The Case for Uranium Mining in Greenland

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48 Cornell Int'l L.J. 423 (2015)

Introduction

On October 1, 2014, Greenland's governing parliamentary coalition collapsed over allegations that Aleqa Hammond, Prime Minister and leader of the democratic Siumut (Forward) party, spent $18,000 on flights and hotels for personal use since taking office the year prior.[1] Concurrent with Ms. Hammond's resignation, Jens-Erik Kirkegaard, Greenland's mining and natural resources minister, also resigned.[2] Hammond's party rose to power in March 2013 largely on the promise to repeal Greenland's ban on uranium mining and to increase royalty payments and oversight of the mining industry.[3] The former Prime Minister fulfilled her promise in October 2013, pushing through a referendum that repealed the ban on uranium mining by a narrow vote—fifteen to fourteen.[4]

While there is support in Greenland for increased mining of the country's large uranium deposits, the future of that industry, now that its champion former Prime Minister Hammond has been dismissed, is less certain.[5] Hammond's successor, Kim Kielsen, of Hammond's Siumut Party, was elected Prime Minister of Greenland on November 28, 2014;[6] during the run up to the election, however, Greenland's leftist opposition party, Inuit Ataqatigiit, sought a referendum on the legalization of uranium mining, and Hammond's party down-played the importance of extracting

1. David Crouch, *Greenland Coalition Collapses over Allegations of Misuse of Funds*, FINANCIAL TIMES (Oct. 2, 2014, 5:49 PM), http://www.ft.com/intl/cms/s/0/0d149b0c-49fd-11e4-8de3-00144feab7de.html#axzz3GDZ29fdv.

2. *Id.*

3. Anna-Katarina Gravgaard, *Greenland's Rare Earths Gold Rush*, FOREIGN POLICY (Oct. 28, 2013), http://www.foreignaffairs.com/features/letters-from/greenlands-rare-earths-gold-rush.

4. Katya Vahl et al., *Greenland Votes to Allow Uranium, Rare Earths Mining*, REUTERS (Oct. 25, 2013, 11:36 AM), http://in.reuters.com/article/2013/10/25/greenland-uranium-idINDEE99O02R20131025. Even this narrow victory was not certain: one of the Hammond government's coalition partners, the leftist nationalist Partii Inuit (People's Party), was dismissed because it refused to support the repeal. Gravgaard, *supra* note 3. The division between supporters of uranium mining and those who are against it is not, however, strictly along ethnic lines: Inuit inhabitants of Narsaq, situated next to the proposed Kvanefjeld mining site, express a desire to lessen their reliance on traditional sources of income, such as cod fishing and shrimping. As the owner of the local slaughterhouse observed: "Many people are unemployed . . . lots of families from Narsaq have moved out to other cities, so we have to do something." James Fletcher, *Mining in Greenland - A Country Divided*, BBC (Jan. 1, 2014), http://www.bbc.com/news/magazine-25421967.

5. Vahl, *supra* note 4.

6. David Crouch, *Greenland PM Seeks to Revive Economy Amid Difficult Coalition Talks*, FINANCIAL TIMES (Nov. 30, 2014, 8:26 PM), http://www.ft.com/intl/cms/s/0/17ebfc72-772b-11e4-8273-00144feabdc0.html#axzz3Ohtxp7hf.

uranium among its policies.[7] Although Kielsen has yet to express an interest in reestablishing Greenland's former ban on uranium mining, the possibility remains that resistance regarding permitting uranium mining will arise in the future.[8]

The continued mining[9] of uranium in Greenland has potentially far-reaching consequences, but very little has been written on the subject.[10] Greenland has one of the world's largest deposits of rare earth elements that are used in technologies from cellular telephones to hybrid cars to solar panels; uranium is a trace element in these deposits and is thus a potential by-product of rare earth element mining.[11] Currently, China supplies 85% of the world's rare earth elements; this is 10% less than two years ago, and a result of the United States and Australia developing native sources of rare earth elements to lessen their reliance on Asia.[12] In developing its mining industry, Greenland has the potential to reduce further the world's reliance on Chinese exports of these materials.[13] This Note

7. Henriette Jacobsen, *Uranium a Hot Topic Again, in Greenland*, EURACTIV.COM (Nov. 14, 2014, 6:13 PM), http://www.euractiv.com/sections/sustainable-dev/uranium-hot-topic-again-greenland-310025.

8. *Id.*

9. Mining in Greenland will largely be conducted by multi-national mining companies, and not state-owned companies. Rebecca Fields Green, *The Implications of Mining in Greenland*, CLIMATE INSTITUTE, http://www.climate.org/publications/Climate%20Alerts/2013-summer/mining-in-greenland-green.html.

10. The only law review article that discusses mining in Greenland in any detail is Rutherford Hubbard's Note. *See* Rutherford Hubbard, *Risk, Rights, and Responsibility: Navigating Corporate Responsibility and Indigenous Rights in Greenlandic Extractive Industry Development*, 22 MICH. ST. INT'L. L. REV. 101, 106 (2013). Tim Boersma and Kevin Foley note in their report, "Comparatively little has been written about Green-land, and this report aims to make a contribution in that respect." *See* Tim Boersma & Kevin Foley, *The Greenland Gold Rush: Promise and Pitfalls of Greenland's Energy and Mineral Resources*, BROOKINGS INST. (Sept. 2014), *available at* http://www.brookings.edu/~/media/research/files/reports/2014/09/24%20greenland%20energy%20mineral%20resources%20boersma%20foley/24%20greenland%20energy%20mineral%20resources%20boersma%20foley%20pdf%202.pdf.

11. Fletcher, *supra* note 4; Mia Bennett, *Analysis: Implications of Greenland's Decision to Allow Uranium Mining*, ALASKA DISPATCH NEWS (Oct. 30, 2013), http://www.adn.com/article/20131030/analysis-implications-greenland-s-decision-allow-uranium-mining.

12. Gravgaard, *supra* note 3.

13. Reducing reliance on Chinese exports is mitigated, of course, if Greenland permits Chinese companies to mine its ore. *See* Green, *supra* note 9. This year, China lifted its quota restrictions on the export of rare earth elements, a shift triggered after the country lost a dispute with the WTO over the quotas in 2013. This will undoubtedly drive prices of rare earth elements down, raising the question of whether Greenland can compete economically in the rare earth and uranium markets given the cost of mining. This is obviously a major consideration in determining whether mining for these materials should take place in Greenland. This Note, however, focuses instead on the legal framework and ethical issues surrounding uranium mining should it proceed in Greenland, rather than the economic conditions required for multinational companies to conduct uranium mining and whether those conditions are now met. The Note does consider the effect of market volatility on remediation in the past, as well as the potential for new technology to alter the economic equation for uranium mining, but the calculations that determine whether a multinational company would now consider uranium mining feasible are outside the scope of this Note. Chuin-Wei Yap, *China Ends Rare-Earth Metals Export Quotas*, WALL ST. J. (Jan. 5, 2015, 11:24 AM), *available at* http://

will argue that Greenland has the opportunity to be a model for the application of best-practice uranium and rare earth element extraction.

To realize the potential for Greenland to set a standard for best-practice uranium mining, Greenland should cautiously continue to permit mining of uranium in areas, such as Kvanefjeld, already surveyed for extraction. Part I of this Note provides background regarding the renewed interest in mining in Greenland. Part II examines the legal framework for uranium export and non-proliferation agreements binding Greenland as a result of its unique legal relationship with Denmark. This Note then looks at recommendations for incorporating Greenland's indigenous population into the dialogue regarding uranium extraction in Part III by examining the International Labour Organization's Convention Concerning Indigenous and Tribal Peoples in Independent Countries (No. 169) and the UN Declaration on the Rights of Indigenous Peoples.[14] Finally, Part IV outlines the possible environmental impact of uranium mining in Greenland and ways that it might be mitigated by charting technological developments in the industry, as articulated by the Organisation for Economic Co-operation and Devel-

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www.wsj.com/articles/china-ends-rare-earth-minerals-export-quotas-1420441285. Note that, in recent analyses, uranium prices are set to improve (potentially even double) as uranium demand is projected to increase sixty-one percent over the next decade. Michael Brush, *Why a New Age of Nuclear Energy is About to Dawn*, THE FISCAL TIMES (May 19, 2015), http://www.thefiscaltimes.com/2015/05/19/Why-New-Age-Nuclear-Energy-About-Dawn.

14. While the Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters would arguably provide equal or greater protections than ILO 169, Denmark's ratification of this convention specifically stated that it did not apply to Greenland or the Faroe Islands, and Greenland has not since ratified the convention. Denmark's declaration explaining this exception indicates that the Aarhus Convention is aimed at large European states and may be burdensome for Greenland to implement:

> Both the Faroe Islands and Greenland are self-governing under Home Rule Acts, which implies inter alia that environmental affairs in general and the areas covered by the Convention are governed by the right of self-determination. In both the Faroe and the Greenland Home Rule Governments there is great political interest in promoting the fundamental ideas and principles embodied in the Convention to the extent possible. However, as the Convention is prepared with a view to European countries with relatively large populations and corresponding administrative and social structures, it is not a matter of course that the Convention is in all respects suitable for the scarcely populated and far less diverse societies of the Faroe Islands and of Greenland. Thus, full implementation of the Convention in these areas may imply needless and inadequate bureaucratization. The authorities of the Faroe Islands and of Greenland will analyse this question thoroughly. . . .

Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, chap. 27, June 25, 1998,2161 U.N.T.S. 447, *available at* https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-13&chapter=27&lang=EN#3 (last visited Mar. 23, 2015). Greenland is also not a signatory to the Espoo Convention, having been excepted in like manner in Denmark's ratification. Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context, U.N. Doc. ECE/MP.EIA/2003/2 (May 21, 2003), *available at* https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-4-b&chapter=27&lang=EN#EndDec (last visited Apr. 12, 2015).

opment (OECD) Nuclear Energy Agency's *Managing Environmental and Health Impacts of Uranium Mining.*[15]

I. The Effects of Rising Temperatures on Greenland's Economy and the Potential for Mineral Extraction

Greenland is the world's largest island; however, because 81% of its landmass is covered by ice, it is largely uninhabited.[16] A majority—89%—of the nation's indigenous Inuit population lives in villages dotted along the southern coast, connected only by plane and boat.[17] With a GDP of $2.1 billion and population of 58,000, Greenland has a deceivingly large GDP per capita.[18] Nonetheless, the cost of living in Greenland remains high, and the nation is heavily dependent upon subsidies from Denmark.[19]

The increasing summer ice melt resulting from the effects of rising temperatures has led to some improvement in Greenland's economy. Farmers are able to plant more diverse crops and receding ice has exposed new islands that are now becoming tourist sites.[20] Fish, which constitute over 90% of Greenland's exports,[21] are being caught in record numbers.[22] Shorter shipping lanes,[23] and shipping lanes that stay open longer,[24] as well as the exposure of new resources and previously impassable areas, have led to increased interest in Greenland's natural resources.[25] The Black Angel zinc and lead mine, closed in 1990 due to the volatility of metal markets,[26] has recently been relicensed; it is slated to operate for another twenty years as rising temperatures allow workers to operate the mine for eight months per year.[27] While detailed exploration of Greenland's mineral deposits outside of its coastal regions has so far been limited,[28] over ninety mining projects have requested approval from the Bureau of Minerals and Petroleum,[29] and a handful of projects are currently underway for zinc, lead, rubies, sapphires, anorthosite, uranium,

15. OECD, *Managing Environmental and Health Impacts of Uranium Mining*, NEA No. 7062 (2014), *available at* http://www.oecd-nea.org/ndd/pubs/2014/7062-mehium.pdf.

16. James Mitchell, *Can Climate Change be Good for Greenland? An Arctic Island's Response to New Development Opportunities*, 8 SUSTAINABLE DEV. L. & POL'Y 23, 23 (2008).

17. *The World Factbook– Greenland*, CIA (June 20, 2014), https://www.cia.gov/library/publications/the-world-factbook/geos/gl.html.

18. *Id.*

19. Hubbard, *supra* note 10.

20. Mitchell, *supra* note 16.

21. *See* Boersma *supra* note 10.

22. Mitchell, *supra* note 16.

23. Sébastien Pelletiera & Frédéric Lasserre, *Arctic Shipping: Future Polar Express Seaways? Shipowners' Opinion*, 43 J. MAR. L. & COM. 553, 559 (2012).

24. Hubbard, *supra* note 10, at 102.

25. *Id.*

26. Mitchell, *supra* note 16, at 23.

27. *Id. See also Black Angel Zinc Lead Mine*, MINING ATLAS, https://www.mining-atlas.com/operation/Black_Angel_Zinc_Lead_Mine.php/.

28. Hubbard, *supra* note 10, at 116.

29. *Id.*

and oil.[30]

Greenland's history of mining for uranium is longer than its history of mining and exploration for other minerals. The Ilímaussaq Intrusive Complex, with includes Kvanefjeld, has been the subject of more than 700 scientific papers,[31] and research that dates back to 1955, when the Danish government initiated a uranium prospecting program in Greenland.[32] During the late 1950s through the early 1980s, scientists attempted to develop efficient methods to extract uranium from Greenland's unique Steenstrupine ore, succeeding in 1982.[33] However, because of resistance to nuclear power in the late 1970s and early 1980s, Denmark passed a "zero tolerance" ban on uranium mining, and the research was abandoned.[34] Consequently, nearly 600 million pounds of uranium remain in Kvanefjeld.[35]

Uranium is minerologically intergrown with most rare earths in Greenland.[36] It is estimated that Kvanefjeld has deposits in Greenland containing nearly ten million tons of rare earth elements, and could produce nearly 20 to 25% of the world's supply of these materials.[37] Without lifting the ban on uranium mining, however, these rare earth elements could not be extracted.[38] The island's unique geology previously caused concern for lifting Greenland's uranium mining ban: uranium and rare earth elements are intergrown, and to extract both from Kvanefjeld ore, miners had to develop a new, untested method of uranium extraction using alkaline pressure leaching.[39] While this process is promising, the potential for the

30. Boersma, *supra* note 10, at 3.

31. John Mair, *Agpaitic Nepheline Syenites of the Ilímaussaq Complex, South Greenland: An Important New Uranium Ore-Type*, GREEN. MINERALS AND ENERGY LTD. (Nov. 2009), http://www.iaea.org/OurWork/ST/NE/NEFW/documents/RawMaterials/TM_Vienna2009/presentations/4_Mair_Australia.pdf.

32. Kristine Thrane, Per Kalvig & Nynke Keulen, *Uranium Potential in Greenland*, GEOLOGICAL SURVEY OF DEN. AND GREEN., http://www-pub.iaea.org/iaeameetings/cn216pn/Tuesday/Session2/023-Thrane.pdf.

33. *Id.* Steenstrupine is a mineral containing rare earth elements; namely, "silicate, phosphate, and fluoride of the rare-earth metals, calcium, sodium, aluminum, iron, and manganese, and occurring in dark brown rhombohedral crystals." *Steenstrupine*, MERRIAM WEBSTER ONLINE (2015), http://www.merriam-webster.com/dictionary/steenstrupine.

34. GEOLOGICAL SURVEY, *supra* note 32.

35. *Id.*

36. *Greenland Eases Uranium-Mining Ban, Greenland Minerals & Energy to benefit*, PROACTIVE INVESTORS (Sept. 10, 2010), http://www.proactiveinvestors.com.au/companies/news/9924/greenland-eases-uranium-mining-ban-greenland-minerals-energy-to-benefit-9924.html. *See also* Lesley Price, *No uranium, no investments, mining company tells Greenlanders*, THE COPENHAGEN POST (Sept. 25, 2013, 10:34 AM), http://cphpost.dk/news14/business-news14/no-uranium-no-investments-mining-company-tells-greenlanders/097401.html.

37. Gravgaard, *supra* note 3.

38. *Id.*

39. Mair, *supra* note 31. Through a dissolution process, the extracted ore is dissolved; subsequent chemical processes separate the uranium from the residual solution, and the rare earth elements are extracted from the remaining solution. Jan Willem Storm van Leeuwen, *Uranium mining at Kvanefjeld*, CEEDATA CONSULTANCY (Apr. 17, 2014), *available at* http://www.ecocouncil.dk/releases/articles-pressreleases/chemicals-

remaining solution to contaminate the environment is significant, given that this would be the first use of this new technology, and that the solution would likely contain chemicals used in the leaching process.[40]

II. Greenland's Legal Framework for Uranium Mining and Export

This Part examines the legal framework for uranium export and nonproliferation agreements in Greenland as a result of its legal relationship with Denmark. It begins by examining Greenland's Mineral Resources Act and Greenland's status as an Overseas Countries and Territories (OCT) entity, and then looks at existing legal frameworks binding Greenland's export of uranium under the International Atomic Energy Agency (IAEA) and the European Atomic Energy Community (Euratom) agreements. Finally, this part suggests recommendations for drafting Greenland's legal framework for uranium export.

A. The 2009 Mineral Resources Act

Uranium mining in Greenland is governed by the 2009 Mineral Resources Act, enacted pursuant to the 2009 Act on Greenland Self-Government.[41] The Mineral Resource Authority—comprised of the Bureau of Minerals and Petroleum, and Environmental Protection Agency—is responsible for all matters relating to mineral resources, with all licensing being conducted by the Bureau of Minerals and Petroleum.[42] Exploration licenses may be granted for ten years, and exploitation licenses—once exploration has determined an economically feasible deposit—for thirty years.[43] The Act requires licensees to submit a closure plan outlining remediation, monitoring, maintenance of measures to protect the environment and public health, and financial means to ensure implementation of the plan.[44] The Act also outlines environmental protection and climate change policies, and ensures that the issuance of licenses is contingent upon completion and review of an environmental impact assessment.[45] Reporting requirements in the event of imminent environmental contamination and strict liability for environmental damage, personal injury, and damage to property are included in the Act.[46] The Mineral Resources Act owes its existence to changes in Greenland's legal relationship with Denmark.

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and-climate/2348-new-report-confirms-that-the-kvanefjeld-mining-project-is-not-sustainable.

40. *See* van Leeuwen, *supra* note 39.

41. 2009 Mineral Resources Act, *available at* http://www.govmin.gl/images/stories/faelles/mineral_resources_act_unofficial_translation.pdf.

42. *Id.* at pt. 1 § 3(3).

43. *Id.* at pt. 7 § 29 (1), (2).

44. *Id.* at pt. 8 § 38; pt. 10 § 43.

45. *Id.* at pt. 15.

46. *Id.* at pt. 14. §§ 67, 68.

B. Greenland's Status as an OCT Entity

OCTs are special territories of European Union (EU) member states that have relationships with the EU as governed by provisions in their country's accession agreements or EU legislative agreements.[47] The current OCT-EU relationship is governed by Council Decision 2013/755/EU,[48] which sets out as its objectives the improvement of trade relations between the OCTs and their EU partner states, as well as the "promotion of [the] EU's values, standards and interests in the wider world via the OCTs."[49] Greenland is unique among OCTs as it is the only OCT to have withdrawn from the European Union.[50] At the time of its withdrawal from the European Economic Community (EEC) in 1985,[51] Greenland was treated as a special case by the EEC and Danish Government, as it was compensated by both entities for rights to its disputed fishing waters, and its citizens were allowed to maintain EU citizenship.[52]

The EU's relationship with its twenty-six OCTs has historically focused on development needs—such as funding for education reform and poverty eradication—and has only recently approached global issues such as human rights and democracy by way of "promotion of the EU's values."[53] While a 2009 EU Green Paper specifically recommended improving OCT compliance with the partner nation's export regulation regime,[54] and while the 2013/755/EU Council Decision includes descriptions of nuclear products that confer originating status for export,[55] the EU has not yet comprehensively addressed non-proliferation objectives with its OCTs, as set out in the 2003 Strategy Against Proliferation of Weapons of Mass

47. *See, e.g.*, EU relations with its associated Overseas Territories and Countries, EUROPEAN UNION EXTERNAL ACTION, http://eeas.europa.eu/oct/index_en.htm.

