EMD Uranium (Nuclear Minerals) Committee

2012 EMD Uranium (Nuclear Minerals and REE) Mid-Year Committee Report

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Founding Member of EMD in 1977, and Past President: 2010-2011

November 15, 2012

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- **Robert Odell, P.G., (Vice-Chair: Industry),** Consultant, Casper, WY
- **Steven S. Sibray, C.P.G., (Vice-Chair: University),** University of Nebraska, Lincoln, NE
- **Robert W. Gregory, P.G., (Vice-Chair: Government),** Wyoming State Geological Survey, Laramie, WY

Advisory Group:

- **Henry M. Wise, P.G.,** Eagle-SWS, La Porte, TX
- **Bruce Handley, P.G.,** Environmental & Mining Consultant, Houston, TX
- **James Conca, Ph.D., P.G.,** Director, Carlsbad Research Center, New Mexico State U., Carlsbad, NM
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- **Karl S. Osvald, P.G.,** Senior Geologist, U.S. BLM, Casper WY
- **Jerry Spetseris, P.G.,** Consultant, Austin, TX

Special Consultants to the Uranium (Nuclear Minerals) Committee:

- **Ruffin I. Rackley**, Senior Geological Consultant, Anacortes, WA (Founding Member of EMD in 1977, Secretary-Treasurer: 1977-1979, and Past President: 1982-1983)
- **Bruce Rubin**, Senior Geological Consultant, Richfield Springs, NY (Founding Member of EMD in 1977)
- **William H. Tonking, Ph.D.**, Senior Mining Consultant, Houston, TX
- **M. David Campbell, P.G.**, Senior Geologist, I2M Associates, LLC, San Diego, CA
- **Robert A. Arrington**, VP, Exploration, Texas Eastern Nuclear, Inc (retired), College Station, TX (Founding Member of EMD in 1977)
- **Jeffrey D. King, P.G.**, President, I2M Associates, LLC, Seattle, WA
- **Jay H. Lehr, Ph. D.,** Science Director, Heartland Institute, Chicago (on Nuclear Power)

Committee Activities

During the past 6 months, the Uranium Committee (UCOM) continued to monitor the expansion of the nuclear power industry and associated uranium exploration and development in the U.S. and overseas. A UCOM teleconference with members of the Committee was held on September 5, 2012 to discuss the possible content of the Mid-Year Report for 2012. Input has once again been provided by Vice-Chairs: Robert Odell, covering industry activities, Steve Sibray, covering university activities, and Robert Gregory, covering government activities, with particular input by members Henry Wise and Bruce Handley, as well as from ideas and suggestions provided by other

members of the UCOM and associated Advisory Group and from the Special Consultants to the UCOM.

This 2012 Mid-Year Report of the Uranium Committee provides information on the current status of the uranium industry in context with the activities of the nuclear power industry and associated activities in exploration and associated environmental issues via input provided by the Committee's Vice Chair, Industry, Robert Odell, on industry activity based from his *Rocky Mountain Scout*, a popular source of information on the uranium industry's exploration activities in the U.S. and Canada.

Thorium activities are also summarized. Finally, the Committee continues to report on rare-earth activities that also involve co-produced thorium, an activity approved by the UCOM in 2011. We cover rare-earth exploration and mining, and associated geopolitical activities.

The EMD Uranium (Nuclear Minerals) Committee is also pleased to announce the Jay M. McMurray Memorial Grant which is awarded annually to a deserving student whose research involves uranium or nuclear fuel energy. This grant is made available through the AAPG Grants-In-Aid Program, and is endowed by the AAPG Foundation with contributions from his wife, Katherine McMurray, and several colleagues and friends. Those students having an interest in applying for the grant should contact the UCOM Chairman for further information and guidance. The biography of Mr. McMurray's outstanding contribution to the uranium industry in the U.S. and overseas is presented here. He passed away in 2008 and only one grant has been made to date to Chiara Mazzoni of the University of Strathclyde, Glasgow, UK.

Committee Publications

Regarding EMD publications, the bi-annual EMD update for the *Journal Natural Resources Research* under the leadership of Peter Warrick has been posted as "2011" at the bottom-right column of the EMD Home page (http://emd.aapg.org/index.cfm).

The Uranium Committee's contribution to the ***AAPG Memoir 101: The History and Path Forward of the Human Species into the Future: Energy Minerals in the Solar System,*** *as* the final Chapter 9: *Nuclear Power and Associated Environmental Issues in the Transition of Exploration and Mining on Earth to the Development of Off-World Natural Resources in the 21st Century* is now in press and will likely be released during the first or second quarter of 2013. For the preliminary press release, see (here).

Executive Summary of Industry, Government, and University Activities

New nuclear power-plant construction applications have begun to increase and the country is returning to full confidence in nuclear power as the Fukushima incident is placed in perspective, and after extensive reevaluations of the many plant's safety features have been completed. This will serve to strengthen the safety of such plants even beyond that demonstrated over the past 30 years in the U.S.; nuclear power production is forecast to remain steady at about 18-20% of the electricity generation mix of coal, natural gas, and nuclear power, with renewables passing 10% this year and projected by EIA (2012) to rise to a high of 16 % by 2035. However, we conclude that the current experiments in renewables are driven more by government expectations than by the realities of likely future use on any large scale.

Rural areas would be the primary market areas for wind and solar installations. The realities will include the impact of operation and maintenance costs of wind and solar on their economic viability and on the delivered cost of electricity to the consumer, which would be at a premium especially in the rural areas of the U.S. Further, we conclude that coal used in the generation of electricity will steadily decrease over the next two decades, primarily because of concerns for the environment and for the actual cost of so-called “clean” coal.

The Nuclear Energy Institute (NEI) provides regular updates regarding the current mix of energy resources consumed in the U.S. Even California continues to support nuclear-power development. We also conclude that coal will continue to be useful to drive the expansion of the new carbon-based industry that will replace wood-based and plastic-based products such as furniture, utility poles, home-construction materials, and a host of other products, including carbon products to be used in off-world exploration and human habitation).

Natural gas and nuclear power will continue to compete for the electricity generation market, and the need for nuclear fuel in the form of yellowcake will rise for decades to come and hence uranium exploration will continue on Earth and off-world until fusion becomes the principal source of power perhaps at least by the end of the 21st Century,

Exploration within the U.S. is continuing in the historical areas of production, i.e., Utah, New Mexico, Texas, Wyoming, Nebraska, North and South Dakota, and in a few new areas. The development of the Virginia deposit is still in question, although clearly of economic benefit to the surrounding communities. These activities involve drilling and development in anticipation of the up-swing in the yellowcake (U_3O_8) price, which has been recently depressed by a short-term lack of buying pressure from China, India and the lack of operational needs in the U.S. and overseas.
Yellowcake prices are still languishing in the low US$40s, but the future remains favorable for major increases in the price as new plans re-surface to expand plant construction, especially in the SE Asia and China, and as the Russian weapons-to-fuel program ends sometime in 2013. India, Africa and South America have continued to emerge as serious exploration targets with numerous projects offering considerable merit in terms of size, grade, and mineability, while Canada and Australia continue in their attempts to bring new deposits into production.

The U.S. production of uranium in the third quarter 2012 was 1,048,018 pounds U_3O_8, down 1 percent from the previous quarter and up 24 percent from the third quarter 2011. During the third quarter 2012, U.S. uranium was produced at six U.S. uranium facilities. As of September 2012, U.S. uranium concentrate production totaled 3,187,711 pounds. This amount is 3 percent higher than the 3,098,754 pounds produced during the first nine months of 2011.
U.S. uranium exploration drilling in 2011 increased 20 percent compared with 2010. U.S. uranium mines produced 3 percent less than in 2010, from 10 mines (underground and in-situ-leach) and one other source. Additionally, five ISL mining operations produced solutions containing uranium in 2011 that was processed into uranium concentrate at ISL plants.

Total production of U.S. uranium concentrate in 2011 was 4.0 million pounds U_3O_8, 6 percent less than in 2010, from six facilities. Total shipments of uranium concentrate from U.S. mill and ISL plants were 4.0 million pounds U_3O_8 in 2011, 22 percent less than in 2010. U.S. producer's sold 2.9 million pounds U_3O_8 of uranium concentrate in 2011 at a weighted-average price of $52.36 per pound U_3O_8.

Total employment in the U.S. uranium production industry was 1,191 person-years in 2011, an increase of 11 percent from the 2010 total. Exploration employment increased the most from 2010 (24 percent). Uranium mining employment increased 16 percent, while reclamation employment decreased 18 percent from 2010 to 2011. Five States (Colorado, Nebraska, New Mexico, Texas, and Wyoming) accounted for 74 percent of total employment in the uranium production industry in 14 States: Arizona, Colorado, Nebraska, New Mexico, Nevada, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Virginia, Washington, and Wyoming.

Total expenditures for land, exploration, drilling, production, and reclamation were 15 percent more than in 2010. Expenditures for U.S. uranium production, including facility expenses, were the largest category of expenditures in 2011 and were up by 27 percent from the 2010 level. Uranium exploration expenditures increased 26 percent from 2010 to 2011. Expenditures for land decreased by 3-percent decrease compared with 2010. Reclamation expenditures decreased 25-percent compared with 2010.

At the end of 2008, U.S. uranium reserves totaled 1.227 billion pounds of U3O8 at a maximum forward cost (MFC) of up to $100 per pound U_3O_8. Wyoming led the Nation in total known uranium reserves, in both the $50 and $100 per

pound U_3O_8 categories, with New Mexico second. Taken together, these two States constituted about two-thirds of the estimated reserves in the country available at up to $100 per pound U_3O_8, and three-quarters of the currently known reserves available at less than $50 per pound U_3O_8.

Kazakhstan has 15% of the world's uranium resources and is an expanding mining sector, producing some 19,450 tonnes U in 2011, and planning for further increase to 2018. In 2009 it became the world's leading uranium producer, with almost 28% of world production, then 33% in 2010 and about 35% in 2011. Kazakhstan operated a single nuclear power reactor from 1972 to 1999, generating electricity and for desalination. The country has a major plant fabricating nuclear fuel pellets and reportedly aims eventually to sell value-added fuel rather than just yellowcake to world markets. It aims to supply 30% of the world fuel-fabrication market by 2015.

Exploration and mine development is proceeding in Africa in countries which have not hitherto supplied uranium. Gabon, South Africa, Namibia, and Niger, have been significant uranium suppliers in the past. A large amount of uranium occurs within rare-earths deposits, and may be extracted as a by-product, especially in China and other countries. As uranium prices rise and as geopolitical developments evolve, these factors will serve to enhance the economic potential for recovering both rare-earth elements and uranium. Russian activities in the world on uranium exploration and nuclear power plant expansion programs. That government is also cooperating with Japan, China, France, India, South Korea, Canada, and the U.S. on a variety of exploration and development projects within Russia and around the world.

In total, about 64 percent of the world's production of uranium from mines is from Kazakhstan, Canada and Australia. An increasing proportion of uranium, now 45%, is produced by in situ leaching. After a decade of falling mine production to 1993, output of uranium has generally risen since then and now meets 85% of world demand for power generation. Kazakhstan produces the largest share of uranium from mines (36% of world supply from mines), followed by Canada (17%) and Australia (11%).

The U.S. Environmental Protection Agency (EPA), in spite of industry input to the contrary, continues to claim that fluid-retention ponds at in-situ uranium recovery facilities will be regulated under 40 CFR Part 61 Subpart W. The NRC has decided to revise some existing Regulatory Guides and NUREGS as well as write new ones. The Commission has contracted with the *Southwest Research Institute* to prepare a NUREG entitled: *Standard Review Plan for Conventional Mill and Heap Leach Uranium Extraction License Applications*. They are seeking input and data from industry. The General Accounting Office (GAO) released report entitled: *Uranium Mining - Opportunities Exist to Improve Oversight of Financial Assurances,* on May 17, 2012.

Uranium-related research activities at the major universities in the United States were limited in funding in 2012. Funding sources were primarily from private sources, usually uranium-mining companies. The *Society of Economic Geologists* [SEG] provided two student grants related to uranium ore deposits.

Funding for the Three Crows study was provided by Cameco while the Lost Creek study was funded by UR Energy and the U.S. Geological Survey. The University of Wyoming's Department of Geology and Geophysics and the Wyoming State Geological Survey (WSGS) are active in research on uranium in Wyoming. Currently, as in the past, the U.S. Geological Survey is leading the way in the U.S. on uranium research and on associated environmental investigations.

In contrast to the limited scope of uranium research in the United States, there is a great deal of research being conducted in the Athabasca region of Canada. The following information on research being conducted in that region was found on the website of the province of Saskatchewan.

The use of thorium-based fuel cycles has been studied for about 40 years, but on a much smaller scale than uranium or uranium/plutonium cycles. Basic research and development has been conducted in Germany, India, Japan, Russia, the UK and the USA. Both China and India have been among the primary catalysts in research efforts to use it. Test-reactor irradiation of thorium fuel to produce high burn-ups has also been conducted and several test reactors have either been partially or completely loaded with thorium-based fuel.

The general consensus is that due to increased demand of carbon-free energy, accelerated growth of global nuclear power is likely to continue in the future, which has in turn made the sustainable use of fuel resources such as uranium

and thorium important. Uranium is the main-stay of the present generation of nuclear power plants; with the anticipated steep growth in nuclear energy it may be necessary to introduce thorium also as a fuel.

