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July 28, 2008

David Frankel
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Pine Ridge, SD 57770

Dear David:

Enclosed please find a copy of Comments and Recommendations Regarding the "Application for 2007License Renewal USNRC Source Materials License SUA-1534 Crow Butte License Area."

This report provides an initial review of the Crow Butte Application for License Renewal.

Sincerely,

<signed>
Paul Robinson
Research Director

Enclosure with attachments

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Comments and Recommendations Regarding the "Application for 2007 License Renewal USNRC Source Materials License SUA-1534 Crow Butte License Area"

Compiled:
July 28, 2008

Prepared by:
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This report compiles comments and recommendations development following review of the Application for 2007 License Renewal USNRC Source Materials License SUA-1534 Crow Butte License Area, (hereinafter "License Renewal Application" or "ALR") License Renewal Application for the Crow Butte in situ uranium mine in northwestern Nebraska.

The review identified portions of the ALR which fail to identify the analytic methods and data used to support information presented, fail to provide current or independently verified information and omit information regarding operations at the mine during the license period.

Technical criteria used in the conduct of this evaluation included, "GUIDANCE FOR REVIEWING HISTORICAL ASPECTS OF SITE PERFORMANCE FOR LICENSE RENEWALS AND AMENDMENTS," are provided at Appendix A of NRC 2003, GUIDANCE FOR REVIEWING

HISTORICAL ASPECTS OF SITE PERFORMANCE FOR LICENSE RENEWALS AND AMENDMENTS" (NUREG-1569, Attachment A to this report).

I. Failure to identify methods, data and supporting information

Much of the data provided by CBR in the ALR is not supported identified analytic methods, demonstrations that methods used are appropriate for the data set being considered, or that the data was collected and analyzed using appropriate standard methods.

A. ALR Section 2.7.3 Discusses Surface Water and Groundwater Quality including water quality restoration standards for mining areas at the CBR sites. CBR appears to state that only two wells were involved in the establishment of baseline water quality conditions in 1996-1997. At p. 2-167, the ALR states, "Monitoring was conducted to establish baseline groundwater quality conditions in the License Area. The program was conducted in 1996 and 1997, and includes samples from a Basal Chadron well (Well 81) and Brule well (Well 78) in the License Area."

No information is provided on the sampling programs at those two wells or the water quality data from those two wells. The ALR appears to indicate that data from those two wells appears to have been the sole source of data used in the development of "Baseline and Restoration Values for Mine Units – 1- 10 on ALR p. 2-166 – 2-176, tables 2.7-6 – 2.7-16."

The ALR fails to provide information on the information collected from the two baseline wells identified on p. 2-167, including: 1) where they are located relative to the various mine units and 2) how water quality in the mine units and water quality in the areas between the mine units and the monitoring wells varies.

The ALR fails to demonstrate that the data base from the two baseline wells identified at p. 2-167 is sufficiently detailed or well developed to determine whether: 1) a sufficient number of samples were collected, 2) the statistical distribution of sampling sites and data are accurately characterized and 3) the statistical analysis of sample data support the restoration values listed.

B. The ALR relies on a USEPA guidance documents for groundwater monitoring that is out of date and no longer current in use:

U.S. Environmental Protection Agency. 1974. Manual of Methods for Chemical Analysis of Water and Wastes, USEPA-62516-74-003a, 1974 (EPA, 1974).

U.S. Environmental Protection Agency. 1977. Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities, USEPA-530/SW-61 1, August, 1977. (EPA 1997)

More recent and appropriate EPA guidance documents for groundwater analyses used in standard setting include:

U.S. Environmental Protection Agency (EPA), 1992. Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance, Washington, DC. (EPA 1992)

U.S. Environmental Protection Agency (EPA), 2000a. Guidance for the Data Quality Objective Process – QA/G-4, EPA/600/R-96/055, Washington, DC. (EPA 2000a)

U.S. Environmental Protection Agency (EPA), 2000b. Guidance for the Data Quality Assessment – Practical Methods for Data Analysis - QA/G-9, EPA/600/R-96/084, Washington, DC. (EPA 2000b)

CBR should be required to demonstrate, prior to license renewal, that the restoration guidelines found in the ALR meet the requirements of the identified EPA guidance documents including whether CBR has: 1) properly collected the number of samples required for specific statistical analyses conducted in the ALR; 2) collected data that are "normally" or "log-normally distributed" and used statistical methods for standard setting that appropriate for the distribution of data collected , and 3) whether samples were collected for the full period of time provided for in the USEPA Guidance documents.

If the CBR data is found to not meet EPA guidance criteria with respect to the number samples, distribution and/or frequency of samples, then a supplemental effort should be required to establish baseline and restoration data that meet USEPA guidance document criteria before additional uranium extraction is permitted.

Where restoration criteria are found to have been inappropriately or erroneously set as defined by the current USEPA guidance documents, additional groundwater restoration efforts should be conducted to complete restoration to appropriate set standards as defined by methods in the USEPA guidance documents.

C. The ALR at p. 5-109 – 5-117 provides Tables 5.8-12 – 5.8-15 which identify uranium and radium results from private well and surface water monitoring activities from 1991- January 2007. CBR provides no information regarding the collection and analysis of these data such as: 1) how wells were purged or pumped before sampling to insure that "water from the aquifer" - rather than water from that has been sitting in a piping system - is collected, 2) how water samples were collected, controlled and analyzed, 3) how many samples were collected and by whom, and 4) whether spilt samples or blank samples were analyzed for to insure proper quality control and quality assurance for sampling programs described.

The ALR should be revised and supplemented to include data about the collection, handling and analysis of water quality samples including a demonstration that quality assurance and quality control measures are in place and used for all CBR sampling and analysis programs.

D. ALR Section 6 addresses Groundwater Quality Restoration, Surface Reclamation and Facility Decommissioning. Tables are provided at p. 6 –8 – 6 – 18. The restoration standard setting methodology described at P. 6-6 – 6-7 does not address the statistical validity of the restoration goals at the site in the context of the EPA groundwater restoration methodologies cited above. Restoration goals should be reconsidered by reviewing the adequacy of the data base supporting the current standard listed in Section 6

to meet the statistical tests for restoration standards and groundwater monitoring in EPA 1992, EPA 2000a and EPA 2000b. If the use of the baseline as established cannot be supported by independent analysis using EPA criteria, a revised set of appropriate derived restoration goals should be established for the CBR mine fields.