48. Council Decision 2013/755/EU, 2013 O.J. (L 344/1), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:344:0001:0118:en:PDF.

49. OCT–EU relations in detail, EUROPEAN COMM'N, http://ec.europa.eu/europeaid/regions/overseas-countries-and-territories-octs/oct-eu-relations-detail_en?language=LV (last visited Oct. 18, 2014).

50. Cindy Vestergaard, *The European Union, Its Overseas Territories and Non-Proliferation: The Case of Arctic Yellowcake*, THE EU NON-PROLIFERATION CONSORTIUM (Jan. 2013), http://www.sipri.org/research/disarmament/eu-consortium/publications/EUNPC_no%2025.pdf [hereinafter Vestergaard, European Union].

51. *Id.*

52. Greenland had been a colony of Denmark since 1953, and Greenland joined the EEC in 1972 when Denmark held a referendum in support of joining, even though Greenlandic voters were against accession. Citizens of Greenland were concerned about limiting European rights to their fishing waters and, after passing the 1978 Greenland Home Rule Act, sought to withdraw from the EEC. *Id.*

53. Vestergaard, European Union, *supra* note 50.

54. European Commission, *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions - Elements for a new partnership between the EU and the overseas countries and territories (OCTs)*, COM/2009/0623 (June 11, 2009), http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52009DC0623.

55. Council Decision 2013/755/EU, Appendix II, 2013 O.J. (L 344/91).

Destruction (WMD Strategy).[56] These objectives include strengthening export control policies and practices, such as conditioning export of nuclear materials on ratification of the IAEA's Additional Protocol,[57] and reinforcing controls in the export of dual-use technology.[58] As the EU has not yet addressed these objectives with its OCTs, there is no model OCT regulation focusing on these issues.

C. The 2009 Act on Greenland Self-Government

In 2009, an agreement between Greenland and Denmark to increase Greenland's independence—the Act on Greenland Self-Government—entered into force, replacing the 1978 Greenland Home Rule Act.[59] Under this Act, Greenland assumed responsibility for a number of its administrative activities, including establishing courts of law, police, and prison services, as well as border control, financial regulation, and mineral resource activities.[60] The Act also contains a provision that Greenland and Denmark will commence negotiations regarding Greenland's complete independence should Greenland seek it.[61] Until that time, however, foreign defense and security policy remains within the province of the Denmark

56. *Id.* Council of the European Union, *EU Strategy against Proliferation of Weapons of Mass Destruction*, 15708/03 (Dec. 10, 2003), http://register.consilium.europa.eu/doc/srv?l=CEN&f=ST%2015708%202003%20INIT.

57. Denmark has negotiated the Additional Protocol on behalf of Greenland, but this is not universal among OCTs. *See* IAEA, *Protocol Additional to the Agreement Between the Government of the Kingdom of Denmark and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on Non-Proliferation of Nuclear Weapons*, IAEA Doc. INFCIRC/176/Add.1 (Apr. 4, 2013).

58. *Id.* The Additional Protocol is an addendum to a safeguards agreement that allows the IAEA to conduct inspections of all parts of a nation's nuclear capabilities, to include uranium mines, as well as collection of environmental samples, verification of fuel-cycle research programs, and accounting and control of nuclear material. *See IAEA Safeguards Overview: Comprehensive Safeguards Agreements and Additional Protocols*, IAEA, http://www.iaea.org/Publications/Factsheets/English/sg_overview.html. Safeguards agreements are concluded pursuant to the Nuclear Nonproliferation Treaty (NPT), ratified by Denmark, which requires that a state party not provide fissionable material or equipment to prepare fissionable material to another state unless that state has also signed safeguards agreements pursuant to the NPT. *See* Treaty on the Non-Proliferation of Nuclear Weapons: Status of the Treaty, U.N. OFFICE FOR DISARMAMENT AFFAIRS, March 5, 1970, http://disarmament.un.org/treaties/t/npt/text (last visited Nov. 21, 2014). The NPT also requires that member states facilitate the exchange of materials for peaceful purposes. Typical comprehensive safeguards agreements include specific agreements that member states cooperate with the IAEA, provide information and reports to the IAEA, notify the IAEA of material transfer, and apply methods for the purpose of verifying that fissionable material is not diverted for nuclear weapons. The IAEA developed the Additional Protocol in 1997 after the discovery of undisclosed weapons programs in Iran and North Korea demonstrated that the initial comprehensive safeguards agreements were insufficient to ensure nuclear security. HELEN COOK, THE LAW OF NUCLEAR ENERGY 32 (2013).

59. Act on Greenland Self-Government, No. 473 (2009), *available at* http://naalakkersuisut.gl/~/media/Nanoq/Files/Attached%20Files/Engelske-tekster/Act%20on%20Greenland.pdf. *See also The Greenland Self-Government Arrangement*, STATSMINISTERIET, http://www.stm.dk/_a_2957.html.

60. *Id.* at Schedule List II.

61. *Id.* at ch. 8.

authorities.[62]

The Act's outline of Greenland's foreign affairs authority appears straightforward but is complex in practice. Where agreements under international law with a foreign state "exclusively concern Greenland and entirely relate to fields of responsibility taken over,"[63] Greenland may negotiate and execute the agreement so long as Denmark is kept informed of such negotiations.[64] However, agreements "negotiated within an international organization [sic] of which the Kingdom of Denmark is a member"[65] shall be conducted by Denmark, keeping Greenland informed where the agreement is of particular importance to Greenland, unless Denmark authorizes Greenland to conduct the negotiations.[66] This complex relationship for the execution of foreign affairs informs the debate regarding the legal framework for Greenland's export of uranium.

As part of the 2009 Act on Greenland Self-Government, Greenland took control of its mineral resources, with revenue from these resources accruing to the Greenland government.[67] Greenland receives an annual subsidy from Denmark, in the 2009 Act given as DKK 3,439.6 million, or nearly $580 million USD.[68] In accordance with Greenland's accruing revenue for its mineral resources, Denmark will reduce its subsidy by half the revenue that exceeds DKK 75 million, or $12.6 million USD.[69] Denmark also agreed to ensure, for payment, consultants to Greenland for exploitation of its mineral resource area, as well as research of relevance to mineral resources in Greenland free of charge.[70] Should Greenland's revenue for its mineral resources result in Greenland receiving no subsidy from Denmark, negotiations will commence to determine Greenland's continued economic relations with Denmark.[71] The favorable terms of the mineral resources provisions—that Greenland will only lose subsidy from Denmark to the extent that its mineral revenues exceed DKK 75 million, with the subsidy only reduced by half of the revenues, as well as the agreement to provide consultancy and free research services—is intended to help Greenland develop an economy that thrives on the extraction of its mineral resources, with a view toward Greenland ultimately achieving independence from Denmark.

D. Greenland's Existing Legal Framework for Uranium Mining and Export Under Agreements with the IAEA and Euratom

One might expect that Denmark would have a robust nuclear program and existing legal framework for its operation—elsewhere in Scandinavia,

62. *Id.* at ch. 4.
63. *Id.* at ch. 4, §12(1).
64. *Id.* at ch. 4, §12(5).
65. *Id.* at ch. 4, §12(4).
66. *Id.* at ch. 4, §13(1), (2).
67. *Id.* at ch. 3, §7(1).
68. *Id.* at ch. 3, §5(1).
69. *Id.* at ch. 3, §8(1).
70. *Id.* at ch. 3, §9(1)–(4).
71. *Id.* at ch. 10.

nuclear power accounts for nearly half of Sweden's energy production, and over a quarter of Finland's.[72] Moreover, Niels Bohr, a national hero, helped to develop the atomic bomb as part of the Manhattan Project.[73] Denmark, however, had a late start to nuclear energy research,[74] establishing the Atomic Energy Commission in 1955.[75] Despite strong public support for nuclear energy during the 1950s and 60s, Denmark never built a nuclear power station.[76] By 1976, concern over nuclear security and the nuclear fuel cycle led to the proposal in the Danish Government that a decision regarding the introduction of nuclear power plants in Denmark would be postponed until a suitable solution could be found for the storage of nuclear waste.[77] In spite of attempts to develop a solution for storing waste in Denmark's underground salt repositories, no solution was found and, in 1985, the Danish Government passed an act excluding nuclear power from Denmark's energy planning.[78]

Part of Denmark's anti-nuclear trajectory is due to the 1968 Thule accident in Greenland[79]—an American B-52 bomber stationed at Thule in northern Greenland crash-landed, igniting 35,000 gallons of jet fuel and detonating the explosives in the four B28 nuclear weapons it carried, spreading nuclear material over a 2,000 foot area.[80] The decontamination operation reclaimed 10,500 tons of contaminated snow and debris.[81] Following the accident, the station manager's wife documented ailments afflicting the 800 Danish workers who assisted with the decontamination, leading to the Danish government providing radiation evaluation assessments for the remaining Thule survivors in 1986; shortly after, Denmark enacted the act excluding nuclear power from its energy planning.[82]

As a result of the Thule accident and Denmark's late start to nuclear energy research, Denmark did not develop a nuclear power program, nuclear fuel cycle, or related activities of uranium mining, and therefore has no legal framework covering nuclear material import or export.[83] Denmark is a signatory to IAEA[84] and Euratom[85] agreements, but the extent to

72. Henry Nielsen & Henrik Knudsen, *The Troublesome Life of Peaceful Atoms in Denmark*, 26 HIST. & TECH. 91, 92 (2010).

73. *Id.* at 94.

74. *Id.* at 95.

75. *Id.* at 91.

76. *Id.*

77. *Id.* at 108.

78. *Id.*

79. *See* Vestergaard, European Union, *supra* note 50, at 5.

80. *Broken Arrows: The Palomares and Thule Accidents*, BROOKINGS INST. (1998), http://www.brookings.edu/about/projects/archive/nucweapons/box7-3.

