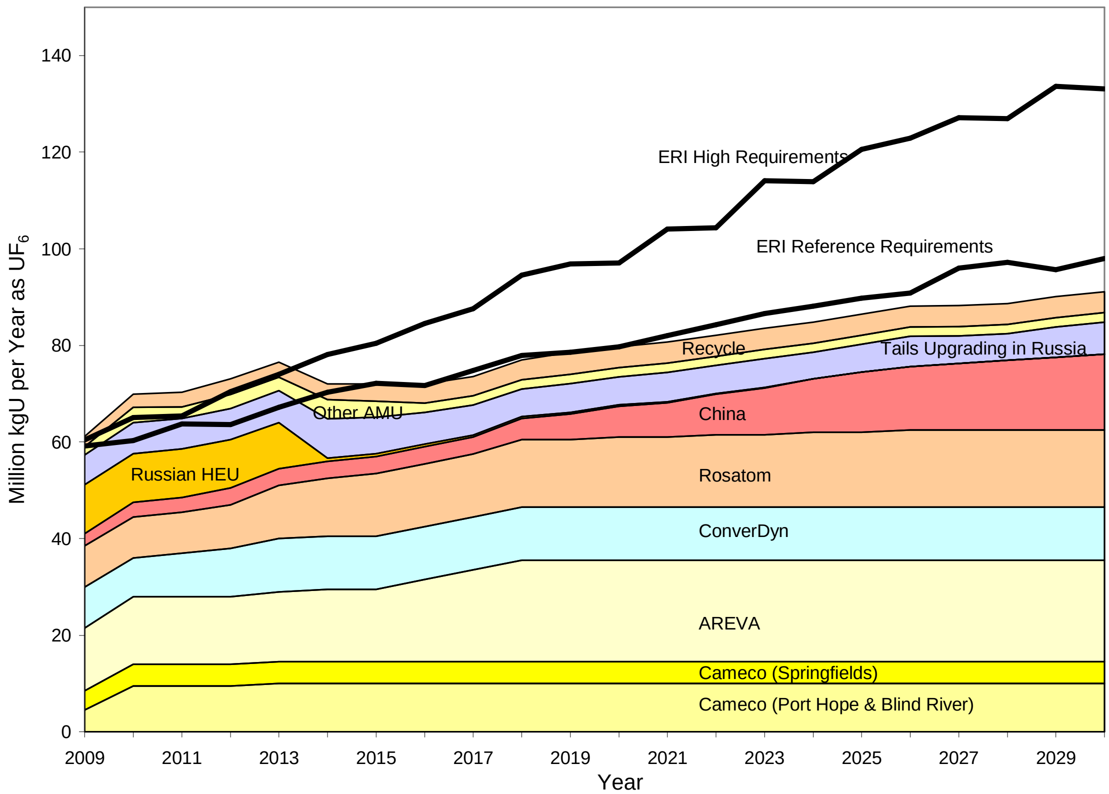

Figure 2.2 Forecast of World Supply and Requirements for Conversion Services

As shown in this figure, a reasonable margin between supply and requirements is expected through 2013, but between 2014 and 2020 there is effectively no margin between supply and requirements under the ERI Reference Nuclear Power Growth Forecast. This could become a problem if any of the presently operating facilities was unable to operate at its presently expected conversion capacity. After 2020 supply is shown to be insufficient to meet requirements. Under the ERI High Nuclear Power Growth Forecast a supply deficit would appear as early as 2014.

In order to meet such deficits in supply, a combination of using lower enrichment tails assays, drawing down some portion of the existing strategic inventories being held by nuclear power plant operating companies, and further expanding existing conversion facilities and building new conversion facilities may be necessary. The lead time for a new plant is expected to be 3 to 5 years; and expansion of an existing plant is about 2 years.

2.2.5 Future Market Price for Conversion Services

The industry recognizes the 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. While present market prices appear to be adequate to support plant expansion activities, they may not be sufficient to support construction of new conversion plants. Facility capital costs, financing, and an adequate return on investment may eventually require prices of as much as $14 per kgU as UF_6. In fact, in an October 2010 letter to its customers, ConverDyn announced that in future contracts the minimum price that it would charge would be $15.00 per kgU. Within the next few years, it is expected that prices may rise to that level.

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 $0.10 per kgU as UF_6 during the period 2010 through 2015. It is important to note that this estimated impact is relative to projected economic market clearing price, which serves as the basis for long-term price projections. 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. More than 80% of the conversion services purchased during 2008 and 2009 was reported to have been purchased under term contracts. As discussed in Section 2.6, the term price has been much less volatile than the spot market price.

2.3 Enrichment Services

2.3.1 Enrichment Market Price Activity

Following a stable period between 2002 and 2005, term prices rose steadily from December 2005 with the long-term price indicator reported by TradeTech reaching $165 per separative work unit (SWU) as of the end of May 2009. The long-term price indicator declined to $160 per SWU in April 2010, where it remained through October 31, 2010, before declining to $158 per SWU as of November 30, 2010. When evaluated in Euros, the overall increase in enrichment prices has not been as significant.

The price increases that occurred between 2005 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. This has 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 continue to have an unfavorable impact on U.S. dollar-denominated enrichment prices.