II. Failure to provide current or independently verified information

A. The ALR provides regional water level information in Tables 2.7-3 – 2.7-4 which show "Brule and Basal Chadron Water Levels" with data from the 1982-3 period only. No information on water level variability in these important regional aquifers is provided for the period of time since start-up of CBR ISL or during current 10-year current license period. The data is out of date and of poor quality, as noted in the ALR, "Because these data presented in Figure 2.7-2 and Figure 2.7-3 are over 10 years old and limited in extent, no potentiometric contours are presented. Further, because the regional flow in the Brule and Basal Chadron differ depending on location (e.g., south versus north of the White River), a regional potentiometric map with data from the [CBR site] is not presented."

To address the failure of the ALR to provide regional water level data on local aquifers including potentimetric surface – water level information; updated, current water level information should be compiled and incorporated in to the ALR. Current, accurate information is data fundamental to mapping local water resource conditions and aquifer flow characteristics including but not limited to the potentiometric surface including season change in the potentiometric surface.

Data in the ALR should be supplemented to include recent, including contemporary, water level data from all wells available from the 1982-3 samples and wells installed since that time, compilation of data for water level for wells in the affected area between 1983 and 2008 to identify variation from the 1982-3 data and mapping of the potentiometric – water level patterns – and other characteristics of the aquifers in the affected area.

This supplementary regional water level information should then be analyzed in the context of the regional stratigraphic profiles shown in Figures 2.6-3 – 2.6-11, to demonstrate the location of the potentiometric surface in the context of existing geologic stratigraphy and structure, including the White River Fault identified on p. 2-11 and 2-11.

B. ALR Section 2.7.2.3 discusses a series of aquifer pump tests. The ALRA provides only a narrative descriptions of the pump tests conducted by CBR and does not provide the data compiled during the pump tests which is essential for an independent review of the analysis and conclusions provided by CBR.

Figure 2.7 –8 for examples, identifies the area of influence of the pump tests but not the location of the observation wells from which data is collected during properly conducted aquifer pump tests. The discussion in the ALR fails to identify well construction or completion methods for pumping or observation wells including whether the screened area – the portion of the well casing that allows water flow into the well – was constructed across the complete cross-section of the aquifers being examined or not.

At p. 2-106 the ALR states, "The vertical thickness of the Chadron Sandstone within the Area of Review averages about 60 feet. An isopach of the Chadron Sandstone in the Area of Review indicates a range in thickness of 0 feet on the northeast to nearly 100 feet on the west." Figure 2.6 – 12 shows large area of the Chadron Sandstone greater than 80 feet thick. P. 2-165 includes the conclusion that the aquifer thickness is 33 – 45 feet from the pump test data at p. 2-165.

Failure to identify the specific observation wells, their logged characteristics and completion methods prevents independent evaluation of the pump tests described in the ALR. As the Chadron Sandstone appears to have a high degree of variation in its thickness - 0-100 feet at p. 2-106 concluding that the aquifer averages 33- 45 feet thick at p. 2-165 fails to accurately characterize the wide variation in aquifer thickness demonstrated in well log data presented other sections of the ALR.

C. The ALR fails to incorporate a current understanding of the geologic structure and stratigraphy of the CBR site and surrounding areas. As the ALR uses the same geological structure and stratigraphic information as the CBR North Trend Expansion Area License Amendment Application and supporting documents. Therefore, the critique of CBR's geologic information provided by the November 2007 "Technical Review of Aquifer Exemption Petition for North Trend Expansion" compiled by Nebraska Department of Environmental Quality also applied to the geologic information in the ALR. The NDEQ Technical Review showing that CBR has failed to provide geologic information in its licensing documents which is up to date with the geologic literature related to structure – including fault and fracture patterns, stratigraphy – including the names for and delineation of geologic units, and geohydrology – including primary and secondary permeability in aquifers of concern for Northwestern Nebraska applies directly to the content of the ALR.

The CBR ALR and other licensing document should be revised to reflect current literature on geologic and hydrologic conditions in the White River Fault area a occupied by the CBR mine.

III. Omission of information regarding operations

A. At p. 3-16, the ALR states that the injection of solutions for mining will be at the rate of 9,000 gallons per minutes and that the volume of liquid waste generated from that injection rate would be 47,304,000 gallons per year. CBR fails to provide information from past operations at the site and neither demonstrates or indicates what operating injection rate as and liquid waste volume during the license period actual were.

At. p. 3-16, the ALR states, "CBR adequately handles the liquid waste through the combination of deep disposal well injection and evaporation ponds."

No information is provided in the ALR to demonstrate whether a 9,000 gpm injection rate was ever attained or was maintained during the 10 year license period. No operational information from CBR experience is provided as to: 1) the actual volume of liquid water was actually generated during the 10 year license period, 2) the portion of that liquid waste that was sent to the evaporation ponds relative to the

volume of liquid waste sent to the deep disposal well and 3) what the concentrations of constituents of concern were in the liquid waste generated.

These omission should be eliminated by addition of supplemental information to the ALR before its approval.

B. At p. 4-3, the ALR provides a narrative regarding liquid and solid wastes including, and, at p. 4-6, the ALR provides a discussion of "Potential Pollution Event involving Liquid Wastes." CBR fails to provide any historical record of site operations – as provided for in NUREG 1569 APP. A – for any incidents regarding liquid or solid wastes. Such records would include such as: 1) inspection reports or records documenting how and when releases were discovered, 2) notices of violations and 3) associated responses for any activity involving liquid or solid wastes.

NRC records show that CBR incidents include, at least, 3 leaks of liquid waste from evaporation ponds detected in 1997, 2004 and 2006. Historical records appropriate for incorporation in to a renewal application per NUREG-1569 App. A would include records of those and other releases of liquid or solid waste, records of responses to those incidents and inspections record resulting for CBR or regulator investigations of releases.