Thorium-fuel cycle offers several potential advantages over a uranium fuel cycle, including greater abundance and availability, superior physical and nuclear properties of fuel, enhanced proliferation resistance, and reduced plutonium and actinide production. Technically, thorium has been well established and it behaves well in Light Water Reactors, High-Temperature Reactors and Liquid-Fluoride Thorium Reactors. Recognizing the potential contribution of thorium-fuel cycle in nuclear energy, renewed R&D efforts are underway in many developed countries around the world, both for small-scale and large-scale reactors.

Most companies in the rare earth elements (REE) sector are trading at or near 12-month lows with, on average, prices for REEs continuing to decline since the mid-year 2011 highs. The slide is expected to continue bearing in mind price differences among the various 16 metals. As of the end of 3rd Quarter, 2012, the medium-term outlook for REEs was not upbeat. Many miners, especially juniors, as well as investors, including those specialized in REEs, are reassessing development, funding and exit strategies in light of current market conditions.

A shakeout is imminent in the REEs industry. Of the over 250 publically listed REE companies, it is likely that more than 75 percent will shut down, be mothballed or merge within the next 24 months, especially in the light rare-earth elements (LREE) sector. The shakeout in the market will intensify as investors increasingly differentiate not only between LREE and Heavy REE (HREE), but they also will identify specific market trends and supply/demand gaps for the more sought-after metals, such as neodymium, europium, terbium, dysprosium and yttrium.

The U.S. Department of Defense (DOD) has made a bold move to support a North American rare-earth project, and this has made waves in the market. U.S. Department of Defense (DOD) recently took the unusual step of contracting with Ucore Rare Metals Inc. to conduct a mineralogical and metallurgical study on the company's Bokan Mountain heavy rare-earth element (HREE) property in southern Alaska. The State of Alaska has also begun a study of REE resources in the state.

Nuclear Power Industry Activities

New nuclear power-plant construction applications have begun to increase and the country is returning to full confidence in nuclear power as the Fukushima incident is placed in perspective (here), and after extensive reevaluations of the many plant's safety features have been completed (see more). This will serve to strengthen the safety of such plants even beyond that demonstrated over the past 30 years in the U.S.; for additional information on the status of the nuclear industry, see (more).

U.S. EIA (2012) reports that outages at U.S. nuclear power plants so far in 2012 are generally higher than in recent years because of extended forced outages at four nuclear power plants. U.S. nuclear reactor operators typically schedule refueling and maintenance outages during the spring and fall to help ensure that reactors are available to meet higher electric demand levels in the summer and winter. The increase in outages at the end of October came as some nuclear power reactors along the East Coast shut down because of precautionary concerns for Hurricane Sandy.

Nuclear power production is forecast to remain steady at about 18-20% of the electricity generation mix of coal, natural gas, and nuclear power, with renewables passing 10% this year and projected by EIA (2012) to rise to a high of 16 % by 2035. However, we forecast that the current experiments in renewables are driven more by government expectations than by the realities of likely future use on any large scale. Rural areas would be the primary market areas for wind and solar installations. The realities will include the impact of operation and maintenance costs of wind

and solar on their economic viability and on the delivered cost of electricity to the consumer, which would be at a premium especially in the rural areas of the U.S. Further, we project that coal used in the generation of electricity will steadily decrease over the next two decades, primarily because of concerns for the environment and for the actual cost of so-called "clean" coal. The Nuclear Energy Institute (NEI) provides regular updates (here) regarding the current mix of energy resources consumed in the U.S.. Even California continues to support nuclear-power development (more).

We also predict that coal will continue to be useful to drive the expansion of the new carbon-based industry that will replace wood-based and plastic-based products such as furniture, utility poles, home-construction materials, and a host of other products, including carbon products to be used in off-world exploration and human habitation, (for example, see here and more).

Natural gas and nuclear will continue to compete for the electricity generation market, and the need for nuclear fuel in the form of yellowcake will rise for decades to come and hence uranium exploration will continue on Earth and off-world until fusion becomes the principal source of power perhaps at least by the end of the 21st Century, (see AAPG-EMD Memoir 101 (here)).

Uranium Exploration Activities

Exploration within the U.S. is continuing in the historical areas of production, i.e., Utah, New Mexico, Texas, Wyoming, Nebraska, North and South Dakota, and in a few new areas. The development of the Virginia deposit is still in question (more), although clearly of economic benefit to the surrounding communities. These activities involve drilling and development in anticipation of the up-swing in the yellowcake price, which has been recently depressed by a short-term lack of buying pressure from China, India and the lack of operational needs in the U.S. and overseas. Yellowcake prices are still languishing in the low US$40s (here), but the future remains favorable for major increases in the price as new plans re-surface to expand plant construction, especially in the SE Asia and China, and as the Russian weapons-to-fuel program ends in sometime in 2013. For additional information, see (more).

India, Africa and South America have continued to emerge as serious exploration targets with numerous projects offering considerable merit in terms of size, grade, and mineability, while Canada and Australia continue in their attempts to bring new deposits into production. Canada's resources are very large, and increasing, and some are so deep and high in grade that they will likely be mined via robotic miners to minimize radiation exposure to humans (more).

Australia too is still expanding its search for and development of new deposits. Validakis (2012) reported that on October 22, 2012, the new Queensland Government revoked a 23-year ban on uranium mining. On the federal level, Australian Prime Minister Julia Gillard supports uranium sales to India, preparing for uranium mining currently valued at US$18.7 billion.

Known deposits in South Australia are having trouble developing into full-scale mining operations because of the complex, multi-metal processing issues that impact economic viability. New shallow deposits have recently been discovered and are under investigation. Western Australia's calcrete-associated deposits are also struggling to bring this type of deposit into production, but most of the companies involved are confident that these will come on-line as the price of

yellowcake begins to increase from the current US$40.00 range to beyond the US$60.00/pound mark (for more). See **FOREIGN NEWS**, page 11 this report for additional information.

STATUS OF U.S. URANIUM INDUSTRY

3RD QUARTER 2012 STATISTICS

U.S. EIA (2012) reported on 3rd Quarter data on October 26, 2012. The next report will be made in February, 2013. The U.S. production of uranium in the third quarter 2012 was 1,048,018 pounds U_3O_8, down 1 percent from the previous quarter and up 24 percent from the third quarter 2011. During the third quarter 2012, U.S. uranium was produced at six U.S. uranium facilities.

U.S. URANIUM MILL IN PRODUCTION

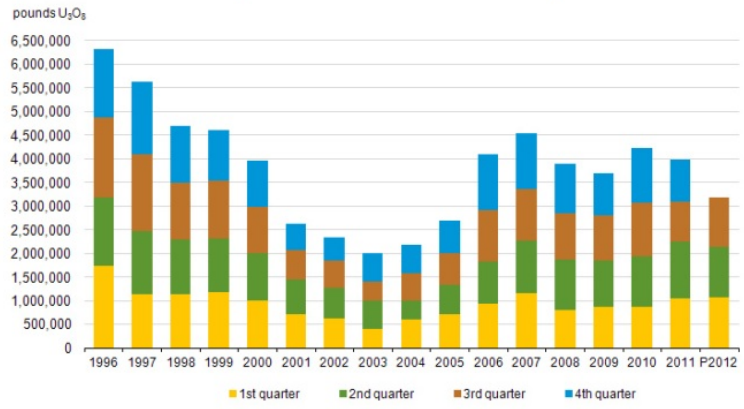
1. White Mesa Mill (Utah)

U.S. URANIUM IN-SITU-LEACH PLANTS IN PRODUCTION

1. Alta Mesa Project (Texas)
2. Crow Butte Operation (Nebraska)
3. Hobson ISR Plant/La Palangana (Texas)
4. Smith Ranch-Highland Operation (Wyoming)
5. Willow Creek Project (Wyoming)

As of September 2012, U.S. uranium concentrate production totaled 3,187,711 pounds. This amount is 3 percent higher than the 3,098,754 pounds produced during the first nine months of 2011 (see Figure 1 for historical production).

Figure 1. Uranium concentrate production in the United States, 1996 - 3rd quarter 2012



P = Preliminary data.
Source: U.S. Energy Information Administration: Form EIA-851A and Form EIA-851Q, "Domestic Uranium Production Report."

Click to Expand

Drilling Statistics in Uranium Exploration

U.S. EIA (2012) reports that U.S. uranium exploration drilling in 2011 was 5,441 holes covering 3.3 million feet. Development drilling was 5,156 holes and 3.0 million feet. Combined, total uranium drilling was 10,597 holes covering 6.3 million feet, 47 percent more holes than in 2010. Expenditures for uranium drilling in the United States were $54 million in 2011, an increase of 20 percent compared with 2010. For historical activity, see (here). For current drilling activity, see the Uranium Industry Vice-Chair Report later in this presentation beginning on Page 7.

Mining, Production, Shipments, and Yellowcake Sales Statistics

EIA has added new information in Table 4 and Table 5 that now include County and State location of existing and planned mills and in-situ-leach (ISL) plants.

EIA (2012) produced their final report on 2011 production in May, 2012, which is summarized here for the first time. The EIA report for 2012 activities will be available in early 2013.

U.S. uranium mines produced 4.1 million pounds U_3O_8 in 2011, 3 percent less than in 2010, from 10 mines (underground and in-situ-leach) and one other source. Five underground mines produced ore containing uranium during 2011, one more than during 2010. Uranium ore is stockpiled and shipped to a mill, to be milled into uranium concentrate (a yellow or brown powder). Additionally, five ISL mining operations produced solutions containing uranium in 2011 that was processed into uranium concentrate at ISL plants.

Total production of U.S. uranium concentrate in 2011 was 4.0 million pounds U_3O_8, 6 percent less than in 2010, from six facilities: one mill in Utah (White Mesa Mill) and five ISL plants (Alta Mesa Project, Crow Butte Operation, Hobson ISR Plant/La Palangana, Smith Ranch-Highland Operation, and Willow Creek Project). Nebraska, Texas and Wyoming produced uranium concentrate at the five ISL plants in 2011.

Total shipments of uranium concentrate from U.S. mill and ISL plants were 4.0 million pounds U_3O_8 in 2011, 22 percent less than in 2010. U.S. producer's sold 2.9 million pounds U_3O_8 of uranium concentrate in 2011 at a weighted-average price of $52.36 per pound U_3O_8.

An indication that the nuclear industry is anticipating price increases for yellowcake is presented in the marketing report for 2011, which was just released in May, 2012 (see here).

Facility Status (Mills and In-Situ-Leach Plants)

EIA (2012) indicated that at the end of 2011, the White Mesa mill in Utah was operating with a capacity of 2,000 short tons of ore per day. Shootaring Canyon Uranium Mill in Utah and Sweetwater Uranium Project in Wyoming were on standby with a total capacity of 3,750 short tons of ore per day. There is one mill (Piñon Ridge Mill) planned for Colorado.

At the end of 2011, five U.S. uranium ISL plants were operating with a combined capacity of 10.8 million pounds U_3O_8 per year (Crow Butte Operation in Nebraska; Alta Mesa Project, Hobson ISR

Plant/La Palangana in Texas; Smith Ranch-Highland Operation and Willow Creek Project in Wyoming). Kingsville Dome and Rosita ISL plants in Texas were on standby with a total capacity of 2.0 million pounds U_3O_8 per year. Nichols Ranch ISR Project was under construction in Wyoming. There are nine ISL plants planned in Colorado, New Mexico, South Dakota, Texas, and Wyoming.

Employment in the Uranium Industry

Total employment in the U.S. uranium production industry was 1,191 person-years in 2011, an increase of 11 percent from the 2010 total. Exploration employment was 208 person-years, about the same as in 2010. Milling and processing employment was 419 person-years in 2011, and increased the most from 2010 (24 percent). Uranium mining employment was 462 person-years and increased 16 percent, while reclamation employment decreased 18 percent to 102 person-years from 2010 to 2011. Five States (Colorado, Nebraska, New Mexico, Texas, and Wyoming) accounted for 74 percent of total employment in the uranium production industry in 14 States: Arizona, Colorado, Nebraska, New Mexico, Nevada, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Virginia, Washington, and Wyoming. See additional EIOA 2011 data on employment (here).

Expenditures in the Uranium Industry

Total expenditures for land, exploration, drilling, production, and reclamation were $319 million in 2011, 15 percent more than in 2010. Expenditures for U.S. uranium production, including facility expenses, were the largest category of expenditures at $169 million in 2011 and were up by 27 percent from the 2010 level. Uranium exploration expenditures were $44 million and increased 26 percent from 2010 to 2011. Expenditures for land were $20 million in 2011, a 3-percent decrease compared with 2010. Reclamation expenditures were $34 million, a 25-percent decrease compared with 2010. For EIA data on 2011 activities, see (here).

Uranium Reserves

EIA (2010) has updated its estimates of uranium reserves for year-end 2008. This represents the first revision of the estimates since 2004. The update is based on analysis of company annual reports, any additional information reported by companies at conferences and in news releases, personal contacts, and expert judgment. The next update is expected in 2012 but this has not been released to date.

At the end of 2008, U.S. uranium reserves totaled 1,227 million pounds of U_3O_8 at a maximum forward cost (MFC) of up to $100 per pound U_3O_8 (Table 1, see left margin for link to Table 1).

In 2008, Wyoming led the Nation in total uranium reserves, in both the $50 and $100 per pound U_3O_8 categories, with New Mexico second. Taken together, these two States constituted about two-thirds of the estimated reserves in the country available at up to $100 per pound U_3O_8, and three-quarters of the reserves available at less than $50 per pound U_3O_8.

