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## Danger in 12,008 A.D.: The Validity of the EPA's Proposed Radiation Projection Standards for the Yucca Mountain Nuclear Repository

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# DANGER IN 12,008 A.D.: THE VALIDITY OF THE EPA'S PROPOSED RADIATION PROTECTION STANDARDS FOR THE YUCCA MOUNTAIN NUCLEAR REPOSITORY<sup>1</sup>

On April 26, 1986, a nuclear energy reactor exploded in Chernobyl, Ukraine; this became the worst nuclear accident in history.<sup>2</sup> While only thirty people died from the explosion, the effects of the radiation contamination have been devastating.<sup>3</sup> The radiation has caused birth defects, heart disease, cataracts, and cancer—including an epidemic of thyroid cancer in children.<sup>4</sup> It is estimated that approximately four thousand people will ultimately die from radiation exposure from the disaster.<sup>5</sup> More than three hundred thousand people were driven from their homes; most have not returned, as the radiation will continue to contaminate the area for decades.<sup>6</sup> The disaster has also cost hundreds of billions of dollars in health and cleanup costs, compensation, and lost productivity.<sup>7</sup> The Chernobyl disaster vividly shows the potential harmful consequences of nuclear energy, and explains why many people are strongly opposed to nuclear power.

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<sup>1</sup> This title refers to the prediction of the National Academy of Sciences (NAS) that the Yucca Mountain facility will leak radiation into the environment sometime later than ten thousand years after the disposal of nuclear waste at the facility. See COMM'N ON TECHNICAL BASES FOR YUCCA MOUNTAIN STANDARDS, NAT'L RESEARCH COUNCIL, TECHNICAL BASES FOR YUCCA MOUNTAIN STANDARDS 2 (1995) [hereinafter NAS REPORT].

<sup>2</sup> Richard Stone, *Long Shadow of Chernobyl*, NAT'L GEOGRAPHIC, Apr. 2006, at 32, 36.

<sup>3</sup> *Id.*

<sup>4</sup> *Id.* at 36, 37, 43, 44.

<sup>5</sup> Joint News Release, World Health Org., Int'l Atomic Energy Agency, United Nations Dev. Programme, Chernobyl: The True Scale of the Accident (Sept. 5, 2005), <http://www.who.int/mediacentre/news/releases/2005/pr38/en/index.html>.

<sup>6</sup> Stone, *supra* note 2, at 36, 47.

<sup>7</sup> *Id.* at 36.

Many Americans, especially Nevadans, are also opposed to storing the United States' nuclear waste at the designated site of Yucca Mountain, Nevada, presumably because of the danger of radiation contaminating the surrounding environment.<sup>8</sup> The United States currently has forty-nine thousand metric tons of nuclear waste sitting in 131 temporary storage areas around the country.<sup>9</sup> Most agree that this nuclear waste must be moved to a more stable facility, as the waste currently presents a serious hazard to the millions of people living near these temporary storage locations.<sup>10</sup>

In 1982, the United States began to take measures to deal with the problem of nuclear waste: Congress enacted the Nuclear Waste Policy Act, which made the Environmental Protection Agency (EPA), the Nuclear Regulatory Commission (NRC), and the Department of Energy (DOE) all responsible for permanent disposal of nuclear waste.<sup>11</sup> In 2002, Congress approved Yucca Mountain, Nevada, as the location for the future nuclear waste repository.<sup>12</sup> Under the Energy Policy Act of 1992 (EnPA), Congress charged the EPA with setting public health and safety protection standards for the Yucca Mountain nuclear repository.<sup>13</sup> The EPA promulgated these standards in 2001,<sup>14</sup> however, in 2004, the United States Court of Appeals for the District of Columbia Circuit declared the standards to be an impermissible interpretation of EnPA in *Nuclear Energy Institute, Inc. v. EPA*.<sup>15</sup> The court stated that the EPA standards were invalid because they were not "based upon and consistent with" the recommendations of the National Academy of Sciences (NAS), as EnPA requires; NAS recommended that the standards be set for the next one million years, while the EPA set the standards for only the next ten thousand years.<sup>16</sup>

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<sup>8</sup> Steve Tetreault, *Poll: Nevadans Remain Opposed to Yucca Mountain*, LAS VEGAS REV.-J., Dec. 19, 2004, available at [http://www.reviewjournal.com/lvrj\\_home/2004/Dec-19-Sun-2004/news/25503351.html](http://www.reviewjournal.com/lvrj_home/2004/Dec-19-Sun-2004/news/25503351.html).

<sup>9</sup> *Nuclear Energy Inst., Inc. v. EPA*, 373 F.3d 1251, 1258 (D.C. Cir. 2004); OFFICE OF PUB. AFFAIRS, U.S. DEP'T OF ENERGY, WHY YUCCA MOUNTAIN? 2.

<sup>10</sup> OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT, U.S. DEP'T OF ENERGY, MANAGING NUCLEAR WASTE: OPTIONS CONSIDERED (Nov. 2003), available at <http://www.ocr.wm.doe.gov/factsheets/doeymp0017.shtml> (discussing various options for radioactive waste disposal).

<sup>11</sup> Pub. L. No. 97-425, 96 Stat. 2201 (1982) (codified as amended at 42 U.S.C. §§ 10101–10270 (2000)).

<sup>12</sup> Act of July 23, 2002, Pub. L. No. 107-200, 116 Stat. 735 (2002) (codified at 42 U.S.C. § 10135 (Supp. IV 2004)).

<sup>13</sup> Pub. L. No. 102-486, § 801(a)(1), 106 Stat. 2776, 2921–23 (1992) (codified at 42 U.S.C. § 10141 (Supp. 2004)).

<sup>14</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 40 C.F.R. § 197 (2003).

<sup>15</sup> *Nuclear Energy Inst., Inc. v. EPA*, 373 F.3d 1251 (D.C. Cir. 2004).

<sup>16</sup> *Id.* at 1267.

Since *Nuclear Energy Institute*, the EPA has proposed new Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada.<sup>17</sup> This Note will examine whether certain aspects of the EPA's proposed standards, including the compliance time, the radiation limits, the group of people subject to those limits, and the use of dose-based limits,<sup>18</sup> will be upheld in court. Specifically, this Note will determine whether these aspects of the standards are "based upon and consistent with" the findings of NAS, as well as not arbitrary and capricious, such that they should be upheld in a reviewing court. This Note will argue that these aspects of the Public Health and Environmental Radiation Protection Standards for Yucca Mountain should be upheld in court.

Part I will give a background on nuclear energy, nuclear waste, Yucca Mountain, Nevada, and the legal history of the Yucca Mountain Project. Part II will explain NAS' recommendations and the EPA's proposed standards and will analyze whether the compliance time periods, the radiation dose limits, the people to whom those dose limits apply, and the use of dose-based limits should be upheld in a reviewing court. Finally, Part III will briefly discuss the future of the Yucca Mountain Project.

## I. BACKGROUND

### *A. Nuclear Energy and Nuclear Waste*

Radioactive elements are useful to the modern age as both weapons and as sources of energy. The world learned of the power of nuclear weapons on and after August 6 and 9, 1945, when the United States dropped atomic bombs on Hiroshima and Nagasaki, Japan, killing hundreds of thousands of people and devastating the surrounding environment.<sup>19</sup> Nuclear energy, on the other hand, was first touted for its safety, economy, and cleanliness.<sup>20</sup> The United States has used nuclear energy since 1955 to provide electricity to

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<sup>17</sup> 70 Fed. Reg. 49,014 (Aug. 22, 2005) (to be codified at 40 C.F.R. pt. 197). These standards are now in the interagency-review period. U.S. Env'tl Protection Agency, *Radiation Protection: Yucca Mountain Standards*, <http://www.epa.gov/radiation/yucca/> (last visited Apr. 15, 2008).

<sup>18</sup> For practical reasons, this Note will not examine every aspect of the proposed standards, such as groundwater limits or methods of assessing compliance.

<sup>19</sup> 1942–2002: *60 Years of Nuclear*, THE ECOLOGIST, Dec. 2002 / Jan. 2003, at 30, 30 (reviewing the history of nuclear technologies and nuclear incidents).