C. At p. 5-88 – Section 5.8.8, the ALR discusses Groundwater/Surface Water Monitoring Programs including, at "Upper Control Limit and Excursion Monitoring" at p. 5-107 and "Excursion Verification and Monitoring" at p. 5-108. CBR fails to include any historical records of site operations regarding excursions including inspection reports, notices of violation and associated responses for those incidents and inspection records resulting from CBR or regulator investigations of those releases.

NRC records show at least 20 instances where CBR monitoring wells were placed on excursion status from 1998 – 2006 including two instances in 2008. The ALR fails to identify these incidents, describe CBR or regulator responses to those incidents or identify and lessons learned to minimize or eliminate future instances of excursion.

D. At p. 1-23, Section 1.9, the ALR provides an overview of the range of groundwater restoration activities proposed by CBR, activities discussed in Section 6. At p. 1-25, Section 1.11, the ALR identifies existing reclamation surety for the CBR facility as in the amount of. $22,980,913. This amount is derived from an evaluation based on groundwater restoration activities described in Section 6.

The ALR discussion of groundwater restoration methods fails to consider or evaluate any historical operational experience at the site related to groundwater restoration in any detail though more than a dozen excursions have been detected. The Crow Butte experience, from both mine fields that have undergone restoration efforts and the history of excursions at the sites should be incorporated into the discussion of restoration methods and activities, including pore volumes calculations, to verify that "real world" field restoration processes reflect the scope of proposed activities and projected reclamation surety level accurately. CBR should be required to reassess its restoration methodology and costs based on the real world experience from data generated during mine field restoration and excursion management including total reclamation surety needs.

E. At Section 8, the ALR addresses alternatives the proposed action. The ALR fails to demonstrate that any uranium from CBR or any other CAMECO mine reaches US uranium consumers. As the ALR does not demonstrate that any CBR uranium is processed or used in the US, rather than CAMECO-owned uranium processing facilities in Canada, the alternatives identified do not demonstrate an accurate assessment of uranium market conditions or the actual use of CBR uranium in fact during its operating life to date. CBR should be required to demonstrate were the uranium produced at the site is used and develop alternative variants based on actual use of uranium from the site rather than conceptual alternatives as discussed in the ALR.

The global uranium market is awash in uranium supplies from existing producers as well as secondary sources. Increased availability of secondary uranium is a major alternative to primary uranium in enrichment tailings-owning countries such as the US. Development of realistic alternative sources of uranium such as upblended enrichment tailings is already conducted in Russia at levels well above the

production rate at CBR. The evaluation of alternative sources of uranium should reflect real world market conditions and the market role of producers such as the licensee in this case, CAMECO. Alternatives should not be developed solely to bolster opportunistic production considerations of well diversified multinational uranium producers such as Cameco. Attachment B – "Need or Greed?: Uranium Prices and Demand" provides an overview of uranium supply and demand conditions in 2005 and 2006 including the availability of more than 50 years of uranium supplies in existing deposits, not including secondary sources, as reported by the World Nuclear Association a nuclear industry trade group, www.world-nuclear.org.

F. The ALR identifies Environmental Justice matters at Section 2.3.3 at p. 2-44 and Section 7.11 at p. 7-31. These discussion fail to identify and address the strong historical and cultural connections of the Lakota Nation to the Crow Butte area. The ALR fails to identify cultural resources in the Crow Butte area, consultation with tribal leaders with authority to address cultural resources, or the history of Lakota cultural activities in the area. The ALR fails to identify community development initiative to insure that Native Americans, the minority ethnic group with the largest population in the region, receive any of the potential economic benefit ascribed to the CBR operations in the ALR. The ALR relegated Environmental Justice to a bean counting exercise and fails to full and completely address environmental justice issues associated with activities described in the ALR.

F. The ALR fails to identify the potential health consequences of uranium, radium, radon, radon decay products, and other radionuclides and heavy metals found in the ore zone and liquid and solid waste from the CBR operations. The ALR should be revised and expanded to identify the potential health consequences of exposures to uranium, radium, radon, radon decay products and other radionuclides and heavy metals associated with the Crow Butte area uranium ores. Attachment C – "Uranium Fact Sheets on the Web" includes citations to the Agency for Toxic Substance and Disease Registry (ATSDR) Toxicology Fact Sheets on Radon, Radium, Uranium, Arsenic, Cadmium and Lead. Other Toxicology/Fact Sheets are readily available.

Conclusion

This brief analysis of the Application for License Renewal for the Crow Butte In Situ Uranium Mine demonstrates that the application fails to use current research and analytic methods, fails to provide historical information about operations at the site including data from restoration and excursion experience on site, and omits key information about social and economic aspects of the uranium development activity proposed.

Because the ALR so fails to provide current and updated data on geologic and water resources in the affected area and fails to recount the CBR operational experience, and other major limitations, the license renewal should not be provided and revised ALR required.

Attachment A – NUREG 1569 Appendix A

Standard Review Plan for In Situ Leach Uranium Extraction License Applications NUREG 1569 – 2003

Appendix A

GUIDANCE FOR REVIEWING HISTORICAL ASPECTS OF SITE PERFORMANCE FOR LICENSE RENEWALS AND AMENDMENTS

For license renewals and amendments, the historical record of site operations, including air and ground-water quality monitoring, provides valuable information for evaluating the licensing actions. Following are specific areas where a compliance history or record of site operations and changes should be provided for review:

- For license renewals, U.S. Nuclear Regulatory Commission (NRC) inspection reports and license performance reports

- Amendments and changes to operating practices or procedures

- License violations identified during NRC or Agreement State site inspections

- Excursions, incident investigations or root cause analyses, and resultant cleanup histories or status

- Exceedences of any regulatory standard or license condition pertaining to radiation exposure, contamination, or release limits

- Exceedences of any non-radiation contaminant exposure or release limits

- Updates and changes to any site characterization information important to the evaluation of exposure pathways and doses including site location and layout; uses of adjacent lands and waters; population distributions; meteorology; the geologic or hydrologic setting; ecology; background radiological or non-radiological characteristics; and other environmental features

- Environmental effects of site operations including data on radiological and non-radiological effects, accidents, and the economic and social effects of operations

- Updates and changes to factors that may cause reconsideration of alternatives to the proposed action

- For license renewals, updates and changes to the economic costs and benefits for the facility since the last application

- For license renewals, the results and effectiveness of any mitigation proposed and implemented in the original license

Attachment B
http://www.sric.org/voices/2006/v7n3/Need_Greed.html

Need or Greed?
Uranium Prices and Demand

In "Voices from the Earth" V7 n3, Fall 2006

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The sevenfold increase in uranium prices during the past four years has resulted in a tidal wave of uranium ore exploration and development activity around the world. But based on a close review of existing and projected world uranium supplies, there's really no need for any new mining sites. The fact is, there's more than enough yellowcake (uranium oxide) in existing deposits and secondary sources to meet projected demand for nuclear fuel for more than 50 years.