81. *Id.*

82. *Id.* Americans were also affected as a result of the accident. *See, e.g.*, Gebe Martinez, *Soldiers, Families Sue Over Atomic Exposure: Class-action Lawsuit Seeks Compensation, Saying that VA's Rules for Benefits Pose Too Great a Hardship*, L.A. TIMES (Aug. 31, 1995), http://articles.latimes.com/1995-08-31/news/mn-40807_1_federal-benefits.

83. *See* Vestergaard, European Union, *supra* note 50, at 5.

84. The IAEA is an international body of the UN. It has 158 member states and has as its objectives to "seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world." *See* COOK, *supra* note 58, at 89.

which these bind Greenland is a matter of dispute.[86] In 2013, Denmark and Greenland established a Uranium Working Group to determine the legal framework for mining and exporting Greenland's uranium.[87] The Uranium Working Group published a preliminary report in October 2013, which included a legal opinion requested by the Greenland Government from the Danish law firm Lett Advokatfirma regarding the division of authorities between Greenland and Denmark for oversight of uranium export (the Lett Report).[88] The Lett Report found that Greenland could conclude agreements on the export and sale of uranium without the involvement of Denmark so long as export is accompanied by a contract for peaceful use.[89] Where uranium may be used for weapons production, however, Denmark would have to negotiate for its export on behalf of Greenland in accordance with Section 13 of the 2009 Act.[90] While it is unclear how the Lett Report defined peaceful use so as to exclude the requirement of IAEA Safeguards Agreements, it did call for Denmark and Greenland to define objectives for the export of uranium.[91] Greenland, apparently dissatisfied with any Danish oversight of its uranium export, commissioned a second legal opinion published in January 2014, which found that because Denmark had transferred control of mineral resources to Greenland under the 2009 Act, Greenland did not need Danish authority to export uranium, even though doing so would have foreign security

85. Euratom, established in 1857, seeks to "contribute to the raising of the standard of living in the Member States and to the development of relations with the other countries by creating the conditions necessary for the speedy establishment and growth of nuclear industries." To this end, it has as its mandate to promote research, disseminate information, establish a common nuclear market, and common supply and safeguards policies. COOK, *supra* note 58, at 99.

86. Bent Ole Gram Mortensen, *The Quest for Resources– The Case of Greenland*, 15 J. OF MIL. & STRATEGIC STUD. 93, 112 (2013).

87. Cindy Vestergaard, *Greenland, Denmark and the Pathway to Uranium Supplier Status*, 2 THE EXTRACTIVE INDUS. & SOC'Y 153 (2015), https://www.google.com/url?sa=t&rct=j&q,=&esrc=&source=web&cd=2&ved=0CCgQFjAB&url=http%3A%2F%2Fwww.sciencedirect.com%2Fscience%2Farticle%2Fpii%2FS2214790X14000690&ei=slpnVOGhAuLasATPm4K4Bw&usg=AFQjCNEhkmuaupUWxP4LfT9sgFSN9vhXbw&sig2=IDw1Szlf7laV3o8GVTqS4g&bvm=bv.79142246,d.cWc&cad=rja [hereinafter Vestergaard, *Greenland*].

88. *Id.* The final report from the working group, which will include the framework for a cooperation agreement between Greenland and Denmark, will be published in Spring 2016.

89. *Id. Rapport om forhold vedrørende en eventuel ophævelse eller ændring af nultolerancepolitikken for udnyttelse af uran og andre radioaktive mineraler*, Apr. 2013, [hereinafter Lett Report], *available at* http://naalakkersuisut.gl/~/media/Nanoq/Files/Publications/Raastof/DK/Rapport%20om%20forhold%20vedr%C3%B8rende%20oph%C3%A6velse%20af%20nultolerancepolitikken%202013%2004%2004%20rette%20version.pdf (Den.).

90. *See* Vestergaard, *Greenland*, *supra* note 87. Greenland has no intent to enrich uranium; however, the Lett Report suggests that international safeguards agreements would only apply if Greenland were exporting weapons-grade uranium. This assumes that agreements to use uranium for peaceful purposes somehow contravene the requirement for international safeguards. Nonetheless, Greenland commissioned the second legal opinion for an even less restrictive interpretation of its responsibilities vis-à-vis Denmark to export uranium. *Id.*

91. *Id.*

implications.[92] At the time of the publication, Greenland and Denmark have not reached a resolution of this disagreement.[93]

This disagreement as to whether Greenland can negotiate to export uranium on its own terms and reporting requirements regarding uranium ore is the result of complexities in IAEA and Euratom regulation of uranium, and how those regulations apply to Greenland as a result of its OCT status and the 2009 Act. IAEA INFCIRC/153, a comprehensive safeguards agreement, establishes that safeguards apply from the point at which the source leaves the plant or process stage,[94] and do not apply to the mining of ore, ore processing,[95] or yellowcake.[96] Conversely, the Euratom Treaty Article 77 holds that the "Commission shall satisfy itself that" in member states "ores; source materials and special fissionable materials are not diverted from their intended uses as stated."[97] As a result of this provision, Euratom requires member states to keep detailed records of ores and to

92. *Id. See also Greenland has Right to Export Uranium, Say Lawyers*, THE ARCTIC J. (Sept. 17, 2013, 8:09 AM), http://arcticjournal.com/oil-minerals/114/greenland-has-right-export-uranium-say-lawyers; Ole Spierman, *Responsum om udenrigspolitiske beføjelser i forhold til uran og andre radioaktive mineraler i Grønland*, Jan. 6, 2014, *available at* http://naalakkersuisut.gl/~/media/Nanoq/Files/Publications/Raastof/DK/Responsum_DK.pdf (Green.).

93. "The two countries have 'agreed to disagree' . . . for the time being." Kevin McGwin, *All Things Uranium*, THE ARCTIC J. (Feb. 25, 2013), http://www.arcticjournal.com/oil-minerals/448/all-things-uranium.

94. The Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty of the Non-Proliferation of Nuclear Weapons, ¶ 34(c), IAEA INFCIRC/153 (June, 1972), http://www.iaea.org/sites/default/files/publications/documents/infcircs/1972/infcirc153.pdf.

95. Uranium in nature is only approximately 0.7% fissile U-235; the remaining material is U-238, and must be enriched into the fissile isotope if it is to be used for either nuclear power plants or nuclear weapons. Most nuclear power plants require uranium enriched with 3.5 to 5% U-235, or low-enriched uranium; nuclear weapons require greater than 20% U-235 enrichment, or highly-enriched uranium. Uranium must be converted into a gas before it is enriched; uranium conversion facilities currently exist in Canada, China, France, Russia, the United Kingdom, and the United States. Typically, conversion processes refine uranium yellowcake into uranium dioxide, and uranium dioxide into uranium hexafluoride. Once uranium is converted into a gas, it must then be enriched, typically in a gaseous diffusion plant, where a series of membranes deplete the U-238. Commercial enrichment facilities exist in France, Germany, the Netherlands, Russia, Japan, China, the United Kingdom, and the United States. Once the uranium is enriched, it must be fabricated to form small pellets and placed into fuel rods. Fuel fabrication is typically conducted by the reactor vendor; fuel fabrication services exist in Argentina, Belgium, Brazil, Canada, China, France, Germany, India, Japan, Kazakhstan, Pakistan, South Korea, Romania, Russia, Spain, Sweden, the United Kingdom, and the United States. Greenland does not appear yet to have the intention of converting or enriching the uranium it mines; it would ship yellowcake (unprocessed uranium) to locations that could convert it, a possibility that Denmark appears to be considering. Kevin McGwin, *All Things Uranium*, THE ARCTIC JOURNAL (Feb. 25, 2013), http://www.arcticjournal.com/oil-minerals/448/all-things-uranium. Because the nuclear fuel cycle is complex and takes place in different countries, complex different restrictions apply when shipping nuclear material and nuclear fuel to different countries pursuant to the NPT, IAEA safeguards agreements and supplier countries' national laws. *See generally* COOK, *supra* note 58.

96. *See* IAEA INFCIRC/153, *supra* note 94 at pt. II, § 33.

97. Treaty establishing the European Atomic Energy Community, ch. VII-Safety Control, art. 77, (Mar. 25, 2957), *available at* http://www.cvce.eu/en/recherche/unit-con-

allow experts access to processing facilities.[98] In 2005, Euratom updated the application of its safeguards requirements with the publication of Commission Regulation No. 302/2005, requiring member states to report basic technical information regarding ore extraction operations and clarifying that reporting requirements include maintaining accounting records of "the quantities of the ore extracted, with the average uranium and thorium content, and the stock of extracted ore at the mine. The records shall also contain details of shipments, stating the date, consignee and quantity in each case."[99] While IAEA safeguards were applied across Euratom member states pursuant to an agreement between the two agencies in 1973, Euratom can be said to have safeguards requirements that are more stringent than the IAEA.[100]

Greenland became a party to the Safeguards Agreement between Euratom and the IAEA in 1973, as Greenland was then part of the European Economic Community (EEC).[101] When Greenland withdrew from the EEC and consequently from Euratom in 1985, it reverted to the previous agreement between Denmark and the IAEA, which grants the IAEA inspection rights and establishes basic reporting and accounting requirements for nuclear materials.[102] In 2013, Denmark negotiated the Additional Protocol on behalf of Greenland,[103] which entered into force on March 22, 2013.[104] As part of this Protocol, Denmark reports directly to

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tent/-/unit/3cb9e142-6ac4-4184-8794-fc3cf619cf33/7c899bfd-8af1-4afa-aa30-e1c29c515c4f/Resources.

98. Vestergaard, *Greenland*, *supra* note 87.

99. On the application of Euratom safeguards, ch. V–Specific Provisions, art. 24, Ore Producers, No. 302/2005 (Feb. 8, 2005), *available at* http://eur-lex.europa.eu/resource.html?uri=cellar:48e4f5fc-d06b-4069-ab40-8c47a3e6a1bb.0005.02/DOC_1&format=PDF.

