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A Nation Called to Intergenerational Justice-- Comments on Nuclear Generated Electricity

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A Nation Called to Intergenerational Justice--Comments on Nuclear Generated Electricity
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In "Reflections on the Energy Crisis," the Catholic bishops questioned whether or not the United States should continue to rely upon nuclear fission to generate electricity. The problems they identified in 1981 were many--the failure to isolate from the biosphere the highly radioactive spent fuel that is removed from the reactors, unresolved safety questions pertaining to the operation of nuclear power plants, the effects of low-level radiation on uranium miners and others exposed to it, and the reality of nuclear weapons proliferation that is possible at various stages of the nuclear fuel cycle. At that time, 12 per cent of U.S. electricity was generated by nuclear fission which the bishops identified as the only "developed and expandable alternative" to oil.

The concerns expressed by the bishops in 1981 have significance today for Catholics and especially Catholic moral theologians who are challenged to address this issue. Why? The problems the bishops identified have escalated. Consider the following:

- Highly radioactive spent fuel continues to accumulate at nuclear power plants throughout the United States. Most storage pools have been reconfigured to allow for increased numbers of spent fuel assemblies that are removed from the reactors¹ while some assemblies have been placed on concrete slabs within the grounds of the facilities where the heat of the radioactivity can dissipate into the ambient air. These hazardous materials remain at the nuclear power plants because a means for isolating them from the biosphere is not operating in the U.S. (or elsewhere in the world), despite years of technical and political efforts by federal officials to identify a method for isolating the spent fuel, settling theoretically on a geological formation, and seeking to site one that would prevent entry of

¹When the nuclear fuel in reactors is no longer effectively sustaining a chain reaction to power the turbines that generate electricity, the "spent" fuel is removed and fresh fuel is inserted. Spent fuel is highly radioactive, thermally hot, and potentially harmful to all forms of life. Technicians remove the assemblies by remote control behind shields and place them in concrete stainless steel-lined storage pools that are filled with water treated with a boron compound that circulates throughout the pool to remove the heat from the spent fuel that is still fissioning. If borated water is not continuously circulating in storage pools that are filled with spent nuclear fuel, the rods could overheat and a Fukushima-type event could occur. See, for example, U.S. Nuclear Regulatory Commission, "Storage of Spent Nuclear Fuel," <http://www.nrc.gov/waste/spent-fuel-storage.html> (accessed March 29, 2014); also Union of Concerned Scientists, "Nuclear Power: Spent Reactor Fuel Security," http://www.ucsusa.org/nuclear_power/nuclear_power_risk/sabotage_and_attacks_on_reactors/spent-reactor-fuel-security.html (accessed March 29, 2014).

the radiation into the biosphere.² Can pushing the resolution of this hazardous burden into the future be justified for any reason after 55 years of relying increasingly upon nuclear power plants to generate electricity?

- Safety questions raised by the bishops about the operation of nuclear power plants persist. The bishops were aware of the 1979 accident at Three Mile Island near Harrisburg, Pennsylvania. Attributed to a combination of mechanical and human errors, radioactive isotopes were emitted into the atmosphere when the nuclear fuel in one TMI reactor partially melted. Two major accidents occurred subsequently that also resulted in significant releases of radioactivity--one in 1986 at Chernobyl (within the Soviet block at that time but currently within the country of Ukraine) and another in 2011 within the Fukushima Prefecture of Japan after a devastating tsunami followed a powerful earthquake.³ Though lessons have been learned from the 1979 and 1986 accidents, attempting to learn from the meltdown of the three nuclear reactors in Japan is ongoing with the goal of striving to assure the safe operation of nuclear power plants throughout that country. The 31 nuclear reactors operating in the United States that are similar to Fukushima's are currently undergoing safety checks and improvements by order of the U.S. Nuclear Regulatory Commission.⁴

Vast areas of land around the sites of the Chernobyl and Fukushima accidents remain sequestered with access limited to experts who are trying to address persisting problems. Though one reactor on Three Mile Island continues to generate electricity, the fuel in the reactor core that partially melted has been shipped off-site, the reactor has been shut down and remains "in storage," and it is scheduled to be decommissioned with

²According to the US General Accounting Office which services requests for research by members of the US House of Representatives and Senate, spent nuclear fuel is considered one of the most hazardous substances on earth. Without protective shielding, its intense radioactivity can kill a person exposed directly to it within minutes or cause cancer in those who receive smaller doses. Although some elements of spent nuclear fuel cool and decay quickly, becoming less radiologically dangerous, others remain dangerous to human health and the environment for tens of thousands of years. *Commercial Nuclear Waste: Effects of a Termination of the Yucca Mountain Repository Program and Lessons Learned*, GAO-11-229, April 2011, <http://www.gao.gov/assets/320/317627.pdf> (accessed 13 February 2013).