The rise in the uranium spot market price (for buyers without long-term contracts) reflects that investors and private industry are focused more on profiting from an imaginary "shortage" than filling a fuel gap to address increased uranium demand to feed new nuclear power stations being advocated by reactor manufacturers. All of which begs the question: is the sudden interest in new uranium mining a matter of real need or plain old-fashioned greed?

That opportunist profiteering may be at the root of the current uranium boom is suggested by the entrance into the market of a new wave of uranium companies — many of which are "junior mining companies" joining the uranium market. The "old wave" of the world's major uranium producers had already identified uranium ore resources at existing deposits that are sufficient to meet the more than 50 years of current or projected uranium demand. Junior mining companies often have limited financial resources, and instead plan to make money on a commodity that is relatively inexpensive to find and produce in comparison to current prices. Many junior companies have never actually mined anything, and are instead buying up existing claims, leases and other forms of "uranium properties" in the hope of attracting capital to develop them at some time in the future. Often, junior companies want to attract more substantial "senior" mining companies and banks to invest in the deposits that the juniors may identify, but lack the financial resources or corporate track record to fund them.

The current boom is resulting in renewed uranium exploration and development activities in communities that have suffered from the legacy of uranium mining in the 20th century and prospecting near communities that have never faced the juggernaut of uranium mining or other industrial development activity. Many of the communities facing renewed interest in long-dormant mining districts are in low-income rural areas and indigenous communities that have little long-term benefit to show from past uranium mining. The legacy of the first 50 years of uranium mining in those communities can provide a warning to areas where new mines, and rosy projections of economic benefit from the new mining activity, are being touted.

How do we know there's enough uranium for the next 50 years?

In 2003, the World Nuclear Association ("WNA") asserted that the known recoverable uranium resources already identified provide a 50-year supply for conventional nuclear reactors at a projected long-term demand of about 70,000 tonnes per year, countering perceptions that uranium for any future nuclear reactors might be in short supply. Recognizing the enormity of the known recoverable uranium resource, WNA asserted:

"The world's present measured resources of uranium in the lower cost category (3.5 million tonnes) and used only in conventional reactors, are enough to last for some 50 years. This represents a higher level of assured resources than is normal for most minerals."

By 2005, WNA's global total of known recoverable uranium resources had increased by 34% to 4.7 million tonnes. The 1.2 million tonnes of additional uranium in unmined deposits identified in just the last three years is roughly equal to the total amount of uranium consumed by the nuclear weapons and reactor industry from its inception in the 1940s through 2005. Estimates of world uranium resources are a long-time interest of the WNA (www.world-nuclear.org), formerly called the Uranium Institute, and a prominent source of uranium supply and demand information for industry and government for decades. The on-line proceedings of WNA's annual symposia are a readily available source of detailed nuclear fuel market information and a major source for this article.

Table 1 identifies the countries with the largest known recoverable uranium resources and the amount of increase in those resources between 2003-2005. The commonly used term for uranium in unmined mineral deposits that can be exploited at market prices is "known recoverable uranium resources," which are identified as the amount of uranium that can be extracted at a specified cost. The standard cost category for known recoverable uranium resources has been set at $80 per kilogram (/kg), or $36/ per pound, for several decades.

TABLE 1
INCREASES IN KNOWN RECOVERABLE URANIUM RESOURCES*
2003 – 2005
$80/pound ($176/kilogram) cost category • 1 tonne = 1 metric ton = 2,200 pounds

COUNTRY	TONNES U 2003	WORLD PERCENT 2003	TONNES U 2005	PERCENT INCREASE 2003-2005	WORLD PERCENT 2005
Australia	989,000	28%	1,143,000	16%	24%
Kazakhstan	622,000	18%	816,000	31%	17%
Canada	439,000	12%	444,000	1%	9%
South Africa	298,000	8%	341,000	16%	7%
Namibia	213,000	6%	282,000	33%	6%
Brazil	143,000	4%	279,000	97%	6%
Russian Federation	158,000	4%	172,000	9%	4%
USA	102,000	3%	342,000	235%	7%
Uzbekistan	93,000	3%	116,000	20%	2%
All Other Countries	480,000	14%	808,000	68%	18%
World total	3,537,000		4,743,000	34%	

Sources: World Nuclear Association 2005 Symposium, International Atomic Energy Agency

NB: Throughout this article, the terms "uranium resources," "uranium oxide," and "yellowcake" refer to natural uranium that has been concentrated after extraction from its host rocks, which are called "uranium ore." Concentrated uranium (U3O8) must be converted, enriched, and fabricated before being used as fuel in nuclear power plants.

While large increases in recoverable resources are reported for many countries, the largest total increase and largest percentage increase is for the United States (U.S.). Much of this increase can be attributed to reconsideration of U.S. deposits — some through paper exploration involving review and republication of decades-old resource estimates — that were previously identified as recoverable at the cost of $50/pound in the 1970s. "Uranium reserves" are a category of available uranium determined based on future operating and capital expenditures incurred in the recovery of uranium and reflect greater certainty regarding the availability uranium from a mineral deposit than uranium "resources." In 1979, U.S. "reserves" of uranium at the $50/pound cost of recovery were 979,000 tonnes — almost three times the total of U.S. recoverable uranium "resources" for 2005 — of which New Mexico uranium reserves were 511,500 tonnes, or 52% of the total. New Mexico would be listed as having the third largest uranium resource tonnage in 2005 if the 1979 New Mexico "reserves" figure was used as New Mexico "resources."

