

REPORT 5 OF THE COUNCIL ON SCIENCE AND PUBLIC HEALTH (A-07)  
Radioactive/Chemical Waste and Radiation in the Environment  
(Resolutions 402 and 417, A-06)  
(Reference Committee D)

EXECUTIVE SUMMARY

**Objective.** To review the storage, management, and transportation of radioactive waste and the monitoring and regulation of nuclear facilities, with regard to their potential impact on the environment and the people living near these facilities and the availability of relevant information to the public.

**Methods.** English-language articles and resources were identified by Google Scholar and MEDLINE searches for 1967 through January 2007 using the key words “nuclear monitoring,” “environmental monitoring,” “environmental radiation,” and “chemical waste.” Articles were chosen based on their ability to describe the extent and frequency of health and environmental monitoring around nuclear waste facilities, superfund sites, or other hazardous or chemical waste disposal or storage facilities. Additional resources on regulations and guidelines for monitoring and oversight of radioactive waste were obtained from the Web sites of the Environmental Protection Agency (EPA), the Nuclear Regulatory Commission (NRC), and the Departments of Energy (DOE) and Defense.

**Results.** The Nuclear Waste Policy Act of 1982 provides a plan and guidance for high-level nuclear waste, but guidelines for the storage and disposal of low-level nuclear waste are less clear. Currently, stakeholder forums are in existence. Several organized programs coordinate the regulation of what are considered “Atomic Energy Act materials,” and promote communication between the states and the NRC. Most of these organizations hold annual meetings and also participate in one another’s annual meetings. These include: the National Materials Program, Office of State and Tribal Programs, Conference of Radiation Control Protection Officers, Organization of Agreement States. It appears that, while not coordinated under 1 agency, the reporting guidelines for reporting of spills, leakages, and airborne emissions of radioactive materials to the appropriate federal and state environmental protection agencies are in place.

**Conclusions.** Given the fragmentation of the oversight system among several different agencies, and the separation of oversight between NRC- and DOE-managed sites, a comprehensive system is lacking. Although several independent federal and state organizations monitor environmental standards and radiation levels, there is no one comprehensive and consistent report on both health status and environmental quality nationally. Given the systems already in place, it is unclear if additional regulations would improve communications among federal agencies, commercial plants, and the states. However, efforts should be made to streamline existing processes while maintaining transparency to the general public.

REPORT OF THE COUNCIL ON SCIENCE AND PUBLIC HEALTH

CSAPH Report 5 - A-07

Subject: Radioactive/Chemical Waste and Radiation in the Environment  
(Resolutions 402 and 417, A-06)

Presented by: Mohamed K. Khan, MD, PhD, Chair

Referred to: Reference Committee D  
(Elizabeth P. Kanof, MD, Chair)

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1 Resolution 402, introduced by the Washington Delegation at the 2006 Annual Meeting and referred  
2 to the Board of Trustees, asks:

3  
4 That our American Medical Association (AMA) advocate for the development of a  
5 transparent, comprehensive national policy and plan for the disposition of United States  
6 Department of Energy (DOE) radioactive and chemical waste based on stakeholder input,  
7 equity between regions, and sound science that ensures the health and safety of the public;  
8 and

9  
10 That the AMA recommend that the DOE hold a National Stakeholder Forum with broad  
11 public participation from elected representatives, regulatory officials, Native American  
12 tribes, non-governmental organizations and the general public.

13  
14 Resolution 417, introduced by the Illinois Delegation at the 2006 Annual Meeting and referred to  
15 the Board of Trustees, asks:

16  
17 That our American Medical Association support or cause to be introduced legislation that  
18 requires an independent third party to conduct environmental testing at all nuclear facilities  
19 throughout the country and that the results of any testing be made available to the public;  
20 and

21  
22 That our AMA urge the appropriate federal and state agencies to conduct an independent  
23 study, or hire an independent third party to conduct such a study, of the health status of  
24 residents in the immediate area of leaking nuclear facilities to accurately determine any  
25 adverse impact on health status by leakage of radioactive materials, and to release publicly  
26 the results of that study; and

27  
28 That our AMA support or cause to be introduced legislation, regulation, and other  
29 appropriate measures which strengthen regulation and oversight of all nuclear facilities,  
30 including a process that mandates the reporting of spills, leakages and airborne emissions  
31 of radioactive materials to the appropriate federal and state environmental protection  
32 agencies.