By mining method, uranium reserves in underground mines constituted just under half of the available product at up to $100 per pound of U_3O_8 (Table 2). At up to $50 per pound U_3O_8, however, uranium available through in-situ leaching (ISL) was about 40 percent of total reserves, somewhat higher than uranium in underground mines in that cost category. ISL is the dominant mining method for U.S. production today. See Table 3 for more estimates from 1993 through 2003 and 2008.

Vice-Chair Reports:

I. Uranium-Related Industry Activity

By Robert Odell, P.G. (Vice-Chair: Industry), Consultant, Casper, Wy.

Excerpts from *The Rocky Mountain Scout,* June-July and October-November Issues, 2012

In the News

As of July, 2012:

- Australian news in *Nuclear Market Review*, (July, 2012) indicates BHP BILLITON may delay until 2014 expansion at Olympic Dam copper and uranium operations in South Australia, pending soft market conditions.

- CAMECO's KINTYRE Project (70% owner) in Western Australia may await US$67 a pound prices, delaying 2014 production plans, according to Tim Gitzel, CEO. MITSUBISHI DEVELOPMENT owns 30% (NMR/July).

- CANALASKA, in a Corporate Update of July 30th, indicated the firm has filed annual audited financial statements for this year ending April 30, 2012 and is marketing its exploration projects in Athabasca Basin. The firm continues to operate CREE EAST and WEST MC ARTHUR JV's for the Korean Consortium and for Mitsubishi. The firm will close its Saskatoon office in September, reducing staff but retaining core technical teams in Vancouver.

- ENERGY FUELS July 24th announced closing of a $22,000,000 "bought deal" debentures sale to cover acquisition of the U.S. mining division of DENISON MINES CORP, including the White Mesa uranium mill and certain producing mines in the western U.S.

- RED BOOK Biennial Report (2012), covering global uranium resources as of January 1, 2011 indicates in *Nuclear Market Review* "resources and production are increasing and security of uranium supply is ensured for the long term." *UX Weekly* noted Red Book worldwide exploration in 2010 totaled US$2 billion, Canada topping all countries in overall uranium exploration and development.

- STRATHMORE completed a Gas Hills, Wyoming drill program of 128 holes in June totaling 32,075 feet within the Main Gas Hills deposit. Following a four-rig exploration program there in July, three drills were to move south to the Beaver Rim area early August.

- PENINSULA ENERGY completed another 150 holes at LANCE, Wyoming at its planned Kendrick Production Unit located west of its Ross Production Unit. Another roll front (K5C) will be evaluated.

- POWERTECH Uranium Corporation in Crook County Wyoming earlier completed a National Instrument 43-101 compliant report for the Aladdin project, wherein Powertech disclosed 1,038,023 pounds averaging 0.111% U_3O_8. Also, 101,255 pounds were identified at the same cutoff averaging 0.119% U_3O_8.

- URANERZ' discovery at the Monument Project in Powder River Basin, Wyoming includes: 5.5 feet grading 0.365% U_3O_8, 14.0 feet grading 0.074% U_3O_8, 10.5 feet grading 0.108% U_3O_8, and 25 feet grading 0.159% U_3O_8. Drilling of a 120-hole campaign continues.

- U.S. Department of Energy will host safety and design analysis of the HOLTEC SMR-100 small modular reactor at the Savannah River National Laboratory.

- U3O8 Corp. and SULPHIDE Resource Processing Pty Ltd have submitted a patent application for a patent on a two-step metallurgical process which uses an initial ferric iron leach followed by an acid wash to extract uranium phosphate vanadium, rare earths, and other metals. This new process will save about 70% of the acid and ferric iron, per ton of processed ore, over a conventional acid leach system, reported by Uranium Exchange Weekly.

- Tom Cavanaugh, Senior Geologist ENERGY RESOURCES for AMEC Environment & Infrastructure, disputing impacts from uranium mining in Arizona, noted more overreach by the EPA and BLM agencies being influenced by some 300,000 PREPRINTED post cards objecting to uranium mining to decide one million acres of federal lands in Northern Arizona should be withdrawn from exploration and development. Cavanaugh questions the science involved.

- In Wyoming, BAYSWATER has discovered a new mineralized zone at Reno Creek, including 27 feet grading 0.06% U_3O_8. AUC plans an upgraded resource estimate for North Reno Creek and Southwest Reno Creek.

- UEC, (Uranium Energy Corp), July 30th, completed a third uranium sale with 150,000 pounds sold at $50.00 per pound. Total sales for the fiscal year ending July 31, 2012 totaled $13.75 million, for 270,000 pounds U_3O_8.

- UR-ENERGY USA, PATHFINDER MINES CORP reported in the July 27 NMR remaining resources of 10 million pounds in Shirley Basin remain at an average grade of 0.21% U_3O_8. The property originally produced 71 million pounds plus, 1960-1990. Gas

Hills resources at LUCKY MC hold another 4.7 million pounds, similar grade, estimated, also included in the acquisition. Shirley Basin facilities are still licensed by the USNRC to receive and dispose of by-product from other in-situ uranium mines. The purchase is expected to close within a year, with UrEnergy to complete reclamation work for COGEMA.

- UR ENERGY at LOST CREEK In Situ Project anticipates production to commence in 2013. Conservation group bringing litigation against BLM for approving LOST CREEK Project.

- In Canada, FISSION ENERGY is operating out of Kelona, BC with Roy McElroy. Scout information indicates two drills were operating in July on a RIO TINTO JV at Roughrider.

- CAMECO at CIGAR LAKE was reported by UXW, July 30th to expect first commissioning of ore mid-2013 and packaging of pounds fourth quarter next year. Assembly of jet-boring equipment has begun with testing to follow soon. In Australia, the firm has completed the prefeasibility study for KINTYRE in Western Australia, assuming future uranium prices will achieve prices of US$67 a pound U_3O_8 and production will recover 62 million pounds U_3O_8, packaged.

- SAUDI ARABIA will plan for nuclear power to conserve oil with a $100 billion program, involving 16 reactors planned by 2010.

As of October, 2012

- AUC LLC of BAYSWATER URANIUM Reno Creek, Wyoming (Powder River Basin) has signed a same-area boundary agreement with URANERZ ENERGY CORP, with monitor rights on either side of the line for both firms (UXW, 10/29/12). AUC reported two exploration drills at Reno Creek in October, to continue into mid-November.

- CAMECO November 2nd (NMR) announced long-term uranium production goals will be lowered due to a weak global economy. The firm will concentrate on advanced projects, expecting to produce 36 million pounds U_3O_8 annually by 2018 (a reduction of 4 million pounds per year), according to Tim Gitzel, CEO. CIGAR LAKE production is anticipated in 2013, along with plans to expand the KEY LAKE mill, extend RABBIT LAKE mine life and satellite ISR recovery operations elsewhere.

- ENERGY FUELS will shift its short term focus on mining its low cost, high-grade breccia pipes in northern Arizona and on processing alternate feed materials at White Mesa which have no associated mining costs, according to CEO Stephen Antony. October 30th Dick White reported one Utah exploration drill at the WHIRLWIND project just west of the state line, near Gateway, Colorado. One underground development drill at the SUNDAY MINE in San Miguel County, CO. will continue into November. Exploration drilling has been shut down temporarily pending prices but permitting activities continue at Sheep Mountain, Wyoming. Energy Fuels produces nearly a third of US uranium.

- LOST CREEK construction by UR-ENERGY commenced this October in Sweetwater County, Wyoming, 40 miles northwest of Rawlins, with production anticipated within 2013. GROATHOUSE CONSTRUCTION of Wyoming will build the 2 million pound per year processing plant, access roads and auxiliary facilities. The Great Divide Basin In Situ Project anticipates production to commence in 2013. Michael Lueders will be the new mine manager for the site, formerly Director of Operations in Mongolia for IKTORHORAL MINING. He has 31 years of experience in ISR mining.

- LARAMIDE RESOURCES Ltd at its LA SAL project in Lisbon Valley, Utah has commenced on- site work towards rehab of the existing decline and ventilation raise, plus surface support facilities. The site was a previous HOMESTAKE mine site in the 1980's, with reports of shipments to offsite mills of 46,000 tons ore. Locally ENERGY FUELS WHITE MESA mill may process bulk samples (UXW, 10/29/12).

- POWERTECH URANIUM this month (10/26/12) reported a private placement financing of 10 million units at $0.10 a share to proceed with permitting for DEWEY BURDOCK, SD.

- STRATHMORE MINERALS recently updated a new NI 43-101 for the Gas Hills, Wyoming properties. New resource estimates now total 4.7 million pounds for DAY LOMA and 900,000 pounds U_3O_8 for ROCK HILL. Their US$1 million development program continues.

- NUCLEAR ENERGY INSTITUTE meetings mid-October in Destin, Florida heard UEC (URANIUM ENERGY CORP) CEO Harry Anthony comment on regulatory complications in the permitting process, indicating new mine permits are being slowed by state and federal processes (NMR 10/19/12). He encourages a unified industrial effort to organize to represent the industry to "fight the bureaucracy that continually creeps into the mining regulatory process".

- UEC recently received all state permits for its GOLIAD ISR and is now awaiting concurrence from the U.S. Environmental Protection Agency. Other projects reported at the Florida seminar included CAMECO'S MILLENNIUM and KINTYRE projects, under review due to the weak market. AREVA's IMOURANEN project in Niger plans production in 2015. URANIUM ONE's Scott Melbye is studying feasibility of the MKUJU RIVER project. PALADIN ENERGY'S Dustin Garrow and AREVA's Guiheux indicated a uranium spot price of at least $75/# U_3O_8 is needed to increase uranium production. In Western Australia, TORO ENERGY'S Greg Hall indicated his firm is working to bring its WILUNA (1.9 million pounds/year) and THESEUS projects to production.

- PENINSULA, with 112 drill holes at LANCE (Wyoming) reports thick mineralization in 23 holes exceeding 0.2% U_3O_8 will encourage further exploration, with a total of 72 intersections exceeding 100 ppm U_3O_8. (NMR, 10/19)

- URANERZ has received the last permit from WDEQ to begin production operations at NICHOLS RANCH in Powder River Basin. The Class 1 Underground Injection Control permit will allow 2013 production to commence, with the installation of two deep disposal wells according to CEO Glen Catchpole. NICHOLS RANCH well-field installation drilling reported GT's as high as 4.7 (compared to a GT of One for good ISR production). Kurt Brown, VP last month reported the firm had drilled and cased 205 recovery and injection production wells in Area 1.

- UR-ENERGY USA, PATHFINDER MINES CORP earlier reported remaining resources of 10 million pounds U_3O_8 in Shirley Basin remain at an average grade of 0.21% U_3O_8. The previous COGEMA property originally produced 71 million pounds plus, 1960-1990. Shirley Basin facilities are still licensed by the USNRC to receive and dispose of by-product from other in-situ uranium mines.

FOREIGN NEWS

Canada

- CROSSHAIR ENERGY 10/26/12 announced a Letter of Intent with WEALTH MINERALS, INC for acquisition of the latter's Argentina land package of 2,600 square miles, for $1.0 million in cash and one million common shares, over a two year period. WEALTH will retain a 1% Yellowcake Royalty and 1% NSR on all other minerals. CROSSHAIR President Stew Wallis reported no October drilling in Wyoming this month.

- DENISON MINES gained proceeds of over $7 million through a private placement of some 4 million flow-through shares at US$1.70 per share, for Athabasca Basin's WHEELER RIVER advancement and other exploration projects in Saskatchewan (NMR10/26).

- PELE MOUNTAIN RESOURCES at Elliot Lake, Ontario reported bench tests for U3O8 and rare earth carbonate concentrates (REE) from ECO RIDGE. Testing of basic processing circuit elements for its NI 43-101 Preliminary Economic Assessment disclosed the discovery, following multiple tests using flotation and high-intensity magnetic separation, acid baking and leaching, purification of leach solutions, solvent extraction to recover U_3O_8, and precipitation of mixed rare earth carbonates.

Australia

As indicated on Page 3 of this report, Queensland has recently approved uranium mining after 20 years of resistance by adversarial groups (more).

Elsewhere in Australia, there are three operating uranium mines, Ranger in NT, Olympic Dam and Beverley in South Australia. A fourth is expected to start operation in 2009: Honeymoon, in South Australia, but a new mine on the Four Mile deposit close to Beverley may be in production before Honeymoon. A new discovery near the coast in South Australia by UraniumSA based in Adelaide may open a new uranium mining district (more).

Wise (2012) presents summaries of other current projects, much of which from the adversarial perspective. See also a presentation on Australia's uranium deposits and prospective mines (here).

Kazakhstan

WNA (2012) reports that Kazakhstan has 15% of the world's uranium resources and an expanding mining sector, producing some 19,450 tonnes U in 2011, and planning for further increase to 2018. In 2009 it became the world's leading uranium producer, with almost 28% of world production, then 33% in 2010 and about 35% in 2011. Kazakhstan operated a single nuclear power reactor from 1972 to 1999, generating electricity and for desalination. The country has a major plant fabricating nuclear fuel pellets and reportedly aims eventually to sell value-added fuel rather than just yellowcake to world markets. It aims to supply 30% of the world fuel-fabrication market by 2015.

The government is committed to increased yellowcake exports, and is considering future options for nuclear power.