How are uranium resources and uranium demand estimated?
WNA reports that annual uranium consumption in 2005 was approximately 70,000 tonnes. Even at the most optimistic of growth projections, future uranium consumption would top off at 125,000 tonnes by 2025; consumption of uranium as nuclear reactor fuel would be even less under more moderate growth predictions. These uranium demand figures are dwarfed by the known recoverable uranium resource in 2005: 4.7 million tonnes, which represents more than 67 years of world requirements at the 2005 rate of 70,000 tonnes. Using the 2025 medium growth scenario of 100,000 tonnes, this total would provide more than 47 years of world requirements. World uranium demand projections are updated frequently by WNA and other sources to reflect changing market conditions.

Is uranium from unmined deposits the only source for potential future use?
Though the amount of identified unmined uranium is enough for 50 years of current and projected use, "recycled or secondary uranium" derived from previously mined and processed uranium (processed for use in nuclear fuel or weapons) has been a significant and growing source of uranium for reactor use in recent years. Secondary sources include:

- Commercial inventories — uranium supplies owned by reactor operators;
- Government inventories — uranium supplies owned by governments;
- Nuclear weapon/military inventories — uranium supplies in the form of "highly enriched uranium" used in nuclear weapons manufacturing and owned by governments;
- Reprocessed uranium and MOX fuel — uranium supplies in used nuclear reactor fuel;
- Re-enriched depleted uranium — uranium supplies in residuals from uranium enrichment processing — called "uranium enrichment tailings," or "depleted uranium."

Uranium from secondary sources such as commercial inventories, weapons-grade uranium stockpiles and, in Russia, uranium enrichment tailings, has been used for nuclear reactor fuel for the past decade. In 2005, secondary sources provided more than 45% of the roughly 70,000 tonnes used worldwide. WNA uranium supply and demand projections estimate that secondary sources will provide 35% of the uranium to be consumed in 2010.

How does the availability of secondary sources of uranium affect uranium prices and future demand?
Secondary uranium sources affect the uranium market in a range of complex ways. In brief, government-held secondary uranium resources entered the reactor-fuel uranium market in a major way during the period when uranium prices were less than $10/pound. The market entry resulted from policy changes by the U.S. and Russian governments that strictly limited the volume and prices of those supplies that have been allowed to enter the market. The prices for the secondary uranium are much higher than the cost of uranium from mines. During the past five years, the price of the uranium at existing mines and unmined deposits or "primary" uranium has risen to approach the secondary uranium prices.

However, mining uranium is very inexpensive compared with the current spot market price. The historic "finding cost" — the cost of finding and identifying mineable uranium ore deposits — is estimated at about $0.60/pound ($1.50/kgU). Estimates of the cost of recovery of uranium oxide by milling or in situ recovery have been in the $15 - $25/pound ($33 - $55/kg) range for more than 20 years. In five years, the uranium market has turned on its head; ore that cost twice the market price to recover in 2000 when the price was $7/pound now costs less than half the September 11, 2006 market price of $52.00.

While the price of uranium has risen, in part, because of secondary supplies, the long-term availability of uranium from secondary sources is yet to be determined. Although the amount of uranium available from secondary sources is very large, the lack of long-term agreements to use the secondary uranium sources leaves the projections of secondary uranium consumption beyond 2010 very uncertain. As plans, and eventually contracts, emerge for use of secondary sources of uranium for reactor fuel, demand for newly mined primary uranium may decrease.

How much uranium is available from secondary supplies?
Substantial amounts of uranium are available in each of the categories of secondary uranium supply. Commercial inventories of uranium — the supplies of uranium owned by reactor operators — were

estimated at 110,000 tonnes of uranium in 2005, equal to about 1.5 years of global uranium demand in 2005. Commercial uranium inventories represent holdings for future use and are not predicted to be maintained near current levels for the next several decades by WNA analysts.

Government inventories of uranium are considered by WNA to be composed primarily of non-military government-owned supplies of "highly enriched uranium" (HEU), a form of uranium usable for nuclear weapons production, held largely by the government of the Russian Federation. As noted in Voices in 2004 (Vol. 5, No. 4), the U.S. and Russia, as well as other nations that have nuclear weapons, continue to retain extensive HEU stockpiles. World HEU stocks at the end of 2003 are reported as 1,900 tonnes, of which non-military resources total 175 tonnes and military resources total 1,725 tonnes. Of the total military uranium, 300 tonnes of HEU in Russia are "declared excess," and available for blending down to reactor grade.

Assuming that one tonne of HEU contains the U-235 content of 360 tonnes of yellowcake (which is refined, but unenriched uranium oxide), then 300 tonnes of HEU contain the U-235 content of 108,000 tonnes of yellowcake. The "recycling" of the Russian "excess" HEU is the projected source of 10,000 to 12,000 tonnes of future uranium supply through the year 2013, though future agreements to reuse HEU may be developed sooner.
Russian civilian HEU — HEU transferred from military to non-military government ownership — was estimated at 175 tonnes, or equivalent to 63,000 tonnes of uranium oxide. This resource is projected to contribute about 9,000 tonnes of uranium to global uranium supplies until existing HEU blending and marketing agreements involving the U.S. and Russia expire in 2013.

The 1,725 tonnes of military HEU, held primarily by the governments of U.S. and Russia, is equivalent to more than 600,000 tonnes of yellowcake. Though the global inventory of HEU is under a sales embargo until 2009, the U.S. has initiated plans to market that uranium when the moratorium expires. The first sale of the U.S. civilian uranium inventory is to Bonneville Power Administration, a federally-owned power provider, in an amount equivalent to 2,500 tonnes of yellowcake to be provided during the 2009-2017 period.

The uranium content of enrichment tailings has been estimated to be equivalent to roughly 770,000 tonnes of uranium oxide. Of that amount, U.S. enrichment tailings contain the equivalent of roughly 450,000 tonnes of uranium and Russian enrichment tailings contain roughly 300,000 tonnes of uranium. In recent years, Russian has made 3,000 tonnes of uranium from enrichment tailings available on the world market. The U.S. has yet to make any uranium from enrichment tailings available for use as reactor fuel.

