Uranium Exploration and Development – United States

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Introduction

The purpose of this paper is to provide an overview of the exploration and development of uranium resources for power generation, the demand for nuclear fuel and worldwide uranium resources. The paper also provides an overview of the legal regimes that apply in the United States (US) to (i) the acquisition of mining rights to explore for and develop uranium, (ii) the conduct of exploration and development operations, (iii) uranium recovery activities under the Atomic Energy Act of 1954, as amended by the Uranium Mill Tailings Radiation Control Act of 1978 (the "AEA"), and (iv) miscellaneous regulatory regimes and related issues involved in uranium recovery activities.

1. Uranium – Facts and Figures

What is Uranium. Uranium is an element that was discovered by Martin Heinrich Klaproth, a German chemist, in 1789. It is a relatively common metal whose occurrence in nature is comparable to tin or zinc.[1] However, uranium is radioactive[2] and occurs in the form of three isotopes, the most common of which is Uranium 238[3], representing over 99% of the uranium found in nature.[4] For purposes of this paper, the term uranium refers both to (i) ore containing U-238 and (ii) yellowcake [U_3O_8 or triuranium octoxide], a form of uranium concentrate obtained from uranium ore that has been mined from a conventional mine and processed in a mill, or recovered from an *in situ* recovery facility ("ISR Facility"). Yellowcake is the form of uranium product that can be marketed and sold after which it must be further processed/enriched to fabricate fuel for use in nuclear reactors to generate electricity or for the military/nuclear weapons.

Uranium Production and Power Generation. In 2007, the most significant producers of uranium were Canada (~23%), Australia (~21%) and Kazakhstan (~16%),[5] who collectively produced approximately 60% of worldwide production from mining operations for that year.[6] Mined production of uranium from the United States in 2007

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1 World Nuclear Association Information Papers, Mining and Uranium Market (hereinafter "WNA Information Papers"), "Supply of Uranium" June 2008, http://www.world-nuclear.org/info/inf23.html.

2 Atomic number 92. See http://www.nrc.gov/reading-rm/basic-ref/glossary/uranium.html.

3 U-238 contained in uranium ore is processed into yellowcake, which in turn must be further processed/enriched to create nuclear fuel. For purposes of this paper, the term uranium refers to U-238 in nature and yellowcake after it has been mined and processed either in a conventional mine/mill or in an ISR [*in situ* leaching] Facility.

4 The other isotopes are U-234 (only minute quantities of which exist) and U-235 (approximately 0.7% of naturally occurring uranium).

5 WNA Information Papers, *supra* note 1, "World Uranium Mining" July 2008.

6 Mined production of uranium is distinguished from nuclear fuel obtained from nuclear weapons stockpiles and other sources. As of the end of 2006, global mined production provided about 60% of the

was only about 4% of worldwide production, and Latin American production was relatively small with Brazil, the largest producer, responsible for less than 1% of worldwide mined uranium production in 2007.[7] Conventional mines[8] continue to account for the largest proportion of uranium production with the 8 largest mines in the world accounting for almost 70% of global uranium production.[9] Increasingly, new uranium producing mines are ISR Facilities, particularly in the US and Kazakhstan.[10] According to the U.S. Nuclear Regulatory Commission ("NRC"), there are about 12 ISR Facilities operating in the US, with applications for an additional 4 ISR Facilities pending.[11]

Demand for Nuclear Fuel. In 2007 worldwide demand for uranium for nuclear power generation was approximately 65,000 tonnes.[12] While demand in recent years has been somewhat reduced due to reactor efficiencies and other factors, overall demand is expected to grow with a total of 44 additional reactors under construction worldwide – 11 in China, 8 in Russia, 6 in India, 5 in Korea, 2 each in Bulgaria, Japan and the Ukraine, and 1 each in Argentina, Finland, France, Iran, Pakistan and the US.[13] Although the number of reactors in the US as a percentage of those operational worldwide has decreased in recent years, the US remains a significant consumer of uranium for nuclear power generation with the largest number of nuclear reactors (104) in operation worldwide in 2007.[14] US demand for nuclear fuel to generate electricity greatly exceeds US production – in 2000, only 16% of all uranium purchased for US nuclear power plants

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world's nuclear fuel for power generation. See Uranium 2007: Resources, Production and Demand, a Joint Report by the OECD Nuclear Energy Agency (NEA) and the International Atomic Energy Agency (IAEA). See: http://www.nea.fr/html/general/press/2008/2008-02.html.

[7] WNA Information Papers, *supra* note 1, "World Uranium Mining" July 2008.

[8] Underground or open pit mines where ore is removed from the ground, crushed and then chemically processed at a mill to produce yellowcake.

[9] WNA Information Papers, *supra* note 1, "World Uranium Mining" July 2008.

[10] Also referred to as *in situ* leach (ISL) mining. In an ISR Facility, uranium is mined by injecting a leaching agent into the ore body via injection wells and then recovering the leach solution with dissolved uranium through recovery wells. The leach solution is then processed to produce yellowcake through an ion exchange process in an above ground processing plant. WNA Information Papers, *supra* note 1, "In Situ Leach (ISL) Mining of Uranium," March 2008 and Figure 1.

[11] As discussed in more detail in Part 3 below, the NRC regulates ISR Facilities either directly or in a reduced capacity in those states ("Agreement States") where the primary regulatory role is performed by agencies of the Agreement States. The 4 pending applications for ISR Facilities are all in Wyoming, a non-agreement state. Note, this figure does not include ISR Facilities that are being pursued in Agreement States which include Colorado, Utah and Texas where there is significant ISR activity.

[12] WNA Information Papers, *supra* note 1, "Supply of Uranium" June 2008.

[13] International Atomic Energy Agency (IAEA)'s Power Reactor Information System (PRIS), Nuclear Power Plant Info, http://www.iaea.or.at/programmes/a2/. Currently, there are 436 nuclear power reactors in operation worldwide with a total installed capacity of 370.120 GWe (gigawatts of electricity). See Appendix I, Figures 2 and 3.