Spent fuel is composed of 96% Uranium as UO₂ (95 % ²³⁸U; 1% ²³⁵U), 3% Fission products (e.g., ⁹⁰Sr, ¹³⁷Cs, ¹⁴⁰Ce), and 1% Plutonium. ¹³⁷Cs and ⁹⁰Sr are the most immediate problem with nuclear waste. After 100 years, nuclear waste consists primarily of Tc [technetium], Pu and U. These adsorb strongly and form insoluble minerals under anoxic conditions. For a breakdown of the composition of spent fuel, see D. M. Sherman, *Radionuclides and Nuclear Waste*, Environmental Geochemistry, University of Bristol, 2001/2002. Also Robert Alvarez, "Spent Nuclear Fuel Pools in the US: Reducing the Deadly Risks of Storage," *Environmental Defense Institute News on Environmental Health and Safety Issues* 22.5 (June 2011), <http://www.environmental-defense-institute.org/publications/News.11.June.Final.pdf> (accessed March 28, 2014).

³The U.S. Nuclear Regulatory Agency reported that the earthquake off the coast of Japan registered at a magnitude of 9.0 on the Richter Magnitude Scale while the tsunami that followed was approximately 45 feet high. "Japan Lessons Learned," <http://www.nrc.gov/reactors/operating/ops-experience/japan-dashboard.html> (accessed March 28, 2014).

⁴Ibid.

the functioning reactor when its operating license expires.⁵ Close regulation of nuclear plants and waste management facilities in the U.S. should minimize the possibility of major accidents.⁶

- The effects of low-level radiation on the health of uranium miners and others exposed to it remain problematic.⁷ A study by the National Institute for Occupational Safety and Health (NIOSH) pointed to increased lung cancer, a lung disease (Pneumoconiosis), tuberculosis, and emphysema in both white and non-white uranium miners.⁸ A recent meta-analysis of 46 peer-reviewed studies of a preponderance of humans with some other animal and plant species at locations around the world found a variation in low-level, natural background radiation that had "small, but highly statistically significant, negative effects on DNA as well as several measures of health" including immunology, physiology, genetic mutation, and disease occurrence.⁹ As the researchers of this analysis conclude, "there is no threshold below which there are no effects of radiation." Thus, exposure to low-level radiation emitted naturally or known to be emitted at various stages of the nuclear fuel cycle should be avoided or at least minimized by individual and communal action.
- The "specter" of nuclear weapons proliferation to which the bishops referred in 1981 has become a reality. In addition to the United States, France, China, the United Kingdom, and the Russian Federation (formerly the Soviet Union) that initiated and committed to the Nuclear Weapons Non-Proliferation Treaty, India, Pakistan, and North Korea have detonated nuclear weapons. Israel has long been suspected of having the capability but has not claimed it,¹⁰ while Iran's uranium enrichment project has raised world-wide

⁵U.S. Nuclear Regulatory Commission, "Backgrounder on the Three Mile Island Accident," <http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html> (accessed March 28, 2014).

⁶Lessons learned from mismanagement of nuclear wastes may help. See, for example, U.S. Department of Energy, Office of Environmental Management, "Accident Investigation Report: Waste Isolation Pilot Project, April 2014," http://energy.gov/sites/prod/files/2014/04/f15/Final%20WIPP%20Rad%20Release%20Phase%201%2004%2022%202014_0.pdf (accessed April 26, 2014).

⁷U.S. Environmental Protection Agency, "Radiation Protection: Health Effects," http://www.epa.gov/radiation/understand/health_effects.html (accessed March 28, 2014).

⁸U.S. Center for Disease Control and Prevention, "Worker Health Study Summaries: Research on long-term exposure: Uranium Miners," <http://www.cdc.gov/niosh/pgms/worknotify/uranium.html> (accessed March 28, 2014).

⁹Anders P. Møller and Timothy A. Mousseau, "The Effects of Natural Variation in Background Radioactivity on Humans, Animals and Other Organisms," *Biological Reviews* 88.1 (February 2013): 226–254. See also Steven Powell, "Even Low-Level Radioactivity is Damaging: Broad analysis of many radiation studies finds no exposure threshold that precludes harm to life," University of South Carolina, <http://www.sc.edu/news/newsarticle.php?nid=5214> (accessed March 28, 2014).