2.3.2 Enrichment Services Requirements

ERI's Reference Nuclear Power Growth requirements forecast indicates that world nuclear power plant requirements for enrichment services will rise from the 2010 level of about 46.3 million SWU per year to 55.9 million SWU in 2015 and 62.5 million in 2020. This is a 35% increase over a period of 10 years, or an average increase of about 3.1% per year. At the same time, U.S. requirements are forecast to increase from 14.2 million SWU per year in 2010 to 15.3 million SWU per year in 2015 and 16.0 in 2020, which is a 12.7% increase in requirements, representing an average increase of about 1.2% per year, which is about 40% of the rate of increase forecast for the world.

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.

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 will be removed from service during the coming 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.

In addition to this supply, there is also the possibility that one or more of these new facilities might be further expanded over time to service larger amounts of world requirements. Also, other presently operating facilities, such as Urenco’s three operating enrichment facilities in Europe, 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.

In addition, 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.

2.3.4 Adequacy of Enrichment Supply Relative to Requirements

Figure 2.3 presents ERI's forecast of uranium enrichment supply and both the ERI Reference Nuclear Power Growth requirements and ERI High Nuclear Power Growth requirements through 2030. 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 little if any margin in the expected supply relative to projected requirements throughout the study period, for the Reference Growth forecast. However, it is recognized that in order for Russia to meet its requirements under the High Nuclear Power Growth case, the Rosatom Internal supply component shown in Figure 5 would have increased redirection of some of its existing enrichment capacity from creation of natural uranium equivalent material by the enrichment of tails to the enrichment of natural uranium for nuclear power plant fuel. This would result in Rosatom Internal supply that is in excess to that under the Reference Growth requirements forecast, which is depicted in the figure, increasing by about 35% by 2020, and 70% by 2030, narrowing the potential gap shown in those years.

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.

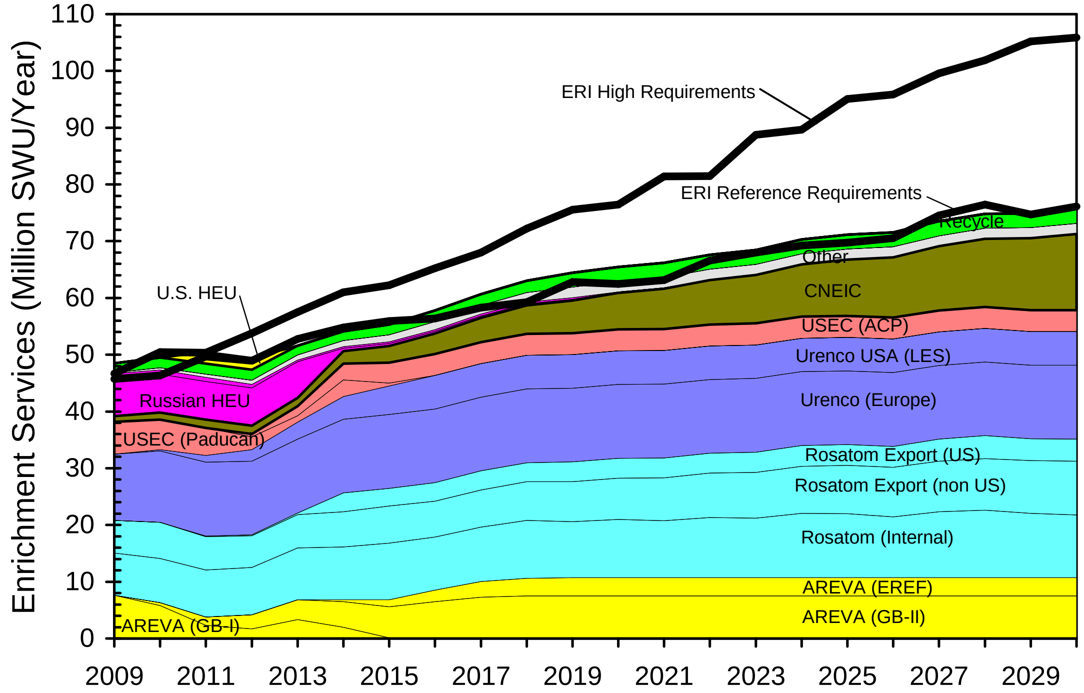

Figure 2.3 Forecast of World Supply and Requirements for Enrichment Services

Supply almost exactly equals requirements at present. A close balance between available supply and power plant requirements is forecast to continue well into the future under the ERI Reference Nuclear Power Growth forecast. During the 2010 to 2012 period, an average annual supply excess under the Reference Nuclear Power Growth forecast of 1.5 million SWU per year (3.0% of requirements) is projected. However, an annual supply deficit averaging 0.8 million SWU (1.5% of requirements) is projected between 2013 and 2015. However, it is expected that this will be easily made up by draw down of inventories. There have been recent indications that China may begin to add indigenous centrifuge enrichment capacity earlier than assumed in the figure, which would also help reduce the potential supply deficit. By 2016, supply is once again able to meet requirements, as new enrichment capacity continues to come on line.

It should be emphasized that this level of supply, which barely meets projected requirements under the ERI Reference Nuclear Power Growth forecast, is dependent on the timely startup and expansion of four new enrichment plants. However, it is worth noting that there are a number of sources that could potentially fill any supply deficits in the long-term under both the Reference Nuclear Power Growth forecast; and even beginning during the next couple of years under the High 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. Small shortages are certainly possible during the next several years, as schedule delays in bringing supply online at new plants are always possible, but are not expected to result in any delivery problems.