[14] *Id.*

was met by domestic production,[15] although US production in 2007 was approximately 12.5% greater than in 2000.[16]

Despite recently depressed prices, the long term demand outlook for uranium as fuel for nuclear power generation should increase significantly, as additional plants under construction are completed and commence operation. Moreover, projections with regard to additional plants continue to grow. The projections for China alone are significant – the Chinese government projects that its nuclear power generation capacity will increase from 9 GWe (gigawatts of electricity) from the 11 plants currently in operation to as much as 70 GWe by 2020.[17] Even in the US, applications to build 26 new plants have been submitted to the NRC most of which would be located at or adjacent to existing plants.[18]

Uranium Resources. Estimates of worldwide uranium resources are principally dependent on the costs of extraction and price.[19] Subject to these and other factors, estimates of known recoverable uranium resources are as much as 5.5 million tonnes of uranium (tonnes U), principally from Australia (23%), Kazakhstan (15%), Russian (10%), South Africa and Canada (8% each), the US (6%) and Brazil (5%).[20] Historically, US production has come from the Colorado Plateau in the four corners area of the Western United States (Colorado, Utah, Arizona and New Mexico)[21], as well as Wyoming and more recently Texas, particularly involving ISR Facilities. Uranium mining in the US has been cyclical, with an initial boom occurring in the 1950's under financial incentives established by the AEA and the responsible agency, the Atomic Energy Commission (AEC), to encourage uranium production for nuclear weapons.[22] Subsequent boom cycles with growing demand for uranium to supply the nuclear power industry occurred in the 1970's and early 1980's and more recently starting in 2003

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[15] Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining, Volume 1: Mining and Reclamation Background, U.S. Environmental Protection Agency, Office of Radiation and Indoor Air (6608J) (hereinafter "Technical Report"), p. 2-14 [Vol. 1 of EPA 402-R-05-007, January 2006, Updated June 2007 and printed April 2008 as EPA 402-R-005].

[16] According to the US Energy Information Administration, US production of uranium in 2007 was approximately 4.5 million pounds from 6 underground mines and 5 ISR Facilities. http://www.eia.doe.gov/cneaf/nuclear/dupr/dupr.html.

[17] "Chinese Capacity Targets Set to Grow," World Nuclear News, February 5, 2009, http://www.world-nuclear-news.org/newsarticle.aspx?id=24603.

[18] Timothy Aeppel, "U.S. Nuclear-Power Industry enjoys Revival 30 Years After Famous Accident," Wall Street Journal, March 28-29, 2009 at A-3.

[19] In July 2006, the price of uranium/lb was in the mid US $40's, after which it rose to almost US $140/lb (June 2007) but has now slid back to the mid to low US $40's again. Although there is no established spot market price for uranium (prices are generally negotiated by contract), the following websites contain useful information on uranium prices: http://www.uxc.com/ (Ix Consulting Group Company, LLC) and http://www.uranium.info/index.cfm?go=c.page&id=0 (TradeTech Uranium.Info).

[20] WNA Information Papers, *supra* note 1, Uranium 2007: Resources, Production and Demand - Reasonably Assured Resources plus Inferred Resources, to US$ 130/kg [approximately US$ 50/lb of uranium].

[21] Technical Report, *supra* note 15, at 1-11.

[22] *Id.* at 2-1. These incentives ceased in 1962, except that the AEC continued to purchase ore from properties discovered prior to November 1958 at guaranteed prices through 1970. The NRC is the successor to the AEC under the AEA.

which has been significantly dampened by the current worldwide financial crisis. As previously discussed, more recent uranium mining in the US has focused on ISR Facilities due to cost structure and the limited number of mills available to process uranium from conventional mines into yellowcake. Geologically, however, not all uranium deposits are good candidates for ISR technology and some deposits must therefore be mined by removing the ore and processing it above ground in a conventional mill.[23]

2. Exploration and Development of Uranium Resources

Acquiring Rights to Uranium.

The US and Canada are common law countries and as such the applicable regimes relating to the exploration and development of uranium are comprised not only of relevant statutes and regulations of the federal, state and provincial governments but also of common law, i.e., case law from the courts as well as agencies charged with rendering decisions on matters that fall within their jurisdiction. The following is a brief summary of the principal means by which a mining company might acquire the right to explore for and develop uranium in the US.[24]

Federal Lands – US: Mineral rights including those with potential value for uranium may be owned and controlled by private parties (fee lands), individual states (state lands) or the federal government (federal land). In the western US, the most significant mineral owner is the federal government under the management of the US Department of Interior's Bureau of Land Management (BLM). Both federal and state law govern the location, perfection and maintenance of mining claims on federal lands.[25] Federal law is based on the General Mining Law of 1872,[26] and applicable regulations

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[23] WNA Information Papers, *supra* note 1, "Geology of Uranium Deposits" March 2009. http://www.world-nuclear.org/info/inf26.html. Only one conventional mill is currently operational in the US, being the White Mesa Mill owned by Denison Mines in Blanding, Utah. Several others are on maintenance/standby or are in the process of being decommissioned. See http://www.nrc.gov/info-finder/decommissioning/uranium/index.html. Energy Fuels Resources Corporation is currently pursuing plans to construct a mill in western Colorado that would be the first new conventional processing mill constructed in the US in over 25 years. See http://www.energyfuels.com/projects/pinon_ridge_mill/.

[24] Details on Canadian regimes affecting the exploration and development of uranium are beyond the scope of this paper. The Canadian regimes were the subject of a paper presented at the Rocky Mountain Mineral Law Foundation Special Institute on Uranium Exploration and Development held on April 27-28, 2006 (hereinafter "RMMLF Uranium Institute"). *See* Michael J. Bourassa, Christopher A, Sullivan and Richard Butler, "Uranium Leases, Licenses and Permitting in Canada," *Uranium Exploration and Development*, Paper No. 9B (Rocky Mt. Min. L. Fdn. 2006).

[25] There has been no federal preemption of the mining law field and therefore state laws are enforceable so long as they do not conflict or interfere with the operation of applicable federal law.