<sup>20</sup> *Nuclear Power: A New Clear Choice?*, GLOBAL ENVTL. CHANGE REP., Dec. 2004, at 1, 1.

homes; today, nuclear energy supplies about twenty percent of the electricity in the United States.<sup>21</sup>

Nuclear energy is produced by the fission, or splitting, of uranium. When uranium-235<sup>22</sup> is bombarded with a neutron, the atom splits, producing two atoms of uranium, and releasing two or three more neutrons, which may cause another uranium atom to split, creating a chain reaction. The fission of uranium atoms releases large amounts of energy, which is used to produce electricity.<sup>23</sup>

Nuclear energy produces low-cost, predictable power at stable prices.<sup>24</sup> It also has arguably “the lowest impact on the environment, including water, land, habitat, species, and air resources,”<sup>25</sup> and it emits virtually zero air pollution, including no greenhouse gases.<sup>26</sup> The only environmentally damaging emissions from nuclear power plants come from heat and trace amounts of radiation.<sup>27</sup> Nuclear energy is also attractive because the United States need not depend on other countries for its production.<sup>28</sup> Furthermore, “[the energy in] one uranium pellet the size of the tip of your little finger is the equivalent of 17,000 cubic feet of natural gas, 1,780 pounds of coal, or 149 gallons of oil.”<sup>29</sup> Because of these environmental and economical attractions, nuclear energy is preferable in many respects to electricity generated by coal, oil, or natural gas.

While it has many benefits, nuclear energy also presents some serious drawbacks. The first is the potential for devastating accidents. The most extreme example is the Chernobyl disaster of 1986, which caused the death of thousands of people, as well as birth defects, heart disease, cataracts, and cancer, including an epidemic of thyroid cancer in children.<sup>30</sup> Also, the radiation in the environment surrounding Chernobyl will continue to contaminate the area for decades to come.<sup>31</sup>

The second drawback of nuclear energy is the unending problem of what to do with the waste.<sup>32</sup> Because the current technology

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<sup>21</sup> NUCLEAR ENERGY INST., NUCLEAR FACTS (2007) (on file with author).

<sup>22</sup> Uranium-235 is the uranium isotope with 235 protons and neutrons in its atom.

<sup>23</sup> *Nuclear Power: A New Clear Choice?*, *supra* note 20, at 2.

<sup>24</sup> NUCLEAR ENERGY INST., *supra* note 21.

<sup>25</sup> Stephen L. Baird, *A Global Need, A Global Resource: Nuclear Power and the New Millennium*, THE TECH. TEACHER, Oct. 2004, at 21, 22.

<sup>26</sup> *Nuclear Power: A New Clear Choice?*, *supra* note 20, at 2.

<sup>27</sup> Alvin M. Weinberg, *Social Institutions and Nuclear Energy*, 177 SCIENCE 27, 29 (1972).

<sup>28</sup> *Nuclear Power: A New Clear Choice?*, *supra* note 20, at 1, 3.

<sup>29</sup> GLOBAL NUCLEAR ENERGY PARTNERSHIP, U.S. DEP'T OF ENERGY, WHY RECYCLE USED NUCLEAR FUEL?, <http://www.gnep.energy.gov/pdfs/factsheetprimerfuelrecycling.pdf>.

<sup>30</sup> Stone, *supra* note 2, at 36, 44.

<sup>31</sup> *Id.* at 47.

<sup>32</sup> See *Nuclear Energy Inst., Inc. v. EPA*, 373 F.3d 1251, 1258 (D.C. Cir. 2004)

requires some radioactive waste, which will not naturally degrade for thousands or even millions of years, nuclear waste is a problem that will not just go away; it will continue to be harmful towards people and the environment for many years.<sup>33</sup> As of 2003, about forty-nine thousand metric tons of nuclear waste has amassed in the United States.<sup>34</sup> This nuclear waste is currently stored in cooling pools at 131 temporary government and commercial storage facilities in thirty-nine states.<sup>35</sup> Most of these cooling pools are significantly undersized for long-term nuclear-waste storage, and if a natural disaster or terrorist event caused a cooling pool to drain or warm, the long-term contamination could be significantly worse than Chernobyl.<sup>36</sup> After considering and rejecting a variety of options for long-term storage of nuclear waste, including sub-seabed, very deep-hole, space, ice-sheet, island geologic, and deep-well injection disposal, the National Academy of Sciences (NAS) recommended deep underground geologic disposal.<sup>37</sup> In 1982, Congress made deep underground geologic disposal the method of choice for storing the U.S.' nuclear waste.<sup>38</sup>

### *B. Yucca Mountain, Nevada*

Yucca Mountain, Nevada, was originally chosen to house the U.S.' nuclear waste because of the low rainfall in the area, its isolation from people, and the low permeability of the rock,<sup>39</sup> although Nevadans contend the State was selected because it had little political clout.<sup>40</sup>

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(discussing nuclear waste storage and related problems).

<sup>33</sup> See generally David P. Ross, *Yucca Mountain and Reversing the Irreversible: The Need for Monitored Retrievable Storage in a Permanent Repository*, 25 VT. L. REV. 815 (2001) (evaluating the regulatory structure proposed for Yucca Mountain and reviewing alternative nuclear waste disposal methods).

<sup>34</sup> *Nuclear Power: A New Clear Choice?*, *supra* note 20, at 3.

<sup>35</sup> *Id.*

<sup>36</sup> Robert Alvarez, Jan Beyea, Klaus Janberg, Jungmin Kang, Ed Lyman, Allison Macfarlane, Gordon Thompson, & Frank N. von Hippel, *Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States*, 11 SCI. & GLOBAL SECURITY 1, 2 (2003), available at [http://www.princeton.edu/~globsec/publications/pdf/11\\_1Alvarez.pdf](http://www.princeton.edu/~globsec/publications/pdf/11_1Alvarez.pdf).

<sup>37</sup> Reprocessing the nuclear waste has also been rejected in the United States because the reprocessed waste could easily be used to develop nuclear weapons. UNION OF CONCERNED SCIENTISTS, NUCLEAR REPROCESSING: DANGEROUS, DIRTY, AND EXPENSIVE, [http://www.ucsusa.org/global\\_security/nuclear\\_terrorism/extracting-plutonium-from-nuclear-reactor-spent-fuel.html](http://www.ucsusa.org/global_security/nuclear_terrorism/extracting-plutonium-from-nuclear-reactor-spent-fuel.html) (last modified Feb. 6, 2007).

<sup>38</sup> Act of Jan. 7, 1983, Pub. L. No. 97-425, 96 Stat. 2201 (1982) (codified as amended at 42 U.S.C. §§ 10101-10270 (2000)).

<sup>39</sup> U.S. DEP'T OF ENERGY, WHY YUCCA MOUNTAIN? 4, [http://www.ocwrm.doe.gov/ym\\_repository/sr/brochure.pdf](http://www.ocwrm.doe.gov/ym_repository/sr/brochure.pdf).

<sup>40</sup> Bret Schulte, *Mired in Yucca Muck*, U.S. NEWS & WORLD REP., Oct. 30, 2006, at 39, 40.

Yucca Mountain is located in the desert within the Nevada Test Site in southern Nevada, about one hundred miles northwest of Las Vegas.<sup>41</sup> The federal government owns the area, which it used as a nuclear test site in the 1940s.<sup>42</sup> There are very few inhabitants of the land surrounding Yucca Mountain; fewer than two thousand people live within a twenty-mile radius of Yucca Mountain, Nevada.<sup>43</sup>

Yucca Mountain is composed of volcanic rock, mostly tuff, a rock formed from ash.<sup>44</sup> The rock contains many faults, which occur when one block of rock shifts relative to an adjacent block of rock, as well as some fractures, which are breaks in the rock.<sup>45</sup> According to geologists, the Yucca Mountain area has been experiencing active deformation for the past sixty-five million years.<sup>46</sup> The area remains tectonically active, as shown by evidence of geologically recent faults and volcanism.<sup>47</sup> The Yucca Mountain area also experiences occasional seismic activity. Its most recent earthquake, with a magnitude of 4.4 on the Richter scale, occurred in June 2002.<sup>48</sup> Despite these past geologic events, Yucca Mountain has been hailed as a "suitable location" that "would protect public health and safety."<sup>49</sup>

The amount of rainfall at Yucca Mountain was important to the site's selection for storing nuclear waste because water could potentially erode the facility and carry radioactive material into the groundwater of the region. There is very little annual rainfall at Yucca Mountain, as "southern Nevada is one of the most arid regions of the United States."<sup>50</sup> Annual precipitation is about 7.5 inches,<sup>51</sup> although

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<sup>41</sup> OFFICE OF AIR AND RADIATION, U.S. ENVTL PROTECTION AGENCY, EPA YUCCA MOUNTAIN FACT SHEET # 1: BACKGROUND ON PROPOSED FACILITY AT YUCCA MOUNTAIN 1 (Oct. 2005).

<sup>42</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. 49,014, 49018 (Aug. 22, 2005) (to be codified at 40 C.F.R. pt. 197).

<sup>43</sup> ENVTL HEALTH CTR., NAT'L SAFETY COUNCIL, YUCCA MOUNTAIN: FREQUENTLY ASKED QUESTIONS, <http://www.nsc.org/ehc/yucca/yuccafaq.htm> (last visited Mar. 12, 2007).