¹⁰Stockholm International Peace Research Institute, "World Nuclear Sources," <http://www.sipri.org/yearbook/2013/06> (accessed March 28, 2014). The Institute estimates that Israel has "approximately 80 intact nuclear weapons, of which 50 are for delivery by Jericho II medium-range ballistic missiles and 30 are gravity bombs for delivery by aircraft.... There was renewed speculation in

concern for over a decade and prompted sanctions by the United Nations. At least the International Atomic Energy Agency has oversight and can spar with nations that appear to be seeking the status of nuclear weapons states.¹¹

In light of the escalation of problems that prompted the bishops in 1981 to question continued reliance on nuclear generated electricity, asking this same question today is warranted. Nuclear fuel currently constitutes nearly 20% of the electricity generated in the U.S. compared with 12% when the bishops were reflecting on the energy crisis. At that time, 70 nuclear reactors were operating in the U.S. whereas 100 are operating today.¹² The first new reactors proposed since the Three Mile Island accident were approved for construction after President Obama stipulated in February 2010 that nuclear should be part of the nation's energy mix and that taxpayers would guarantee the utilities' loans for constructing the two they proposed.¹³ At this time, the Nuclear Regulatory Commission is reviewing combined applications for constructing and operating 14 additional nuclear reactors in various parts of the U.S.¹⁴ Should applications for constructing and operating these additional nuclear reactors be accepted when putting more online to generate electricity will further escalate problems the bishops identified--especially the

2012 that Israel may also have developed nuclear-capable submarine-launched cruise missiles." Also see Julian Borger, "The truth about Israel's secret nuclear arsenal," *The Guardian*, January 15, 2014, <http://www.theguardian.com/world/2014/jan/15/truth-israels-secret-nuclear-arsenal> (accessed March 28, 2014).

¹¹International Atomic Energy Agency, "IAEA and Iran," <http://www.iaea.org/newscenter/focus/iaeairan/index.shtml> (accessed 29 March 2014). See also CNN Library, "Iran's Nuclear Capacity Fast Facts," March 25, 2014, <http://www.cnn.com/2013/11/07/world/meast/irans-nuclear-capabilities-fast-facts/index.html> (accessed March 29, 2014).

¹²This number changes as reactors are taken offline for safety modifications and decommissioning. For a current number, consult the list and map provided by the Nuclear Regulatory Commission at <http://www.nrc.gov/info-finder/reactor/>; a list of 100 reactors was updated May 19, 2014 (accessed April 27, 2014).

¹³Environmental News Service, "Obama Backs First New U.S. Nuclear Plant with \$8.3 Billion," *ENR International Daily Newswire*, February 16, 2010, <http://www.ens-newswire.com/ens/feb2010/2010-02-16-091.html> (accessed March 29, 2014). In contrast with President Obama's statement on December 30, 2007 when running for President of the U.S. that he opposed taxpayer subsidies for nuclear power, he announced on February 16, 2013 that his administration is offering conditional commitments for a total of \$8.33 billion in loan guarantees for the construction and operation of the first U.S. nuclear power plant to break ground in nearly three decades. See also "Hannah Northey, "DOE: Obama admin calculations spared developers millions in loan guarantee fees for Ga. nuclear project, documents show," *E&E Greenwire*, April 21, 2014, <http://www.eenews.net/stories/1059998194> (accessed April 22, 2014).

¹⁴U.S. Nuclear Regulatory Agency, "Combined License Applications for New Reactors," <http://www.nrc.gov/reactors/new-reactors/col.html> (accessed March 29, 2014). The NRC also lists the suspension of 9 reactors for various reasons. According to the World Nuclear Organization, lower gas prices since 2009 have put the economic viability of some proposed nuclear projects in doubt; "Plans For New Reactors Worldwide," <http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/USA--Nuclear-Power/> (accessed March 29, 2014).

accumulation of more irradiated used fuel on top of amounts that have been increasing exponentially over the past 55 years?

My response to that question in 2014 is emphatically negative based on the bishops' rationale in 1981. They underscored the moral imperative to address the energy crisis (1) out of concern for current and future human life and (2) with the desire to build "a just society" in which everyone has access to life's necessities. Refusing to approve applications to build and operate more nuclear plants until isolation of the highly radioactive used fuel from current plants is underway would show concern for human life now and in the future, especially the lives of generations who should be spared the burden of monitoring and determining how to isolate the hazardous substances from exposure to human life as well as to other living creatures with whom humans are intricately interconnected in the ecological systems of which we are constituents. Refusing now to approve applications to build more nuclear plants until the existing irradiated spent fuel is isolated would place the U.S. on the path toward a society that practices intergenerational justice. To increase the number of nuclear plants from which additional highly radioactive used fuel will be removed and stockpiled at their sites indeterminably perpetuates the blatant violation of the principle of justice that has been ongoing in the U.S. for the 55 years that our nation has been relying upon nuclear-generated electricity.