[26] 30 U.S.C. § 28 (121 Stat. 2101). Legislative proposals to amend the General Mining Law of 1872 would, among other things, impose royalty payment obligations where none currently exist, provide stricter environmental/operating standards, and withdraw additional federal lands open to mining activity. In 2008 such a proposal passed the US House of Representatives but died in the Senate. The current bill, HR 699, the "Hardrock Mining and Reclamation Act of 2009," was introduced in the House in January 2009.

found in the Code of Federal Regulations (CFR),[27] which set forth requirements for locating and perfecting federal mining claims. In addition to complying with federal law, a locator must comply with the requirements of the State in which the mining claim is located.[28] The following is a summary of the principal federal and state requirements for locating lode mining claims on federal lands in the State of Colorado[29]:

- The lands must be open to location – they have not been withdrawn, as for example in the case of a national park[30]
- The locator must be a US citizen – individuals, corporations and, in general other US entities, including joint ventures that are comprised of US citizens[31]
- The mineral must be locatable – uranium is a locatable mineral as are base metals and precious metals but not coal or oil and gas
- The claim must be staked and monumented on the ground
- A location certificate with the name and address of the locator, the name of the claim, the date of location and a description of the claim must be posted on the claim
- A copy of the location certificate must be timely filed with the local BLM office and the applicable fees, currently $170 per claim, must be paid
- A copy of the location certificate must be recorded in the office of the County Clerk and Recorder where the lands are located
- Annual maintenance fees, currently $125 per claim, must be paid on or before September 1 of each year[32]

During the location process, the locator of a mining claim only has possessory rights – rights to enter upon and occupy the claim to the exclusion of third parties.[33] Such rights are not true legal title and must be perfected by making a discovery of valuable

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[27] Applicable regulations can be found beginning at 43 C.F.R. § 3800. For applicable regulations with regard to locating and maintaining federal mining claims, *see* 43 C.F.R. §§ 3830 *et seq*.

[28] *See, e.g*., Colo. Rev. Stat. § 34-43-101, *et seq*.

[29] In addition to lode mining claims, the mining law recognizes placer claims, mill sites and tunnel sites. See *American Law of Mining* (Cheryl Outerbridge ed., 2d ed., 2008), Chapters 30 et seq. for a thorough description of the applicable requirements for locating and perfecting federal mining claims under the General Mining Law of 1872.

[30] Recently, the "Omnibus Public Lands Management Act" was signed into law which will further reduce lands open to mineral entry by creating a 26 million acre "National Landscape Conservation System," and adding some 2 million acres of new wilderness area and some 1,000 miles of wild and scenic rivers. See http://www.doi.gov/news/09_News_Releases/033009.html.

[31] It has been established that a corporation or other legal entity organized under the laws of a US state is a US citizen for this purpose. For example, a corporation organized under Colorado law by a non-US mining company qualifies.

[32] The General Mining Law of 1872, as amended, and the Federal Land Policy Management Act ("FLPMA") currently provide for the payment of such maintenance fees in lieu of minimum annual work requirements (annual assessment work). See *American Law of Mining*, Ch. 44-45 (Cheryl Outerbridge ed., 2d ed., 2008).

[33] These possessory rights are referred to as "*pedis possessio."* A significant body of law, i.e., common law, exists as to such possessory rights, in particular with respect to conflicts as between claims located on all or part of the same lands. See *American Law of Mining*, Ch. 34 (Cheryl Outerbridge ed., 2d ed., 2008).

mineral within the boundaries of the claim. Absent a discovery, a subsequent locator may acquire superior right to those of the original locator. Also, special rules apply for locating mining claims on federal minerals where the surface ownership is separate or severed.[34] Although title by patent is contemplated under the Mining Law of 1872, there is currently a moratorium on the issuance of patents.[35] Nonetheless, the rights afforded by a properly located mining claim that is perfected by a discovery is generally viewed as sufficient not only for exploration purposes but also for the development and extraction of locatable minerals, including uranium, subject to obtaining appropriate licenses and permits as discussed below.

State and Fee Lands. Mineral rights on fee lands may be acquired from the mineral owner. Generally this is done by leasing the mineral rights pursuant to a lease, the terms of which are negotiated as a matter of contract between the mineral owner and the person wishing to acquire the right to mine.[36] Mineral rights on state lands may also be acquired, generally by lease from the appropriate state agency. In the State of Colorado, the Board of Land Commissioners has been authorized pursuant to statute to enter into and administer solid mineral leases and has adopted a specific form of lease with regard to uranium.[37]

Canada. The exploration and development of uranium in Canada is beyond the scope of this paper. There are similarities to the US in that a person desiring to obtain the rights to explore for and develop uranium in Canada must comply both with federal and provincial law. In Canada as opposed to the US, government controlled mineral lands are owned by the Provinces as "Crown" lands. As in the US, prospecting can be done under an appropriate prospecting license on mining claims that are staked on Crown lands but any development of the minerals discovered must be pursued pursuant to a mining lease or other form of tenement granted by the Provincial government, together with other appropriate permits obtained from both the Provincial and federal government with regard to environmental matters and the like, including extensive regulation at the federal government level with respect to uranium.[38]

Exploration and Development

Federal. Mining and milling operations are subject to extensive regulation by numerous federal and state agencies under federal and state statutes, including the BLM, the Environmental Protection Agency (EPA), the Mine Safety and Health Administration (MSHA), the Office of Surface Mining and Reclamation (OSM)[39] and others responsible

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34 43 CFR §§ 3838 *et seq*.

35 The proposed legislation described above in note 26 would make this moratorium permanent.

36 *See* Mark T. Nesbitt, "Uranium Leases, Licenses and Other Delights," *Uranium Exploration and Development*, Paper No. 9A (Rocky Mt. Min. L. Fdn. 2006).

37 Colo. Rev. Stat. §36-1-113. See also Policy No. 2003-01, as amended April 18, 2003, "Oil & Gas and Solid Mineral Leasing" - http://www.trustlands.state.co.us/Documents/Policies/2003-1.pdf which includes the form of Uranium Lease for state lands in Colorado.