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 $4.30 per SWU during the period 2010 through 2015. It is important to note that this estimated impact is relative to projected economic market clearing price, which serves as the basis for long-term price projections. 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. More than 95% of the enrichment services purchased during 2008 and 2009 were believed to have been purchased under term contracts.

2.4 Summary of U.S. Requirements for Nuclear Fuel

Table 2.1 provides a summary of U.S. requirements for nuclear fuel materials and services based upon the ERI 2010 Reference Nuclear Power Growth forecasts. This information will be used to provide perspective regarding the quantities of material that DOE is considering for transfer relative to the markets into which they would be introduced.

	2011	2012	2013
U.S. Uranium Concentrates Requirements, million pounds of U_3O_8	50.8	51.2	53.4
U.S. Uranium Conversion Requirements, MTU of U as UF_6	19,450	19,590	20,430
U.S. Enrichment Services Requirements, Million SWU	14.4	14.6	15.2
Source: ERI "2010 Nuclear Fuel Cycle Supply and Price Report", May 2010, 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 excellent agreement with the most recent analysis by the World Nuclear Association (WNA), which was published in September 2009 and is entitled "The Global Nuclear Fuel Market Supply and Demand, 2009 - 2030". It also provides projected U.S. requirements for nuclear fuel materials and services. Over the 2011 through 2013 period, the total U.S. natural uranium requirements forecasts published by WNA are 1.4% higher than those shown in Table 2.1 and total U.S. enrichment services requirements are the same as those shown in Table 2.1.

2.5 Summary of Published Market Prices

Current monthly spot and term market prices[14] (also referred to as "price indicators") are summarized in Table 2.2.

	Spot Market Prices	Term Market Prices
U concentrates:$/lb U_3O_8	60.25	65.00
Conversion Services (North American): $/kgU as UF_6	12.50	15.00
Enrichment Services (Restricted): $/SWU	155.00	158.00
U as Nat UF6: $/kgU as UF_6	170.00	185.00
Market prices are as published by TradeTech in the November 30, 2010 issue of its weekly publication, Nuclear Market Review.		

Table 2.2 Recently Published Market Prices

[14] 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."

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 USEC and 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., change), respectively, in published spot and term market prices for uranium concentrates, conversion services, natural UF_6, and enrichment services during the previous 12 month period, through the end of November 2010.

	Total Change in Published Market Price Over Past 12 Month Period		Absolute Value of Largest Change in Monthly Market Price Over Past 12 Month Period	Average of Absolute Values of Month to Month Change in Published Market Price Over Past 12 Month Period	
	Change,Dollar Basis	Change,Percent Basis	Dollar Basis	Average Monthly Change, Dollar Basis	Average Monthly Change, Percent Basis
Uranium Concentrates, $ per pound U3O8					
Spot Market Price	$15.00	33.1%	$8.25	$2.21	4.6%
Term Market Price	$5.00	8.2%	$3.00	$0.42	0.7%
Conversion Services, $ per kgU as UF6					
Spot Market Price	$7.00	82.8%	$3.50	$0.75	9.0%
Term Market Price	$4.00	33.6%	$2.00	$0.33	2.6%
Natural Uranium, $ per kgU as UF6					
Spot Market Price	$47.00	37.1%	$21.00	$6.58	5.0%
Term Market Price	$17.06	10.0%	$9.80	$1.42	0.8%
Enrichment Services, $ per SWU					
Spot Market Price	-$10.00	-6.4%	$5.00	$1.17	0.7%
Term Market Price	-$7.00	-4.3%	$3.00	$0.58	0.4%
Source of market price data used to calculate volatility is that published by Trade Tech. The Natural Uranium price is 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 a significant change during this period, with a total increase in price over the 12 month period of $15.00 per pound U_3O_8, which represents a 33.1% change in the underlying spot market price. During the same period the term price for uranium concentrates demonstrated a $5.00 per pound increase, which represents a 8.2% change in the underlying term market price. On a percent basis, the the change in spot market price for uranium concentrates was four times greater than the change in the term market price over this 12 month period.

Looking at month-to-month price volatility, it is observed that the absolute value (i.e., independent of the direction in the change) of the maximum month-to-month change in uranium spot market price was $8.25 per pound and $3.00 per pound for term price. Based on the average of the absolute values of monthly price change over the last 12 months, as presented in Table 2.3, the volatility in the spot market price for uranium concentrates is observed to have been five times the volatility shown by term market prices during this same period; on a percent basis that is 4.6% in the spot market versus 0.7% in the term market. This is further confirmed when it is observed that over the entire 12 month period the spot market price increased by an average of 2.7% per month, while the term market price increased by an average of 0.7% per month.

As indicated in Table 2.3, the spot market price for conversion services has demonstrated the greatest relative change in price over the 12 month period, an increase of $7.00 per kgU as UF_6 which represents a 82.8% change in the underlying spot market price. During the same 12 month period the term price for conversion services demonstrated a $4.00 per kgU annual change in price, which represents a 33.6% change in the underlying term market price. On a percent basis the change in the spot market price for conversion services during this 12 month period was at 2.5 times greater than the change in the term market price.