1 These resolutions relate to the storage, management, and transportation of radioactive waste, and  
2 the potential impact of this waste on the environment and the people who live near these facilities.  
3 Monitoring and regulation of nuclear facilities (both production and waste facilities) in the United  
4 States is complex. This report describes how the monitoring of these sites is organized, and  
5 evaluates the merit of our AMA implementing these resolutions.

#### 6 7 Methods

8  
9 English-language articles and resources were identified by Google Scholar and MEDLINE  
10 searches for 1967 through January 2007 using the key words “nuclear monitoring,” “environmental  
11 monitoring,” “environmental radiation,” and “chemical waste.” Articles were chosen based on their  
12 ability to describe the extent and frequency of health and environmental monitoring around nuclear  
13 waste facilities, superfund sites, or other hazardous or chemical waste disposal or storage facilities.  
14 Additional resources on regulations and guidelines for monitoring and oversight of radioactive  
15 waste were obtained from the Web sites of the Environmental Protection Agency (EPA), the  
16 Nuclear Regulatory Commission (NRC), and the Departments of Energy and Defense.

#### 17 18 Nuclear Facilities

19  
20 There are currently 140 nuclear facilities in the United States.<sup>1</sup> Of these, 104 are commercial  
21 nuclear power plants and 36 are research and test reactors. Oversight of these facilities, including  
22 operation, safety regulations, and waste monitoring, is carried out by four primary agencies: the  
23 Department of Defense (DOD), the Department of Energy (DOE), the EPA, and the NRC.

24  
25 The majority of regulations fall to the NRC, which has oversight for the commercially operated  
26 sites. DOE has oversight over the 36 research and test reactors. In addition to these agencies, the  
27 Department of Transportation (DOT) has some oversight over shipment containers and waste  
28 transport.

#### 29 30 Pertinent Federal Legislation

31  
32 Several pieces of federal legislation affect the regulation and oversight of nuclear facilities, nuclear  
33 waste repositories, and the environment. The Atomic Energy Act of 1954 is the overarching law on  
34 the use of nuclear materials, and has been amended many times to expand or clarify agency roles  
35 and responsibilities. The act was amended in 1974 to create the NRC (Energy Reorganization Act  
36 of 1974) as a regulatory and oversight body. This act empowers the NRC “...to govern these uses  
37 as the Commission may deem necessary or desirable in order to protect health and safety and  
38 minimize danger to life or property.”<sup>2</sup> Prior to 1974, the Atomic Energy Commission had  
39 responsibility for both the development of nuclear weapons and the oversight of civilian uses of  
40 nuclear materials. However, after 1974 these functions were disaggregated and DOE gained  
41 responsibility for oversight of nuclear weapons, nuclear power, and energy facilities, while the  
42 NRC gained oversight of all regulatory activities with the exception of nuclear facilities. Further  
43 amendments were made to specifically address issues such as disposal of high level nuclear waste,  
44 which was outlined in the Nuclear Waste Policy Act of 1982.<sup>3</sup>

45  
46 Other legislation establishes standards for environmental monitoring, many of which are  
47 administered either partially or wholly through the EPA. These include: the Comprehensive  
48 Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), the Resource  
49 Conservation and Recovery Act of 1976 (RCRA), the Air Pollution Control Act of 1955, and the

1 Federal Water Pollution Control Act Amendments of 1972. The latter 2 acts have been amended  
2 and are more commonly known as the Clean Air Act and the Clean Water Act. In November 2006  
3 the EPA issued its final Ground Water Rule, although this predominantly applies to monitoring  
4 ground water supplies for viral and bacterial contamination, and thus is not applicable to nuclear  
5 waste sites.<sup>4-8</sup>