38 See RMMLF Uranium Institute, *supra* note 24.

39 Principally with regard to coal mines and the reclamation of abandoned mines.

for mining activities, health, and environmental quality, including water and air quality.[40] Exploration and development/mining operations on federal lands administered by the BLM are subject to regulation by the BLM adopted pursuant to applicable federal mining law.[41] Preliminary prospecting in connection with locating mining claims on lands open to location managed by the BLM may be undertaken provided they only involve activities that result in no or negligible disturbance.[42] Such activities are referred to in the applicable regulations as "casual use."[43] Prospecting and exploration activities that exceed casual use fall in to two categories: (i) "notice-level operations" that require the operator to submit a notice to the BLM and (ii) "plan-level operations." Notice-level operations are restricted to exploration activities that will not disturb more than 5 acres of land.[44] Otherwise, operations, including exploration, require that the operator first submit and obtain the BLM's approval of a plan of operations, the purpose of which is to demonstrate that the proposed operations will not result in unnecessary or undue degradation of the public lands.[45] Among other things, a Plan of Operations is required to describe the operations to be undertaken, provide for reclamation and monitoring, address interim management during periods of temporary closures, and may require that baseline environmental information be provided.[46] In addition, the operator is required to post a bond or other form of financial assurance.[47]

State. Exploration and development of mining activities are also subject to state regulation, including those that occur on federal lands.[48] In Colorado, the Division of Reclamation, Mining & Safety ("DRMS") regulates prospecting, exploration and mining activities on all lands within the State pursuant to the Colorado Mined Land Reclamation Act and applicable regulations.[49] As discussed above, the BLM and the DRMS coordinate their regulatory roles to the effect that compliance with DRMS procedures and

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[40] See various papers presented at the RMMLF Uranium Institute, including with respect to health and safety, Laura E. Beverage and Karen L. Johnston, "A Primer on Federal and State Occupational Safety and Health Laws and Regulations Applicable to Uranium Mining and Milling," *Uranium Exploration and Development*, Paper No. 8 (Rocky Mt. Min. L. Fdn. 2006).

[41] Applicable regulations can be found beginning at 43 C.F.R. § 3800. For applicable regulations with regard to locating and maintaining federal mining claims, see 43 C.F.R. §§ 3830 *et seq*.

[42] Federal lands administered by other agencies such as National Forest lands and the National Wildlife Refuge System are subject to different rules. In addition, federal lands administered by BLM that are under wilderness review, are subject to special rules under 43 C.F.R. §§3802 *et seq*.

[43] 43 C.F.R. §3809.5. Examples of casual use include the collection of samples using hand tools and the use of metal detectors and other battery-operated devices but not the use of any mechanized equipment, chemicals or drilling. 43 C.F.R. §3809.5 also defines "Exploration" as surface disturbance activities greater than casual use that include sampling, drilling, or developing surface or underground workings to evaluate the type, extent, quantity, or quality of mineral values present. However, exploration does not include extraction activities.

[44] 43 C.F.R. §3809.5.

[45] 43 C.F.R. §3809.11.

[46] Applicable rules with regard to a Plan of Operations are found in 43 C.F.R. §§ 3809.400 *et seq*.

[47] 43 C.F.R. §§ 3809.500 *et seq*.

[48] 43 C.F.R. §§ 3809.200 *et seq*. Federal – State agreements are specifically authorized to avoid duplication of administration and enforcement. State regulation of mining activities on federal lands are generally not precluded as long as they are not in direct conflict with the federal rules.

[49] Colo. Rev. Stat. §§ 34-43-101, *et seq*., and Mineral Rules and Regulations of the Colorado Mined Land Reclamation Board for Hard Rock, Metal and Designated Mining Operations (hereinafter, "CRMS Rules").

regulations is generally sufficient to meet applicable BLM regulations with regard to operations on BLM lands.[50] Under the authority of Colorado's Mined Land Reclamation Act, the DRMS regulates exploration and mining activities in Colorado on all lands, state and privately owned fee lands as well as federal lands. Colorado recently amended its Mined Land Reclamation Act to impose specific requirements on ISR Facilities.[51] These amendments provide, among other things, that any operation where uranium is extracted, whether in an ISR Facility or a conventional mine, is a "designated mining operation" and thereby subject to more stringent rules that previously applied only to operations involving toxic or acidic chemicals or that used materials that produce such chemicals.[52] As a result, any uranium mining operation in Colorado, ISR Facilities as well as conventional mines, will be required to submit and have approved an Environmental Protection Plan under DRMS Rules that addresses, among other things, the protection of human health, wildlife and the environment from the use of toxic or acidic chemicals/materials associated with the operation.[53]

3. The Nuclear Regulatory Commission (NRC), Licensing and Regulation under the AEA

NRC Regulation of Uranium Recovery Activities. According to its website, the regulatory actions of the NRC "focus on protecting the health and safety of the public and the environment during the active life of a uranium recovery operation and after the facility has been decommissioned" by (i) providing regulations and guidance for licensees, (ii) licensing uranium recovery facilities, (iii) developing environmental assessments and environmental impact statements in connection with its regulatory functions, (iv) inspection of uranium recovery facilities and (v) overseeing decommissioning activities.[54] The authority for the NRC is derived from the Atomic Energy Act as amended by the Uranium Mill Tailings Radiation Control Act of 1978 (AEA).[55] Under the AEA, the jurisdiction of the NRC covers "Source Material," "Byproduct Material" and "Special Nuclear Materials."[56] The definition of "Source

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50 CRMS Rules, Rule 5.

51 Colorado House Bill, H.B. 08-1161 approved effective May 20, 2008, imposes specific requirements in connection with permitting an ISR Facility in Colorado. These amendments were in large part enacted in response to ISR Facilities proposed in Weld County, Colorado, a highly populated area in the front range north of Denver with significant agricultural interests.

52 Colo. Rev. Stat. §§ 34-32-103(3.5)(a)(III) and 34-43-112.5.

53 CRMS Rules, Rules 6 and 7. Note in particular CRMS Rule 6.4.20. Certain aspects of the 2008 amendments may raise supremacy issues to the extent that they are in direct conflict with applicable federal law, including the AEA. A recent case of interest decided by the Colorado Supreme Court with regard to preemption issues as between state law and local (county) rules banning the use of cyanide or other toxic/acidic chemicals in heap leaching mining operations held that the Colorado Mined Land Reclamation Act preempted the field and therefore the county's rules were invalid. *Colorado Mining Association v. Board of County Commissioners of Summit County*, 199 P.3d 718 (Colo. 2009).

54 See http://www.nrc.gov/materials/uranium-recovery.html.

55 42 U.S.C. §§ 2011 et seq. (68 Stat. 919) and 42 U.S.C. §§ 7901 et seq. (92 Stat. 3021)

56 Defined in Section 11 of the AEA (42 U.S.C. §11) and in 40 C.F.R. §40.4. "Source material" is defined to mean: (1) uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05%) or more of: (i) uranium, (ii) thorium or (iii) any combination thereof, but not Special Nuclear Material. Byproduct Materials are essentially tailings and waste produced by the extraction or concentration of uranium or thorium from ore processed

Material" is broad enough to include uranium ore. As discussed below, however, the NRC's regulatory authority over Source Material and the licensing thereof does not apply until after the Source Material is removed from its place of deposit in nature and therefore conventional mining of uranium is not subject to NRC regulation under the AEA.