100. The Text of the Agreement Between Belgium, Denmark, the Federal Republic of Germany, Ireland, Italy, Luxembourg, the Netherlands, the European Atomic Energy Community and the Agency in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, IAEA INFCIRC/193 (Sep. 14, 1973), *available at* https://www.iaea.org/publications/documents/infcircs/text-agreement-between-belgium-denmark-federal-republic-germany.

101. *See* Vestergaard, *Greenland*, *supra* note 87, at 156. The Agreement between Euratom and the IAEA, INFCIRC/193, created uniform safeguards for all Euratom member states. *Id.*

102. IAEA, *Agreement Between Denmark and the Agency for the Application of Safeguards in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons*, IAEA Doc. INFCIRC/176 (Apr. 9, 1973).

103. IAEA, *Protocol Additional to the Agreement Between the Government of the Kingdom of Denmark and the International Atomic Energy Agency for the Application of Safeguards in Connection with the Treaty on Non-Proliferation of Nuclear Weapons*, IAEA Doc. INFCIRC/176/Add.1 (Apr. 4, 2013). When Greenland seceded from Euratom, the Agreement between the Agency and Denmark (INFCIRC/176) came back into force for Greenland, and the Additional Protocol for Greenland entered into force on March 22, 2013. *See* IAEA, *The Safeguards Implementation Report for 2013*, at 6, n.11, IAEA Doc. GOV/2014/27 (Apr. 23, 2014).

104. *See* IAEA, *The Safeguards Implementation Report for 2013*, *supra* note 103, at n.11.

the IAEA on behalf of Greenland,[105] including providing information in regards to production capacities, but not a detailed nuclear material account.[106] One purpose of the Additional Protocol is to ensure that Denmark assists with oversight of Greenland's uranium mining industry,[107] and the timing of its passage is a result of Greenland lifting the moratorium on uranium mining.[108] Although Denmark is part of Euratom, Greenland is not; because the Additional Protocol does not require that information regarding uranium mines include a detailed account of the nuclear material, when Denmark reports information regarding Greenlandic uranium to the IAEA, that information may not align with Euratom's requirements, reflecting a gap in the regulatory regime.[109]

The regulation adopted under the Euratom Treaty guides the export of uranium in EU member states.[110] This regulation, which applies to Denmark, is more stringent—for instance, by requiring reporting of uranium greater than four grams contained in monitoring equipment[111]—than the voluntary Nuclear Suppliers Group export controls,[112] which apply to both Denmark and Greenland.[113] Should Greenland choose to export uranium to Denmark, or to the EU generally, it would have to follow the EU's dual-use regulations,[114] regardless of the fact that it is not a member of Euratom.[115] Notably, Greenland could have joined Euratom through a

105. That is, Denmark reports directly to the IAEA on behalf of Greenland with respect to Greenlandic uranium, without reporting first through Euratom. *See* Vestergaard, *Greenland*, *supra* note 87, at 157.

106. *See* IAEA, *Protocol Additional*, *supra* note 103, at 2. The relevant language is as follows: "[i]nformation specifying the location, operational status and the estimated annual production capacity of uranium mines and concentration plants and thorium concentration plants, and the current annual production of such mines and concentration plants for Denmark as a whole." The Protocol continues that "Denmark shall provide, upon request by the Agency, the current annual production of an individual mine or concentration plant." However, "[t]he provision of this information does not require detailed nuclear material accountancy."

107. *See* IAEA, *Statement by Denmark as Delivered by Ambassador Uffe Balslev Under-Secretary for Disarmament, Non-proliferation and Arms Control*, 57th Gen. Conf. (Sept. 16–20, 2013).

108. Denmark had an Additional Protocol in place with the IAEA from 1985 to 1998, but did not seek to pursue its application to Greenland until establishment of the joint Uranium Working Group. *See* Vestergaard, *Greenland*, *supra* note 87, at 157–58.

109. This gap also exists for export outside of Europe; see *infra* note 115 and accompanying text.

110. Council Regulation 428/2009, Setting Up a Community Regime for the Control of Exports, Transfer, Brokering and Transit of Dual-Use Items, 2009 O.J. (L 134/1).

111. *See id.* at 45.

112. *About the NSG*, NUCLEAR SUPPLIERS GROUP, http://www.nuclearsuppliersgroup.org/en/about-us (last visited Nov. 15, 2014).

113. *See* Vestergaard, *Greenland*, *supra* note 87, at 157.

114. Council Regulation 428/2009, *supra* note 110.

115. *Id.* It is important to note, too, that many countries have requirements for bilateral agreements imposing export restrictions, including Canada, which converts yellowcake into uranium dioxide or uranium hexafluoride suitable for fuel production. Thus, should Greenland choose to export uranium without Denmark's oversight not to the EU, but to another country for enrichment, it may have to negotiate a bilateral agreement with that country. *See* Vestergaard, *Greenland*, *supra* note 87; James Fahey & Richard Pu, *Regulation of the Uranium Industry in Australia: Comparison to the Canadian*

treaty modification without rejoining the EU.[116] Doing so would have ensured clearer reporting requirements for Greenland's uranium ore and would have also resolved complexities in the application of other Euratom safeguards agreements to which Denmark is a party.[117] However, Euratom membership perhaps proved too politically sensitive for Greenland, given its move towards self-rule and that it specifically voted to leave the EU.[118]

Note that none of the regulations discussed here cover environmental controls, which have traditionally been left to local governments.[119] The initial report of the Uranium Working Group also located responsibility for these regulations with the Greenland government, along with transport and emergency preparedness.[120] While Greenland's Mineral Resources Act seeks to ensure that "environmental risks are identified, assessed and reduced as much as is practically possible,"[121] neither the Act nor the Bureau of Minerals and Petroleum Guidelines outline specific environmental requirements for uranium mining. Potential licensees are required to submit environmental impact assessments, and to conduct consultations with communities that may be affected as identified in the impact assessment,[122] but Greenland's guidance for completing the environmental impact assessment only contains water quality guidelines for use in connection with mining activities.[123] Although Greenland previously looked to other leaders in uranium mining—such as Canada and Australia—for guidance on environmental standards,[124] review of the Mineral Resources Act has been on hold since Prime Minister Aleqa Hammond resigned in

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Approach and the Nedd for a Single Federal Regulator, 26 AUSTRALIAN RESOURCES AND ENERGY L. J. 268, 285 (2007) (describing Australia's bilateral agreements that apply IAEA safeguards).

116. *See* Vestergaard, European Union, *supra* note 50, at 8. Indeed, re-entry into Euratom is what Cindy Vestergaard recommended as the best method to resolve the discrepancy between Greenland and Denmark's nuclear regulatory regimes in her January 2013 paper. *Id.*

117. These agreements include the Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency, Convention on Nuclear Safety, International Convention for the Suppression of Acts of Nuclear Terrorism, Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, and the Convention on the Physical Protection of Nuclear Material and 2005 Amendment. *See* Vestergaard, *Greenland*, *supra* note 87, at 157, Table 1.

118. *Cf. id.* at 157.

119. *Id.* at 155–56.

120. *Id.* at 157.

121. The Mineral Resources Act, Greenland Parliament Act no. 7 of Dec. 7, 2009, art. 53, §§ 4–5 (Jan. 2010).

122. *See* Hubbard, *supra* note 10, at 118.

123. Poul Johansen, Christian Glahder & Gert Asmund, *BMP Guidelines for Preparing an Environmental Impact Assessment: Report for Mineral Exploitation in Greenland*, BUREAU OF MINERALS AND PETROLEUM (Jan. 2011), *available at* http://www.govmin.gl/images/stories/minerals/EIA_guidelines_mining.pdf.

124. *See* Clemens Bomsdorf, *Greenland Seeks Advice on Uranium Extraction*, WALL ST. J. (Jan. 10, 2014, 2:03 PM), http://online.wsj.com/articles/SB10001424052702304347904579312692158761308; Falke Thue Mikailsen, Palle Bendsen, Varste M. Berndtsson & Niels Henrik Hooge, Op-Ed., *Uranium in Greenland: Phasing out Democracy*, THE ARCTIC JOURNAL (Sept. 9, 2014, 6:29 PM), http://arcticjournal.com/opinion/983/phasing-out-democracy.

2014.[125] As a result, the Act has received some attention for its failure to address the environmental requirements of mining.[126] This Note will examine recommendations for environmental regulation in more detail in Part IV, but it is important to note here that Greenland does not have a robust regulatory regime in place to address the potential environmental impacts of uranium mining.

E. Recommendations for Greenland's Regulatory Framework for Uranium Ore Mining and Export

Though the political and regulatory climates surrounding Greenland's legal framework for uranium ore production and export are complex, what is fairly clear is that regardless of whether Greenland requires Denmark's approval to export uranium, Greenland would still need to develop a legal regime for producing and exporting uranium ore. Most importantly, Greenland should strive to ensure that its uranium is not diverted to non-peaceful uses; arguably the best way for Greenland to do this is to adopt an export control regulation like Euratom's, thereby ensuring that international safeguards are in place. While the Additional Protocol is a first step in the right direction, it is insufficient to ensure accountability of nuclear materials because it does not require detailed nuclear material accountancy.[127] As a responsible uranium exporter, Greenland should take all measures to ensure that Greenland-origin uranium does not find its way to nuclear weapons programs.

Greenland has made efforts to improve its uranium regulatory regime. For example, the government visited Canadian uranium mines in the Athabasca Basin and engaged in active discussions with First Nation leaders about the benefits and impacts of uranium mining in their territory.[128] Additionally, the government recently encouraged the extractive industry

125. *See Mining Boom at Stake, Greenland Votes Amid Turmoil*, N.Y. TIMES (Nov. 27, 2014, 5:52 AM), http://www.nytimes.com/aponline/2014/11/27/world/europe/ap-eu-greenland-elections.html?_r=0.

126. The act has also received attention for lawmakers' efforts to remove the right of public access to mining permits submitted pursuant to the Act. *Uranium in Greenland: The government aims at undermining environmental rights*, DANISH ECOLOGICAL COUNCIL, (Jul. 10, 2014), http://www.ecocouncil.dk/dk/releases/articles-pressreleases/chemicals-and-climate/2395-uranium-in-greenland-the-government-aims-at-undermining-environmental-rights.