Africa

WNA (2012) indicates that Africa has considerable uranium deposits. Exploration and mine development is proceeding in countries which have not hitherto supplied uranium. Gabon, South Africa, Namibia, and Niger, have been significant uranium suppliers in the past.

China

WNA (2012) also indicates that a large amount of uranium is in rare earths deposits, and may be extracted as a by-product, especially in China and other countries. As uranium prices rise and as geopolitical developments evolve, these factors will serve to enhance the economic potential for recovering both rare-earth elements and uranium.

Russia

Wise (2012) summarizes Russian activities in the world on uranium exploration and nuclear power plant expansion programs. The government is also cooperating with Japan, China, France, India, South Korea, Canada, and the U.S. on a variety of exploration and development projects within Russia and around the world.

Elsewhere in the World

WNA (2012) states that about 64 percent of the world's production of uranium from mines is from Kazakhstan, Canada and Australia. An increasing proportion of uranium, now 45%, is produced by in situ leaching. After a decade of falling mine production to 1993, output of uranium has generally risen since then and now meets 85% of demand for power generation.

Kazakhstan produces the largest share of uranium from mines (36% of world supply from mines), followed by Canada (17%) and Australia (11%).

U.S. DRILLING ACTIVITY, JULY, 2012

Arizona

ENERGY FUELS

One development rig underground at the Arizona One Mine

QUATERRA RESOURCES

Tom Patten had no report.

VANE

No report

Colorado

BLACK RANGE MINERALS

Permitting in progress.

ENERGY FUELS

Reported 5 rigs drilling in July.

POWERTECH

No Colorado drilling.

Nebraska

CAMECO

Continued with two development drills at Crow Butte.

New Mexico

HOMESTAKE

Reported one reclamation drill again in July.

NEUTRON ENERGY

Had no report.

QUATERRA RESOURCES

No drilling reported.

URANIUM ENERGY CORP (UEC)

No drilling.

South Dakota

POWERTECH URANIUM

Started up in July with one development drill on DEWEY BURDOCK.

Texas

MESTENA

Reported one development drill at Alta Mesa in July.

URANIUM ENERGY CORP.

At Palangana UEC had 5 production drills operating and 6 exploration drills at Burke Hollow in Bee County. There was no drilling at Salvo but the firm had 2 exploration drills in Goliad County on the Channon Project, for a total of 13 rigs in July.

URANIUM RESOURCES

Reported two exploration drills at Los Finados.

Utah

ENERGY FUELS

Three underground drills in the state. One surface development drill operated at the La Sal Complex. One exploration drill continued at the ENERGY QUEEN MINE.

Wyoming

AUC

Three exploration drills were active at Reno Creek, Powder River Basin.

CAMECO

Nineteen production drills were reported operating, 10 at Smith Ranch and 9 at North Butte, all in Powder River Basin. Drilling in the Gas Hills is planned for the near future.

CROSSHAIR ENERGY

Reported two exploration drills at JUNIPER RIDGE.

ENERGY FUELS

Reported permitting in the Red Desert.

PENINSULA/STRATA

Two Lance formation exploration drills operating in the Oshoto area.

STAKEHOLDER ENERGY LLC

Three drills operating in Converse County in June.

STRATHMORE MINERALS

Four exploration drills were reported in the Gas Hills in July. Plans to start up at Beaver Rim in August with three drills.

URANERZ

July 5th Curt Brown reported July drilling used one exploration rig on the

PRB ARKOSE project and 3 production drills operating at NICHOLS RANCH.

Ur-ENERGY

Started-up mid-July with three drills at Lost Creek for 2013 production.

URANIUM ONE

Dayton Lewis had 18 development drills operating in the PRB

U.S. July Drilling Summary:

Companies: 6 Surface Rig Count: 87 Underground Rig Count: 3

U.S. DRILLING ACTIVITY, OCTOBER, 2012

Arizona

No surface rigs reported active in October

ENERGY FUELS

No underground drilling reported at the Arizona One Mine but mining continues.

VANE

No report

Colorado

BLACK RANGE MINERALS

Permitting in progress with no drilling reported.

ENERGY FUELS

Reported one development drill underground at the Sunday Mine doing monitoring well drilling, October. The Beaver and Daneros mines on the Colorado Plateau are now on stand-by.

POWERTECH

No Colorado drilling.

Nebraska

CAMECO

Continued with two drills at Crow Butte.

New Mexico

HOMESTAKE

Reported reclamation drill completed in August for 2012.

URI

Purchased NEUTRON ENERGY
No report.

QUATERRA RESOURCES

No drilling reported.

URANIUM ENERGY CORP (UEC)

No current drilling out of Albuquerque office.

South Dakota

POWERTECH URANIUM

One development drill in October at DEWEY BURDOCK.

Texas

MESTENA

Mike Maxsom reported seven production drills at Alta Mesa in October, with plans to continue through the end of the year at the same level.

URANIUM ENERGY CORP.

UEC reported eleven drills operating in October, with 5 production drills operating at Palangana and 4 exploration drills again at Burke Hollow in Bee County this month. There was no drilling at Salvo but the firm had 2 exploration drills in Goliad County on the Channon Project, for a total of 11 rigs for October.

URANIUM RESOURCES

Los Finados this month of October Bob Jamison reported no drilling.

Utah

ENERGY FUELS

Whirlwind Mine exploration drilling with one drill in October completed the program.

Wyoming

AUC/BAYSWATER/NCA

Two October exploration drills were active at the Reno Creek Project this month, according to Dan Dowers. Drilling will continue into mid-November.

CAMECO

Seven drills were indicated operating in Wyoming this October, with two each in the Gas Hills, 2 drills in Shirley Basin (with one moving to Eastern Wyoming), and 2 on the Brown Ranch, PRB. November will see 4 drills on exploration projects, with 2 each in the Gas Hills and at the Brown Ranch, PRB, plus 2 in Nebraska.

CROSSHAIR ENERGY

Reported no exploration drills in October at JUNIPER RIDGE. (Argentina acquisition of 2,600 square miles made news).

ENERGY FUELS

Reported permitting in the Red Desert and at SHEEP MOUNTAIN.

PENINSULA

Reported two exploration rigs at Lance Creek, eastern PRB, through the end of October. No drilling is planned for November.

STAKEHOLDER ENERGY LLC

One drill operating in Converse County, into November.

STRATHMORE MINERALS

Indicated four exploration drills in the Gas Hills on Beaver Rim again for October and November.

URANERZ

Kurt Brown reported 3 production drills in Powder River Basin, for October and November. The firm's deep disposal well permit has been approved for Nichols Ranch.

Ur-ENERGY

Continued on schedule in the Great Divide Basin with seven drills at Lost Creek for the planned 2013 production. Mill construction broke ground in October.

URANIUM ONE

Dayton Lewis had 15 development drills again operating in October in the Powder River basin, with plans to continue at the same rate through December.

U.S. October Drilling Summary:

Companies: 14 Surface Rig Count: 62 Underground Rig Count: 1

CANADIAN DRILLING ACTIVITY, JULY, 2012

AREVA

West Athabasca Basin, three exploration drills were reported for July.

CAMECO

14 rigs were drilling in July. Last month the firm reported for Athabaska Basin 2 drills operated at MacArthur, 2 at Read Lake, 3 at Cree Extension, and one at Cree Zimmer. In Nunavut, the firm reported two drills and 2 were in Quebec Province at the Otish project.

CROSSHAIR

Two drills reported coring in Labrador.

DENISON MINES – ENERGY FUELS

Reported two drills at Wheeler River.

HATHOR

Scouting indicates 2 drills operating at the Rough Rider project.

JNR RESOURSES

Planned no drilling in July following two exploration drills at Black Lake earlier this year.

PUREPOINT

No July 2012 Activity was reported by press time

Canada July Drilling Summary:

Companies: 6 Rig Count: 23

CANADIAN DRILLING ACTIVITY, OCTOBER, 2012

AREVA

Reported two exploration drills in Western Athabasca Basin in October.

CAMECO

Uranium exploration saw drilling with 4 drills in October, two of them at Rabbit Lake and 2 on the Virgin River site.

DENISON MINES

Lawson Forand's secretary reported no drills active October, November or December, 2012.

JNR

Geologist Dave Billard indicated JNR had no drilling planned for October.

Canada October Drilling Summary:

Companies: 4 Rig Count: 6

Regulatory Issues – July 2012

Courtesy of Oscar Paulson

1. Environmental Protection Agency – 40 CFR Part 61 Subpart W Impoundments

The EPA, in spite of industry input to the contrary, continues to state that fluid retention ponds at in-situ uranium recovery facilities will fall under 40 CFR Part 61 Subpart W.

At a meeting with representatives of the uranium recovery industry on October 29, 2009 in Washington, D.C., Reid Rosnick stated that 40 CFR Part 61 Subpart W, as it is written, gives the EPA jurisdiction over fluid retention ponds containing 11(e).2 byproduct material fluids. He reiterated that the Agency must review and approve any plans for construction of new tailings impoundments, fluid retention ponds and heap-leach pads prior to commencement of work. In this latest discussion, heap-leach pads were included in addition to fluid retention ponds. He also stated that fluid retention ponds would count against the two (2) operating forty (40) acre impoundment limit in 40 CFR Part 61 Subpart W.

Additional information may be found at:
http://www.epa.gov/radiation/neshaps/subpartw/rulemaking-activity.html

The last conference call regarding this regulatory review was held on Thursday July 5, 2012. Reid Rosnick began the call by stating that he had very little to say. He stated that the final agency review of the proposed rule was completed on April 19, 2012. The proposed rule was then sent to the Office of Policy which will then submit it to the Office of Management and Budget (OMB). It is scheduled to be sent to the Office of Management and Budget (OMB) on August 2, 2012. To the best of industry knowledge it has not yet been submitted.

The following items were discussed:

- Oscar Paulson asked that the National Mining Association's (NMA's) Wednesday, May 2, 2012 presentation on radon flux from fluid surfaces be included on the Agency's 40 CFR Part 61 Subpart W web site. Katie Sweeney stated that she would officially submit the presentation to the Agency for inclusion on the site. Reid Rosnick stated that the presentation would be included. Katie Sweeney recently stated that the presentation has been submitted.

- Paul Carestia stated that it took 2 ½ years for the Agency to post CCAT's comments on the web site. He inferred that the Agency handles comments and submittals from industry differently that it does comments and information from others.

- Katie Sweeney discussed the Office of Management and Budget (OMB) review stating that it normally requires ninety (90) days however due to a recent backlog of proposed rules and the fact that 2012 is a presidential election year, the review could take up to one (1) year.

- Jennifer Thurston of Information Network for Responsible Mining (INFORM) stated that Travis Stills was unable to participate in the call and expressed disappointment with the Agency's delays and the fact that deadlines in the settlement agreement for the lawsuit had not been met.

- Sara Fields of Uranium Watch asked about the relationship between 40 CFR Part 61 Subpart W and 40 CFR Part 192, both of which are currently under review. Reid Rosnick replied that there is a partial connection. He stated that 40 CFR Part 61 Subpart W is a Clean Air Act rule while 40 CFR Part 192 is a Uranium Mill Tailings Radiation Control Act (UMTRCA) rule. He stated that a proposed rule regarding 40 CFR Part 192 will be issued

in a year and that this rule is proving more difficult to revise since it involved Science Advisory Board (SAB) review.

- Joanna Avonick (sp?) of AC Telluride (?) asked if the Agency tests emissions itself at tailings sites. She asked if the results reported by the companies accurately reflect actual conditions on the ground. Reid Rosnick replied that it is not Agency policy to perform its own tests. She requested that the Agency test areas around these sites in the field.

The last conference call regarding this regulatory review was held on Thursday, October 4, 2012 at 11:00 A.m. Eastern Time. Reid Rosnick was not present as he was having back surgery. The call was facilitated by Phil Egidi. No proposed rule has been submitted to the Office of Management and Budget (OMB).

Regarding any proposed rule, the Agency's web site states:

> *"EPA plans to propose a decision on Subpart W in February 2013. After allowing for public comment and/or hearings we plan to have a final decision in late 2013 or early 2014. This estimate will be revised as needed."*

The next conference call is scheduled for Thursday, January 24, 2013 at 11:00 a.m. Eastern Time. The call in number is 1-866-299-3188. You will be prompted for a conference code, which will be 2023439563. After entering the conference code press the # key and you will then be placed into the conference call. The call's date and time has not been officially posted on the Agency's website nor have the minutes from the Thursday, October 4, 2012 conference call.

Oscar Paulson gave a presentation summarizing research conducted by the National Mining Association (NMA) on radon flux from fluids at the Joint National Mining Association (NMA)/Nuclear Regulatory Commission Uranium Recovery Workshop in Denver, Colorado on Wednesday, May 3, 2012. The presentation concluded that radon fluxes from Radium-226/Radon-222 bearing water at the water/air interface were minimal.

On Thursday, November 10, 2011, the Environmental Protection Agency (EPA) released the long-awaited S. Cohen and Associates report entitled *Risk Assessment Revision for 40 CFR Part 61 Subpart W – Radon Emissions from Operating Mill Tailings.* This document may be downloaded (here).

2. Updates to Uranium Recovery Guidance by the Nuclear Regulatory Commission (NRC)

The following is the schedule for updating uranium recovery guidance presented by Stephen J. Cohen and Dominick A. Orlando of the Nuclear Regulatory Commission (NRC) in a presentation entitled *Guidance Update and Licensing Logistics* presented at the uranium recovery workshop on Thursday, May 26, 2011 in Denver, Colorado:

- *In-situ uranium recovery rulemaking (Deferral of Active Regulation of Ground-Water Protection at In Situ Leach Uranium Extraction Facilities)* – delayed until the Environmental Protection Agency (EPA) completes the 40 CFR192 rulemaking.