Uranium Recovery – Conventional Mining vs. ISR Facilities. Under the AEA, the NRC regulates various aspects of the uranium recovery and post recovery cycle.[57] However, the NRC's jurisdiction does not extend to conventional mining of uranium, which as discussed above is subject to regulation by federal and state agencies responsible for exploration and mining activities generally. This is because the authority of the NRC under the AEA with regard to Source Materials does not extend to ore extracted from the ground using conventional mining techniques and prior to its being processed and chemically altered.[58] As a consequence, in addition to regulating mills that process uranium ore extracted from conventional mines and the disposal of liquid and solid wastes (tailings), the NRC regulates/licenses ISR Facilities which, in effect both mine and process the ore in place to produce yellowcake. Similarly, mine wastes from conventional mines are not "Byproduct Materials" as defined in the AEA and applicable regulations where such mines do not "process" the ore for its Source Material content. Accordingly a byproduct license is generally not required to be obtained from the NRC for a conventional uranium mine.[59] Thus the NRC's jurisdiction and licensing authority with respect to mining operations depends on the method of extraction involved. To summarize, the NRC licenses uranium recovery facilities – both mills and ISR Facilities with respect to the processing of uranium ore for its Source Material and the resulting wastes /Byproduct Material, but does not license or regulate uranium ore extracted using conventional mining techniques, which remain subject to federal and state regulatory regimes applicable to mining generally.

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primarily for its Source Material content including discrete surface wastes resulting from uranium solution extraction processes", but excluding underground ore bodies depleted by such solution extraction operations. Special nuclear materials are principally comprised of plutonium, and forms of enriched uranium and are not covered in this paper.

[57] Uranium milling and the disposal of the resulting waste/byproduct material by NRC licensees are regulated under 10 C.F.R. Part 40, "Domestic Licensing of Source Material" and Appendix A thereto which sets forth criteria for the operation of uranium mills and the disposition of tailings or wastes from the extraction or concentration of Source Material from ores processed primarily for their Source Material content. NRC licensees are subject to standards with regard to doses of radiation in connection with the receipt, possession, use, transfer, and disposal of licensed material by licensees (including doses resulting from licensed and unlicensed radioactive material). 10 C.F.R. Part 20. In addition, the EPA has jurisdiction over active uranium processing facilities under the Clean Air Act and 40 C.F.R. Part 61, Subpart W, work practice standards and generally applicable EPA standards at 40 C.F.R. Part 190.

[58] Under Section 62 of the AEA and 10 C.F.R. §40.3, Source Material is only subject to the licensing authority of the NRC "after it has been removed from its place of deposit in nature." (emphasis added)

[59] As discussed above, conventional uranium mining is subject to extensive regulations by state and federal agencies, including the EPA under the Resource Conservation and Recovery Act (RCRA), the Toxic Substances Control Act (TSCA), the Clean Air Act, and the Clean Water Act and the National Pollutant Discharge Elimination System (NPDES). Note that conventional mines as well as uranium recovery operations from ISR Facilities and mills are subject to the National Environmental Policy Act (NEPA) and requirements with respect to environmental assessments (EAs) environmental impact statements (EISs).

Agreement States. Pursuant to Section 274(b) of the AEA,[60] the NRC has entered into agreements with certain states ("Agreement States") whereby the authority of the NRC to regulate Source Materials and Byproduct Materials, and related licensing and monitoring, is delegated to and exercised by the Agreement State. Agreement States for the licensing of uranium recovery facilities (i.e., Source Materials) include Colorado, Utah and Texas. Wyoming, Nebraska, New Mexico and Arizona, among others, continue to be NRC regulated.[61] In Colorado, an Agreement State, uranium recovery operations, including ISR Facilities, are regulated by the Colorado Department of Public Health and Environment (CDPHE) within its authority to regulate radioactive materials under the Colorado Radiation Control Act.[62] The principal permits/authorizations required under the Colorado Act and applicable rules include (i) a Radioactive Materials License from the Radiation Management Unit of the Hazardous Materials and Waste Management Division for possession of radioactive materials and uranium recovery operations,[63] (ii) a permit from the Water Quality Control Division for discharge to surface water or for surface runoff from disturbed areas, and (iii) a permit from the Air Pollution Control Division for emissions from the site and for dust control from construction activities.[64]

Foreign Investment. In addition to the restrictions on acquisition and ownership of mining claims on federal lands under the General Mining Law of 1872, there are restrictions on the acquisition of a US business under the Defense Production Act of 1950, as amended by the Foreign Investment and National Security Act of 2007 (FINSA).[65] Under FINSA, the acquisition of control of a "US Business" by a "foreign person" is a "covered transaction" and subject to investigation and review by the Committee on Foreign Investment in the United States (CFIUS). Although a detailed discussion of FINSA is beyond the scope of this paper, it appears that FINSA review would be required if a foreign person were to seek to acquire, directly or indirectly, a controlling interest in an existing US mine such as an ISR Facility or if such mine or facility were deemed to be "critical infrastructure" vital to US interests. However, it appears that most exploration and development projects would not be subject to FINSA under the regulations which exempt start-up or greenfields investments by foreign persons in the US.[66]

Summary – Key Regulatory Functions of NRC/Agreement States.

- ISR Facilities are required to be licensed with respect to both Source Materials and Byproduct Materials. ISR Facilities are uranium recovery facilities as they "process" uranium ores for Source Materials (yellowcake) and the

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60 42 U.S.C. §2021

61 http://www.nrc.gov/info-finder/materials/uranium/#licensed-facilities.

62 Colo. Rev. Stat. §§ 25-11-101 et seq. and the CDPHE's Rules and Regulations Pertaining to Radiation Control (6 Colo. Code Regs. §1007-1).

63 Requires an environmental assessment report.

64 "Summary of Regulation of Uranium Recovery in Colorado" at CDOHE RAM web site: http://www.cdphe.state.co.us/hm/rad/rml/energyfuels/recoveryregs.pdf.