6  
7 Radioactive Waste

8  
9 Nuclear facilities create hazardous and radioactive waste, which can be further categorized as low-  
10 level, high-level, and mixed waste. Low-level waste is considered to be items that may have  
11 shielded a person or object from a radioactive source or have come in contact with a radioactive  
12 source. Examples are shoe coverings, rags, mops, syringes, animal carcasses, and so forth. Levels  
13 of radiation from these sources can vary depending on the item.<sup>9</sup> High-level radioactive waste is  
14 used reactor fuel or the waste product of reprocessed nuclear fuel. Mixed radioactive waste is  
15 further subcategorized into low-level mixed waste, mixed transuranic waste, and high-level mixed  
16 waste. Uranium mill tailings or the byproduct of uranium and thorium ore extraction constitute a  
17 separate category as well.<sup>10</sup>

18  
19 Disposal and storage of radioactive waste differs for high- and low-level waste. For commercial  
20 nuclear facilities, low- level nuclear waste facilities are located in Barnwell, South Carolina;  
21 Hanford, Washington; and Clive, Utah. The Utah site accepted 76% of the more than 1400 cubic  
22 feet of low-level waste produced in 1998.<sup>11</sup> The high level waste facility, Yucca Mountain in  
23 Nevada, has yet to open (earliest possible acceptance of waste is now estimated to be 2017).  
24 Because this facility is not yet operational, high-level nuclear waste is stored on site at the  
25 commercial nuclear facilities that create it. This has prompted several lawsuits against the  
26 government by commercial nuclear facilities, which have been forced to consolidate waste or build  
27 new facilities to accommodate it. The interim plans for high-level waste storage have created many  
28 concerns among state advisory groups, citizens, and industry professionals.

29  
30 Yucca Mountain as a site of high-level radioactive waste disposal was contentious to begin with,  
31 and Nevada continues to fight the decision. The site was first investigated in 1978, and it was 1 of  
32 9 final sites selected for further study in 1983. In 1986, this list was reduced to 5 sites, of which 3  
33 were recommended by President Reagan for further study. The final sites were Yucca Mountain,  
34 Nevada; Deaf Smith County, Texas; and Hanford, Washington.

35  
36 In February 2002, the DOE Secretary recommended to President Bush that Yucca Mountain be  
37 approved as the final site for high level nuclear waste; this resolution was subsequently passed by  
38 the House of Representatives and the Senate. In July 2002 President Bush signed the resolution,  
39 allowing DOE to apply to the NRC for a license. Although this application was scheduled for  
40 submission in December of 2004, it has not yet been filed. In testimony to the Senate Committee  
41 on Energy and Natural Resources, titled "Uncertainties about the Yucca Mountain Repository  
42 Project," concern was expressed about the licensing process, specifically that DOE would be  
43 unable to submit an acceptable application for a license and that the application process would  
44 impair the ability of the facility to open in a timely fashion.

45  
46 Oversight of Yucca Mountain, when and if it opens, will fall under four agencies: the EPA, DOT,  
47 NRC, and DOE. The EPA would establish environmental standards for the facility. DOT would  
48 regulate the transportation of waste to the facility; enforce requirements on shippers, routing, and  
49 vehicles; and interact with state, tribal, and local facilities on transport issues. The NRC would

1 enforce facility standards; inspect the facility; regulate the shipping casks; and interact with state,  
2 local and tribal authorities on facility operations. DOE would design, construct, and operate the  
3 facility.<sup>12-14</sup>

4 Low-level waste facilities (commercial) are regulated by the NRC unless a state has assumed  
5 regulatory authority for a disposal site through the "Agreement State Program." Through this  
6 program, states are allowed to assume control and inspection of the sites, adhering to guidelines  
7 established by the NRC and permitted by section 274 of the Atomic Energy Act. Currently, all 3  
8 low-level waste facilities are located in agreement states that have oversight of these facilities.  
9 Transportation of waste to the sites is overseen by the NRC and DOT, and in agreement states by  
10 state governments as well. State regulations for these facilities must comply with NRC  
11 guidelines.<sup>15</sup>