<sup>44</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. at 49018.

<sup>45</sup> See Alan P. Morris, David A. Ferrill, Darrell W. Sims, Nathan Franklin & Deborah J. Waiting, *Patterns of Fault Displacement and Strain at Yucca Mountain, Nevada*, 26 J. STRUCTURAL GEOLOGY 1707, 1708 (2004) (exploring the seismic hazards and fault strains at Yucca Mountain).

<sup>46</sup> *Id.* at 1707.

<sup>47</sup> *Id.*

<sup>48</sup> Allison Macfarlane, *Underlying Yucca Mountain: The Interplay of Geology and Policy in Nuclear Waste Disposal*, 33 SOC. STUD. SCI. 783, 788 (2003).

<sup>49</sup> U.S. DEP'T OF ENERGY, *supra* note 39, at 3.

<sup>50</sup> J.R. Dyer & M.T. Peters, *Progress in Permanent Geologic Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste in the United States*, 218 PROC. INSTITUTION MECHANICAL ENGINEERS: J. POWER & ENERGY 319, 319 (2004).

<sup>51</sup> U.S. DEP'T OF ENERGY, *supra* note 39, at 4.

little of this actually seeps into the mountain—more than ninety-five percent of the annual rainfall runs off the mountain or evaporates.<sup>52</sup> The water table at Yucca Mountain lies approximately five hundred to eight hundred meters underground.<sup>53</sup> Therefore very little water per year is expected to reach the repository, delaying erosion.<sup>54</sup>

Background radiation consists of radiation from radionuclides in rocks, the soil, and the air, from radiation from the sun and stars, from radioactive nuclides in food, and from radon in bricks and concrete in buildings.<sup>55</sup> The background radiation at Yucca Mountain is about 350 millirem (mrem)<sup>56</sup> committed effective dose equivalent (CEDE)<sup>57</sup> per person per year.<sup>58</sup> The average annual background radiation in the United States is about 300 mrem, although some places around the country receive up to 1,000 mrem.<sup>59</sup>

At the Yucca Mountain repository, “[the nuclear waste will] be buried 1,000 feet below the peak of the mountain in canisters coated with an eight-to-twelve-inch thick stainless steel and nickel alloy.”<sup>60</sup> The canisters will be protected by drip shields and be housed in horizontal tunnels reinforced with steel, rock, and wire mesh.<sup>61</sup> The facility will be monitored for one hundred to three hundred years, and then be permanently sealed.<sup>62</sup>

### *C. Legal History of the Yucca Mountain Project*

In 1982, Congress enacted the Nuclear Waste Policy Act, which made the EPA, the Nuclear Regulatory Commission (NRC), and the Department of Energy (DOE) all responsible for permanent disposal

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<sup>52</sup> Dyer & Peters, *supra* note 50, at 322.

<sup>53</sup> *Id.*

<sup>54</sup> U.S. DEP’T OF ENERGY, *supra* note 39, at 4.

<sup>55</sup> WASH. ST. DEP’T OF HEALTH, BACKGROUND RADIATION: NATURAL VERSUS MAN-MADE, 2–6 (2002).

<sup>56</sup> A rem is the unit used to measure radiation. A millirem is 1/1000th of a rem.

<sup>57</sup> The term “committed effective dose equivalent” essentially refers to the dosage of radiation a person receives from exposure, taking into account the variables relating to the effect of radiation on different organs in the body and the long-term retention of radiation. See Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 40 C.F.R. § 197.2 (2003) (“Committed effective dose equivalent means the effective dose equivalent received over a period of time (e.g., 30 years), as determined by NRC, by an individual from radionuclides internal to the individual following a one-year intake of those radionuclides. . . . Effective dose equivalent means the sum of the products of the dose equivalent received by specified tissues following an exposure of, or an intake of radionuclides into, specified tissues of the body, multiplied by appropriate weighting factors.”).

<sup>58</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. 49,014, 49037 (Aug. 22, 2005) (to be codified at 40 C.F.R. pt. 197).

<sup>59</sup> *Id.*

<sup>60</sup> Mike Zapler, *Yucca Mountain*, PLANNING, Feb. 2003, at 19.

<sup>61</sup> *Nuclear Energy Inst., Inc. v. EPA*, 373 F.3d 1251, 1261 (D.C. Cir. 2004).

<sup>62</sup> Zapler, *supra* note 59, at 19.



of nuclear waste.<sup>63</sup> With the goal of choosing and safely operating a long-term nuclear waste facility, the EPA is charged with setting public health and safety protection standards; the NRC is charged with licensing the facility; and the DOE is charged with choosing, designing, and operating the facility.<sup>64</sup> In the Nuclear Waste Policy Amendments Act of 1987, Congress directed the DOE to focus exclusively on Yucca Mountain, Nevada, for the long-term storage of nuclear waste,<sup>65</sup> and, subsequently, directed the EPA and the NRC to focus exclusively on Yucca Mountain in the Energy Policy Act (EnPA) of 1992.<sup>66</sup> In 2004, the U.S. Court of Appeals for the District of Columbia Circuit upheld Congress's joint resolution<sup>67</sup> approving Yucca Mountain as the nuclear waste storage facility.<sup>68</sup>

EnPA directs the EPA to develop public health and safety standards for the Yucca Mountain repository in conformity with the recommendations of the National Academy of Sciences (NAS),<sup>69</sup> with which Congress contracted "to conduct a study to provide . . . findings and recommendations on reasonable standards for protection of the public health and safety" for the Yucca Mountain repository.<sup>70</sup> Specifically, EnPA stated:

[T]he [EPA] shall, based upon and consistent with the findings and recommendations of the National Academy of Sciences, promulgate, by rule, public health and safety standards for protection of the public from releases from radioactive materials stored or disposed of in the repository at the Yucca Mountain site. Such standards shall prescribe the maximum annual dose to individual members of the public from releases to the accessible environment from radioactive materials stored or disposed of in the repository.<sup>71</sup>

Pursuant to this directive, the EPA promulgated radiation dose limits for the Yucca Mountain repository in 2001.<sup>72</sup> These standards

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<sup>63</sup> Pub. L. No. 97-425, 96 Stat. 2201 (1982) (codified as amended at 42 U.S.C. §§ 10101-10270 (2000)).

<sup>64</sup> *Nuclear Energy Inst.*, 373 F.3d at 1259.

<sup>65</sup> 42 U.S.C. § 10133 (2000).

<sup>66</sup> Pub. L. No. 102-486, § 801(a), 106 Stat. 2776, 2921-22 (1992) (codified at 42 U.S.C. § 10141 (Supp. 2004)).

<sup>67</sup> Act of Oct. 24, 1992, Pub. L. No. 107-200, 116 Stat. 735 (2002) (codified at 42 U.S.C. § 10135 (Supp. 2004)).

<sup>68</sup> *Nuclear Energy Inst.*, 373 F.3d 1251.

<sup>69</sup> Energy Policy Act § 801(a)(1).

<sup>70</sup> *Id.*

<sup>71</sup> *Id.*

<sup>72</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 40 C.F.R. § 197 (2003).

stated that the radiation dose limit could not exceed 15 mrem committed effective dose equivalent (CEDE) per person per year for ten thousand years following disposal at the Yucca Mountain site.<sup>73</sup>

Several different groups, including the State of Nevada, challenged the Yucca Mountain public health and safety standards in the Court of Appeals for the District of Columbia Circuit in June 2001, arguing that the ten-thousand-year compliance period was an impermissible interpretation of EnPA.<sup>74</sup> Because the issue in *Nuclear Energy Institute* was whether a federal agency's regulation was a reasonable interpretation of a federal statute, the court applied the *Chevron* rule in arriving at its conclusion.<sup>75</sup> The *Chevron* rule requires that a court reviewing an agency regulation first ask whether Congress has spoken to the precise question at issue in the governing statute (Step One); if so, then the review is complete, and the rule is upheld or struck down in accordance with Congress's dictates.<sup>76</sup> If Congress has not spoken to the precise question at issue, meaning that the governing statute is silent or ambiguous on the issue, then the court must determine whether the agency's rule is a permissible interpretation of the statute (Step Two).<sup>77</sup>

Applying *Chevron*, the court in *Nuclear Energy Institute* first determined that EnPA was ambiguous as to whether the ten-thousand-year compliance time was "based upon and consistent with" the recommendations of NAS.<sup>78</sup> Pursuant to *Chevron* Step Two, the court then held that the ten-thousand-year compliance period was not a permissible interpretation of EnPA, because the compliance period was not consistent with the recommendations of NAS.<sup>79</sup> NAS recommended that the standard be set for the geologic period of stability, or one million years, because peak radiation risk is likely to occur at some unknown time after ten thousand years and before one million years after disposal,<sup>80</sup> although it added that the EPA might decide to differ from NAS' recommendations "for policy reasons."<sup>81</sup> The EPA had declined to set the standard beyond ten thousand years because of the uncertainties involved in making predictions for such a

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<sup>73</sup> *Id.*

<sup>74</sup> *Nuclear Energy Inst., Inc. v. EPA*, 373 F.3d 1251 (D.C. Cir. 2004). Petitioners challenged several other aspects of the Yucca Mountain repository, including a constitutional challenge to EnPA, which was rejected, and challenges to the NRC, which were declared moot.