65 50 U.S.C. §2170 as amended by 121 Stat. 246. See also regulations recently adopted by the Department of the Treasury at 31 C.F.R. Part 800, §§800.101 *et seq*.

66 31 C.F.R. §800.301(c), Example 3.

resulting wastes/tailings including surface wastes resulting from solution extraction process are within the definition of Byproduct Materials. However, the depleted ore body of an ISR Facility in place is not waste or tailings for NRC licensing purposes. The EPA (or pertinent authorized state agency) has concurrent jurisdiction for ISR Facilities with regard to Underground Injection Control (UIC) Permits and aquifer exemptions under the Safe Drinking Water Act, which requires that the operator demonstrate that the affected aquifer or portion thereof will not be affected by ISR Facility operations.[67]

- GEIS – The NRC has prepared a Draft Generic Environmental Impact Statement (GEIS) for In-Situ Leach Uranium Milling Facilities[68] to identify and evaluate potential environmental impacts associated with the construction, operation, aquifer restoration, and decommissioning of ISR Facilities. The purpose of the GEIS is to improve the efficiency of the NRC's environmental review of ISR Facility license applications required under NEPA.[69]

- Decommissioning – Title I of UMTRCA establishes a program whereby the federal and state governments jointly fund remedial/clean up actions at abandoned uranium and thorium milling sites. Under the Title I program, the Department of Energy (DOE), or the pertinent state, is responsible for regulating cleanup and remediation, as well as long term care and maintenance of Title I sites.[70]

- Active Uranium Recovery Facilities – Title II of UMTRCA deals with active uranium recovery facilities licensed by the NRC (or the pertinent Agreement State) with regard to Byproduct Materials, which includes mill tailings from a conventional processing facility/mill as well as ISR Facilities.

- Export/import – The export or import of Source Materials and therefore yellowcake requires an NRC license under 42 U.S.C. §§ 2156-7 and 10 CFR § 110.9.[71]

- Transportation – The NRC oversees the safety of the transportation of nuclear materials, including Source Materials and Byproduct Materials, through a

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[67] 42 U.S.C. §300(f) *et seq*. 40 C.F.R. Part 146 or applicable state requirements establish criteria for specific classes of wells to assure safety of drinking water sources (ISR Facility wells are Class III wells). See http://www.epa.gov/ogwdw/uic/wells_class3.html.

[68] See http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/. The draft GEIS (NUREG-1910, Vols. 1-2) was issued for public comment and the comment period is now closed.

[69] See http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1910/. NRC regulations that implement NEPA and discuss environmental reviews are found in Title 10, "Energy," of the Code of Federal Regulations (10 C.F.R.) Part 51.

[70] 10 C.F.R. § 40.27, "General License for Custody and Long-Term Care of Residual Radioactive Material Disposal Sites."

[71] With regard to exporting Source Materials from the US, see Anthony J. Thompson and Christopher S. Pugsley, "United States Federal/State Licensing/Permitting Regimes Implicated by Uranium Development," *Uranium Exploration and Development*, Paper No. 3, Page Nos. 3-25/3-29 (Rocky Mt. Min. L. Fdn. 2006).

combination of regulatory requirements, transportation package certification, inspections, and a monitoring system to ensure safety requirements are met.[72] Additional regulatory functions are carried out by the Department of Transportation with regard to shipments while in transit and standards for labeling and packaging,[73] as well as by state agencies under state law.[74]

4. Conclusions

This paper has attempted to provide an overview of opportunities that exist in the US for the exploration and development of uranium, as well as key regulatory issues to be addressed by an operator at both the federal and the state level. Successful operators should plan ahead and be proactive as well as transparent in dealing with regulatory agencies as well as with other stakeholders, including the public.

5. Appendices

Appendix I Figures

Appendix II Sources/Useful Websites

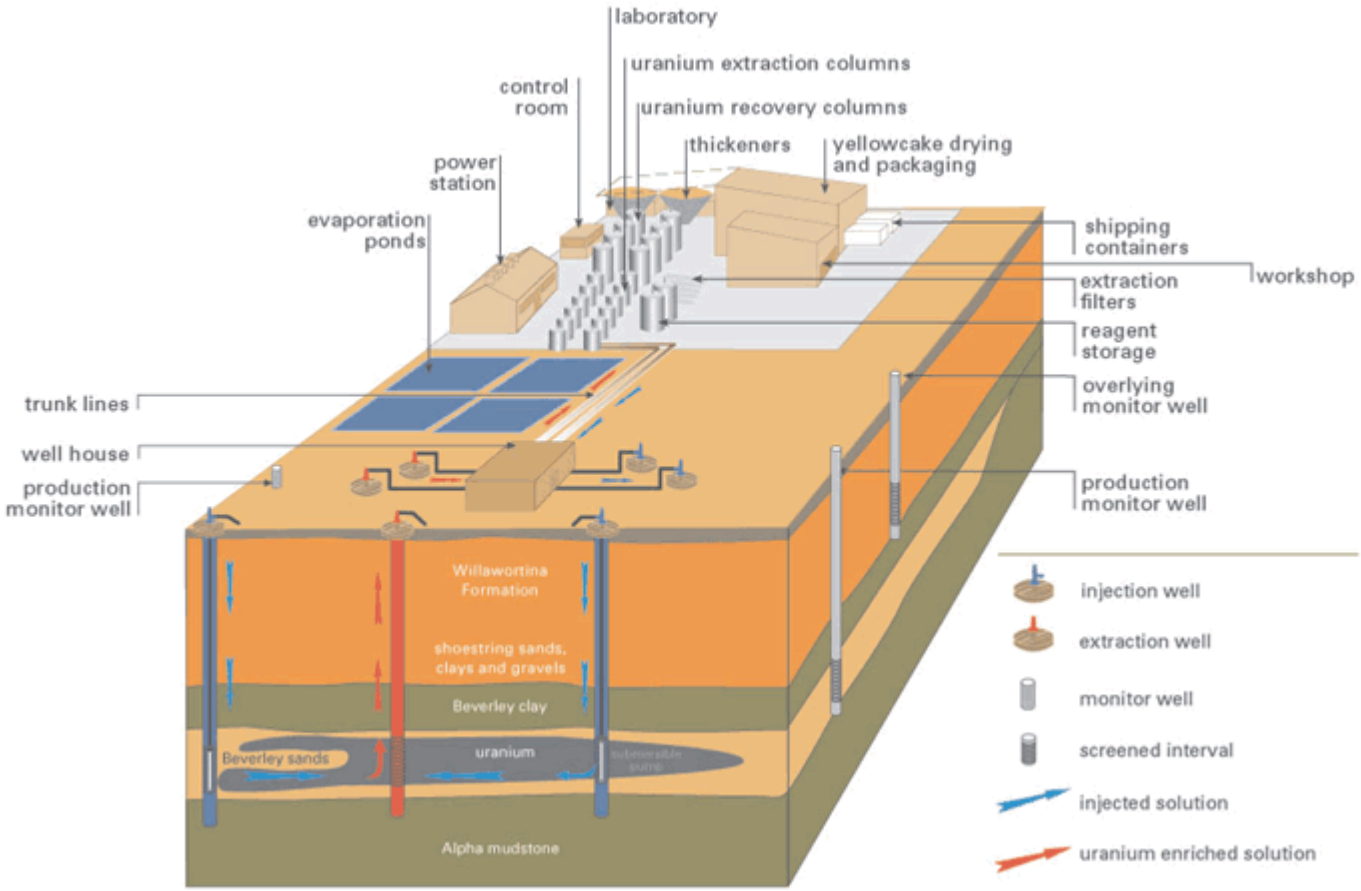
Appendix III Examples of Recent Articles of Interest