127. For example, the Franck Report, one of the most influential reports on the importance of tracking the exact quantities of uranium ore, notes that the peaceful development of the nuclear industry must be accompanied by "actual and efficient controls" to ensure the materials are not converted for use in atomic weapons. *See* JAMES FRANCK, DONALD J. HUGHES, J.J. NICKSON, EUGENE RABINOWITCH, GLENN T. SEABORG, J.C. STEARNS & LEO SZILARD, Record Group 77, Manhattan Engineer District Records, Harrison-Bundy File, folder no. 76, THE FRANCK REPORT: REPORT OF THE COMMITTEE ON POLITICAL AND SOCIAL PROBLEMS (June 11, 1945).

128. *See* Trish Saywell, *Greenland's Timeless Allure: With a Receptive Government and Receding Ice, a New Exploration Frontier is on the Rise*, THE NORTHERN MINER (July 3, 2013), http://www.northernminer.com/news/greenland-generates-interest/1002431012/?&er=na.

to set up a training center near Kvanefjeld.[129] These are steps in the right direction toward establishing a robust regulatory framework for uranium ore mining and export. Similarly, Greenland's "one door" policy for permitting—allowing potential mineral extractors to conduct all permitting with the Bureau of Minerals and Petroleum—is useful for centralizing oversight of licensing and monitoring of the extractive industry.[130] These actions, however, are a far cry from meeting the accounting principles for ensuring that nuclear material is safeguarded from non-peaceful uses contained in Euratom regulations. Unfortunately, it is likely that a stronger regulatory framework for Greenland's extraction of uranium and its potential export will not be realized until the Uranium Working Group publishes its final recommendations in the spring of 2016.[131]

III. A New Paradigm for Incorporating Indigenous Populations into Uranium Mining Decision-Making

In addition to developing a robust regime for its export of uranium, Greenland must also seek to ensure that indigenous groups are incorporated into the mining decision-making process to serve as a model of best-practice uranium mining. Although the citizens of Greenland may be particularly sensitive to radioactive contamination given their experience with the Thule accident, Greenland provides an interesting test case for operating a uranium mine within an indigenous community, given that Greenland is a mostly indigenous democracy, therefore presumably providing the native Inuit greater access to the political process. This section of the Note suggests that despite instances of mistreatment of indigenous communities via the promotion of uranium mining, Greenland, with the assistance of Denmark, has the opportunity to serve as a paradigm for promoting the respect of indigenous rights by extractive industries. This Part provides a brief overview of the history of uranium mining's impact on indigenous communities in the United States.[132] It then examines the international legal framework for respecting indigenous rights before providing recommendations on how to incorporate indigenous perspectives into the uranium mining licensing process in Greenland.

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129. *Terms of Reference for Environmental Impact Assessment, Kvanefjeld Multi-Element Project*, GREENLAND MINERALS AND ENERGY LTD. (July 2011), http://www.ggg.gl/docs/Projects/20110706_EIA_ToR_FINAL.pdf.

130. *See* Hubbard, *supra* note 10, at 116.

131. *See* Vestergaard, *Greenland*, *supra* note 87, at 158.

132. This Note focuses on the United States as a source of comparison because the effects of uranium mining on indigenous populations there is well documented and the author is most familiar with uranium mining in the United States. Future research should focus on comparing Canada and Greenland, which share environmental similarities.

A. The History of Uranium Mining in Indigenous Communities in the United States

Distrust of the uranium mining industry stems in part from the historical treatment of indigenous communities and the pollution of native lands as a result of uranium mining.[133] In the United States, the U.S. government oversaw uranium mining on Navajo lands in New Mexico, Arizona, Colorado, and Utah to supply material for its nuclear weapons program from World War II until 1971.[134] The mines employed many Navajo from the reservation but failed to educate these workers, many of whom did not speak English, about the risks of working in the mines.[135] More troubling, the mines did not provide the Navajo with protective equipment, and the mining shafts were not adequately vented, even though the increased risk of lung cancer from working in poorly ventilated shafts with inadequate protective equipment was widely known.[136] Mines were uniformly abandoned without remediation or closure, leaving open mine shafts and uranium mill tailings[137] spread across the Navajo nation.[138] Navajo children played in and near the mines, cattle grazed over the waste material, and the Navajo used mill tailings in their home construction.[139] It was not until 1990 that Navajo activists finally succeeded in persuading Congress to pass the Radiation Exposure Compensation Act, which compensated victims of lung cancer and leukemia linked to radiation exposure from the uranium mines.[140] Since then, there has been progress. For example, in

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133. This is historically true for many forms of mining in general; however, this Note focuses on uranium mining.

134. *See* Doug Brugge & Rob Goble, *The History of Uranium Mining and the Navajo People*, 92 AM. J. PUB. HEALTH 1410, 1411, Fig. 1 (2002). Uranium mining on Navajo lands continued through the 1990s, though it was no longer overseen by the U.S. government for military purposes. *See* U.S. NUCLEAR REGULATORY COMM'N, *Homestake– Grants Uranium Recovery Facility: Site Summary* (Feb. 9, 2015), http://www.nrc.gov/info-finder/decommissioning/uranium/is-homestake.pdf.

135. Brugge & Goble, *supra* note 134.

136. *Id.* at 1412. Brugge and Goble note that in Germany and Czechoslovakia, workers were compensated for lung cancer resulting from working in uranium mines as early as 1932. *Id.* at 1410. Eventually, federal legislation passed at the end of the 1960s made ventilation standard in uranium mines. *Id.* at 1412, n.17.

137. Uranium mill tailings are the waste material of extracting uranium from ore. *See* U.S. NUCLEAR REGULATORY COMM'N, *Uranium Mill Tailings* (Apr. 8, 2015), http://www.nrc.gov/waste/mill-tailings.html.

138. *See, e.g.*, Dan Frosch, *Nestled Amid Toxic Waste, A Navajo Village Faces Losing Its Land Forever*, N.Y. TIMES, Feb. 20, 2014, at A10.

139. H.R. Rep. No. 103-58, at 16 (1993). *See also* Erin Klauk, *Human Health Impacts on the Navajo Nation from Uranium Mining*, SCIENCE EDUCATION RESOURCE CENTER AT CARLETON COLLEGE, http://serc.carleton.edu/research_education/nativelands/navajo/humanhealth.html. One early claim seeking compensation for the harm to the Navajo suggests that the failure of the United States government to provide protection from harmful radiation exposure may have been the result of unclear federal and state jurisdiction for overseeing work on the mines. *See* Begay v. United States, 768 F.2d 1059 (9th Cir. 1985) (holding that the federal government was not liable to uranium miners under the Federal Tort Claims act for damages caused by radiation because the decision not to warn miners about the dangers of uranium was within the scope of the government's discretionary regulatory authority).

140. 42 U.S.C. § 2210 *et seq.* (1990).

2008 the Environmental Protection Agency began a $100 million cleanup project in the Navajo nation, which included closing 500 abandoned mines.[141]

B. ILO Convention No. 169, the UN Declaration on the Rights of Indigenous Peoples, and the Consultation Process

The International Labour Organization's Convention 169 provides ratifying countries with a legally-binding framework for ensuring indigenous rights, including the right of indigenous groups to be consulted on issues that affect them, the right to decide priorities of development, and the recognition and preservation of the specific customs and traditions of indigenous groups.[142] It is the most significant legally-binding international treaty for indigenous rights, and reflects emerging customary international law governing those rights.[143]

Convention 169 enters into force one year after a country chooses to ratify it.[144] Once in force, Convention 169 can be applied in national courts; complaints of non-observance may also be brought to the ILO directly, which then appoints a committee to examine and draft a report on the complaint, including recommendations that it forwards to the governing body for adoption.[145] Convention 169's Right to Consultation and Participation has arguably been the most influential part of the convention and underlies the convention's remaining rights.[146]

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141. *See, e.g.*, Frosch, *supra* note 138. The United States now has an established consultation process with indigenous tribes under Section 106 of the National Historic Preservation Act, Pub.L. 89–665, Oct. 15, 1966, 80 Stat. 915, that is folded into the National Environmental Policy Act (NEPA) process, Pub.L. 91–190, Jan. 1, 1970, 83 Stat. 852.

142. Int'l Labour Org. [ILO], *Convention No. 169: Convention Concerning Indigenous and Tribal Peoples in Independent Countries*, June 27, 1989, I.L.O. No. 169, 1650 U.N.T.S. 383 (Sept. 5, 1991) [hereinafter Convention 169].

143. *See* Aqqaluk Lynge, *Inuit in the New Arctic: Challenges of Change*, Speech at Artic Frontiers Conference, at 2 (Jan. 21, 2014), *available at* http://www.arcticfrontiers.com/downloads/arctic-frontiers-2014/conference-presentations-3/tuesday-21-january-2014/460-10-aqqaluk-lynge-txt/file (describing the importance of ILO Convention 169 for indigenous and tribal peoples); CULTURAL SURVIVAL, *International Law and Indigenous Peoples: Historical stands and contemporary developments*, http://www.culturalsurvival.org/ourpublications/csq/article/international-law-and-indigenous-peoples-historical-stands-and-contempor.

144. *See Convention No. 169*, INT'L LABOUR ORG., http://www.ilo.org/indigenous/Conventions/no169/lang–en/index.htm. So far, twenty countries have ratified the convention.

145. *See* ILO, *Indigenous and Tribal Peoples' Rights in Practice: A Guide to ILO Convention No. 169*, 1, 182 (2009).