<sup>75</sup> *Id.* at 1268–69 (citing *Chevron, U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837 (1984)).

<sup>76</sup> *Chevron*, 467 U.S. at 842–43.

<sup>77</sup> *Id.* at 843.

<sup>78</sup> *Nuclear Energy Inst.*, 373 F.3d at 1269–70.

<sup>79</sup> *Id.* at 1270.

<sup>80</sup> See NAS REPORT, *supra* note 1.

<sup>81</sup> *Id.* at 3.

long time into the future and because both the EPA and international groups had previously used the ten-thousand-year timeframe.<sup>82</sup> The court stated:

It would have been one thing had EPA taken [NAS'] recommendations into account and then tailored a standard that accommodated the agency's policy concerns. . . . Instead, [the EPA] unabashedly rejected NAS' findings, and then went on to promulgate a dramatically different standard, one that [NAS] had expressly rejected. Although [EPA's] 'based upon and consistent with' standard does not require EPA to walk in lock-step with [NAS], we think it entirely unreasonable for EPA to have acted *inconsistently* with NAS findings and recommendations.<sup>83</sup>

In June 2004, the EPA published a draft of a new set of health and safety standards for the Yucca Mountain nuclear repository.<sup>84</sup> The proposed standards are almost entirely consistent with the old standards; the main difference is that the EPA now has a limit of 15 mrem CEDE per person per year for ten thousand years from disposal and 350 mrem CEDE per person per year for ten thousand years to one million years from disposal at the facility.<sup>85</sup>

## II. ARE THE EPA'S PROPOSED STANDARDS "BASED UPON AND CONSISTENT WITH" THE RECOMMENDATIONS OF THE NATIONAL ACADEMY OF SCIENCES?

This Note will now examine whether certain aspects of the EPA's proposed Public Health and Environmental Radiation Protection Standards, including the compliance time, the radiation limits, the group of people subject to those limits, and the use of dose-based radiation limits, are valid under both *Chevron*<sup>86</sup> and arbitrary and capricious review.<sup>87</sup>

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<sup>82</sup> *Nuclear Energy Inst.*, 373 F.3d at 1268.

<sup>83</sup> *Id.* at 1270.

<sup>84</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. 49,014 (Aug. 22, 2005) (to be codified at 40 C.F.R. pt. 197). "The standards are currently undergoing interagency review, and EPA anticipates issuing the standards later this year." U.S. Envtl Protection Agency, *Radiation Protection: Yucca Mountain Standards*, <http://www.epa.gov/radiation/yucca/> (last visited Apr. 15, 2008).

<sup>85</sup> *Id.* at 49,014. The proposed standards will be discussed further, *infra* Part II.B.

<sup>86</sup> *Chevron, U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 842-43 (1984).

<sup>87</sup> Administrative Procedure Act, 5 U.S.C. § 706(2)(A) (2000).

### A. The Reviewing Court's Standard

As in *Nuclear Energy Institute*, the reviewing court will analyze the standards pursuant to *Chevron* because the standards are an agency's interpretation of the governing statute's mandate to promulgate the standards "based upon and consistent with" the recommendations of NAS.<sup>88</sup> Under *Chevron* Step One, the reviewing court must first determine whether the governing statute, EnPA, is ambiguous as to the issue.<sup>89</sup> The court in *Nuclear Energy Institute* held that the language "based upon and consistent with the findings and recommendations of [NAS]" was ambiguous.<sup>90</sup> Since the governing statute is ambiguous, therefore, as to what "based upon and consistent with" means, the reviewing court must determine whether the EPA's interpretation of EnPA is permissible<sup>91</sup> or reasonable,<sup>92</sup> under *Chevron* Step Two.<sup>93</sup>

The reviewing court will most likely also analyze whether the standards are arbitrary and capricious under the Administrative Procedure Act (APA). This standard applies to any agency action, and is usually the standard applied to agency rules or policy decisions.<sup>94</sup> Here, the specific radiation dose limits per person are policy decisions. The APA states that "[t]he reviewing court shall . . . hold unlawful and set aside agency action, findings, and conclusions found to be . . . arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law."<sup>95</sup> To satisfy the arbitrary and capricious standard, it must be evident from the administrative record that the EPA examined the relevant data and factors, including alternatives, and explained why it chose the standards, in such a way as to make a rational connection between the facts and the standards.<sup>96</sup> If the EPA has examined the relevant factors and explained why it chose the specific standards, then the reviewing court must determine whether the decision was based on a consideration of the relevant factors and whether there has been a "clear error of judgment."<sup>97</sup>

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<sup>88</sup> *Nuclear Energy Inst.*, 373 F.3d at 1268–69.

<sup>89</sup> *Chevron*, 467 U.S. at 842–43.

<sup>90</sup> *Nuclear Energy Inst.*, 373 F.3d at 1269–70.

<sup>91</sup> *Chevron*, 467 U.S. at 843.

<sup>92</sup> *United States v. Riverside Bayview Homes, Inc.*, 474 U.S. 121, 131 (1985) (citing *Chemical Mfrs. Ass'n v. Natural Res. Def. Council, Inc.*, 470 U.S. 116, 125 (1985), and *Chevron*, 467 U.S. at 842–845).

<sup>93</sup> *Chevron*, 467 U.S. at 843.

<sup>94</sup> See *Citizens to Preserve Overton Park, Inc. v. Volpe*, 401 U.S. 402, 414 (1971), *rev'd on other grounds*, 494 F.2d 212 (6th Cir. 1974).

<sup>95</sup> 5 U.S.C. § 706(2)(A) (2000).

<sup>96</sup> *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Co.*, 463 U.S. 29, 43 (1983).

<sup>97</sup> *Id.*

Normally, an agency rule would be arbitrary and capricious if the agency has relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.<sup>98</sup>

Under the arbitrary and capricious standard, the court is not to substitute its judgment for that of the agency.<sup>99</sup>

### *B. The National Academy of Sciences' Recommendations*

The National Academy of Sciences (NAS) is a private group of scholars, researchers, and scientists who are charged with advising the government on scientific and technical matters.<sup>100</sup> Pursuant to EnPA, the EPA contracted with NAS to provide "findings and recommendations on reasonable standards for protection of the public health and safety" from the Yucca Mountain nuclear repository.<sup>101</sup> It is these findings and recommendations that the EPA's radiation protection standards must be "based upon and consistent with."<sup>102</sup> To make the necessary findings, NAS comprehensively reviewed reputable research and held several open meetings attended by dozens of scientists and engineers.<sup>103</sup> NAS ultimately made several relevant recommendations in its official report, *Technical Bases for Yucca Mountain Standards*, published in 1995.<sup>104</sup>

First, NAS recommended that the compliance period be set for the time of geologic stability, or one million years, because peak risk of radiation releases is expected to occur sometime after ten thousand years, but before one million years, after disposal.<sup>105</sup> NAS believes that, because Yucca Mountain is expected to remain geologically stable on a large scale up to one million years from now, these standards can be set for the period of one million years even though there are "substantial uncertainties" in predicting what will happen

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<sup>98</sup> *Id.*

<sup>99</sup> *Id.*

<sup>100</sup> NAS REPORT, *supra* note 1, at vi.

<sup>101</sup> Pub. L. No. 102-486, § 801(a)(2), 106 Stat. 2776, 2922 (1992) (codified at 42 U.S.C. § 10141 (Supp. 2004)).

<sup>102</sup> *Id.* at § 801(a)(1).

<sup>103</sup> NAS REPORT, *supra* note 1, at vii.