[72] See 10 C.F.R. Part 71 – Packaging and transportation of radioactive material and Part 73 – Physical protection of plants and materials.

[73] *See* 49 Code of Federal Regulations, Title 49, Part 173 and limited application to "natural uranium" at § 173.426.

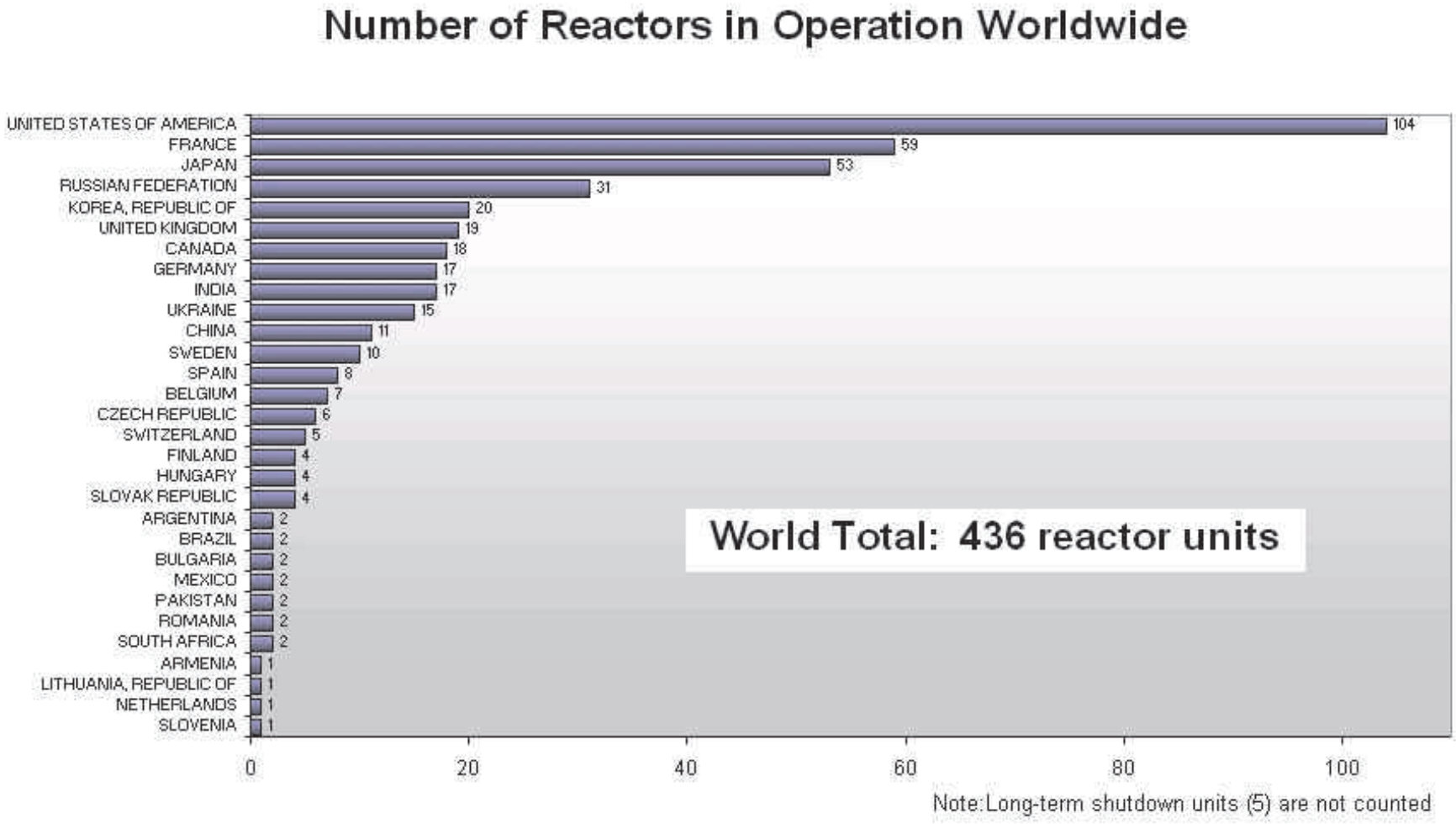
[74] In Colorado the transportation of radioactive material is regulated under Part 17 of the CDPHE's Rules and Regulations Pertaining to Radiation Control. See note 52.