Uranium market analysts estimate that only about 20%, or 130,000 tonnes of uranium oxide equivalent in uranium enrichment tailings, is likely to be marketed during the next 25 years. Of that amount, some 60,000 tonnes of uranium are projected to come from Russian enrichment tailings and 70,000 tonnes from uranium from U.S. enrichment tailings. Since current U.S. policy is not to use recycled enrichment tailings for reactor fuel, stockpiles of uranium enrichment tailings have been growing at the U.S. uranium enrichment sites at Portsmouth, Ohio; Paducah, Kentucky; and Oak Ridge, Tennessee.

The uncertainty about future availability of large amounts of uranium from secondary sources is a focus of considerable speculation within the nuclear industry and is reflected in presentations from WNA symposia. Analysts recognize that government policies play a key role in determining if and when major amounts of secondary sources — particularly highly enriched uranium and uranium enrichment tailings — will enter the uranium market. This uncertainty involves many issues that governments must address, from nuclear weapons production and nuclear non-proliferation policy to the need of states to assure domestic uranium supplies when the U.S. might free up uranium enrichment tailings to supplement primary uranium sources. Certainly, if uranium from non-proliferation-driven "blending down" of highly enriched uranium and reuse of the uranium content of enrichment tailings enters the uranium reactor fuel market during the next several decades, the need for primary uranium, ore from yet to be mined deposits, will be significantly reduced, and the market price would likely drop considerably.

Who is involved in the new uranium boom?
In 2000, about 30 companies were actively involved in uranium exploration. About half were uranium producers, including government-owned companies, and the other half were junior companies. By 2005, the number of firms involved in uranium exploration had increased 500% to approximately 175 companies, and almost all the new entrants are juniors.

Uranium exploration expenditures have also risen steeply. World uranium exploration spending grew from $55 million (U.S.) in 2000 to approximately $185 million (U.S.) in 2005, an increase of more than 333%. During the 2000-2005 period, exploration work by juniors grew from $15 million, about 27% of world uranium exploration spending, to $100 million, or about 54% of world uranium exploration spending.

While the number of uranium exploration companies has exploded in the past five years, the number of uranium producing companies has remained relatively static. In 2004, the leading uranium producer in the world controlled about 20% of world uranium production capacity and 28% of "Western World" capacity. The top three companies controlled more than 50% of world production and more than 70% of Western production capacity. The top five companies controlled 70% of world capacity and 89% of Western capacity.

In 2005 the top uranium producing companies, both "Western World" and "non-Western World" were:

- **Cameco** — a company that is part-owned by the government of the Province of Saskatchewan, Canada, with production primary from its home Province; 20% of world production
- **Rio Tinto** — a private company with production in Australia and Nambia; 13% of world production
- **Areva** (formerly known as Cogema) — a company part-owned by the government of France with production in Saskatchewan and Niger; 12% of world production
- **KazAtomProm** — A government-owned company in Kazakhstan that produces uranium in its home country; 10% of world production
- **BHP Billiton** — a private company with production in Australia; 9% of world production
- **TVEL** — a company owned by the government of the Russian Federation with production in Russia; 8% of world production
- **Navoi** — a company owned by the government of Uzbekistan that produces uranium in its home country; 6% of world production

That list demonstrates the growing significance of uranium production from the Former Soviet Union — the Russian Federation, Kazakhstan and Uzbekistan — and the lack of significant major U.S.-based uranium companies or production.

The 235% increase in known recoverable uranium resources in the U.S., the largest for any country during the 2003-2005 period, may be an indication that the U.S. will return to the list of major uranium-producing regions. Recent uranium exploration and development activity in the U.S. has included both major uranium producers and juniors. Cameco is the only leading world uranium producer operating in the U.S. with in situ leach (ISL) uranium properties in Wyoming and Nebraska.

Only four conventional uranium mills remain in the U.S., as more than 50 have been dismantled since the late-1960s. Cotter Corporation's Canon City, Colo., mill has been in operation the longest, beginning in 1958, but operating only intermittently since 1979. International Uranium Corp., which has kept its White Mesa uranium mill at Blanding, Utah, operating in the past decade by recovering uranium from "alternate feed sources" — usually wastes from remediation projects with high uranium content — has announced plans to operate uranium mines in southeastern Utah. In July 2006, SXR Uranium One (SUO) announced its acquisition of the other two uranium mills in the U.S., the Sweetwater mill in Wyoming (formerly owned and operated by hardrock mining giant Rio Tinto) and the Shootaring Canyon mill in Utah. Both of these facilities have been inactive for many years. Uranium is also being produced from at least three ISL mines operating in Nebraska, Texas and Wyoming. Unlike conventional mills, which crush and grind rocks to extract and concentrate uranium, ISL plants "recover" uranium from groundwater that has been oxidized by injection of chemicals that liberate uranium from the host rocks underground.

Junior companies with no past history of uranium production lead the uranium exploration boom in the U.S. Ur-Energy is actively re-exploring formerly investigated uranium properties in Wyoming. Energy Metals, which recently acquired fellow junior Quincy Energy, Inc., has exploration activities in Wyoming, Arizona, Colorado and New Mexico. Laramide Resources, a Canadian firm, announced the acquisition of Homestake Mining Co.'s properties in the Grants, N.M., area, and is planning exploration on the flanks of Mt. Taylor in the Grants Minerals Belt, the most productive uranium district in the U.S. Mesa Uranium is developing deposits in the Lisbon Valley of southeastern Utah. Strathmore Minerals Corp. (SMC), another Vancouver-based company, has acquired properties in predominantly Navajo areas of New Mexico. Hydro Resources, Inc. (HRI), the wholly owned subsidiary of Uranium Resources, Inc. (URI), a Texas-based uranium company, continues to pursue permits for its Church Rock and Crownpoint holdings. Numerous other junior companies — for example, Glen Hawk Minerals, Golden Patriot, Mill Bay Ventures, Mangum Uranium, Powertech Uranium — have been big splashes in the trade and investor press in the past year with their announcements of acquisitions of existing uranium deposits in the Western U.S. Each of these firms touts the prospects of making serious money in the "hot" uranium market.

Few, if any, of these junior uranium companies have articulated policies reflecting the internationally recognized guidelines for socially responsible mineral development and informed prior consent for mineral exploration and development reflected in the Equator Principles adopted by a growing set of international firms. The principles are reflected in the International Finance Corporation emerging Environmental and Social Development Guidelines (www.ifc.org/enviro) and other institutional policies of the World Bank Group.