<sup>104</sup> *Id.*

<sup>105</sup> *See id.* at 2.

such a long time into the future, especially in predicting future human behavior.<sup>106</sup>

Second, NAS recommended that the standard be an individual risk-based limit, meaning “the risk to individuals of adverse health effects” from radiation releases from Yucca Mountain, as opposed to a limitation on the amount of radiation released overall from Yucca Mountain in a given period of time.<sup>107</sup> NAS did not recommend a specific numerical standard, such as a one-in-one-million chance of contracting fatal cancer in one person’s lifetime caused by the Yucca Mountain nuclear repository, explaining that this is a policy decision best left to EPA’s rulemaking.<sup>108</sup> Instead, NAS suggested that the EPA start with around  $10^{-5}$  to  $10^{-6}$  (one-in-one-hundred-thousand to one-in-one-million chance of) health effects per year per person,<sup>109</sup> which corresponds to roughly 2-20 mrem CEDE of radiation per person per year.<sup>110</sup> NAS also noted that the international and national consensus on establishing radiation protection standards have used limits of 100 mrem CEDE of radiation per person per year from all anthropogenic sources of radiation other than medical exposures and 5-30 mrem from radioactive waste disposal,<sup>111</sup> although NAS noted that no group has yet created standards for the long-term storage of radioactive waste.<sup>112</sup>

Third, NAS recommended that the standard should be designed to protect the “critical group” of people, those:

representative of those individuals in the population who, based on cautious, but reasonable, assumptions, have the highest risk resulting from repository releases. The group should be small enough to be relatively homogeneous with respect to diet and other aspects of behavior that affect risks. The critical group includes the individuals at maximum risk and is homogeneous with respect to risk [meaning there is a small difference in the level of risk].<sup>113</sup>

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<sup>106</sup> *Id.* at 1.

<sup>107</sup> *Id.* at 2.

<sup>108</sup> *See id.* at 5–8.

<sup>109</sup> *Id.* at 49–50.

<sup>110</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 40 C.F.R. § 197.20–.25 (2003).

<sup>111</sup> NAS REPORT, *supra* note 1, at 40–41.

<sup>112</sup> *Id.*

<sup>113</sup> *Id.* at 53.

Such an approach ensures that no person receives an unacceptably high dose of radiation<sup>114</sup> and protects the health of the general public.<sup>115</sup>

NAS also recommended: (1) that “the estimated risk calculated from the assumed intrusion scenario be no greater than the risk adopted for the undisturbed-repository case;”<sup>116</sup> and (2) the use of assumptions about the environment and people around Yucca Mountain based upon current technology and living patterns.<sup>117</sup>

*C. The EPA’s Proposed Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada*

The EPA published its proposed Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada, on August 22, 2005.<sup>118</sup> This Note will focus on the compliance time, the radiation limits, the group of people subject to those limits, and the use of dose-based, as opposed to risk-based, radiation limits.

First, the EPA proposed that the compliance time be extended to include the time of peak risk from radiation, to one million years, consistent with NAS’ recommendation.<sup>119</sup> However, the EPA proposed two separate individual dose-based limits: one for ten thousand years after disposal, and the other for ten thousand to one million years after disposal.<sup>120</sup> Specifically, the EPA proposed 15 mrem CEDE of radiation per person per year for the first ten thousand years after disposal and 350 mrem CEDE per person per year for ten thousand to one million years after disposal.<sup>121</sup> The EPA also proposed that these limits should not be exceeded even because of a human-intrusion event, such as a person drilling a well into the repository, intentionally or otherwise.<sup>122</sup>

As opposed to NAS’ critical group approach,<sup>123</sup> the EPA proposed that the radiation dose limits be applied to the reasonably maximally exposed individual (RMEI).<sup>124</sup> The RMEI is “a hypothetical person whose lifestyle is representative of the local population.”<sup>125</sup> The EPA

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<sup>114</sup> *Id.* at 6.

<sup>115</sup> *Id.* at 7.

<sup>116</sup> *Id.* at 12.

<sup>117</sup> *Id.* at 122.

<sup>118</sup> 70 Fed. Reg. 49,014 (Aug. 22, 2005) (to be codified at 40 C.F.R. pt. 197).

<sup>119</sup> *Id.*

<sup>120</sup> *Id.*

<sup>121</sup> *Id.*

<sup>122</sup> *Id.* at 49,060.

<sup>123</sup> See *supra* note 107 and accompanying text.

<sup>124</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. at 49,023.

<sup>125</sup> *Id.* at 49,019.

claims that this standard will “protect those individuals most at risk from the proposed repository but specifies one or a few site-specific parameters at their maximum values.” The RMEI is defined specifically for Yucca Mountain as a reasonably normal person who will be living in the “accessible environment” of Yucca Mountain above where the plume of radiation in the groundwater will be; the RMEI is one who will be a rural-residential dweller, who will drink local water and eat a little local food, but mostly outside food, who will do gardening and a little farming, but will get income from something other than farming.<sup>126</sup> Essentially, the EPA is assuming that the people who live around Yucca Mountain in the distant future will have a similar lifestyle to people who live there now.<sup>127</sup> In doing so, the EPA is choosing not to make predictions about the future people, their future culture, or the future technology, but, rather, uses the “reasonably conservative” approach of defining the lifestyle of the RMEI using present-day conditions.<sup>128</sup>

The EPA explained that it sought a standard that responds to the court’s ruling in *Nuclear Energy Institute*, is “protective of public health and safety,” is “reflective of the best science and cognizant of the limits of long-term projections,” and is “implementable by NRC in its licensing process.”<sup>129</sup> The EPA implies that the latter goal can be at odds with NAS’ recommendations, and explains that the EPA is charged with blending science and policy to create these standards.<sup>130</sup>

The EPA noted that in determining the 350 mrem limit, the only change from the prior standards,<sup>131</sup> it considered several factors, including the inherent uncertainties, the potential impacts on future generations, and the radiation exposures residents of other U.S. states currently experience from natural sources of radiation.<sup>132</sup> The EPA strongly emphasized the uncertainties in the models and predictions about the long-term performance of the Yucca Mountain nuclear repository in explaining why it chose the 350 mrem standard.<sup>133</sup> The EPA stated that uncertainties generally increase with longer time periods and confidence in reasonable projections correspondingly decrease with longer time periods.<sup>134</sup> Specifically, the EPA suggested

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<sup>126</sup> *Id.* at 49,019–20.

<sup>127</sup> *See id.* at 49,020.

<sup>128</sup> *Id.* at 49,023.

<sup>129</sup> *Id.* at 49,029.

<sup>130</sup> *Id.* at 49,029–30.

<sup>131</sup> This refers to the only change considered by this Note. *See supra* note 18.

<sup>132</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. at 49,035–36.

<sup>133</sup> *Id.* at 49,026.

<sup>134</sup> *Id.*



that there are uncertainties in predicting: (1) future human behavior and lifestyles, (2) future climate, (3) geological changes, (4) the natural variability of the radionuclide transport at Yucca Mountain, and (5) the rate of failure of waste packages.<sup>135</sup> Furthermore, the measurements of current conditions may not be completely accurate,<sup>136</sup> and impacts differ depending on initial assumptions.<sup>137</sup> The EPA stated that long-term modeling frequently uses conservative assumptions, which may result in "unrealistic, overly pessimistic" predictions of the future performance of the Yucca Mountain nuclear repository.<sup>138</sup> Therefore, the EPA recommended the use of "cautious, but reasonable, assumptions," and requires a "reasonable expectation" standard for assessing compliance with its health and safety standards.<sup>139</sup>

#### *D. Chevron Analysis*

Under *Chevron* Step Two, the reviewing court must determine whether the EPA's interpretation as to what "based upon and consistent with the findings and recommendations of [NAS]"<sup>140</sup> means is permissible<sup>141</sup> or reasonable.<sup>142</sup>

First, the EPA's compliance period differs from NAS' recommendation in that the EPA requires two different time periods for compliance, while NAS only recommended that the compliance period extend to include peak risk, which is up to one million years from closing the Yucca Mountain nuclear repository.<sup>143</sup> In creating such standards, the EPA argued that it is permissible to have both the one-million-year standard required by *Nuclear Energy Institute* and the ten-thousand-year standard because EnPA states that the EPA must establish standards to protect public health and safety, and did not limit the EPA to one standard only.<sup>144</sup> Furthermore, NAS did not recommend *against* using two standards for the compliance time, and the EPA feels that it may reasonably make standards NAS did not

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<sup>135</sup> *Id.* at 49,023, 26, 35.

<sup>136</sup> *Id.* at 49,027.

<sup>137</sup> *Id.* at 49,035.

<sup>138</sup> *Id.*

<sup>139</sup> *Id.*

<sup>140</sup> *Nuclear Energy Inst., Inc. v. EPA*, 373 F.3d 1251, 1269 (D.C. Cir. 2004).

<sup>141</sup> *Chevron, U.S.A. Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 843 (1984).

<sup>142</sup> *U.S. v. Riverside Bayview Homes, Inc.*, 474 U.S. 121, 131 (1985) (citing *Chemical Mfrs. Ass'n. v. Natural Res. Def. Council, Inc.*, 470 U.S. 116, 125 (1985), and *Chevron*, 467 U.S. at 842-845).

<sup>143</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. at 49,031.