- *Regulatory Guide 8.30 - Health Physics Surveys in Uranium Recovery Facilities* – delayed

- *NUREG-6733 - A Baseline Risk-Informed Performance-Based Approach for In Situ Leach Uranium Extraction Licensees* – delayed

- *NUREG-1569 – Standard Review Plan for In Situ Leach Uranium Extraction License Applications* – delayed

- *Regulatory Guide 4.14 – Radiological Effluent and Environmental Monitoring at Uranium Mills* – work beginning

- *Regulatory Guide 3.51 – Calculational Models for Estimating Radiation Doses to Man from Airborne Radioactive Materials Resulting from Uranium Milling Operations* - Complete in Fiscal Year 2012

- *Regulatory Guide 3.59 – Methods for Estimating Radioactive and Toxic Airborne Source Terms for Uranium Milling Operations* - Complete in Fiscal Year 2012

It has been decided not to revise *Regulatory Guide 3.63 - Onsite Meteorological Measurement Program for Uranium Recovery Facilities -- Data Acquisition and Reporting.*

In a Federal Register notice (Federal Register /Volume 76, Number 185 / Friday, September 23, 2011 /Notice pages 59173 to 59174) the Nuclear Regulatory Commission (NRC) withdrew *Draft Regulatory Guide (DG)-3024 Standard Format and Content of License Applications for Conventional Uranium Mills* stating, "…*has decided not to revise RG 3.5 at this time. For this reason, DG–3024 will be withdrawn*."

A member of Commission staff has stated that the revised Regulatory Guide 4.14 will include information specific to the content and preparation of Land Use Reports for uranium recovery facilities.

3. Response to Comments on Regulatory Issues Summary *(RIS) 2009-05 URANIUM RECOVERY POLICY REGARDING: (1) THE PROCESS FOR SCHEDULING LICENSING REVIEWS OF APPLICATIONS FOR NEW URANIUM RECOVERY FACILITIES AND (2) THE RESTORATION OF GROUNDWATER AT LICENSED URANIUM IN SITU RECOVERY FACILITIES*

The NMA and the WMA submitted comments on this document to the Commission on or about June 2009. No response from the Commission has been received. The regulation (10 CFR Part 40 Appendix A Criterion 5B) referenced in this document may ultimately be revised if the underlying Environmental Protection Agency (EPA) regulation (40 CFR part 192) is revised. 40 CFR part 192 is currently under review by the Agency and potentially may be revised.

NRC Staff has stated that, despite any indications otherwise, applicants should follow NUREG-1569 Standard Review Plan for In Situ Leach Uranium Extraction License Applications exactly as published, presumably with the exception of guidance regarding 10 CFR Part 40, Appendix A, Criterion 5(B)(5) incorporated in the Regulatory Issues Summary (RIS). At the May 25 to 26, 2011 Uranium Recovery Workshop in Denver, Colorado, it was stated that any proposed revisions to 10 CFR Part 40 Appendix A Criterion 5B will not be released until after the Environmental Protection Agency (EPA) has completed its review of 40 CFR Part 192. In addition, any revisions to *NUREG-1569 – Standard Review Plan for In Situ Leach Uranium Extraction License Applications* will be delayed until completion of the review of 40 CFR Part 192 as well.

4. Preparation of NUREG document entitled "*Standard Review Plan for Conventional Mill and Heap Leach Uranium Extraction License Applications*."

The NRC has decided to revise some existing Regulatory Guides and NUREGS as well as write new ones. The Commission has contracted with the Southwest Research Institute to prepare a NUREG entitled *Standard Review Plan for Conventional Mill and Heap Leach Uranium Extraction License Applications*. They are seeking input and data from industry. Two of the four current conventional uranium mill licensees are Association members. A conference call on this issue hosted by the NMA

involving all of the four conventional mill licensees as well as two companies planning conventional mills was held on Friday, March 26, 2010.

If you have questions, please contact: Jim Durham, Center for Nuclear Waste Regulatory Analyses, San Antonio, TX 78238, and Telephone: (210) 522-6934, E-mail: jsdurham@cnwra.swri.edu

The draft table of contents for this document remains:

- *Proposed Activities*
- *Site Characterization*
- *Description and Design of Proposed Facility (including liner design)*
- *Management*
- *Monitoring*
- *Reclamation*
- *Accidents*

An internal draft was scheduled for completion by September 30, 2011. It is unclear how the withdrawal of *Draft Regulatory Guide (DG)-3024 Standard Format and Content of License Applications for Conventional Uranium Mills* will impact this work.

5. General Accounting Office (GAO) Report Entitled *URANIUM MINING - Opportunities Exist to Improve Oversight of Financial Assurances*

The General Accounting Office (GAO) released report entitled URANIUM MINING - Opportunities Exist to Improve Oversight of Financial Assurances on May 17, 2012. This report was released on May 17, 2012. It concludes in part:

> *"We found that nearly all of the uranium operations on federal land had adequate financial assurances, according to our analysis of agency data. However, we found some limitations in agencies' oversight of uranium operations' financial assurances, which raise some concerns about these financial assurances. In particular, ISR operations account for a large proportion of financial assurances in place for uranium operations on federal land and have recently been increasing for some operations, yet there is little coordination between BLM and NRC when establishing and reviewing these assurances. This lack of coordination raises concerns about the adequacy of the financial assurances in place for existing ISR operations and for those ISR operations that are awaiting approval. Both BLM and NRC have specific expertise in assessing certain aspects of the reclamation activities that are required at ISR sites, but have no process in place to share this information and leverage their expertise. Without such coordination, the agencies cannot be confident that the assurances they establish for ISR operations will be adequate to cover the costs of reclamation."*

One recommendation in the report was the following one:

> "*The Secretary of the Interior and the Chairman of the Nuclear Regulatory Commission should enhance their coordination on financial assurances for ISR operations through the development of a memorandum of understanding that defines roles and promotes information sharing."*

The Nuclear Regulatory Commission (NRC) responded to this document in a letter dated Monday, July 23, 2012 which stated:

"The NRC has reviewed existing and pending agreements with the U.S. Department of Interior and its Bureau of Land Management (BLM) and has concluded that an existing NRC-BLM Memorandum of Understanding (MOU) could be amended to include language that would address GAO's recommendation. The NRC will develop the language with the assistance of an internal steering committee and then propose the amendment formally to BLM."

The entire letter may be found here.

A special thanks to John Cash of UR Energy for providing the link below to the Wyoming Public Radio report about this document (here): The link to the actual report is here.

6. Aquifer Exemption

Katie Sweeney, General Counsel of the National Mining Association (NMA) recently provided the following information regarding aquifer exemptions:

"Over the last year or two, the National Mining Association (NMA) has become increasingly aware of U.S. Environmental Protection Agency (EPA) delays with respect to approvals and permits under the Safe Drinking Water Act, particularly aquifer exemptions and underground injection control (UIC) permits. Not only is EPA prolonging the permit process by requesting data and analyses not contemplated by existing regulations or guidance, the agency is withholding aquifer exemptions and may even be reconsidering existing aquifer exemptions"

This problem is growing. In Texas, for example, Environmental Protection Agency (EPA) Region 6 is involved in a dispute with the Texas Commission on Environmental Quality (TCEQ) regarding aquifer exemptions for in-situ uranium recovery. This is discussed in a *Corpus Christi Caller – Times* article linked here.

Dr. Bryan W. Shaw, Chairman of the TCEQ testified on this dispute before U.S. House of Representatives Committee on Energy and Commerce Subcommittee on Energy and Power on June 6, 2012. 2012. His testimony may be found here.

In New Mexico, Environmental Protection Agency (EPA) Region 6 is considering a request to rescind an already granted aquifer exemption for in-situ uranium recovery.

Issues regarding permitting of deep disposal wells are also emerging. The agency is refusing to grant or renew permits for new deep disposal wells that inject above a formation that is used anywhere in the State of Wyoming as a source of drinking water regardless of how deep that formation lies below ground surface at the proposed injection site.

7. Revised Guideline 4 - IN-SITU MINING

Revisions to *Guideline 4 - IN-SITU MINING* are being addressed by the uranium recovery industry/ Department of Environmental Quality (DEQ) working group. The working group completed its review on Thursday, June 13, 2012. The working group is preparing a presentation on in-situ uranium recovery for presentation to the Land Quality Advisory Board (LQAB) on Monday, August 20, 2012 in Casper, Wyoming.

8. Linear No Threshold (LNT)

The document entitled: *President's Special Session Low Level Radiation and Its Implications for Fukushima Recovery:*

http://www.new.ans.org/about/officers/docs/special-session-low-level-radiation-version1.4.pdf

This special session was part of the American Nuclear Society's (ANS's) 2012 Annual Meeting held in Chicago, Illinois from June 24 to 28, 2012. This document contains a number of papers that discuss the Linear No Threshold (LNT) hypothesis as well as hormesis.

The link below connects to an article written by Norman Rogers that appeared on the web site *American Thinker:*

(http://www.americanthinker.com/2012/07/forbidden_science_low_level_radiation_and_cancer.html).

This excellent article discusses Linear No Threshold (LNT) and hormesis. One of the article's references was the paper entitled *Nuclear Shipyard Worker Study (1980–1988): a large cohort exposed to low-dose-rate gamma radiation.* The paper is an excellent one because:

- It references: "…*a large cohort of 27,872 nuclear workers drawn from a pool of over 100,000 nuclear shipyard workers. The 32,510 controls were job and age matched to the cohort. They were chosen from nearly 600,000 non- nuclear shipyard workers*."

- The cohort was "…*primarily exposed to external 60Co gamma rays resulting from neutron activation of cobalt in the reactor that was deposited in pipes and valves associated with the reactor cooling systems*."

- "*There was little missing personnel dosimetry data and little possibility of internal contamination or high LET exposure since few workers were involved with radiochemical environments or with any radionuclide other than external exposure to 60Co*."

The paper concludes that:

> "*The NSWS is the world's largest and most rigorously controlled study of radiation workers. Significantly lower total mortality was observed in both groups of nuclear workers. Significantly lower mortality from all causes was observed among the cohort of nuclear workers who were exposed to an average dose rate of 7.59 mGy y–1 and median dose rate of 2.80 mGy y–1 than among unexposed controls. In addition, the cohort had significantly reduced mortality for all cardiovascular disease, arteriosclerotic heart disease, respiratory diseases and cancer. This significantly lower mortality contradicts the linear non-threshold (LNT) model of radiation risk.*"

The actual nuclear shipyard study document entitled *Health Effects of Low Level Radiation in Shipyard Workers* may be downloaded by clicking the link below:

http://www.orau.org/ptp/PTP%20Library/library/Subject/Risk/shipyard.pdf

Dr. Standler, MD, Ph.D. reviewed the paper and states:

> *"I have reviewed the Sponsler and Cameron paper in Int. J. Low Radiation on the Nuclear Shipyard Worker Study. Neither of the authors of the current paper were involved in collecting the data in the study, for which Oscar Paulson has provided the complete reference (over 400 pages) at the orau site he lists below. The Sponsler and Cameron paper is attempting to present some of the core results of the Shipyard Worker Study in a published journal. It is carefully done and accurately reflects the major results of the original study. Of particular significance is Tables 1 to 4 in Sponsler and Cameron paper, which have the statistical data.*
>
> *The original study had large, very carefully chosen, populations from the shipyard workers, with low dose (<5 mGy) cohort (10,348 workers), high dose (>= 5 mGy) cohort (27,872 workers), and very carefully age, sex, and type of work matched, unexposed shipyard worker controls (32,510). The radiation source was gamma 60 radiation, and very careful and complete dosimetry records were available. The overall standardized mortality ratio for the higher dose cohort (>= 5mGy) was statistically smaller that the non-exposed controls, with SMR of 0.77 (e.g. 23% fewer deaths) for the higher dose cohort compared to unexposed controls.*
>
> *Similar results were seen with the lower dose cohort (<5mGy) compared to the non-exposed controls, with SMR of 0.83 (e.g. 17% fewer deaths). Other statistically significant results were that all diseases of the circulatory system were reduced to SMR of 0.76 in the low dose group and 0.73 in the high dose group; arteriosclerotic disease was reduced in the high dose group with SMR of 0.74; all respiratory disease was reduced in the high dose group with SMR of 0.54; deaths from all external causes were reduced with SMR of 0.65; and deaths from all malignant neoplasms were slightly but statistically significantly reduced with SMR of 0.95 (SMR of controls was 1.12). The numbers of deaths of more finely divided diseases were mostly too small to reach statistical significance, but as I review the Tables 3 and 4, I note that the in the vast majority of the non-cancerous deaths (those in table 3) the mortality of the low dose and high dose cohorts were both way down from that of the controls. In contrast, the breakdown of cancer deaths in Table 4 does not seem to show so strong an effect."*

9. National Institute for Occupational Safety and Health (NIOSH) Report entitled Evaluation of Exposure to Radon Progeny During Closure of Inactive Uranium Mines - Colorado

The National Institute for Occupational Safety and Health (NIOSH) released a report entitled *Evaluation of Exposure to Radon Progeny During Closure of Inactive Uranium Mines – Colorado* in July 2012.