The new uranium boom is driven by a rising price of uranium that is considerably higher than the cost of discovery and extraction of known unmined uranium resources. Thus, greedy companies are eagerly pursuing potentially large profits from development of previously explored and cheap to mine uranium deposits. The victims of the boom could again be communities around the world — and including many native communities in the Western U.S. and Canada — that have the legacy of busted uranium economies, health impacts from human exposures, and land and water contamination from past uranium exploration and production.
- Paul Robinson

Attachment C

Uranium Fact Sheets on the Web
May 24, 2008

Compiled by
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Southwest Research and Information Center
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I. Uranium Fact Sheet
http://www.ieer.org/fctsheet/uranium.html
Institute for Energy and Environmental Research – "Uranium: Its Uses and Hazards"

II. Laguna Pueblo Uranium Curriculum
http://www.miningwatch.ca/index.php?/Uranium/Laguna_curriculum
Uranium Mining and its Impact on Laguna Pueblo: A Study Guide for an Interdisciplinary Unit, July 21, 1998

III. Uranium Overviews from Wise Uranium Project
http://www.wise-uranium.org/uwai.html
Uranium Mining and Milling Wastes: An Introduction, by Peter Diehl
Contents
- URANIUM MINES
  - WASTE ROCK
  - HEAP LEACHING
  - IN SITU LEACHING
  - MILLING OF THE ORE
- URANIUM MILL TAILINGS DEPOSITS
  - Characteristics of uranium mill tailings
  - Potential hazards from uranium mill tailings
  - Concepts for tailings disposal
  - Standards for uranium mill tailings management
  - Reclamation of uranium mill tailings deposits
- DISPOSAL OF OTHER MATERIALS

http://www.wise-uranium.org/stk.html?src=stkd01e
WISE Uranium Project - Slide Talk: Uranium Mining and Milling
- Uranium mining and milling basics
- Environmental impacts
- Health hazards for miners and residents
- Uranium mill tailings hazards and reclamation
- Tailings dam stability

www.wise-uranium.org includes pages for uranium sites around the world among other material.

IV. Environmental Protection Agency Uranium Fact Sheet
http://www.epa.gov/radiation/radionuclides/uranium.htm
URANIUM
The Basics
- Who discovered uranium?
- Where does uranium come from?
- What are the properties of uranium?
- What is uranium used for?

Exposure to Uranium
- How does uranium get into the environment?

- How does uranium change in the environment?
- How are people exposed to uranium?
- How does uranium get into the body?
- What does uranium do once it gets into the body?

Health Effects of Uranium

- How can uranium affect people's health?
- Is there a medical test to determine exposure to uranium?

Protecting People From Uranium

- How do I know if I'm near uranium?
- What can I do to protect myself and my family from uranium?
- What is EPA doing about uranium?

V. Uranium Mining documents from USEPA Technology Enhanced Naturally Occurring Radioactive Materials
Uranium Mining Wastes page - http://www.epa.gov/rpdweb00/tenorm/uranium.html

Includes TENORM from Uranium Mining Reports
In 2008, EPA updated and re-released a two-volume technical report on uranium mining TENORM wastes, *Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining,* Volumes 1 and 2:

Volume 1: Mining and Reclamation Background provides background information on the occurrence, mining, and reclamation of uranium mines - http://www.epa.gov/rpdweb00/tenorm/pubs.html#402-r-08-005

Volume 2: *Investigation of Potential Health, Geographic, and Environmental Issues of Abandoned Uranium Mines* provides a general scoping evaluation of potential radiogenic cancer and environmental risks posed by abandoned uranium mines - http://www.epa.gov/rpdweb00/tenorm/pubs.html#402-r-08-005ii

VI. Uranium and Radium Human Health Fact Sheets – 2 pages
http://www.ead.anl.gov/pub/doc/Uranium.pdf and
http://www.ead.anl.gov/pub/doc/Radium.pdf
Uranium Human Health Fact Sheet? Radium Human Health Fact Sheet - Argonne National Laboratories

Contents

- What is it?
- Where does it come from?
- How is it used?
- What's in the Environment?
- What Happens to It in the Body?
- What Are the Primary Health Effects?
- What Is the Risk?

VII. Agency for Toxic Substances and Disease Registry (ATDR) – as 2 page fact sheets as well as detailed Public Health Statement and voluminous Toxicological Profile for a wide range of metals and radionulides.

Two page ToxFAQs fact sheets related to potential hazards at uranium mines and mills include:

http://www.atsdr.cdc.gov/tfacts145.html - http://www.atsdr.cdc.gov/tfacts145.pdf - Radon

http://www.atsdr.cdc.gov/tfacts150.html - http://www.atsdr.cdc.gov/tfacts150.pdf - Uranium

http://www.atsdr.cdc.gov/tfacts144.html - http://www.atsdr.cdc.gov/tfacts144.pdf - Radium

http://www.atsdr.cdc.gov/tfacts5.html – http://www.atsdr.cdc.gov/tfacts5.pdf - Cadmium

http://www.atsdr.cdc.gov/tfacts13.html - http://www.atsdr.cdc.gov/tfacts13.pdf – Lead

http://www.atsdr.cdc.gov/tfacts2.html - http://www.atsdr.cdc.gov/tfacts2.pdf – Arsenic

TOXFAQs all use a similar outline, such as:

- What is radon?
- What happens to radon when it enters the environment?
- How might I be exposed to radon?
- How can radon affect my health?
- How likely is radon to cause cancer?
- Is there a medical test to show whether I've been exposed to radon?
- Has the federal government made recommendations to protect human health?
- Glossary, References, and Contact Information

ATSDR Public Health Statements and toxicological profiles for Radon are at:

http://www.atsdr.cdc.gov/toxprofiles/tp145.html#bookmark05 - ATSDR Full Toxicological Profile on Radon

VIII. Selected Uranium Related-materials on the Southwest Research and Information Center Web Site: Additional materials available related to renewable energy, nuclear safety, mining and waste management and community development.

http://www.sric.org

Uranium Overview:
http://www.sric.org/uranium/upresentation/4-1.html –
Uranium Health and Environmental Research in Diné Communities