While the bishops feared that failure to pursue nuclear technology would eventually disadvantage the U.S. in relation to other nations that are supplying their citizens with energy, refusing to encourage more nuclear power plants now should not jeopardize the availability of electricity to U.S. customers. Abruptly halting the operation of current nuclear generating facilities most likely would. At the present time, the U.S. produces 30% of nuclear-generated electricity throughout the world, and the projected increase of 14 more reactors would add significantly to that percentage.¹⁵ If sufficient efforts are made to develop means through which electricity and other forms of energy are used more efficiently,¹⁶ if renewable energy sources are encouraged and subsidized at least to the extent that nuclear and non-renewable sources are encouraged and subsidized, and if all sectors of the U.S. economy consciously conserve electricity and avoid using it for superfluous purposes, customers should have sufficient electricity for their needs. At least a serious commitment should be made to take this course of action, thereby demonstrating a U.S. desire to become a virtually just nation.

In their 1981 statement, the bishops endorsed the right of citizens "to participate democratically in decisions" pertaining to nuclear generated electricity. Among the opportunities they encouraged are voting for government officials, speaking at public hearings, and voicing their opinion in referenda provided by state governments. Holding referenda to determine public

¹⁵World Nuclear Association, "Plans For New Reactors Worldwide," <http://www.world-nuclear.org/info/Current-and-Future-Generation/Plans-For-New-Reactors-Worldwide/> (accessed March 29, 2014).

¹⁶See, for example, suggestions and projections by the Industrial Energy Efficiency and Combined Heat and Power Working Group of The State and Local Energy Efficiency Action Network in *Industrial Energy Efficiency: Designing Effective State Programs for the Industrial Sector* released in March 2014, http://www.iipnetwork.org/IEE_Effective_State_Programs.pdf2 (accessed March 30, 2014). The Network is a state and local effort facilitated by the federal government that helps states, utilities, and other local stakeholders take energy efficiency to scale and achieve all cost-effective energy efficiency by 2020.

opinion would have to be fair, the bishops emphasized, by establishing spending limitations for pro and con sides of constructing and operating nuclear power plants and disposition of the spent fuel. Linking both in a referendum would provide an opportunity to educate citizens on the reality of nuclear plants as *de facto* interminable storage sites for irradiated fuel that must be isolated from the biosphere. Would the referenda be advisory or binding? Of course, if any semblance of justice can be claimed through a referendum of any kind, the voices of future generations who will be saddled with the tasks of having to monitor the spent fuel to assure containment and figuring out how to isolate it must be represented.

What might propel Catholics today to want to be just as individuals and collaboratively as a nation? Our desire to show love for our neighbor now and our neighbor in the future for whom we wish good health and happiness in this life as they strive for the ultimate goal of living in the presence of God forever. We do so out of love for God. As emphasized by Karl Rahner, the great German Jesuit theologian of the 20th century, we love God when we love our neighbor.¹⁷

Acting justly as a nation by prohibiting the construction of more nuclear power plants until a system is operating for isolating the current stockpile of highly radioactive spent fuel does not rule out employing advanced nuclear powered reactors in the future.¹⁸ Third and fourth generation nuclear reactors may be helpful toward minimizing carbon-spewing fossil-fueled electricity plants if nuclear generated electricity is essential to meet U.S. energy needs after reaching and maintaining high levels of energy efficiency in all sectors of our nation's economy and after maximally employing renewable energy sources. Of course, a major criterion for adding advanced nuclear reactors to the U.S. energy mix is the availability of space within an operating system that is isolating the used nuclear fuel from the biosphere. Until that time, jumping to nuclear now would be highly imprudent as well as highly unjust.¹⁹

¹⁷Karl Rahner, "Reflections on the Unity of the Love of Neighbour and the Love of God," in *Theological Investigations*, vol. 6, trans. Karl H. and Boniface Kruger, 231-49 (New York: Crossroad, 1982).

¹⁸Nuclear scientists and technicians allege that more advanced nuclear reactors will yield lesser amounts of spent fuel than current reactors operating in the U.S. and elsewhere. See World Nuclear Association, "Advanced Nuclear Power Reactors," April 2014, <http://world-nuclear.org/info/Nuclear-Fuel-Cycle/Power-Reactors/Advanced-Nuclear-Power-Reactors/> (accessed April 26, 2014). See also "US Nuclear Power Policy," April 2014, <http://world-nuclear.org/info/Country-Profiles/Countries-T-Z/USA--Nuclear-Power-Policy/> (accessed April 26, 2014).

¹⁹See, for example, my discussions of the moral virtues of prudence and justice and the motivating theological virtue of *caritas* in chaps 8-10 of *Theological Foundations for Environmental Ethics: Reconstructing Patristic & Medieval Concepts* (Washington DC: Georgetown University Press, 2009).