Again, looking at month-to-month price volatility, it is observed that the absolute value of the maximum month-to-month change in conversion services spot market price was $3.50 per kgU and for term price it was $2.00 per kgU. Based on the average of the absolute values of the monthly price change over the last 12 months, as presented in Table 2.3, the volatility in the spot market price for conversion services is observed to have been more than twice the volatility shown by term market prices during this same period; on a percent basis that is 9.0% in the spot market versus 2.6% in the term market. This is further confirmed when it is observed that over the entire 12 month period the spot market price for conversion services increased by an average of 6.9% per month, while the term market price increased by an average of less than 2.8% per month.

Also as shown in Table 2.3, the change in spot market price for natural UF_6, which reflects the impact of changes in both uranium concentrates and conversion services, has been $47 per kgU as UF_6 over the 12 month period, representing a 37.1% change in the underlying spot market price. During the same 12 month period the term price for natural UF_6 demonstrated a $17 per kgU annual change in price, which represents a 10.0% change in the underlying term market price. The month-to-month price volatility for natural UF_6 over the last 12 months – independent of the direction in the change – is generally consistent the volatility exhibited by the spot market price for uranium concentrates, which is observed to have been about 4 times the volatility shown by term market prices during this same period.

With regard to enrichment services, as shown in Table 2.3, spot market prices have demonstrated a change that is 1.4 times that of the term market prices during the last 12 months. The change in spot market price over the 12 month period was -$10.00 per SWU, which represents a -6.4% change in the underlying spot market price. During the same period, the term price for enrichment services demonstrated a -$7.00 per SWU change in price, which represents a -4.3% change in the underlying term market price for the period.

Finally, considering the month-to-month price volatility, it is observed that the absolute value of the maximum month-to-month change in enrichment services monthly spot market price was $5.00 per SWU and for term price it was $3.00 per SWU. Based on the average of the absolute values of the monthly price change, the volatility in month-to-month spot market enrichment prices has also been about twice that of the term prices for enrichment services as shown in Table 2.3, but the volatility for both spot and term market enrichment prices are relatively low at 0.7% and 0.4% per month, respectively.

It is also interesting to note that during the past 12 months there have been five DOE transfers of natural UF_6 that resulted in 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 650,000 pounds U_3O_8 equivalent. During the individual months in which two of these transfers occurred (December 2009 and end of February 2010), the spot market price for uranium declined by $0.75 and $1.75 per pound, respectively. This decline in price is less than the average month-to-month change in spot market price that occurred during the past 12 months. 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 then 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.

Further highlighting the nature of price volatility in the uranium market, Jerry Grandey, President and CEO of Cameco Corporation, which is a major supplier of uranium concentrates and also owns two out of three of the 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 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 two 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., 2011 through 2013); they are (i) the NNSA down blended HEU and (ii) the natural UF_6 that may be used for barter with the DOE contractor(s). Each is addressed separately and then they are combined for further evaluation.

3.1 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;
- Reliable Fuel Supply barter material for the NNSA contractor;
- Mixed Oxide (MOX) LEU Inventory (12 MTU HEU) 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.

The DOE 2008 Plan – specifically Table 8. Representative DOE Excess Uranium Management Plan and Table 9. Representative Enrichment Associated with Uranium Management Plan – identifies the total amount of natural uranium and enrichment equivalent quantities associated with the NNSA down blended HEU in categories of "allocated" and "unallocated" HEU down blend. During the 2011 through 2013 period, these two categories represent a total of 2,912 MTU (or 2.912 million kgU) as UF_6 and 2.360 million SWU. According to NNSA, the TVA numbers that were used in preparing Tables 8 and 9 were based on when the LEU was expected to be loaded as fuel assemblies into the TVA nuclear power plants.

However, subsequent to publication of the DOE 2008 Plan, DOE realized that using the time of loading for the TVA off-spec material is inconsistent with the assumptions in the DOE 2008 Plan and also with the other entries in Tables 8 and 9 of the DOE 2008 Plan, which are based upon when the deliveries of uranium are expected to occur. Accordingly, in 2009 DOE corrected the TVA numbers to be consistent with the others in the DOE 2008 Plan and reflect when deliveries of the down blended material to TVA are expected to occur. When the numbers in Tables 8 and 9 of the DOE 2008 Plan are corrected to reflect when deliveries to TVA occurred and are expected to occur, the result is that the TVA off-spec material quantities are lower during the 2011 through 2013 period.

Table 3.1 presents a summary of the annual and total NNSA equivalent quantities of nuclear fuel materials and services that DOE/NNSA expects to transfer during this period. According to DOE/NNSA, the transfers to TVA during 2011, 2012 and 2013 will be 138, 213 and 228 MTU of natural uranium equivalent, respectively. In total, this 579 MTU will account for 46% of the DOE/NNSA transfers, which are expected to total 1,268 MTU, during these three years.

ERI believes that the DOE material transfers to TVA and any resulting market impact would be most appropriately viewed as being that of a long-term contract arrangement, which has been known to the market for many years, with first delivery to TVA in the form of finished fuel assemblies having occurred in March 2005.

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.[15]

	2011	2012	2013	Total
DOE/NNSA Expected Transfers				
Equiv Net MTU as UF_6 (a)	340	479	449	1,268
Equiv Net Million pounds of U_3O_8 (b)	0.9	1.3	1.2	3.3
Equiv Net Million SWU (a)	0.3	0.4	0.4	1.1

(a) DOE/NNSA communciation, October 26, 2010
(b) Calculated by multiplying the MTU of U value by a conversion factor of 0.00261285, then rounded.
(c) Totals may not add due to rounding.