This report was prepared following:

> *"...June 2011, HHE request from managers of a federal agency in Colorado. NIOSH was asked to evaluate employees' exposure to ionizing radiation hazards during construction of various types of closures at abandoned uranium mines. The primary health concern at these sites involved inhalation of naturally occurring short-lived radon progeny (i.e., polonium-218, lead-214, bismuth-214, and polonium-214) at mine entrances (adits). Also of concern, but to a lesser extent, was exposure to gamma radiation emitted from mine waste and nearby geological formations.*"

The report concludes that:

> *"The potential for workplace exposures to radon was low. Controls were needed in some instances to keep exposures as low as reasonably achievable.*

...ionizing radiation hazards during mine closure activities are relatively low overall; however, radon exposures necessitating intervention can occur at some work locations. Limiting occupancy, simple engineering controls (i.e., barriers, ventilation), and the use of respiratory protection in some/ certain situations are the preferred control measures for keeping radon exposures ALARA."

These conclusions are in sharp contrast to the conclusions in Robert Durasky's February 1, 2011 Environmental Protection Agency (EPA) presentation entitled: *PUBLIC AND WORKER EXPOSURES AT LEGACY (ABANDONED) URANIUM MINES* in which, among other things, he states:

"During these expeditions the radon levels are so high that people can exceed the recommended public exposure limit of 15 mrem/yr in about four breaths…

A worker can exceed the 5,000 mrem/yr or 4 Working Level Month (WLM) annual limit in a little over an hour…

...there is no ventilation in an abandoned mine so the radiation dose rates can be 10,000 times higher than found in an operating mine."

The document also includes an excellent table entitled: *Occupational radon regulations, guidance, and recommended limits* that cover current radon and radon decay product exposure limits.

10. Withdrawal of Public and National Forest System Lands in the Grand Canyon Watershed; Arizona

On January 9, 2012, Secretary Ken Salazar, Secretary of the Interior signed *Public Land Order No. 7787; Withdrawal of Public and National Forest System Lands in the Grand Canyon Watershed; Arizona***.** This order withdrew approximately 1,006,545 acres of public and National Forest System lands from location and entry under the Mining Law of 1872. These lands are home to breccia pipes that can contain uranium, however the order effects all minerals not just uranium. This order is a severe blow to the uranium industry recovery in Arizona. The order and associated documents may be found at the following links:

http://www.blm.gov/pgdata/etc/medialib/blm/az/pdfs/withdraw/feis.Par.24671.File.dat/NAZ_WLDL_PLO_1_5_2012.pdf–Order

http://www.blm.gov/pgdata/etc/medialib/blm/az/pdfs/withdraw/feis.Par.88586.File.dat/NorthernArizona-ROD-v20-1%2011%202012_wsignederrata.pdf – Record of Decision

Legal action regarding the withdrawal is pending and has been consolidated under a single judge. The government has made a motion for summary judgment.

11. Environmental Protection Agency Review and Potential Revision of Health and Environmental Standards for Uranium and Thorium Milling Facilities

The EPA will be reviewing and potentially revising its regulations for uranium and thorium milling to bring them up-to-date. For additional information, see:

http://www.epa.gov/radiation/docs/tenorm/40cfr192-063009-announcement.pdf

The Agency has established a discussion blog regarding the revision of 40 CFR Part 192. It may be found at: http://blog.epa.gov/milltailingblog/

This regulation covers inactive uranium processing sites and includes control of residual radioactive material and remediation of land and buildings. It addresses the management of byproduct materials

including uranium processing and thorium processing wastes. It covers specific areas including byproduct materials and uranium processing. It addresses construction of impoundments and incorporates the double liner requirement in 40 CFR Part 264.92, effluent limitations in 40 CFR Part 440 and radiation protection standards in 40 CFR Part 190. It addresses reclamation including remediation of buildings, supplemental standards, alternate concentration limits (ACLs), and radon releases, following radon barrier emplacement and soil remediation standards (5/15 rule).

A draft technical report is available at:

http://www.epa.gov/radiation/docs/tenorm/post-closure-monitoring.pdf

This review will directly impact the Nuclear Regulatory Commission's (NRC's) proposed revision of Appendix A of 10 CFR Part 40. These revisions will be delayed until the review of 40 CFR Part 192 is complete.

The revised draft report entitled *Considerations Related to Post-Closure Monitoring of Uranium In-Situ ISL/ISR Sites* dated Tuesday, November 22, 2011 has been posted on the Environmental Protection Agency's (EPA's) web site and may be found at:

http://yosemite.epa.gov/sab/sabproduct.nsf/c91996cd39a82f6485257424006901 27/0314cef928df63cc8525775200482fa3! OpenDocument&TableRow=2.2#2.

Reid Rosnick recently stated that a proposed rule regarding 40 CFR Part 192 will be issued in a year and that this rule is proving difficult to revise since it involved Science Advisory Board (SAB) review. On Thursday, September 20, 2012 the Environmental Protection (EPA) distributed an e-mail regarding its review of 40 CFR Part 192 which stated in part:

> *"EPA has completed its review and is considering proposing standards for In-Situ Leach/In-Situ Recovery (ISL/ISR) facilities. The U.S. Environmental Protection Agency (EPA) last revised its regulations for uranium and thorium milling in 1995, and has recently completed a review of them. The regulations establish standards for protection of the public health, safety, and environment from radiological and nonradiological hazards associated with uranium and thorium ore processing, and their associated wastes…*
>
> *…The EPA Science Advisory Board (SAB) reviewed a draft report, Considerations Related to Post-Closure Monitoring of Uranium In-Situ Leach/In-Situ Recovery (ISL/ISR) Sites. The SAB subsequently issued an Advisory that recommends that this draft report be expanded to serve as a technical guide for the development of standards for ISL/ISR facilities.*
>
> *EPA is now considering proposing standards that would apply to ISL/ISR facilities. If EPA were to propose such standards, a Notice of Proposed Rulemaking would be published in the Federal Register no sooner than Spring 2013. Regulated entities, stakeholders, and members of the public will be given the opportunity to submit formal comments on any proposed revisions to the standards as part of the formal rulemaking process."*

12. Deferral of Active Regulation of Ground-Water Protection at In Situ Leach Uranium Extraction Facilities/New Regulatory Section for Uranium Recovery

The Nuclear Regulatory Commission (NRC) released a Regulatory Issues Summary (RIS entitled:

> "*NRC REGULATORY ISSUE SUMMARY 2009-05 URANIUM RECOVERY POLICY REGARDING: (1) THE PROCESS FOR SCHEDULING LICENSING REVIEWS OF APPLICATIONS FOR NEW URANIUM RECOVERY FACILITIES AND (2) THE*

RESTORATION OF GROUNDWATER AT LICENSED URANIUM IN SITU RECOVERY FACILITIES," dated April 29, 2009.

In it they stated:

"*As indicated above, the staff is now working with the EPA to resolve groundwater protection issues at ISR facilities and to revise Appendix A of 10 CFR Part 40 accordingly. The NRC expects that a draft of the proposed revisions to Appendix A will be published for public comment in 2010.*"

This Regulatory Issues Summary (RIS) states:

"Accordingly, the requirements in Criterion 5B of Appendix A apply to restoration of groundwater at uranium ISR facilities."

The Environmental Protection Agency (EPA) is reviewing and may revise 40 CFR Part 192. This regulation contains specific language regarding Alternate Concentration Limits (ACLs) which undoubtedly is being considered for potential revision. Changes to 40 CFR Part 192 would impact 10 CFR Part 40 Appendix A Criterion 5B. The EPA's review and potential revision of 40 CFR Part 192 will further delay work on deferral of active regulation of ground water protection at in- situ leach uranium extraction facilities. The primary focus of the EPA's revision effort of 40 CFR Part 192 would be related to long term stability of groundwater restoration in depleted in-situ uranium recovery well fields and that this issue would be the primary focus of the expert review panel that the Agency is in the process of selecting.

Any proposed revisions will not be released until after the Environmental Protection Agency (EPA) has completed its review of 40 CFR Part 192. This was discussed at the May 25 to 26, 2011 Uranium Recovery Workshop in Denver, Colorado.

13. Proposed Changes To Colorado Radiation Regulations - Part 4

The Colorado Department of Public Health and Environment (the Department) is proposing to make changes to certain parts of the *Colorado Rules and Regulations Pertaining to Radiation Control* (the Regulations) 6 CCR 1007-1. Changes are proposed to *Part 4 – Standards for Protection Against Radiation.*

The draft regulatory changes are posted on the Departments website (under "*Regulations Development*") at: http://www.colorado.gov/cs/Satellite/CDPHE-HM/CBON/1251617273636

Comments are due on or before November 26, 2012.

14. Draft Tribal Protocol Manual - Section 106 Process/Traditional Cultural Properties

On October 12, 2012, the Nuclear Regulatory Commission (NRC) released a draft *Tribal Protocol Manual* for review and comment. The link to the web page devoted to this document is as follows:

http://www.nrc.gov/about-nrc/state-tribal/tpm.html

The Federal Register notice regarding this document may be found at:

http://www.regulations.gov/#!docketDetail;D=NRC-2012-0235

The Federal Register notice regarding this document states:

> *"In addition to the request for comments on the draft Tribal Protocol Manual, the NRC also seeks suggestions on the development of the proposed tribal consultation policy statement from tribal governments and organizations, the public, and other interested parties. The questions found in section II are offered for consideration. Respondents are not limited to these questions and are encouraged to submit any comments/feedback they think would benefit the NRC in developing a tribal consultation policy statement"*

Comments are due by April 1, 2013.

CALENDAR, Remainder of 2012

Dec 3-7 NWMA'S 118thAnnual Meeting, Spokane Convention Center, WA USA http://www.nwma.org/convention.asp

Dec 9-12 European Nuclear Conference 2012, European Nuclear Society, Manchester Central Convention, Manchester UK http://www.euronuclear.org/events/enc/

Dec 12-14 ATOMEX 2012: Expocentre, Moscow, Russia http://www.atomeks.ru/en/atomex2012

Calendar, 2013

Jan 30 Nuclear Fuel Supply Forum, Westin Georgetown, Washington, DC http://nei.org/newsandevents/conferencesandmeetings

Feb 4-7 Mining Indaba Cape Town Intn'l Convention Centre, Cape Town, South Africa: http://www.miningindaba.com

Feb 24-28 WM 2013 CONFERENCE, Phoenix Convention Center, Phoenix, AZ http://www.wmsym.org

For More: http://www.uranium.info/events.php

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II. Uranium-Related University Research Activity

By Steven S. Sibray, C.P.G., (Vice-Chair: University), University of Nebraska, Lincoln, NE

Uranium Research Related Activities – Midyear Report, 2012

In 2010, University of Wyoming sponsored the Energy Resources and Produced Water Conference: Water Quality, Management, Treatment, and Use, during which L. Clapp, *et. al*., of the University of Texas, Kingsville, and of the Uranium Resources International (URI) gave the presentation titled: *H_2 Injection for Restoring Ground Water at a Uranium In-Situ Recovery Mining Site*, which is now available as a video (here). The full conference is available (here).

Otherwise, uranium-related research activities at the major United States universities were limited in scope in 2012. Funding sources were primarily from private sources, usually uranium mining companies. The *Society of Economic Geologists* [SEG] provided two student grants related to uranium ore deposits. One of the uranium-related grants was for study of U-REE mid-crustal systems and their links to Iron Oxide Copper Gold [IOCG] deposits, while the other grant was for a study of a deposit in British Guyana. In contrast, a total of 4 SEG grants were made for the study of REE. The SEG grants relating to uranium and REE are listed are as follows:

2012

Jim Renaud, CAN$2,000 [CAN] University of Western Ontario, Canada, Ph.D.;
Scope: Aricheng uranium deposit. Roraima Basin, British Guyana, South America.

Matt McGloin, US$3,250 Monash University, Australia,, PhD.
Scope: The genesis of U-REE mid-crustal systems and their links to IOCG deposits.

Laurie Christine O'Neill, US$1,000 University of Texas at Austin (USA) M.Sc.
Scope: Rare Earth Element Mineralisation associated with the Paleogene Round Top Laccolith (West Texas, USA).

Andrew Peter George Fowler, US$ 2,000 University of California, Davis (USA) M.Sc.,
Scope: Detrital rutile in the Au-bearing Moeda Formation, Minas Gerais, Brazil, and Rare-Earth Element concentrations in geothermal fluids from Icelandic geothermal systems (Iceland).

Erik Hanson, US$3,250 Southern Illinois University (USA) M.Sc.,
Scope: The origin and REE investigation of the Sparks Hill and Chamberlain diatremes near Hick's Dome (Southeastern Illinois, USA).

2011

Luisa Ashworth-Broccardo US$2,000 University of Witwatersrand (South Africa) Ph.D.
Scope: Rare metal and abyssal pegmatites (Damara Belt, Namibia)

Benjamin Snook US$2,000 Camborne School of Mines (UK) Ph.D.
Scope: High-Purity Quartz and Rare Metals, Bamble-Evje pegmatite belt (Norway)

Jim Renaud, CAN$2,000 [CAN] University of Western Ontario, Canada, Ph.D.;
Scope: Aricheng uranium deposit. Roraima Basin, British Guyana, South America

As mentioned on page 2 of this report, the AAPG offers the Jay M. McMurray Memorial Grant, which is awarded annually to a deserving student whose research involves uranium or nuclear fuel energy.