<sup>144</sup> *Id.*

address.<sup>145</sup> As opposed to establishing a standard that is inconsistent with NAS' recommendation, the standards with respect to having two compliance periods were not addressed by NAS. Therefore, the EPA says, it is permissible for it to establish two compliance periods, as such is not inconsistent with any NAS recommendation.<sup>146</sup>

The reviewing court will most likely agree with the EPA that it is permissible to have two compliance periods for the Yucca Mountain nuclear repository. It is the duty of the EPA to protect public health and safety; assuming the less strict standard is upheld, there is no reason why the EPA could not regulate more strictly, if such is likely to better protect public health and safety. Therefore, this aspect of the standards should be upheld by a reviewing court.

Second, the EPA proposed a limit based on radiation doses to individuals, while NAS recommended a limit based on risk of adverse health effects to individuals.<sup>147</sup> The dose-based limit is 15 mrem and 350 mrem CEDE of radiation per person per year, while the risk-based limit would be something like a  $10^{-6}$  (one-in-one-million) chance of contracting an adverse health effect from radiation from Yucca Mountain. The EPA noted that these limits are closely related to one another, as the radiation dose directly corresponds to the risk of adverse health effects, and one can be computed by the other through a mathematical formula.<sup>148</sup> NAS recommended the risk-based limit because a certain dose of radiation may be found in the future to have a greater adverse health effect than is currently known.<sup>149</sup> EnPA, however, specifically directs the EPA to develop a dose-based standard.<sup>150</sup> Therefore, even if the EPA's use of the dose-based limit is not "based upon and consistent with" the recommendations of NAS, it should be upheld under *Chevron* Step One because Congress was clear that the EPA should use a dose-based limit.

The third difference between NAS' recommendations and the EPA's standards is that NAS recommended the use of the critical group as the persons the standards applies to,<sup>151</sup> while the EPA used the reasonably maximally exposed individual (RMEI).<sup>152</sup> The critical

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<sup>145</sup> *Id.*

<sup>146</sup> *Id.*

<sup>147</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 66 Fed. Reg. 32,074, 32,086 (June 13, 2001) (to be codified at 40 C.F.R. pt. 197).

<sup>148</sup> *Id.*

<sup>149</sup> NAS REPORT, *supra* note 1, at 64.

<sup>150</sup> Pub. L. No. 102-486, § 801(a)(1), 106 Stat. 2776, 2921-23 (1992) (codified at 42 U.S.C. § 10141 (Supp. 2004)).

<sup>151</sup> NAS REPORT, *supra* note 1, at 53.

<sup>152</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. 49,014, 49,023 (Aug. 22, 2005) (to be codified at 40 C.F.R. pt. 197).

group approach uses a group of people who are expected to have the highest risk of radiation doses, with a small difference in the level of risk among the group.<sup>153</sup> The RMEI approach chooses a hypothetical "composite" person expected to have the reasonably highest radiation doses, but also takes into account the lifestyle and habits of those people specifically at Yucca Mountain.<sup>154</sup> The EPA believes the RMEI approach "more appropriately protects individuals and is less speculative to implement than the [critical group] approach given the unique conditions present at Yucca Mountain."<sup>155</sup> Important to the EPA's choice to use the RMEI approach, over the critical group approach, is that the critical group is spread out in location, and not every member of the group would be affected by the plume of radiation in the groundwater.<sup>156</sup> The result of this would be that some members of the critical group would receive low or zero doses of radiation, which the EPA does not believe adequately protects those most vulnerable to radiation from the Yucca Mountain nuclear repository.<sup>157</sup> The RMEI, on the other hand, would be assumed to live wherever the plume of radiation occurs.<sup>158</sup>

The question remains whether the RMEI approach is sufficiently "based upon and consistent with" NAS' recommendation to use the critical group approach. The EPA stated that the RMEI approach "accomplishes the same goal as the [critical group] approach,"<sup>159</sup> as it "would result in dose estimates comparable" to the critical group approach.<sup>160</sup> Even NAS implied that the RMEI approach is "broadly consistent" with the critical group approach.<sup>161</sup> Furthermore, the EPA noted that the RMEI approach is widely used, "sufficiently conservative," and "fully protective of the general population (including women, children, the very young, the elderly, and the infirm)."<sup>162</sup> Therefore, it seems that while the RMEI and critical group approaches are not the same, the RMEI approach appears to be consistent with the goals of the critical group approach and seems to be more protective of the public health than the critical group approach, which is the EPA's goal in establishing the standards. A

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<sup>153</sup> NAS REPORT, *supra* note 1, at 53.

<sup>154</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. at 49,019-20.

<sup>155</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 66 Fed. Reg. 32,074, 32,088-89 (June 13, 2001) (to be codified at 40 C.F.R. pt. 197).

<sup>156</sup> *Id.* at 32,089.

<sup>157</sup> *Id.*

<sup>158</sup> *Id.*

<sup>159</sup> *Id.*

<sup>160</sup> *Id.* at 32,090.

<sup>161</sup> *Id.* at 32,091.

<sup>162</sup> *Id.*

reviewing court would, therefore, likely find that the EPA's use of the RMEI approach is a permissible interpretation of the "based upon and consistent with" language of EnPA.

As to the EPA's radiation dose limits, 15 mrem and 350 mrem CEDE per person per year, NAS did not recommend any specific dose or risk limit to compare to the EPA's. Therefore, any analysis of the validity of the dose limits would have to be analyzed under arbitrary and capricious analysis, rather than *Chevron* analysis, because the EPA is not interpreting EnPA, but is, rather, making a policy decision to carry out the goals that Congress stated.<sup>163</sup>

### *E. Arbitrary and Capricious Analysis*

As stated in Section II(A) above, to satisfy the arbitrary and capricious standard, the EPA must have examined the relevant factors, including alternatives and explained why it chose the standards, in such a way as to make a rational connection between the facts and the standards.<sup>164</sup> The reviewing court must also determine that the decision was based on a consideration of the relevant factors and that there has not been a "clear error of judgment."<sup>165</sup> The two radiation dose limits will likely be analyzed under the arbitrary and capricious standard; this Note will now determine whether those limits are valid under that legal standard.

The EPA is first proposing that the given radiation dose per RMEI per year from the Yucca Mountain nuclear repository not exceed 15 mrem CEDE for ten thousand years following disposal.<sup>166</sup> EnPA did not specify what relevant data or factors the EPA should rely upon when promulgating the health and safety standards besides NAS' recommendations. NAS did not recommend any specific dose or risk limit.

The EPA explained that, in determining the proper dose limit for the ten thousand year period, it considered NAS' suggestion that the EPA begin with a dose limit corresponding to 2-20 mrem,<sup>167</sup> as well as other EPA standards, other federal agencies' standards, other countries' regulations, and national and international radiation advisory groups' guidance.<sup>168</sup> The EPA's 15 mrem standard is

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<sup>163</sup> See *Citizens to Preserve Overton Park, Inc. v. Volpe*, 401 U.S. 402, 414 (1971).

<sup>164</sup> *Motor Vehicle Mfr. Ass'n v. State Farm Mut. Auto. Co.*, 463 U.S. 29, 43 (1983).

<sup>165</sup> *Id.*

<sup>166</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. 49,014, 49,014 (Aug. 22, 2005) (to be codified at 40 C.F.R. pt. 197).

<sup>167</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 40 C.F.R. § 197.20-.25 (2003).

<sup>168</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain,

consistent with all of the guidance that it considered. However, the EPA also noted that it desired to set a standard that is both protective of public health and safety and is implementable, or possible to comply with.<sup>169</sup> Setting an implementable standard will not invalidate the standard unless Congress did not intend that the EPA should consider that factor. Congress most likely actually intended the contrary: that the EPA *only* establish a standard that is both protective of public health and possible to comply with, considering Congress's intention to safely dispose of the nation's nuclear waste at Yucca Mountain.

Based upon what the EPA considered when choosing the 15 mrem standard, the EPA clearly considered the relevant factors to this policy decision, and the standard does not represent a "clear error of judgment." Therefore, the 15 mrem standard for the first ten thousand years should be upheld in court as satisfying arbitrary and capricious analysis.

The EPA is also proposing that the radiation dose per RMEI per year not exceed 350 mrem CEDE for ten thousand years to one million years after disposal at the Yucca Mountain nuclear repository.<sup>170</sup> NAS again makes no recommendation for the radiation dose or risk limit for this time period, although it notes that no international group has yet considered such long time periods.<sup>171</sup>

Nuclear waste has the unique quality of not degrading for up to billions of years; for example, iodine-129 and neptunium-237, both of which will be buried at the Yucca Mountain nuclear repository, have half-lives of seventeen million years and over two million years, respectively.<sup>172</sup> The reason the radiation dose limit has to be so much higher for the time period of ten thousand years to one million years, than that for up to ten thousand years after disposal, is because the Yucca Mountain nuclear repository is expected to fail sometime during the later timeframe, and the nuclear waste will not have completely degraded by the time of failure.<sup>173</sup> Eventually, rainwater moving through the ground will erode the repository and storage

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NV, 66 Fed. Reg. 32,074, 32,087 (June 13, 2001) (to be codified at 40 C.F.R. pt. 197).