Table 3.1 Summary of Presently Expected NNSA Transfers During the 2011 – 2013 Period

The quantities of nuclear fuel materials and services presented in Table 3.1 serve as the basis for estimating potential market impact.

3.2 DOE Material Being Considered for Transfer in Exchange for Services

DOE is presently considering plans to transfer certain quantities of natural UF_6 to its contractor(s) beginning in the first quarter of 2011 and continuing through the fourth

[15] 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.

quarter of 2013. It is expected that the transfers would be made in approximately equal amounts on a quarterly basis throughout this three year period. These transfers would be in exchange for services performed by the contractor(s) under contract to DOE. 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.

	2011	2012	2013	Total
Maximum DOE Material Transfers Based on 10% of U.S. Requirements (a)				
Equiv Net MTU as UF_6	1,945	1,959	2,043	5,947
Equiv Net Million pounds of U_3O_8 (b)	5.1	5.1	5.3	15.5
Equiv Net Million SWU	1.4	1.5	1.5	4.4
DOE/NNSA Expected Transfers (c)				
Equiv Net MTU as UF_6	340	479	449	1,268
Equiv Net Million pounds of U_3O_8	0.9	1.3	1.2	3.3
Equiv Net Million SWU	0.3	0.4	0.4	1.1
Quantities Under Consideration by DOE for Transfer to the Contractor(s)				
Equiv Net MTU as UF_6	1,605	1,480	1,594	4,679
Equiv Net Million pounds of U_3O_8	4.2	3.9	4.2	12.2
Equiv Net Million SWU	-	-	-	-
Total DOE Material as Percent of U.S. Fuel Cycle Requirements (a)				
Equiv Net MTU as UF_6	10.0%	10.0%	10.0%	10.0%
Equiv Net Million pounds of U_3O_8	10.0%	10.0%	10.0%	10.0%
Equiv Net Million SWU	2.3%	2.9%	2.5%	2.6%

(a) ERI "2010 Nuclear Fuel Cycle Supply and Price Report", May 2010, as summarized in Table 2.1 of this report.
(b) U3O8 values are calculated by multiplying the MTU of U value by a conversion factor of 0.00261285, then rounded.
(c) Table 3.1
(d) Totals may not add due to rounding.

Table 3.2 Summary of Transfers Under Consideration by DOE to the Contractor(s) During the 2011 – 2013 Period

The quantities shown in Table 3.2 are consistent with guidelines provided in the Plan under which the total annual DOE transfers do not exceed 10% of U.S. annual requirements. The resulting quantities under consideration by DOE for transfer to the contractor(s) average 1,560 MTU of U as UF_6 per year, which is equivalent to that amount of conversion services and 4.1 million pounds of U_3O_8 per year. Since natural UF_6 would be transferred, there is no enrichment component.

Once DOE delivers material to one of its contractors, DOE will no longer be able to exercise control over when (e.g., immediately or with some delay) or how (e.g., through spot market or long-term contracts) such material will enter the commercial market. Therefore, any potential impact that the DOE material has on a market due to transfers to the contractor(s) is assumed to take place during the year in which it is originally transferred by DOE to its contractor.

3.3 Summary of All DOE Material Presently Being Considered for Transfer

The transfers presently expected to be made by DOE/NNSA during the period 2011 through 2013, as presented in Table 3.1 are combined with the transfers that are presently under consideration by DOE to the DOE contractor(s) for the same period, as presented in Table 3.2. The totals are presented in Table 3.3, assuming TVA quantities based on time of expected transfer to TVA.

Table 3.3 indicates that approximately 79% of the total DOE transfers of natural uranium during this period would be to the DOE contractor(s), with the other 21% being DOE/NNSA transfers.

Table 3.3 also shows annually and in total for this period the DOE transfers that are presently under consideration as a percent of U.S. nuclear fuel requirements. As shown in Table 3.3 the DOE transfers would be equivalent to 10% of U.S. requirements for natural uranium in 2011, 2012 and 2013. The DOE transfers would never exceed the equivalent of 3% of U.S. requirements for enrichment services in any single year, and would be equivalent to 2.6% of U.S. requirements for enrichment services over the entire period.

	2011	2012	2013	Total
DOE/NNSA Expected Transfers (a)				
Equiv Net MTU as UF_6	340	479	449	1,268
Equiv Net Million pounds of U_3O_8 (b)	0.9	1.3	1.2	3.3
Equiv Net Million SWU	0.3	0.4	0.4	1.1
Quantities Under Consideration by DOE for Transfer to the Contractor(s) (c)				
Equiv Net MTU as UF_6	1,605	1,480	1,594	4,679
Equiv Net Million pounds of U_3O_8	4.2	3.9	4.2	12.2
Equiv Net Million SWU	-	-	-	-
Total DOE Material to be Transferred				
Equiv Net MTU as UF_6	1,945	1,959	2,043	5,947
Equiv Net Million pounds of U_3O_8	5.1	5.1	5.3	15.5
Equiv Net Million SWU	0.3	0.4	0.4	1.1
Total DOE Material as Percent of U.S. Fuel Cycle Requirements (d)				
Equiv Net MTU as UF_6	10.0%	10.0%	10.0%	10.0%
Equiv Net Million pounds of U_3O_8	10.0%	10.0%	10.0%	10.0%
Equiv Net Million SWU	2.3%	2.9%	2.5%	2.6%

(a) Table 3.1
(b) U3O8 values are calculated by multiplying the MTU of U value by a conversion factor of 0.00261285, then rounded.
(c) Table 3.2.
(d) ERI "2010 Nuclear Fuel Cycle Supply and Price Report", May 2010, as summarized in Table 2.1 of this report.
(e) Totals may not add due to rounding.