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1. University Research

Two faculty members of the *Colorado School of Mines* had active research projects related to uranium ore deposits. Dr. Thomas Monecke and a Ph.D. graduate student (Julie Leibold) were investigating the mineralogy and geochemistry of the Three Crows roll front uranium deposit in Nebraska. Dr. Monecke was also conducting research on the mineralogy and geochemistry of the Lost Creek roll front deposit in Wyoming.

Funding for the Three Crows study was provided by Cameco while the Lost Creek study was funded by UR Energy and the U.S. Geological Survey. Dr. Moenke and a new Masters student have a new project, Roll-front mineralization at the Buss Pit, Gas Hills, Wyoming (sponsored by Cameco). Dr. Murray Hitzman and Sophie Hancock (Ph.D. graduate student) finished up the study of the hydrogeology of the Lost Creek deposit that was funded by UR Energy.

I presented a talk on "Exploring for Roll Front Uranium Deposits and Groundwater Using Airborne Electromagnetic Surveys in the Nebraska Panhandle" at the Rocky Mountain section of AAPG in Grand Junction, Colorado. Recent advances in application of airborne electromagnetic [AEM] surveys to groundwater management programs can also be utilized to map aquifers that host uranium deposits. The *U.S. Geological Survey* and the *Nebraska Geological Survey* have collected AEM data as part of an ongoing project to define the hydrogeologic framework of the principal shallow aquifer in the Nebraska Panhandle. Additional interpretation of these data sets has identified areas where the deeper confined aquifer of the Tertiary White River Group may contain economic deposits of uranium.

At the 244th meeting of the *American Chemical Society* in Philadelphia in August 2012, scientists reported on new technology that could extract uranium from seawater. It is estimated that seawater contains at least 4 billion tons of uranium. Dr Erich Schneider, *University of Texas*, said that the current goal is not to make seawater extraction as economical as terrestrial mining. Instead, scientists are trying to establish uranium from the ocean can act as a sort of "economic backstop" that will ensure there will be enough uranium to sustain nuclear power through the 21st century and beyond. The standard extraction technique uses mats of braided plastic fibers embedded with compounds that capture uranium atoms. Each mat is 50 to 100 yards long and suspended 100 to 200 yards under the water. After being brought back to the surface, the mats are rinsed with a mild acid solution to recover the uranium. DOE-funded technology now can extract about twice as much uranium from seawater as the first approaches developed in Japan in the late 1990s. That

improvement reduces production costs down to around $300 per pound of uranium, from a cost of $560 per pound.

In contrast to the limited scope of uranium research in the United States, there is a great deal of research being conducted in the Athabasca region of Canada. The following information on research being conducted in that region was found on the website of the province of Saskatchewan. (more)

Canada

Research Projects in the Athabasca Region of Saskatchewan

Nancy Université,

Michel Cuney, colleagues and students:
Scope: Fluid history of the Athabasca Basin proximal to ore deposits.

Queen's University

1) Uravan Minerals/NSERC: Exploration geochemistry for deep uranium deposits
Uravan Minerals, Queen's University, U. Wisconsin involving PDF, Ph.D., MSc and 4 BSc
Scope: Exploration geochemistry using core and surface samples in the Outer Ring, Johannsen Lake, Halliday Lake and Stevenson areas of the Athabasca Basin.

2) Raven Minerals/NSERC: Basin-related uranium systems
Raven Minerals, Queen's University, involving 2 PDF, 2Ph.D., MSc, 4 BSc
Scope: Identify the critical factors that control uranium mobility and precipitation in sedimentary basins, including specific areas in the Athabasca Basin

3) Cameco Corp/NSERC: Iron Oxidation State study
Cameco Corp., Queens University (Kyser), U. Manitoba Fayek), involving Ph.D. and M.Sc. Thesis
Scope: Distribution of iron oxidation state using well-characterized clay minerals to trace preferential pathways for uraniferous paleofluids.

4) Cameco Corp/NSERC: Uranium Deposits in Successor Basins
Cameco Corp., Queens University, involving Ph.D. and Ph.D. Dissertation
Scope: Re-evaluate the character and formation of vein type deposits in successor basins in Canada (Beaverlodge area) and Australia (South Alligator River area) and compare them to those in the younger U-rich basins with which they are associated, using structural settings, mineral paragenesis and crystal chemistry, character of fluids involved, the nature of the paleohydrologic system and critical factors in deposit formation. Goal is to relate significance of deposits in successor basins to more significant deposits younger basins.

University of Regina

1) "Geological, petrographic and geochemical characterization of the west zone of the Roughrider U deposit" (Thesis defended in May 2012).
Participants: Rachel Boulanger (U of Regina, M.Sc. student), Guoxiang Chi (U of Regina), Alistair McCready (Hathor/Rio Tinto), Mostafa Fayek (U of Manitoba)
Scope: Detailed petrographic studies of alteration and mineralization, paragenesis, and 3D distribution; whole-rock geochemistry; U-Pb geochronology with SIMS

2) "A petrographic, fluid-inclusion and clay mineralogy study of the Athabasca Group from the Rumpel Lake drill core" (In progress).
Participants: Ryan Scott (U of Regina, M.Sc. student), Guoxiang Chi (U of Regina), Sean Bosman (SER)
Scope: Detailed petrographic studies of Athabasca Group sedimentary rocks; fluid inclusion microthermometry, Raman spectroscopy, and SEM-EDS, and EMP study of clay minerals. The aim is to reconstruct the paleo-geothermal gradient in the Athabasca Basin and estimate the thickness of eroded strata.

3) "Numerical modeling of fluid pressure regime in sedimentation history of the Athabasca basin: implications for fluid flow models related to unconformity-type uranium mineralization (In progress; paper in review)
Participants: Guoxiang Chi (U of Regina), Sean Bosman and Colin Card (SER)
Scope: 2D numerical modeling of fluid overpressure caused by disequilibrium compaction in the history of the Athabasca Basin, using the software Basin.

4) "Diagenetic studies of the Athabasca basin and implications for uranium mineralization" (In progress)
Participants: Haixia Chu (U of Regina, Ph.D. student), Guoxiang Chi (U of Regina)
Scope: Detailed petrographic studies of sedimentary rocks of the Athabasca Group, mainly from deep drill cores away from known mineralization; analysis of fluid inclusions in authigenic quartz; major and trace element analysis of sedimentary rocks by affected by different diagenetic processes and mass balance calculation; establishment of background fluid temperature and composition to be compared with those in mineralized areas.

5) "Genetic relationship between episyenite and vein-type uranium mineralization in the Beaverlodge area" (started in 2012 summer)
Participants: Rong Liang (U of Regina, M.Sc. student), Guoxiang Chi (U of Regina), and Kenneth Ashton (SER)
Scope: Detailed petrographic studies of episynite; analysis of fluid inclusions in related hydrothermal minerals; major and trace element analysis of episynite and protoliths and mass balance calculation.

6) "Characterization of mineralizing fluids associated with vein-type uranium deposits in the Beaverlodge area: relationships with structures and the Martin Group"
Participants: Student to be identified (U of Regina, M.Sc. student), Guoxiang Chi (U of Regina), Charles Normand and Kenneth Ashton (SER)

Scope: Detailed studies of fluid inclusions in vein minerals associated with uranium mineralization and in quartz overgrowths in the Martin Group; fluid-inclusion plane studies in oriented samples.

7) "3D geological characterization of the southeastern part of the Athabasca basin and modeling of fluid flow related to uranium mineralization" (Will be carried out under TGI-4 program of the Geological Survey of Canada, Started in spring, 2012 and will continue until spring, 2015.)
Participants: Zenghua Li (U of Regina, Ph.D. student), Kathryn Bethune, Guoxiang Chi (U of Regina), Sean Bosman and Colin Card (SER)
Scope: Regional analysis of the surface/subsurface geology and construction of a 3-dimensional model that will image fundamental lithological, structural and alteration features of the Key Lake–Russell Lake structural corridor of the eastern Athabasca Basin. Structural modeling will be accompanied by fluid flow modeling to determine fluid pathways and structural-fluid factors affecting mineralization.

8) "Deposit-scale study of structures and their relationship to alteration and fluids in the eastern Athabasca Basin" (Will be carried out under TGI-4 program of the Geological Survey of Canada. Project to be initiated in January, 2013 and will continue until 2015).
Participants: (U of Regina, M.Sc. student), Kathryn Bethune, Guoxiang Chi (U of Regina), Sean Bosman and Colin Card (SER)
Scope: Detailed structural/microstructural, alteration and fluid inclusion study of an unconformity-style uranium deposit (to be determined) in the Key Lake–Russell Lake structural corridor of the eastern Athabasca Basin. This project aims to determine, at a detailed level, if mineralizing fluids were focused at particular structural/microstructural sites (e.g., faults intersections, jogs and/or dilatant zones) in the deposit area/volume. It will also investigate the types, sources and fracture pathways of fluids and if/how changes in fluid pressure promoted faulting. The project is intended to complement the regional-scale modeling project described above.

9) "Regional basement geology to the Athabasca Basin: role of inherited structures in post-Athabasca fault reactivation and uranium mineralization"
Participants: Colin Card (U of Regina, Ph.D. student), Kathryn Bethune (U of Regina).
Scope: Investigation of geological relationships in the basement to the Athabasca Basin, their tectonic development and controls, and their influence on the nature and location/distribution of uranium mineralization. Investigation will involve a combination of targeted field study and analysis of legacy geological maps, satellite imagery and radiometric and geophysical data.

University of Saskatchewan (see GSC and CMIC projects) Seismic Laboratory (Hajnal) and Industry:
Scope:
1) Seismic investigations in the eastern Athabasca Basin. Study of full wave response properties of the sandstone and basement rocks utilizing a number of in situ measurements. Influences of alterations zones on intrinsic properties of the seismic signals. Determination of unique structural and attribute properties of mineralized zones in the Athabasca Basin

2) Geology, geochemistry and origin of the Fraser Lakes U-Th-REE pegmatites, Wollaston Domain (M.Sc.); Christine Austman, Kevin Ansdell, Irv Annesley (JNR Resources); supported by JNR Resources and NSERC

3) B, Li and Th-U-Pb analytical techniques and application to uranium mineralization (M.Sc); Rob Millar, Kevin Ansdell, Irv Annesley (JNR Resources); supported by SRC and NSERC

4) BSc students have been involved in numerous projects over the last few years, e.g. 2 last year - Geochemistry of mafic dykes in the Dufferin Lake area (complete), petrology of basement rocks, West Key Lake area (incomplete); Kevin Ansdell and students

University of Windsor

Jianwen Yang and colleagues: Integrated Numerical Investigation of Hydrothermal Fluid Flow in Sedimentary Basins: Implications for the formation of unconformity-type uranium deposits. Recent publications include: Cui, T., Yang, J., and Samson, I.M., 2012. Uranium transport across basement/cover interfaces by buoyancy-driven thermohaline convection: implications for the formation of unconformity-related uranium deposits, submitted to *American Journal of Science*. In review; and Cui, T., Yang, J., and Samson, I.M., 2012. Tectonic deformation and fluid flow: implications for the formation of unconformity-related uranium deposits, *Economic Geology*, 107, 147-163.

2.0 Canadian Government

Geological Survey of Canada Managed Research (GSC)

GEM Program
1) Origin, transport and emplacement of uranium mineralization in different Paleoproterozoic Basins of Northern Canada.
Proponents: Mostafa Fayek (University of Manitoba) and graduate students.
Scope:

- Determination of the relative and absolute timing of primary and secondary uranium ore minerals and disseminated uraniferous phosphate minerals such as fluorapatite and xenotime;

- For both the Thelon and Athabasca basins: investigate the paragenetic, isotopic and spatial relationships of uranium-oxides and phosphates in a basinal context, and identify and evaluate the pathways most important for uranium deposition.

2) The Centennial unconformity-related uranium deposit, south-central Athabasca Basin, Saskatchewan. (Additional funding from Cameco Corp. and NSERC)
Proponents: Kevin Ansdell, PhD student Kyle Reid, Colin Card (SGS), Dan Jiricka (Cameco), Gary Witt (Cameco) and Eric Potter (GSC).

Scope:

• Regional setting, geology and paragenesis of the Centennial unconformity-related uranium deposit, Athabasca Basin, Saskatchewan, Canada

• Compare basement geology of the immediate deposit area to nearby exposures of Virgin River domain to improve surface-subsurface correlations and predictions.

• Evaluate secondary processes tied to the MacKenzie Dykes

TGI4 Uranium Project

1) Alteration and radiogenic nuclides in various media along major faults in the Athabasca Basin, Saskatchewan.
Proponents: Keiko Hattori (U of O), M.Sc. student Jack Dann, M.Sc. student Michael Power, M.Sc. Student Erin Adlakha, Eric Potter and SGS
Scope:

• Investigate and characterize alteration along major faults associated with uranium mineralization and compare this to barren or "background" alteration; and

• Evaluate the surface expression of concealed uranium deposits by examining the chemistry of various surface media over deeply buried systems.

• Link surficial geochemical anomalies to alteration in bedrock and track vertical element mobility, forming the basis of a robust exploration vectoring tool.

2) Graphite loss associated with unconformity-related uranium mineralization in the Dufferin Lake area, Virgin River trend (Additional funding from Cameco Corp. and NSERC)
Proponents: Kevin Ansdell (U of S), MSc student Marjolaine Pascal, Irvine Annesley (JNR), Dan Jiricka, Gary Witt, and Aaron Brown (Cameco).
Scope:

• Characterize and compare the mineralogy, petrology and geochemistry of graphite-bearing basement rocks with texturally and lithologically similar rocks that appear to have lost their graphite content near uranium mineralization; and

• Understand the processes under which graphite forms or is destroyed, and the relationship, if any, to the formation of uranium mineralization.