<sup>169</sup> *Id.* at 32,088.

<sup>170</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. at 49,014.

<sup>171</sup> NAS REPORT, *supra* note 1, at 41.

<sup>172</sup> Nuclear Energy Inst., Inc. v. EPA, 373 F.3d 1251, 1258 (D.C. Cir. 2004).

<sup>173</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. at 49,026.

canisters, causing relatively large amounts of radiation to leak into the groundwater and be emitted into the air.<sup>174</sup>

In determining what radiation dose limit to set for the time period of ten thousand years to one million years after disposal at the Yucca Mountain nuclear repository, the EPA considered several factors, including the ability to comply with the limit, international guidance, uncertainties, natural background radiation in other areas of the country, and intergenerational equity, which is the notion of not sacrificing the health or safety of future generations for the benefit of the present and near-present generations..<sup>175</sup>

First, the EPA noted that it sought to set a reasonable goal that is possible to comply with, while still being protective of public health and safety.<sup>176</sup> Because of the expected failure of the Yucca Mountain nuclear repository sometime during the timeframe at issue, there will be radiation doses at that time to individuals, which are significantly greater than during the first ten thousand years. As argued above, Congress most likely did actually intend for the EPA to adopt only standards that are possible to achieve, while still being protective of public health and safety. Therefore, it does not seem that the consideration of whether the limit could be complied with renders the standard arbitrary and capricious.

Second, the EPA considered international guidance on the one-million-year standards and found that other countries recommended the EPA's method of comparing the dose limit to current natural doses of radiation in other areas of the country,<sup>177</sup> although no other country has attempted to create a dose limit for up to one million years in the future.<sup>178</sup> A reviewing court will most likely determine that consideration of international standards is a relevant factor because of the lack of U.S. regulatory guidance for establishing radiation protection standards for up to one million years from the present.

Third, the EPA strongly emphasized the uncertainty in making predictions about a time period so far into the future.<sup>179</sup> Specifically, there are uncertainties in predicting the future culture, human lifestyle, climate, geology, the way in which the repository will fail, and the variability of radionuclide transport in the environment.<sup>180</sup>

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<sup>174</sup> *Id.* The EPA is assuming that future generations will not take measures to update the repository or further protect themselves from leaks.

<sup>175</sup> *Id.* at 49,035–40.

<sup>176</sup> *Id.* at 49,029.

<sup>177</sup> *Id.* at 49,036.

<sup>178</sup> *Id.* at 49,030.

<sup>179</sup> *Id.* at 49,035.

<sup>180</sup> See *supra* Part II.C.

Such uncertainties are certainly relevant in the determination of the dose limit.

Most importantly, the EPA considered current natural background radiation in other areas of the country in proposing the 350 mrem CEDE per RMEI per year standard.<sup>181</sup> Natural background radiation comes from cosmic sources, terrestrial sources, and natural indoor radon.<sup>182</sup> The average natural background radiation dose in the Yucca Mountain area is currently about 350 mrem per person per year,<sup>183</sup> while the average natural background radiation dose around the country is about 300 mrem per person per year.<sup>184</sup> Some areas of the country receive up to 1000 mrem per person per year.<sup>185</sup> Therefore, for ten thousand years to one million years after disposal, the total possible annual radiation dose for a Yucca Mountain RMEI would be 700 mrem CEDE. In its proposed standards, the EPA compared this dose to what the residents of Colorado receive now in natural background radiation, 700 mrem CEDE per person per year.<sup>186</sup> The EPA chose Colorado for comparison because it has higher natural background radiation than the Yucca Mountain area and because it has generally similar characteristics in geography, population, radon potential, water features, and the size of cities.<sup>187</sup> It may be important to note that other states have similar or higher background radiation levels than Colorado, including North Dakota, South Dakota, and Iowa.<sup>188</sup>

The EPA defends this comparison by citing "the large uncertainties surrounding the outcomes at these unprecedented time frames."<sup>189</sup> The EPA, therefore, believes that the 350 mrem standard is sufficiently protective of the public health and safety because such a dose limit is comparable to what many people in the United States are currently getting from natural background radiation.<sup>190</sup> "[U]nder this standard the additional radiation exposure at the time of peak dose to a resident of [the area around] the Yucca Mountain disposal system would be no greater than what would be incurred if that person moved today from the vicinity of Yucca Mountain to a nearby

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<sup>181</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. at 49,036.

<sup>182</sup> *Id.* at 49,037.

<sup>183</sup> *Id.*

<sup>184</sup> *Id.*

<sup>185</sup> *Id.*

<sup>186</sup> *Id.*

<sup>187</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. at 49,037.

<sup>188</sup> *Id.*

<sup>189</sup> *Id.* at 49,036.

<sup>190</sup> *Id.* at 49,039.

state.”<sup>191</sup> The EPA also compares the 350 mrem dose limit with the natural radiation coming from uranium ores, which is often much higher than 350 mrem CEDE per person per year.<sup>192</sup>

On the whole, it seems a reviewing court should not strike down the 350 mrem standard because of the comparison to natural background radiation in other parts of the country. Such a comparison seems to be a relevant factor in determining what standard should apply.

Finally, the EPA addressed concerns about intergenerational equity, or not sacrificing the health or safety of future generations for the benefit of the present and near-present generations.<sup>193</sup> This also raises the question of whether the change in dose limit from 15 mrem to 350 mrem is arbitrary and capricious. In the proposed standards, the EPA emphasized that the present generation’s safety should not be sacrificed for the uncertain safety of generations far into the future.<sup>194</sup> The peak dose of radiation will not be emitted for tens or hundreds of thousands of years into the future, while not storing our nuclear waste soon could cause more radiation emissions in the present time because the temporary storage locations are expected to fail relatively soon. The EPA emphasized that while future generations should not be sacrificed for the current generation, neither should the current generation be subjected to extreme dangerousness because of the potential for increases in radiation emissions in the far future, especially given the uncertainties in making predictions about a time period so far into the future.<sup>195</sup> The EPA noted that “there is wide agreement that future generations should not be unduly compromised by the decisions of the current generation,”<sup>196</sup> but then goes on to cite Swedish conclusions that “increasing uncertainties ‘means that our capacity to assume responsibilities changes with time. In other words, our moral responsibility diminishes on a sliding scale over the course of time.’”<sup>197</sup>

Others argue that future doses should be less than current doses because the current generation benefits from nuclear power.<sup>198</sup> On the other hand, future generations may in fact benefit from the current

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<sup>191</sup> *Id.*

<sup>192</sup> *Id.* at 49,038–39.

<sup>193</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. at 49,035–36.

<sup>194</sup> *Id.*

<sup>195</sup> *Id.* at 49,040.

<sup>196</sup> *Id.* at 49,036.

<sup>197</sup> *Id.* (quoting SWEDISH NATIONAL COUNCIL FOR NUCLEAR WASTE, NUCLEAR WASTE STATE-OF-THE-ART REPORTS 27 (1998)).

<sup>198</sup> *Id.*



generation's use of nuclear power through the advancement of technology, the conservation of fossil fuels, and the reduction of greenhouse-gas emissions.<sup>199</sup>

Furthermore, while the EPA does not resort to the following argument, it is worth pointing out that in ten thousand or more years from now there may be a technology that will sufficiently protect that generation from our present nuclear waste.

Overall, the EPA believes that the 350 mrem standard is actually sufficiently protective of public health and safety based on the comparison to natural background radiation in Colorado and that it is not, in fact, sacrificing the health and safety of future generations for that of the present. It seems entirely proper for the EPA to consider intergenerational equity in determining its standards, because Congress charged the EPA with protecting health and safety for all, regardless of generation.

As alternatives to the 350 mrem standard, the EPA considered implementing radiation dose limits of 100 or 200 mrem CEDE per person per year.<sup>200</sup> It stated that the difference between 100, 200, or 350 mrem would make indistinguishable projections after several hundred thousand years.<sup>201</sup> It also considered maintaining the 15 mrem standard for up to one million years, but this would limit the ability to comply with the standard, as such precision is not possible for the longer time period.<sup>202</sup>

The EPA summarized the factors it examined in proposing the 350 mrem CEDE per RMEI per year standard:

Using the NAS suggestions as a starting point, and considering international guidance and examples, we have derived the proposed dose limit to balance competing factors highlighted by NAS and acknowledged by us as important: the dual objectives to effectively address the effects of uncertainty on compliance assessment and to adhere as closely as possible to the relevant ethical principles, including a consideration of impacts on future generations. We believe that our selection of a 350 mrem standard is reasonable and effectively addresses the factors it is necessary to consider when projecting exposures very far into the future.<sup>203</sup>

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<sup>199</sup> Public Health and Environmental Radiation Protection Standards for Yucca Mountain, NV, 70 Fed. Reg. at 49,036.