Table 3.3 Summary of All Expected DOE Transfers Under Consideration During the 2011 – 2013 Period

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

Table 4.1 shows the equivalent average annual quantities that might be transferred by DOE in a single year during the entire period 2011 through 2013, which would include the natural uranium transferred to the DOE contractor(s), as described in Section 3.3. These quantities include the equivalent materials and services that would result from projected DOE/NNSA transfers of down blended HEU during this period.

	Uranium Concentrates	Conversion Services	Uranium Hexafluoride	Enrichment Services
Units	Million Pounds U3O8 or Dollars per Pound U3O8 or Percent	Million kgU as UF6 or Dollars per kgU as UF6 or Percent	Million kgU as UF6 or Dollars per kgU as UF6 or Percent	Million SWU or Dollars per SWU or Percent
Average Annual Quantity of DOE Inventory to be Transferred During 2011 - 2013 (a)	5.2	2.0	2.0	0.4
Potential Impact on Term Market Price	$-1.24 / pound U3O8	$-0.20 / kgU as UF6	$-3.44 / kgU as UF6	$-1.62 / SWU
Long-Term Market Price (b)	65.00	15.00	185.00	158.00
Spot Market Price (b)	60.25	12.50	170.00	155.00
Potential Impact relative to Long-Term Market Price	-1.9%	-1.3%	-1.9%	-1.0%
Potential Impact relative to Spot Market Price	-2.1%	-1.6%	-2.0%	-1.0%
(a) Table 3.3; rounded values. (b) Table 2.2; sourced to TradeTech.				

Table 4.1 Potential Effect on Market Clearing Prices of DOE Material Projected to be Transferred During the 2011 – 2013 Period, Including Natural Uranium to be Transferred to the DOE Contractor(s)

The application of ERI’s economic market clearing price analysis to these average annual equivalent quantities over this three year period leads to the following estimates of potential price effect, which is also summarized in Table 4.1:

- the potential effect of DOE's transfer of the equivalent of 5.2 million pounds of U_3O_8 in a single year is a $1.24 per pound reduction in market clearing price;
- the potential effect of DOE's transfer of the equivalent of 2.0 million kgU as UF_6 in conversion services in a single year is a $0.20 per kgU reduction in market clearing price;
- the potential effect of DOE's transfer of the equivalent of 2.0 million kgU as UF_6 in natural uranium in a single year is a $3.54 per kgU reduction in market clearing price; and
- the potential effect of DOE's transfer of the equivalent of 0.4 million SWU in enrichment services in a single year is a $1.62 per SWU reduction in market clearing price.

Also, it may be noted that approximately 79% of the potential price effect for uranium concentrates and conversion services is associated with the natural uranium that is expected to be transferred to the DOE contractor(s), with the balance of the effect due to the equivalent materials and services associated with transfer of the DOE/NNSA materials. However, the entire effect of the equivalent enrichment services is due to the DOE/NNSA materials since only natural uranium, which has no enrichment component, is expected to be transferred to the DOE contractor(s).

These estimates of potential price impact do not reflect the fact that most of these equivalent DOE materials and services have already been anticipated by many market participants[16], as summarized in the previously published DOE 2008 Plan.

These estimates do not reflect the simultaneous effects that any other unanticipated events might have on the markets or market prices during the period of time that such inventories are being transferred into the market by DOE. Other unanticipated events may either accentuate or mitigate any potential effect of the DOE transfers. For example, as discussed in Section 2.6, during the past 12 months there have been five 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 520,000 pounds U_3O_8 equivalent and 650,000 pounds U_3O_8 equivalent. During the individual months in which two of these transfers occurred, the spot market price for uranium declined by $0.75 and $1.75 per pound, which is less than the average month-to-month change in spot market price that occurred during the past 12 months. During the other three months 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 then 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.

Table 4.1 also provides some perspective for each of these potential effects on price by comparison to the current market price indicators.

As shown in this table, the estimated $1.24 per pound potential reduction in the market clearing price of uranium is equivalent to 1.9% of the term price and 2.1% of the spot market price.

The estimated $0.20 per kgU potential reduction in the market clearing price of conversion services is equivalent to 1.3% of the term price and 1.6% of the spot market price.

The estimated $3.54 per kgU potential reduction in the market clearing price of natural UF_6 is equivalent to 1.9% of the term price and 2.1% of the spot market price.

The estimated $1.62 per SWU potential reduction in the market clearing price of enrichment services is equivalent to 1.0% of the term price and 1.0% of the spot market price.

On the basis of these comparisons to current market price indicators, the potential impact on price appears to be quite minimal.

[16] TVA first loaded fuel assemblies using down blended NNSA material in 2005.