3) Mg- and Fe-isotopic signatures of alteration associated with formation of unconformity-related U deposits, Athabasca Basin, Saskatchewan.
Proponents: Eric Potter, Simon Jackson, Isabelle Girard (GSC)
Scope:

• Quantify the Mg and Fe-isotopic signature associated with weathering, diagenetic alteration and hydrothermal alteration in the Athabasca Basin;

• Distinguish between fertile (redox evident) and barren (no redox signature) alteration systems; and

• Develop exploration criteria for critical examination of unconformity-related uranium alteration systems through a combination of Mg and Fe-isotopes.Update: Planning start of project in spring 2013.

Saskatchewan Geological Survey (SGS)

Colin Card and Sean Bosman: Athabasca Uranium Ore Systems:

• 3D and 4D analysis of the Athabasca Basin and its ore systems to help define the geologic environment through time and the background conditions in the Athabasca Basin and it basement rocks, and

• Project involves collaboration with the Geological Survey of South Australia, particularly on 3D modeling, geophysical interpretation and scientific direction.

3.0 INDUSTRY

AREVA

1) Iron Oxides; Georges Beaudoin (Laval University); (being organized)
Characterize iron oxides present in and around uranium deposits - Shea Creek and Kiggavik;

2) Projet Wollaston; Philippe Goncalves and Pauline Jeanneret (Université de Franche-Comté; Ph.D thesis)
Scope: Role of metamorphism, partial melting, and transpressive deformation on U (re)mobilization in the Mudjatik-western Wollaston Domains boundary region

3) Alteration systems; Daniel Beaufort and Freddy Uri (Université de Poitiers; Ph.D thesis)
Scope: Clay alteration and uranium mineralization in the Shea Creek area

4) Alteration systems; Daniel Beaufort and Thomas Riegler (Université de Poitiers; Ph.D thesis)
Scope: Uranium mineralization and alteration systems along the Kiggavik and Andrew Lake trend (NU), with comparisons to Athabasca alteration systems

5) Quaternary indicator minerals; Dan Layton-Matthews and Scott Robinson (Queen's University; MSc thesis)
Scope: Drift prospecting indicator mineral technology to be developed for eastern Thelon Basin unconformity-type uranium deposits; possible applications to Athabasca exploration

6) Geochronology; Mostafa Fayek and Dan Hrabok (University of Manitoba; B.Sc thesis)
Scope: Uranium mineralization and geochronology of the Sue D deposit

7) Geochronology; Mostafa Fayek and Ryan Sharpe (University of Manitoba; B.Sc thesis; Ph.D thesis TBD)
Scope: The Kiggavik (Thelon Basin) and Shea Creek (Western Athabasca Basin) Uranium Deposits: A Comparative Study

Cameco Corporation (See also GSC projects and Queen's University)

1) Uranium Deposit Speciation study (Unconformity only) University of Manitoba - Dr Mostafa Fayek - joint with Laurentian University as well. Ph.D. project student Jennifer Durocher
Scope: To geochemically "map" alteration and ore minerals at McArthur River. This speciation study is using VESPERS beamline technology at the CLS facility in Saskatoon. This new technology has XRF, XRD and XAS components and has the capability of determining trace element contents to PPM levels in mineral grains of only several microns in size.

2) BSc. Theses, University of Saskatchewan. A budgeted amount has been set aside to support B.Sc. thesis students/projects, to date exclusively at the University of Saskatchewan.
Scopes Completed: "Petrography and Geochemistry of the Key Lake Trend Basement Stratigraphy" and "The petrology and geochemistry of diabase dykes from the Centennial deposit and area, Northern Saskatchewan".

CanAlaska Uranium

No specific research but continuously investigate the relations between what the responses of the various geophysical methods (mainly ground EM and DC) and what the drill core is and what down-hole probing measures.

JNR Resources
See University of Saskatchewan.

Uravan Minerals (See Queen's University)

OTHER NON-PROFIT ORGANIZATIONS

Canadian Mining Innovation Council (CMIC)
University of Saskatchewan (Kevin Ansdell), 15 Industry Participants (Cameco is the project host), Geological Survey of Canada, Saskatchewan Geological Survey: Footprints Project – Uranium
Scopes: Develop a profile of the mineralizing system focused along the Millennium-McArthur trend, and develop quantitative multi-parameter models and tools that combine a wide range of different data types in order to derive the most sensitive indicators of the ore-system "footprint" and thereby enhance our ability to detect and navigate from their most distal margins to their high-grade cores.

III. Uranium-Related Government Research Activity

By Robert W. Gregory, P.G., (Vice-Chair: Government), Wyoming State Geological Survey, Laramie, WY

Year before last, I presented: "An Overview of Uranium Geology and Production in Wyoming," at the *Forum on In Situ Uranium Recovery* in August (here). Subsequent research on in situ production was funded by the State of Wyoming (more); reports on the projects funded will be forthcoming.

Also, the University of Wyoming sponsored the *Energy Resources and Produced Water Conference: Water Quality, Management, Treatment, and Use*, during which the presentation titled: *The Riverton Uranium Mill Tailings Remediation Action (UMTRA) Site on the Wind River Indian Reservation, Wyoming*, was given, which is now available as a video (here). The full conference proceedings are available (here).

Currently, as in the past, the U.S. Geological Survey is leading the way in the U.S. on uranium research and on associated environmental investigations. An extensive list of the available publications is included (here). News items of the activities of the U.S.G.S are also provided (here).

In Canada, the Government of Saskatchewan is currently implementing the Uranium Development Partnership (UDP) developed in October, 2008, with a mandate to identify, evaluate, and make recommendations on Saskatchewan-based value-added opportunities to further develop the province's uranium industry. The UDP presented its report to government on March 31, 2009, in which it provided recommendations for capturing growth opportunities across the uranium value chain (more). This activity has a significant impact on the attitudes of other governments around the world, especially because Saskatchewan has over one billion pounds of identified uranium resources, second only to Australia, and has been mining uranium continuously for 56 years. The province is the leading uranium producer in Canada.

Australia is one of the world's largest producers and exporters of uranium. Australia has the world's largest uranium reserves with 33 per cent of the world's reasonably assured resources recoverable at less than US$130/kg U (more and additional information (here)). The government supports a wide-ranging program of supporting uranium exploration and development (more).

In other parts of the world, governments are managing uranium exploration and development to supply the more than 400 nuclear reactors now in operation, and to supply those in the decades to come in the U.S. and throughout the world. The WNA publishes regular reports on the future fuel needs of only those future reactors envisaged in specific plans and proposals and expected to be operating by 2030.

Longer-range estimates, conservative by nature, are based on national governmental strategies, capabilities and needs and may be found in the WNA's *Nuclear Century Outlook* (here). The WNA country-specific papers linked to this table cover both areas: near-term developments and the prospective long-term role for nuclear power in national energy policies. They also provide more detail of what is tabulated (here).

STATUS OF THE THORIUM INDUSTRY

Brown (2011) reports that although not fissile itself, thorium has started to reemerge as a tempting prospect to employ as fuel in nuclear power reactors (also see Zerbisias (2011). Thorium-232 will absorb slow neutrons to produce uranium-233, which is fissile (and long-lived). The irradiated fuel can then be unloaded from the reactor, the uranium-233 separated from the thorium, and fed back into another reactor as part of a closed fuel cycle. Alternatively, uranium-233 can be bred from thorium in a blanket, the uranium-233 separated, and then fed into the core.

The use of thorium-based fuel cycles has been studied for about 40 years, but on a much smaller scale than uranium or uranium/plutonium cycles. Basic research and development has been conducted in Germany, India, Japan, Russia, the UK and the USA. China and India have been among the primary catalysts in research efforts to use it. Test-reactor irradiation of thorium fuel to produce high burn-ups has also been conducted and several test reactors have either been partially or completely loaded with thorium-based fuel.

Thorium can be used in Generation IV and other advanced nuclear fuel-cycle systems. China has been working on developing the technology for sodium-cooled fast reactors, which are a type of liquid-fluoride thorium reactors (LFTRs). The advanced breeder concept features molten salt as the coolant, usually a fluoride salt mixture. This is hot, but not under pressure, and does not boil below about 1400°C. Much research has focused on lithium and beryllium additions to the salt mixture. In mid-2009, AECL signed agreements with three Chinese entities to develop and demonstrate the use of thorium fuel in the CANDU reactors at Qinshan in China.

India is working on adapting heavy-water reactors in order to effectively secure domestic long-term energy requirements and make use of their abundant supply of thorium for prospective commercial international energy solutions. The technological development would harness external innovation in both equipment and fuel that would allow India to use its indigenous supply of thorium.

Areva Group and Lightbridge Corporation agreed in 2009 to collaborate on earlier research efforts to assess the use of thorium fuel in Areva's Pressurized Water Reactor (EPR). Other endeavors include the development of the Radkowsky Thorium Reactor concept being carried out as a joint venture involving Lightbridge aligned with Russian collaboration.

Brown (2011) further indicates that the world is progressively cognizant of global warming; the popular press reported that 2010 was a record year for greenhouse gases levels. The earth's population is estimated to hit nine billion by 2050, which underscores the increasing urgency of delivering safer, cleaner, reliable and renewable sources of energy. In reconciling competing economic, social, environmental and political agendas, the future of nuclear technology will be of significant interest in the coming decades. Much development work appears to be required before the thorium-fuel cycle can be commercialized, and the effort required may be unlikely while (or where) abundant uranium is available. Nevertheless, the thorium-fuel cycle, with its potential for breeding fuel without the need for fast-neutron reactors, holds considerable potential in the long term and should be a consideration in the sustainability of nuclear energy, see (here).

In summary, due to increased demand of carbon-free energy, accelerated growth of global nuclear power is likely in future, which has in turn made the sustainable use of fuel resources such as uranium and thorium important. Uranium is the main-stay of the present generation of nuclear power plants; with the anticipated steep growth in nuclear energy it may be necessary to introduce thorium also as a fuel. Thorium-fuel cycle offers several potential advantages over a uranium fuel cycle, including greater abundance and availability, superior physical and nuclear properties of fuel, enhanced proliferation resistance, and reduced plutonium and actinide production. Technically, thorium has been well established and it behaves well in Light Water Reactors, High-Temperature Reactors and Liquid-Fluoride Thorium Reactors. Recognizing the potential contribution of thorium-fuel cycle in nuclear energy, renewed R&D efforts are underway in many developed countries around the world, both for small-scale and large-scale reactors.

Geochemically, thorium is four times more abundant than uranium in the crust of the Earth and economic concentrations of thorium are found in a number of countries. Geologically, thorium deposits are found in various geological environments, such as alkaline complexes, pegmatites, carbonatites and heavy mineral sands with wide geographic distribution. Worldwide, thorium resources are estimated to total about 6 million tonnes. Major resources of thorium are present in Australia, Brazil, Canada, India, Norway, South Africa and the U.S. Thorium exploration is presently ongoing in some countries, such as India and U.S. The present production of thorium is mainly as a by-product of processing of heavy mineral sand deposits for titanium, zirconium, tin and REEs.

Thorium (and REEs) have also been tentatively identified on the Moon (see more and summary (here).

STATUS OF THE RARE EARTH INDUSTRY

The EMD Mid-Year Report for 2011 (2011) offers the uninitiated an introduction to the rare earth commodities. That report covers the list of 17 REEs, their geological origins and distribution, production, prices, and explores some of the geopolitical issues involved, with a brief description of the REEs on the Moon. That report contains numerous references on REE subjects.

For this 2012 report, Piedra (2012) reports that most companies in the rare earth elements (REE) sector are trading at or near 12-month lows with, on average, prices for REEs continuing to decline since the mid-year 2011 highs. The slide is expected to continue bearing in mind price differences among the various 16 metals. As of the end of 3rd Quarter, 2012, the medium-term outlook for REEs was not upbeat. Many miners, especially juniors, as well as investors, including those specialized in REEs, are reassessing development, funding and exit strategies in light of current market conditions.

He further warns that a shakeout is imminent in the REEs industry. Of the over 250 publically listed REE companies, it is likely that more than 75 percent will shut down, be mothballed or merge within the next 24 months, especially in the light rare-earth elements (LREE) sector.

The shakeout in the market will intensify as investors increasingly differentiate not only between LREE and Heavy REE (HREE), but they also will identify specific market trends and supply/demand gaps for the more sought-after metals, such as neodymium, europium, terbium, dysprosium and yttrium. For the foreseeable future, investors will likely postpone developing the 100 billion tons of REEs that Japan reportedly recently found on the ocean floor (see more). Additional resources also appear to be available off-world on the Moon (see more and summary (here)).

U.S. Government is supporting the U.S. REE Industry

Sylvester (2012) reports that the U.S. Department of Defense (DOD) has made a bold move to support a North American rare-earth project, and this has made waves in the market. He also reports that the U.S. Department of Defense (DOD) recently took the unusual step of contracting with Ucore Rare Metals Inc. to conduct a mineralogical and metallurgical study on the company's Bokan Mountain heavy rare earth element (HREE) property in Southern Alaska, which, in essence, puts a stamp of approval and credibility on Ucore's resources as the primary source for the DOD's domestic supply chain.

Long (2012) reports in his interview with the well-known metals consultant, Jack Lifton, on the complexities of the REE industry.

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