146. *See* Hubbard, *supra* note 10, at 143 ("The Right to Consultation and Participation lies at the very foundation of ILO 169 and, in practice, is the primary mechanism for guaranteeing the other rights."). Article 6 of Convention 169 provides:

> 1. In applying the provisions of this Convention, governments shall:
>
> (a) consult the peoples concerned, through appropriate procedures and in particular through their representative institutions, whenever consideration is being given to legislative or administrative measures which may affect them directly;

While Convention 169 mandates consultation with indigenous communities on matters that affect them, the United Nations Declaration on the Rights of Indigenous Peoples[147] standard of "free, prior and informed consent" (FPIC) reflects international expectations for governmental engagement with indigenous peoples.[148] According to the U.N. Guidelines on FPIC, "free" refers to a process "that is self-directed by the community from whom consent is being sought, unencumbered by coercion, expectations or timelines that are externally imposed"; prior "means at the 'early stages of a development or investment plan, not only when the need arises to obtain approval from the community'"; and informed means that information should be accessible, given in an appropriate language, objective, culturally appropriate, and "with sufficient time to be understood and verified."[149] Effective implementation of the U.N. Declaration on the Rights of Indigenous Peoples is still in progress in Greenland and other ratifying states, but it nevertheless provides an aspirational framework for consultation with indigenous groups.[150]

Greenland and Denmark have ratified Convention 169.[151] On the one hand, Greenland may be in compliance with Convention 169 by default because a majority of its population is indigenous and it has a popularly elected democratic government, meaning that indigenous people are in control of the government's decisions.[152] On the other hand, the language of Convention 169 is non-specific, and it may therefore fail in application in spite of the clarification provided by FPIC. In Greenland, extractive industry entities are required to conduct consultations with potentially affected communities as part of the initial licensing process. However,

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(b) establish means by which these peoples can freely participate, to at least the same extent as other sectors of the population, at all levels of decision-making in elective institutions and administrative and other bodies responsible for policies and programmes which concern them;

(c) establish means for the full development of these peoples' own institutions and initiatives, and in appropriate cases provide the resources necessary for this purpose.

Convention 169, *supra* note 142.

147. United Nations Declaration on the Rights of Indigenous Peoples, G.A. Res. 61/295, U.N. GAOR, 61st Sess., Supp. No. 295, U.N. Doc. A/61/295 (Sept. 13, 2007).

148. *See Convention No. 169*, *supra* note 144, at 64; Hubbard, *supra* note 10, at 145. A full consideration of FPIC, which is complex and contingent upon the sociopolitical realities of each indigenous community and mining company, is beyond the scope of this paper.

149. Jennifer Laughlin et al., UN-REDD Programme, *Guidelines on Free, Prior and Informed Consent*, at 18–19 (Jan. 2013), *available at* www.unredd.net/index.php?option=com_docman&task=doc_download&gid=8717&Itemid=53 (quoting Rep. of the Economic and Social Council, Jan. 17, 2005–Jan. 19, 2005, U.N. Doc. E/C.19/2005/3).

150. *See, e.g.*, Lynge, *supra* note 143; Nuuk Arctic Declaration on the World Conference on Indigenous Peoples 2014, Oct. 23, 2012–Oct. 24, 2012, *available at* http://www.un.org/esa/socdev/unpfii/documents/arctic-decl-wcip.pdf.

151. *See* ILO, *Ratifications of C169-Indigenous and Tribal Peoples Convention*, http://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:11300:0::NO:11300:P11300_INSTRUMENT_ID:312314:NO; ILO, *Declarations for Greenland*, http://www.ilo.org/dyn/normlex/en/f?p=1000:11200:0::NO:11200:P11200_COUNTRY_ID:103695

152. *See* Hubbard, *supra* note 10, at 114.

these consultations are typically outsourced, and concerns have been raised about their efficacy.[153] For example, the Bureau of Minerals and Petroleum, responsible for the entire extractive industry's licensing process, does not oversee or ensure the suitability of the consultation process, and instead appears to pursue an agenda to ensure that permits are granted expediently.[154] Additional problems with the consultation process include a lack of funding from the applicants for the process, "consultation fatigue"[155] in indigenous communities, limited time to complete the consultation process, and complications with language and differences in decision-making between cultures.[156] The process has been said to fail to provide sufficient opportunity for affected communities to discuss the potential mining project within their community.[157] While Greenland's government has recently attempted to provide greater oversight in the consultation process, many of the same problems unfortunately persist,[158] perhaps due to inadequate funding for overseeing consultations.

C. Recommendations to Improve the Consultation Process

In spite of the history of uranium mining in indigenous communities and Greenland's own deficiencies in the consultation process, there is still hope for adequately incorporating indigenous communities in the permitting process for uranium mining in Greenland. Denmark is a world leader in the promotion of indigenous rights—indeed, the adoption of the Home Rule Act and Act on Greenland Self-Government reflects Denmark's long-standing recognition of the right to self-determination of Greenland's indigenous communities.[159] Moreover, Denmark's support of Greenland's self-government historically reflects culturally-sensitive norms. For instance, Greenland's criminal code incorporates the customary law of the Inuit, relying on lay locals to serve as district judges and defense counsel, and imposing imprisonment for only the most serious cases.[160] Two seats in the Danish Parliament are dedicated to Greenlandic representatives.[161] Internationally, Denmark is also a leader in supporting indigenous rights, and it was one of the first nations to establish a program for these rights, publishing its Strategy for Danish Support to Indigenous Peoples as "an integral part of Denmark's foreign policy" in 1994.[162] Additionally, as of 2013, Denmark was the largest contributor to the U.N.'s Trust Fund on

153. *See id.* at 119.
154. *Id.* at 146–47.
155. Consultation fatigue in this sense refers to fatigue or disinterest that results from repeated consultations about mining projects in indigenous communities.
156. *See* Hubbard, *supra* note 10 at 148–49. While most citizens of Greenland speak Greenlandic, extractive industry entities typically speak English, and the Bureau of Minerals and Petroleum operates in Danish. *Id.* at 149.
157. *Id.* at 149.
158. *Id.* at 149–50.
159. *See* ILO, *Indigenous and Tribal Peoples' Rights*, *supra* note 145, at 27, 52–54.
160. *See id.* at 90.
161. *See id.* at 138.
162. *See* DANIDA, DANISH MINISTRY OF FOREIGN AFFAIRS, *Strategy for Danish Support to Indigenous Peoples*, 1, 7 (2004), *available at* http://amg.um.dk/en/~/media/amg/Docu

Indigenous Issues.[163] Though the Act on Greenland Self-Government intends to set the conditions for Greenland's independence, Denmark is arguably the ideal nation to shepherd Greenland into a self-government that is sensitive to indigenous rights.

In order to augment indigenous rights in the area of uranium extraction, Greenland should consider adopting a spectrum analysis for the consultation process, as has been suggested by scholars of Arctic energy development.[164] Spectrum analysis is a situation-dependent analysis to ensure that consultations are conducted meaningfully and meet the U.N.'s requirements of ensuring that consent is free, prior, and informed. Essentially, applying a spectrum analysis means tailoring the amount of consultation for a given project to that project's potential impact on an indigenous community.[165] Indigenous communities that already have experience with mining projects in their communities may not require the same type of information as communities new to the process; if the project hardly affects the community, spectrum analysis suggests that, while a community should be informed of a project, it should not have effective veto power in the form of requisite consent.[166]

Tailoring the consultation process to the particular community and project may help to alleviate "consultation fatigue" and to ensure that adequate timelines are established for larger projects, without delaying projects with a minor impact on indigenous groups. Executing the consultation process using a spectrum analysis may also assist the Bureau of Minerals and Petroleum in optimally allocating funding and personnel to oversee the consultations. However, consultation must also respect cultural norms. While Greenland has recently made efforts to ensure that consultations take place in a tri-lingual forum,[167] it must also be prepared to acknowledge when indigenous communities do not consent to a new project, given that "[t]he purpose of consultation and participation is to respect Indigenous communities rather than to force changes upon them."[168]

In sum, Greenland, a majority indigenous nation guided by Denmark (which is a leader in indigenous rights), arguably provides the optimal environment for the successful operation of uranium mining to set a model for the engagement of the indigenous population. However, changes do need to be made to ensure that the consultation process is particularized to

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ments/Policies%20and%20Strategies/Freedom%20Democracy%20and%20Human%20Rights/Indigenous%20people/StrategyForDanishSupportToIndigenousPeople.ashx.

163. *See* DANIDA, MINISTRY OF FOREIGN AFFAIRS OF DENMARK & NAALAKKERSUISUT, *Review Report: Strategy for Danish Support to Indigenous Peoples 2001-2010*, 1, 23 (Mar. 2011), *available at* http://www.netpublikationer.dk/um/11085/pdf/review_strategy_indigenous_peoples.pdf.

164. *See, e.g.*, Dwight Newman, Michelle Biddulph & Lorelle Binnion, *Arctic Energy Development and Best Practices on Consultation with Indigenous Peoples*, 32 B.U. INT'L L.J. 449, 482–83 (2014).

165. *See id.* at 482–83.

166. *Id.* at 483, n.243.

167. *See* Hubbard, *supra* note 10, at 114.

168. *See* Newman, *supra* note 164, at 485.

the project and community to optimize guidance in the free, prior, and informed consent standard. While tailoring the consultation process may require significant effort upfront, it will undoubtedly engender trust and confidence between the government, indigenous communities, and extractive industries that is essential for future developments. Doing so will serve to balance the interests of commerce with the indigenous right to effective participation in processes and projects that affect them.

IV. Environmental Impacts and Technological Advances in Uranium Mining

In tandem with the treatment of indigenous communities, distrust of uranium mining stems from the negative environmental impact resulting from the lack of environmental regulation and understanding of environmental effects during the early history of uranium mining.[169] In addition to the failure to ensure that workers understood and exercised personal protective standards,[170] leaks from mill tailing containment facilities contaminating groundwater were not uncommon.[171] Fortunately, leading practices to contain mill tailings demonstrate that it is possible to engineer site-specific containment facilities that pose a minimal risk of leakage.[172]

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169. *See* OECD, *supra* note 15, at 11–15.

170. *Id.* at 28. The OECD report notes that miners working in uranium mines were at greater risk from non-radiological hazards than they were from radiological hazards. *Id.* For example, miners were allowed to smoke in mines, were provided with poor ventilation that contributed to silica inhalation, and were not given emergency egress routes. *Id.* at 22, 28.