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

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 five months during the past year in which DOE material was sold by a DOE contractor into the spot market the spot market price 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 November 2010 and has an R^2 = 90.5%, which is very 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

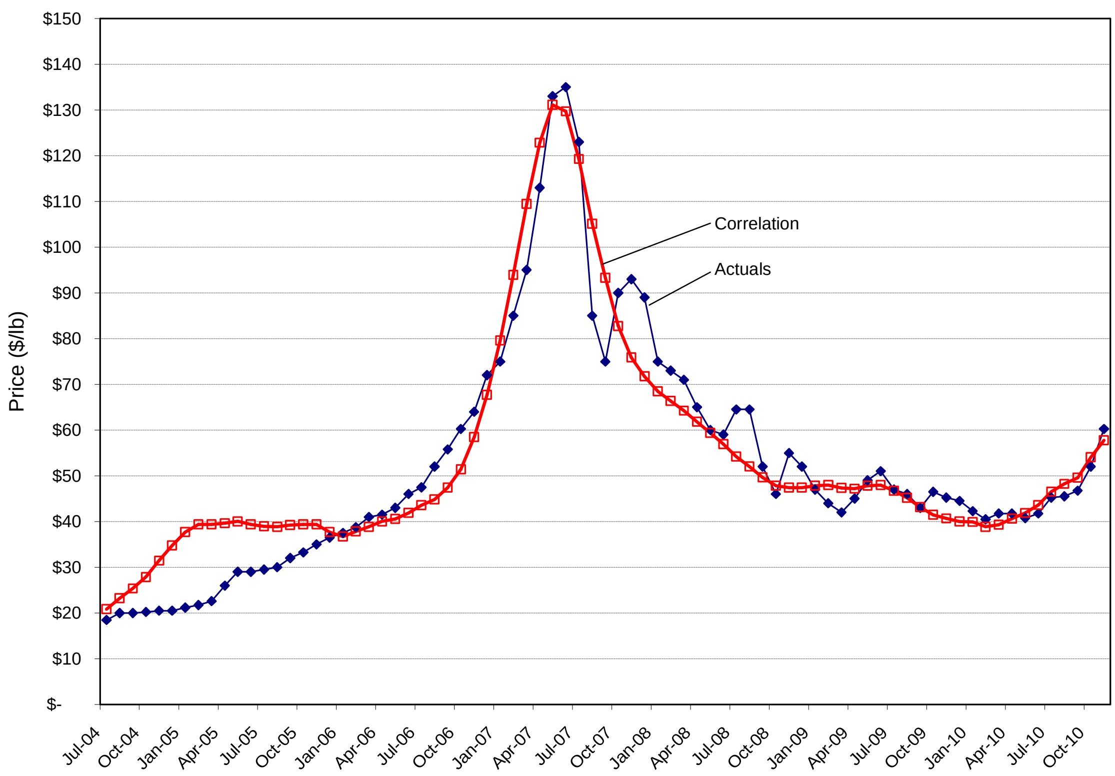

Figure 4.1 Spot Market Prices for Uranium – Actual versus Correlation

This correlation was then used to simulate the 2011 through 2013 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 two years, with and without the DOE transfers that are presently under consideration. The annual DOE total transfers shown in Table 3.3 for 2011, 2012 and 2013 – less the expected transfers to TVA that are identified in Section 3.1 as being part of a long-term contract and which account for 9.7% of the total 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. For example, in 2011 it is assumed from Table 3.3 that 1,945 MTU as UF_6, less the 138 MTU of material to be transferred to TVA, is distributed equally among the four calendar quarters (i.e., 451.75 MTU per quarter); and this quarterly amount is then assumed to be sold into the spot market in a single month.

The results of applying this correlation are projections of potential spot market price decreases of $2.96 per pound U_3O_8 in 2011, $5.02 in 2012 and $5.37 in 2013, for a three year average of $4.45 per pound due to the DOE transfers. This represents a potential impact on spot market price during this period in the range of 4.9% to 8.9%, with an average of 7.4%, relative to the November 30, 2010 spot market price of $60.25 per pound U_3O_8. It 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.

For instance, as previously noted, during 2009 and 2010, in three of the five 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 4.2 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 12 months[17], 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

[17] A review of month-to-month volatility in market price indicators published by TradeTech over the past 3, 5 and 10 year periods shows that spot and term price volatility during those periods had been higher for uranium concentrates; lower for conversion; and slightly lower for enrichment, as compared to the past 12 months.

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.

	Average of Absolute Values of Month to Month Change in Published Market Price Over Past 12 Month Period		Absolute Value of Largest Change in Monthly Market Price Over Past 12 Month Period (c)		Potential Impact on Market Clearing Price and Spot Market Price of U3O8 of All DOE Transfers Including Those to the DOE Contractor(s)	
	Average Monthly Change, Dollar Basis	Average Monthly Change, Percent Basis	Dollar Basis	Percent Basis, Relative to Price in the Month Prior to Change	Dollar Basis (d)	Percent Basis
Uranium Concentrates, $ per pound U3O8						
Spot Market Price (a)	2.21	4.6%	$8.25	15.9%	-$4.45	-7.4%
Term Market Price	0.42	0.7%	$3.00	4.8%	-$1.24	-1.9%
Conversion Services, $ per kgU as UF6						
Spot Market Price	0.75	9.0%	$3.50	50.0%	-0.20	-1.6%
Term Market Price	0.33	2.6%	$2.00	15.4%		-1.3%
Natural Uranium, $ per kgU as UF6						
Spot Market Price	6.58	5.0%	$21.00	14.1%	-3.44	-2.0%
Term Market Price	1.42	0.8%	$9.80	5.6%		-1.9%
Enrichment Services, $ per SWU						
Spot Market Price	1.17	0.7%	$5.00	3.2%	-1.62	-1.0%
Term Market Price	0.58	0.4%	$3.00	1.8%		-1.0%

(a) Potential impact is based on use of ERI correlation with actual spot market prices.
(b) Other potential impacts and comparisons are based on use of ERI market clearing price.
(c) Table 2.3.
(d) Table 4.1 for potential impact on Market Clearing Prices.