Appendix I – Figure 1



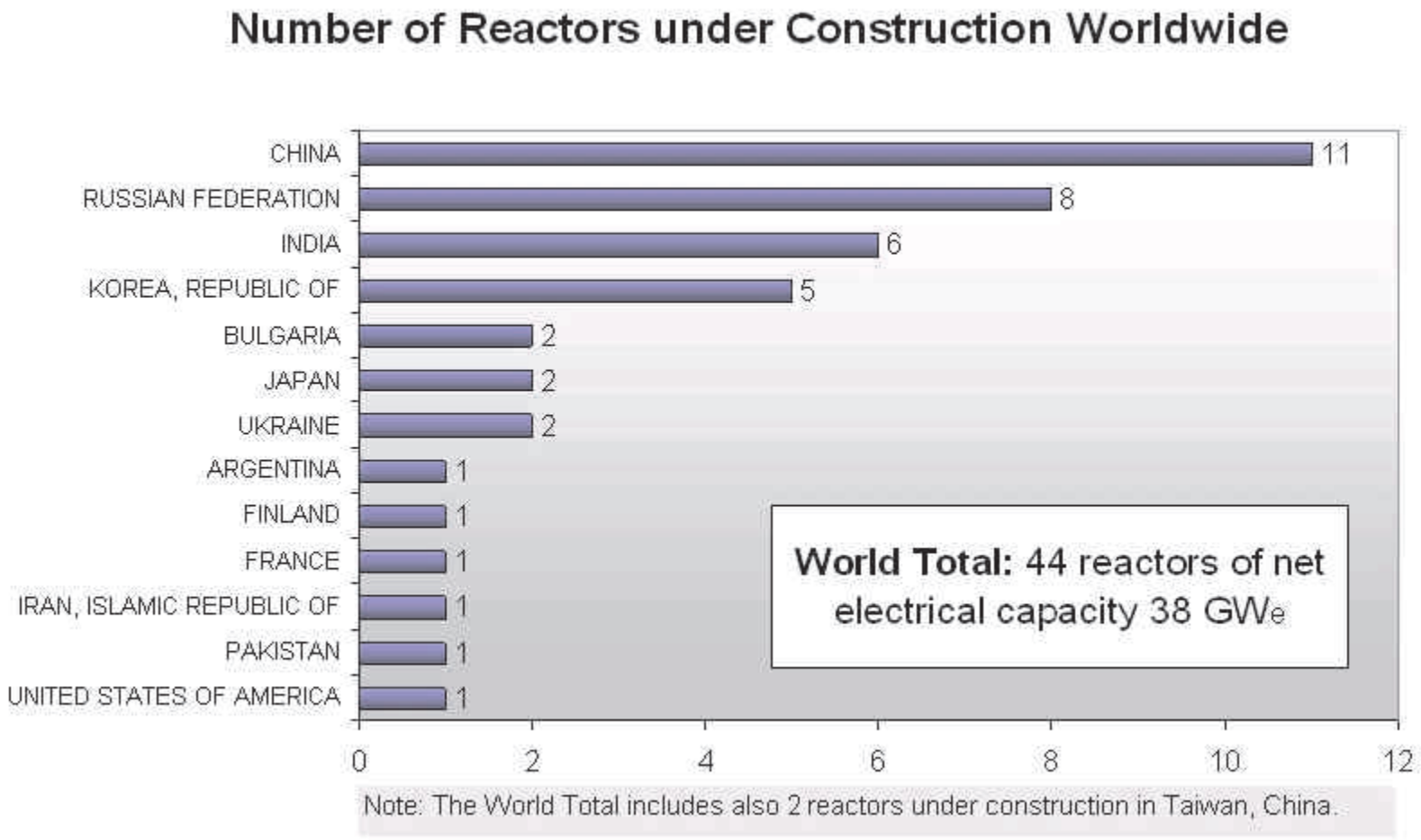
Source: World Nuclear Association Information Papers, Mining and Uranium Market ("WNA Information Papers"), "In Situ Leach (ISL) Mining of Uranium" March 2008

Appendix I – Figure 2



Source: IAEA – Power Reactor Information System (PRIS)
Nuclear Power Plant Info, World Summary

Appendix I Figure 3



Source: IAEA – Power Reactor Information System (PRIS)
Nuclear Power Plant Info, World Summary

Appendix II – Sources/Useful Websites

- International Atomic Energy Agency (IAEA) - http://www.iaea.org/
- World Nuclear Association (WNA) - http://www.world-nuclear.org/
- U.S. Nuclear Regulatory Commission (NRC) - http://www.nrc.gov/
- Nuclear Energy Institute (NEI) - http://www.nei.org/
- National Mining Association (NMA) - http://www.nma.org/
- International Forum on Sustainable Options for Uranium Production - http://www.ifsoup.org/
- Nuclear Energy Agency, a specialised agency within the Organisation for Economic Co-operation and Development - http://www.nea.fr/welcome.html
- Energy Information Administration, Nuclear - http://www.eia.doe.gov/fuelnuclear.html
- Trade Tech LLC - http://www.uranium.info/
- The Ux Consulting Company, LLC - http://www.uxc.com/
- Uranium Watch, a Uranium Mining and Milling Information and Action Project - http://uraniumwatch.org/
- Australia Uranium Association - http://aua.org.au/

Appendix III – Examples of Recent Articles of Interest

- "Swedes revisit ban on new nuclear plants" – The Northern Miner, March 2-8, 2009 at D-3

- "Western Australia lifts its ban on uranium mines" – The Australian, November 18, 2008. http://www.theaustralian.news.com.au/story/0,25197,24667265-2702,00.html

- "No easy stroll down the yellowcake road – Canadian Uranium Miners Face tough Federal Standards," Ernest Becker, Ph.D., Golder Associates Ltd. - The Northern Miner, April 14, 2008

- "Uranium and iron exploration gain momentum in Québec," Patrice Roy, Jocelyne Lamothe et al., Québec Ministère des Resources Naturelles et de la Faune – The Northern Miner, March 2-8, 2009, Exploration & Development Highlights (2009 PDAC Supplement)

- "Saskatchewan's potash, uranium and coal garner unprecedented interest," by the Staff of the Saskatchewan Ministry of Energy and Resources – The Northern Miner, March 2-8, 2009, Exploration & Development Highlights (2009 PDAC Supplement)

- "UPDATE 2 – Russia nuclear chief sees uranium price rise in '09," Katya Golubkova, Reuters, Business & Finance, Markets, Market News, March 6, 2009

- "S. Korea scraps uranium deals on weak prices - report," Reuters, Business & Finance, Markets, March 2, 2009

- "U.S. Nuclear-Power Industry enjoys Revival 30 Years After Famous Accident," Timothy Aeppel, Wall Street Journal, March 29, 2009 at A3