171. *See id.* at 75, 80, 83. The OECD report describes specific leak accidents and provides guidelines on how to ensure that future leaks do not occur. *Id.* at 30–31. Arguably the most catastrophic of such leaks occurred in the U.S. in 1979, when the United Nuclear Corporation's Church Rock Mill released 93 million gallons of contaminated liquid and 1,100 tons of contaminated solids from an unlined pond into an arroyo that reached the Rio Puerco river, eventually contaminating nearly 100 miles of land in New Mexico and Arizona. *See* John D. Collins, *Reclamation and Groundwater Restoration in the Uranium Milling Industry: An Assessment of UMTRCA, Title II*, 11 J. NAT. RESOURCES & ENVTL. L. 23, 52 (1995–96).

172. *See* OECD, *supra* note 15, at 9. In the United States, the failure to plan for the collapse of the uranium mining industry resulted in taxpayers footing the bill for reclamation after the uranium industry bust of the 1980s. *See generally* Collins, *supra* note 171. Initially, to address the possible environmental and public health threats posed by uranium mill tailings, Congress passed the Uranium Milling Tailings Radiation Control Act, or UMTRCA, 42 U.S.C.A. § 7901, *et seq.* (1978). *Id.* at 24. The Nuclear Regulatory Commission (NRC) had already begun requiring new mills to dispose of mill tailings in an environmentally responsible manner, but UMTRCA Title II specifically required mills to pay for the reclamation of all tailings they generated, including those produced under government contract prior to 1970. *Id.* at 36–37 (citing 42 U.S.C. § 7925 (1988)). After uranium prices crashed in 1980, most uranium mining stopped and mills sought federal assistance for reclamation that they could no longer afford; mills eventually received assistance in 1992 when companies were allowed federal reimbursement for reclamation resulting from government contracts. *Id.* at 72 (citing Energy Policy Act of 1992, Pub. L. No. 102-486, SS 1001-1004, 106 Stat. 2776, 2946-48 (1992) (codified at 42 U.S.C. S 2296(a) (Supp. V 1993))). Given that UMTRCA's regulatory emphasis on new mills was virtually moot, as plans for new mills were shuttered after the 1980 crash, the regulation ultimately proved to be "the wrong law for the times." *Id.* at 96. UMTRCA is still the framework that the government uses for decommissioning legacy mines. *See, e.g.*, U.S.

The OECD's Nuclear Energy Agency outlines a number of leading practices that uranium mines have developed since the 1990s to ensure the proper containment of radioactive materials, describing uranium mining as "one of the safest forms of mining in the world."[173] All of these practices are site-specific, but nonetheless provide models for engineering controls that can serve to protect the environment and public from radioactive contamination.[174]

A. Leading Practices for Storage of Mill Tailings

The storage of mill tailings is a significant undertaking in the uranium mining industry as mill tailings piles can be very large.[175] The leading practices for mill tailings containment include storing tailings in a management facility or in an open-pit mine engineered to ensure that the tailings do not contaminate the surrounding environment.[176] The International Commission on Large Dams (ICOLD) consolidates best practices for the construction of dams, including mill tailing management facilities, and certain practices uncommon in the early history of uranium mining (such as construction of an emergency spillway) have now become commonplace.[177] For example, as early as 1973, some uranium mills were thickening tailings with compression thickeners in order to dewater the tailings material, thereby reducing storage facility requirements and decreasing pressure on facility embankments.[178] One notable mill that uses this technique is the Cluff Lake Tailings Management Area (TMA) in Saskatchewan, Canada, where mill tailings are segregated between liquids and solids, allowing for better control of the waste, and where wastes are monitored using multi-level ground movement and temperature sensors.[179] The Cluff Lake TMA, now undergoing decommissioning,[180] also employed a series of pools that allowed the mill tailings to precipitate radium-226 before the water was returned to nearby Snake Lake.[181]

Similarly, the McClean Lake Tailings Management Facility, another Canadian facility, uses passive techniques to minimize the potential for contamination. For instance, maintaining a conductivity differential between the mill tailings and surrounding groundwater helps to ensure that groundwater will flow around tailings.[182] The McClean Lake uranium

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NUCLEAR REGULATORY COMM'N, STATUS OF THE DECOMMISSIONING PROGRAM: 2013 ANNUAL REPORT, § 2.4, *available at* http://pbadupws.nrc.gov/docs/ML1331/ML13311A566.pdf

173. OECD, *supra* note 15, at 9.

174. *See id.* at 24.

175. For instance, the Homestake mill tailings pile in New Mexico is 100 feet high and one mile long. *See* U.S. NUCLEAR REGULATORY COMM'N, *Homestake*, *supra* note 134, at 1.

176. *See* OECD, *supra* note 15, at 80.

177. *Id.* at 80–81.

178. *See id.* at 82.

179. *Id.* at 82, 85–86.

180. *See Cluff Lake*, AREVA (2015), http://us.areva.com/EN/home-983/areva-resources-canand-activities.html

181. *See* OECD, *supra* note 15, at 86.

182. *See id.* at 88.

ore also contains high levels of arsenic and other chemicals of concern, so the mill established a Tailings Optimization and Validation Program to ensure that the concentration of arsenic in discharged water is maintained at predicted levels, despite significant variation in the amounts of arsenic in the mined ore.[183] While these practices are site-specific, they nonetheless demonstrate how resources may be used to overcome challenges that threaten to shutter prospective uranium mines.

B. Environmental Concerns for Uranium Mining at Kvanfjeld

The Kvanfjeld mining site presents a number of unique challenges for uranium mining that are causes for concern.[184] A 2014 site report notes that the Kvanfjeld mine is slated to be positioned on the top of a hill, as are the mill tailing confinement facilities, raising the possibility that any contaminated material leaking from the mine or confinement facilities would rapidly spread downhill toward population centers.[185] The report also notes that Kvanfjeld ore contains a number of non-radioactive elements, such as heavy metals, that could pollute groundwater or raise additional public health concerns.[186]

Significantly, the report also raises major questions regarding the integrity of the mill tailing confinement facilities over time—queries include how long the impermeable barrier will remain impermeable, how safe the mill tailings will be during winter when temperatures drop, and the lifespan of the planned sixty-two meter embankment.[187] These are all valid concerns; yet as the OECD's report indicates, site-specific challenges in the design of the uranium mine may be overcome with the appropriate engineering and monitoring controls. For example, Canada's McClean Lake uranium mine developed a suitable solution to the high levels of arsenic and other chemicals in its ore, and the construction of an appropriately sited emergency spillway could help to ensure that any leak from the confinement facility would be routed away from population centers. Any company mining at Kvanfjeld will be required to demonstrate the potential effect on groundwater in an environmental impact assessment. While the risks of uranium mining at the Kvanfjeld site are significant, thorough research and proper oversight, as in the case of McClean Lake, may ensure that no harm to the public or environment occurs as a result of mining.[188]

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183. *Id.* at 89-90.

184. In a report published in April, 2014, Jan Willem Storm van Leeuwen of Ceedata Consultancy outlines a number of these concerns. *See generally* van Leeuwen, *supra* note 39.

185. *Id.* at 16. The argument that the mine is on top of the hill is a valid argument; however, it is not unique that mines are at high elevations, as ore deposits are typically discovered where they are exposed.

186. *Id.* at 15. Indeed, the Ilimaussaq Complex, which contains the Kvanfjeld mining site, contains over 220 minerals, thirty-four of which were discovered at the site, and sixteen of which are unique to the Complex. *See* Thrane, *supra* note 32, at 8.

187. *See* van Leeuwen, *supra* note 39, at 20.

188. The van Leeuwen report also notes that the cost of extracting uranium from Kvanfjeld may greatly exceed the market price for uranium. *See id.* at 4. This is an important consideration in light of the history of UMTRCA II and market volatility for

C. Recommendations for Licensing Requirements to Ensure Oversight of the Public Health and Environmental Impacts at Kvanfjeld

Licensing of uranium mining at Kvanfjeld should require significant research and demonstration of the long-term feasibility and integrity of the proposed mill tailing containment facilities. This research must address the unique geologic composition of the Kvanfjeld site, and include a monitoring and validation program to ensure compliance. While the concerns raised in the 2014 report are important, with proper oversight, the Kvanfjeld mine may still be developed without putting inhabitants or the environment at unnecessary risk of radiation or chemical exposure from either uranium or rare earth elements.

Conclusion

While the risks inherent in mining in Kvanfjeld are significant, Greenland should cautiously continue to permit mining of uranium there. Doing so has the potential to increase the world's supply of rare earth elements and also provides an opportunity to demonstrate that uranium mining may proceed without negative environmental impacts or the mistreatment of indigenous communities in a unique environment where the population and government are made up of mostly native peoples. Greenland will need to develop robust regulatory controls for export control of uranium, and oversight of licensing at Kvanfjeld will require a detailed proof of concept, but these are not insurmountable obstacles. Moreover, if Greenland wishes to achieve its goal of self-government through the support of its mining industry, mining of uranium, either directly or as by-product, is essential to achieving that goal. As the new government takes office, the uncertainty of the future of uranium mining in Greenland may soon prove moot, allowing for increased investment in this field.

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uranium mining. *See supra* note 13 and accompanying text regarding market volatility. However, the report does not take into account results of a 2009 pre-feasibility study by Greenland Minerals and Energy LTD, a mining company interested in developing Kvanfjeld, indicating that uranium may be economically extracted from Kvanfjeld's new ore type through the use of an innovative alkaline pressure leach process. *See* Development of Metallurgical Flowsheet Kvanefjeld Multi-Element Project, GREENLAND MINERALS AND ENERGY LTD., https://www.iaea.org/OurWork/ST/NE/NEFW/documents/Raw Materials/TM_LGUO/3b%20Bunn%20Greenland%20Kvanefjeldx.pdf. The alkaline pressure leach process is untested for the use of a full-scale mine; however, as with the unique geology and location of the proposed uranium mining site, significant research and oversight into the potential for environmental contamination and long-term public health effects should be conducted on the alkaline pressure leach process prior to its approval. But the fact that the process is new should not itself result in the project's veto.