Table 4.2 Comparison of Potential Effect on Market Prices of the DOE Material Transfer Relative to Monthly Market Price Volatility Data

As shown in Table 4.2, the potential impact on the spot market price for uranium concentrates is less than the maximum month-to-month change experienced during the past year – potential impact of $4.45 per pound (7.4% of price) versus maximum month-to-month change of $8.25 per pound (15.9% of price); and equivalent to about two months of average month-to-month change in spot market price. The potential impact on the term price for uranium concentrates is approximately 41% of the maximum month-to-month change experience during the past year; and equivalent to about three times the average month-to-month change in term price.

The potential impact when compared to the spot market price for conversion services is less than 6% of the maximum month-to-month change experienced during the past year; and equivalent to 27% of the average month-to-month change in spot market price. The potential impact when compared to the term price for conversion services is approximately 10% of the maximum month-to-month change experience during the past year; and equivalent to 61% of the average month-to-month change in term price.

The potential impact when compared to the spot market price for enrichment services is less than 37% of the maximum month-to-month change experienced during the past year;

and equivalent to 1.6 times the average month-to-month change in spot market price. The potential impact when compared to the term price for enrichment services is approximately 61% of the maximum month-to-month change experience during the past year; and equivalent to about three times the average month-to-month change in term price.

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

4.3 Potential Effect 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 Effect on the Domestic Uranium Concentrates Industry

The majority of domestic uranium production has already been committed through commercial sales for 2011, together with some amount of additional forward sales that would be expected to extend through at least 2013. DOE transfers would not displace these already committed sales by the domestic industry. In addition, based on ERI's analysis, the presently operating domestic producers are not among the highest cost producers of uranium 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.

Cameco, owner of the majority of operating U.S. uranium mines, estimates the price sensitivity of its current contract portfolio for sales of uranium relative to change in future spot market price.[18] Cameco's most recent estimate indicates that the projected change in realized price is 40% to 50% of the change in spot market price during 2011 to 2013. For example, if the spot market price were to drop by $4.45 per pound, then this means that Cameco's realized price would drop by between $1.78 and $2.23 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 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

[18] Cameco, *2009 Annual Report.*

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 Effect on the Domestic Conversion Services Industry

Virtually all domestic production capacity for conversion services through 2013 is understood to have already been committed under contracts, together with some amount of additional forward sales. DOE transfers would not displace these 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. 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.

4.3.3 Potential Effect 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, and USEC is believed to have committed at least 90% of its expected enrichment capacity through 2013. DOE transfers would not displace these already committed sales by the domestic industry. 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.

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

5.1 Potential Market Implications

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 next several years beginning in the first quarter of 2011; 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.

5.2 Nature of Industry Concern

The nuclear fuel markets recognize that DOE controls a very large amount of material and 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. If based upon DOE actions, the perception of domestic suppliers of uranium concentrates, for example, was that DOE might begin to transfer into the market quantities of uranium that are significantly larger than those quantities that DOE had previously indicated to the industry it may transfer (e.g., DOE 2008 Plan), then the potential adverse impact on uranium exploration and development could become significant for the domestic industry. 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.

The transfer by DOE of material during any year in an amount that is substantially larger than 10% of U.S. annual requirements is likely to be viewed by the industry as DOE establishing a precedent by which it may make future transfers without any regard for the "*maintenance of a strong domestic nuclear industry*."

If the industry believes that such a precedent is being established, then ERI expects that domestic suppliers within each of these markets may become concerned that (i) previously proposed schedules of transfers would be accelerated at some time in the future, resulting in a larger amount of DOE inventory being introduced into the market each year and/or (ii) additional U.S. inventory that has not yet been identified as surplus would be added to the transfer schedule. Either of these could result in a larger amount of equivalent nuclear fuel materials and services being introduced into the market, which, if of sufficient magnitude, could potentially have a material adverse effect on the markets.

It is the perceived uncertainty regarding DOE's potential future involvement in the commercial markets that ERI expects may have the greatest potential impact on the markets. 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. This adverse impact would be due to a perception of risk among suppliers and possibly external funding sources regarding the availability of as yet unknown amounts of excess materials and services that would lead to depressed prices, which would not support expenditures related to expansion of the present supply infrastructure.

Notwithstanding the above, it also should be recognized that there are (i) differences among each of the markets with regard to the relationship that exist between supply and requirements; (ii) differences among the various suppliers and purchasers in each of these markets with regard to existing inventories, production centers and facilities in operation; (iii) differences among the various commercial contracts with regard to their specific pricing mechanisms and duration; and (iv) differences in investments that either have been made or are being anticipated in the near future by any of these companies. These differences may result in different reactions among the various market participants to DOE announcements regarding transfers of its material.

GLOSSARY

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.

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.