<sup>200</sup> *Id.* at 49,038.

<sup>201</sup> *Id.*

<sup>202</sup> *Id.* at 49,040.

<sup>203</sup> *Id.* at 49,039.

Based on the above analysis, it appears that the EPA did, in fact, examine the relevant data and factors, explain why it chose the standards, and make a rational connection between the facts and the standards, as required under the arbitrary and capricious standard.<sup>204</sup> It also seems that the EPA's decision for the proposed limit of 350 mrem CEDE per RMEI per year was based on a consideration of the relevant factors. Congress did not specify the factors the EPA should consider, and each factor the EPA did consider seems to be rationally done, as argued above. Therefore, a reviewing court may only strike down the standards if there has been a "clear error of judgment" or if the standards are "so implausible that it could not be ascribed to a difference in view or the product of agency expertise."<sup>205</sup> By this standard, it seems clear that the 350 mrem limit is neither a "clear error of judgment" nor "implausible." Congress directed the EPA to make a policy decision; this it did, and it based the decision on relevant factors. The arbitrary and capricious standard is one of relative deference to the agency, in that the court cannot substitute its judgment for that of the agency's.<sup>206</sup> Therefore, the EPA's 350 mrem CEDE per RMEI per year standard for ten thousand years to one million years after disposal at the Yucca Mountain nuclear repository should be upheld under the arbitrary and capricious standard.

### III. THE FUTURE OF THE YUCCA MOUNTAIN PROJECT

After the interagency-review period ends for the EPA's Public Health and Environmental Radiation Protection Standards, the EPA will likely adopt these standards with little or no change. Next, Nevada will most likely challenge whether these regulations are valid in court, as Nevadan officials believe that their best chance of defeating the Yucca Mountain project lies in court.<sup>207</sup> Assuming that the proposed regulations are upheld in court, the NRC must then issue licensing regulations for Yucca Mountain that will implement the standards and determine whether the Yucca Mountain repository will be safe to open.<sup>208</sup> The DOE must then submit a license application to the NRC, which it plans to file in 2008,<sup>209</sup> showing how the Yucca Mountain repository meets the applicable licensing requirements, including the EPA's standards.<sup>210</sup> The NRC then must review and

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<sup>204</sup> *Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Co.*, 463 U.S. 29, 43 (1983).

<sup>205</sup> *Id.*

<sup>206</sup> *Id.*

<sup>207</sup> Zapler, *supra* note 59, at 19, 20.

<sup>208</sup> OFFICE OF AIR AND RADIATION, U.S. ENVTL PROTECTION AGENCY, *supra* note 41.

<sup>209</sup> Schulte, *supra* note 40.

<sup>210</sup> OFFICE OF AIR AND RADIATION, U.S. ENVTL PROTECTION AGENCY, *supra* note 41.

approve the license application.<sup>211</sup> Following approval, construction on the facility and storage of the waste can begin.<sup>212</sup>

New legislation may help or impede the project. First, in 2006, the Department of Energy submitted legislation to raise the amount of nuclear waste the Yucca Mountain repository could hold from seventy thousand metric tons to one hundred twenty thousand metric tons, to increase the DOE's access to funds, and to claim adjacent federal land for use on the project.<sup>213</sup> Second, Senator Pete Domenici has introduced one bill that would create interim nuclear waste storage until the Yucca Mountain repository is complete, and another bill that would consolidate nuclear waste at current locations and create a recycling program.<sup>214</sup> Finally, Nevada Senators Harry Reid and John Ensign recently introduced the No Yucca bill, which would keep nuclear waste where it is now, and end the Yucca Mountain project.<sup>215</sup>

By current estimates, the U.S.' nuclear waste could be stored at Yucca Mountain by 2017.<sup>216</sup> The project has been delayed by, among other things, a torrent of litigation,<sup>217</sup> allegations of falsifying documents,<sup>218</sup> surprises in data,<sup>219</sup> and a federal-district-court ruling saying that Nevada need not supply the project with water.<sup>220</sup>

### CONCLUSION

The radiation dose limits per person, the compliance time periods, the group of people the limits must be applied to, and the use of dose-

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<sup>211</sup> *Id.*

<sup>212</sup> *Id.*

<sup>213</sup> Schulte, *supra* note 40.

<sup>214</sup> *Id.*

<sup>215</sup> *Nevada Senators Introduce No Yucca Bill*, UNITED PRESS INT'L, Mar. 7, 2007.

<sup>216</sup> Schulte, *supra* note 40.

<sup>217</sup> See, e.g., *Xcel Wins \$116 Million Yucca Mountain Court Ruling*, DESERET MORNING NEWS, Sept. 29, 2007, available at <http://deseretnews.com/dn/view/0,5143,695214156,00.html> (damages awarded to owner of two nuclear power plants for the DOE's failure to remove the plants' spent nuclear waste by 1998, as required by contract); *Judges Refuse to Rule on Document Access*, LAS VEGAS REV.-J., Sept. 14, 2007, available at <http://www.lvrj.com/news/9780642.html>; Steve Tetreault, *Yucca Mountain Project: Judges Reject Nevada Lawsuit*, LAS VEGAS REV.-J., Aug. 9, 2006, available at [http://www.reviewjournal.com/lvrj\\_home/2006/Aug-09-Wed-2006/news/8958695.html](http://www.reviewjournal.com/lvrj_home/2006/Aug-09-Wed-2006/news/8958695.html) (challenging the DOE's plans for transporting the nation's nuclear waste); *Indian Tribe's Plea to Block Yucca Denied*, LAS VEGAS REV.-J., May 19, 2005, available at [http://www.reviewjournal.com/lvrj\\_home/2005/May-19-Thu-2005/news/26551374.html](http://www.reviewjournal.com/lvrj_home/2005/May-19-Thu-2005/news/26551374.html).

<sup>218</sup> Doug Abrahms, *E-mail Shows Yucca Data Could Be False*, RENO-GAZETTE J., Apr. 1, 2005, available at <http://www.rgj.com/news/stories/html/2005/04/01/96097.php>.

<sup>219</sup> *Quake Data Shifts Yucca Nuclear Burial Location*, MSNBC, Sept. 26, 2007, <http://www.msnbc.msn.com/id/20987216/>.

<sup>220</sup> *Judge Rejects Feds' 'Voracious' Demands for Water at Yucca Mountain*, 28 ANDREWS ENVTL. LITIG. REP. 6 (2007).

based limits in the EPA's proposed Public Health and Environmental Radiation Protection Standards for Yucca Mountain, Nevada, should be upheld in a reviewing court.

First, the compliance time of one million years from storage at the Yucca Mountain nuclear repository is "based upon and consistent with" the recommendation of NAS for the compliance time to include the time of peak dose. Furthermore, using two compliance time periods is not inconsistent with the recommendations of NAS and is permissible for the EPA to do, considering that using two time periods is more protective of public health and safety, which is the goal of the standards.

Second, the EPA's use of dose-based radiation limits is comparable to and "based upon and consistent with" NAS' recommendation to use risk-based limits, as one limit can be mathematically computed into the other. Furthermore, Congress specifically directed the EPA to use dose-based limits.

Third, the EPA's use of the reasonably maximally exposed individual in assessing compliance with the radiation dose limits is consistent with NAS' recommendation to use the critical group of people. These two approaches are similar enough so that the EPA's approach is not inconsistent with NAS' recommendation, and the EPA's approach is expected to be more protective of public health and safety.

Finally, the specific radiation dose limits per person, which are subject to arbitrary and capricious analysis because NAS made no recommendations on this issue, should also be upheld because the EPA examined the relevant data and explained its decision in such a way as to make a rational connection between the data and the decision, and because the radiation dose limits are based upon a consideration of the relevant factors, and there has been no clear error of judgment.

Most agree that the United States' nuclear waste should be stored in a permanent facility like Yucca Mountain in the near future because of the safety and protection such a facility would provide relative to the 131 temporary storage locations currently holding the nuclear waste around the country.<sup>221</sup> The EPA's proposed Public Health and Environmental Radiation Protection Standards represent one more step on the road toward storage and disposal of the nation's nuclear waste. This Note has argued that these standards are

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<sup>221</sup> OFFICE OF CIVILIAN RADIOACTIVE WASTE MGMT., U.S. DEP'T OF ENERGY, MANAGING NUCLEAR WASTE: OPTIONS CONSIDERED, *supra* note 10.

sufficiently protective of the public health and safety and should be upheld in a reviewing court.

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