- Brief History of Uranium Development in Diné communities
- Basics of Radiation Health Issues
  - Sources
  - Pathways of Exposure
  - Review of Uranium Health Studies
    - workers, general population, livestock, environment
- Case Study — Outdoor Radon in Church Rock
- Implications for Navajo Communities
- Educational Programs
- Resources for Information

http://www.sric.org/uranium/1979-SRIC-URANIUM%20MINING%20AND%20MILLING%20PRIMER.pdf
Southwest Research and Information Center – Uranium Mining and Milling: A Primer

Uranium developments in Southwest US – AZ and NM; Mt. Taylor Traditional Cultural Property Petition, Uranium and the 1872 Mining Law
http://www.sric.org/1872/index.html

Navajo Nation Legislation
http://www.sric.org/uranium/DNRPA.pdf
Dine Natural Resources Protection Act of 2005

From the SRIC Newsletter Voices From The Earth:
http://www.sric.org/voices/2006/v7n4/index.html
CONTINUING TARGETS: New Mexico and Navajo & Hopi lands

http://www.sric.org/voices/2006/v7n3/index.html
New Uranium Boom Threatens Communities

http://www.sric.org/voices/2006/v7n3/NewUBoom.html
The New U Boom: Speculation or Serious Development?

http://www.sric.org/voices/2006/v7n3/Need_Greed.html
Need or Greed? Uranium Prices and Demand

http://www.sric.org/voices/2004/v5n4/uspotprice.html
Uranium Price Rise...Still No Need for New Mines

http://www.sric.org/voices/2004/v5n3/index.html
Uranium...the problems continue

http://www.sric.org/voices/2004/v5n3/UMTRCA.html
Reclaiming the Land: History of Uranium Mill Tailings Clean-up – full report listed below

Environmental Justice Principles
http://www.sric.org/voices/2003/v4n1/principles.html

http://www.sric.org/U_Mill_Tailing_Remediation_05182004.pdf
Uranium Mill Tailings Remediation Performed by the US DOE: An Overview
Table of Contents – ***brief introductory "fact sheet-like" sections in bold italics***

- Acknowledgements
- ***Summary***
- ***Introduction***
- ***UMTRAP and Uranium Mill Tailings Information Sources on the Internet***
- ***Characteristics of Uranium Mill Tailings and the Hazardous Materials They Contain***
- ***UMTRAP Uranium Mill Tailings Sites Before and After Remediation***
- DOE's UMTRAP Project is a Unique and Significant Example of a Complete Radioactive Waste Management Program
- Uranium Mill Tailings Radiation Control Act (UMTRCA) and Associated Implementing Regulations
- Summary of UMTRAP Performance After 25 Years of Effort
- Ground Water Remediation and UMTRAP
- Cost of UMTRAP Uranium Mill Tailings Remediation
- Projected Cost of Long-Term Surveillance and Maintenance at UMTRAP Sites
- DOE Policy Developments Related to Uranium Mill Tailings Since 2000
- Reference
- Appendix A – Tables and Figures
- Appendix B – Photographs of UMTRAP Sites
- Appendix C – Summary of NRC Criteria Adopted to Implement the Uranium Mill Tailings Radiation Control Act

IX. Radiation Exposure Compensation Act/Uranium Worker Compensation Program

http://www.bu.edu/formerworker/RECP_Factsheet.pdf
Radiation Exposure Compensation Program

http://www.recalaw.com/index.htm
In 1990, the Radiation Exposure Compensation Act (RECA) was signed into law by President George Bush. The law established one time payments of $100,000.00 to uranium miners who suffered a compensable disease. On July 10, 2000, President Clinton signed the RECAA amendments that expanded the program to include uranium millers and ore transporters. Energy Employees Occupational Illness Compensation Program Act (EEOICPA) of 2000 also included an additional $50,000.00 and medical benefits for uranium workers approved under RECA.

If you or a deceased relative of yours worked in the uranium industry between 1942 and 1971, you may be eligible for benefits under the Radiation Exposure Compensation

http://www.recalaw.com/faq.htm
Radiation Exposure Compensation Act: Frequently Asked Questions

X. Uranium Market

http://www.infomine.com/commodities/uranium.asp
Uranium Market Home page - INFOMINE

http://www.goldletterint.com/egr/egr_uranium.pdf
Uraniumletter International – "Uranium Price Remains on the Move," July, 2006 – 20 pp.

XI.News Reports

http://www.latimes.com/news/nationworld/nation/la-na-navajo-series,0,4515615.special
"Blighted Homeland" – Four-part series on uranium problems in Navajo Country

Southwest Research and Information Center News Links Focussed on Uranium
http://www.sric.org/news/index.html

See Community-Oriented Uranium Information Sites

XII. Nuclear Regulatory Commission (NRC) – Uranium Licensing Overviews
http://adamswebsearch2.nrc.gov/idmws/ViewDocByAccession.asp?AccessionNumber=ML070460009
Includes:
- 02/08/07 NRC Licensing Process Presentation by Stephen Cohen.
- 2/08/07 NEPA Process Presentation by J. Park.
- 02/08/07 Underground Injection Control Program Presentation by M. Ginsberg, EPA.

Materials from NRC-National Mining Association April- May 2008 meeting
http://www.uraniumwatch.org/nrc_nma_workshop.2008.htm

Updates and NRC posting anticipated by June 1, 2008

XIII. Community-Oriented Uranium Information Sites

WISE Uranium Project
www.wise-uranium.org

Uraniumwatch
www.uraniumwatch.org

Miningwatch Canada
www.miningwatch.ca

Western Mining Action Network
www.wman-info.org

Indigenous Environmental Network
www.ienearth.org

XIV. Uranium Policy Statements and Resolutions

All Indian Pueblo Council and Navajo Nation Resolutions
http://www.uraniumwatch.org/envjustice.htm

XV. Atomic Posters
http://www.orau.org/ptp/collection/Atomicposters/atomicmovieposters.htm
Movie Posters

http://www.printsandprintmaking.gov.au/Catalogues/Works/tabid/57/frmView/Record/itemID/56672/Default.aspx
Anti-Uranium Poster, 1978 (Spanish)