12  
13 Storage and disposal of high- and low-level nuclear waste from DOE-managed sites is summarized  
14 below (from the DOE Office of Environmental Management Web site):

15  
16 DOE stores its high-level waste...in tanks at ...West Valley, New York; Savannah River,  
17 South Carolina; and Hanford, Washington. At the Hanford Site, some of the original  
18 single-shell tanks that have begun to leak have been replaced by double-shell, carbon-steel  
19 tanks. These range in volume from 500,000 to approximately one-million gallons each.  
20 The double-wall is actually a tank within a tank. Highly sensitive monitoring equipment is  
21 installed in the space between the tank walls to detect any leaks that might occur. At the  
22 Savannah River Site, high-level liquid waste is being removed from the tanks and  
23 converted to a solid-waste form suitable for permanent disposal. DOE reduces the volume  
24 of high-level waste that it vitrifies by pretreating the stored high-level waste to separate  
25 many of the non-radioactive substances from the radioactive ones. The remaining less  
26 radioactive waste will be mixed with cement and fly ash and solidified as grout or  
27 "saltstone" as a final form for disposal.<sup>16</sup>

28  
29 Environmental and Resident Health Monitoring, Reporting Guidelines

30  
31 For the 36 sites overseen by DOE, an annual site environmental report is required. This report,  
32 released in 4-year increments, details the estimated environmental effects on both the physical  
33 surroundings (specifically air and water quality) and the impact on people in the community. The  
34 most recent report, released in 2004 for the years 1998-2001, does not indicate contamination or  
35 health hazards to the general public; however, because DOE both manages the sites and produces  
36 the report, this process cannot be considered independent oversight.<sup>17</sup>

37  
38 Environmental monitoring at commercially operated plants is conducted primarily on a site-  
39 oriented basis by the facility itself. In addition, states have increased their environmental  
40 monitoring procedures at commercial sites within their borders. This is most often accomplished  
41 through the state environmental protection agency or an equivalent entity.

42  
43 There are specific regulations for reporting incidents, such as spills and leaks, to the NRC, as well  
44 as to state and tribal governments. The NRC maintains state liaison officers (SLOs), who are  
45 governor-appointed liaisons between the NRC and state government. The NRC requires that all  
46 plant discharges and the results of any environmental monitoring and/or testing be reported  
47 annually. Sites must also participate in an inter-laboratory comparison program that serves as an  
48 independent check on the environmental test results. This includes reporting of liquid and airborne

1 releases, as well as environmental radioactivity levels. In addition to these annual reports, the NRC  
2 periodically conducts site visits to inspect the onsite monitoring programs of each facility.

3  
4 The EPA also conducts monitoring. The Center for Environmental Restoration, Monitoring, and  
5 Response is 1 of 3 centers of the Radiation and Indoor Environments National Laboratory within  
6 the EPA. The center conducts periodic studies of air, soil, and water testing of site facilities. The  
7 EPA also oversees RadNet (formally known as the Environmental Radiation Ambient Monitoring  
8 System [ERAMS]). This system monitors samples of air, drinking water, milk, and precipitation  
9 from 59 monitoring stations nationwide. The associated database for the system is available online  
10 and is searchable by the public.<sup>18</sup>

11  
12 The National Atmospheric and Oceanic Administration's Global Monitoring Division monitors  
13 surface radiation levels through the Surface Radiation Research Branch of the Earth System  
14 Research Laboratory. Data, images, and information are available for download.<sup>19</sup> The  
15 Neighborhood Environmental Watch Network also monitors radiation levels in New Mexico, as an  
16 extension of the Los Alamos National Laboratory.<sup>20</sup>

17  
18 Although many agencies monitor some component of the environment, little testing is done on  
19 residents in the vicinity of these facilities. Most estimates of human contamination are formulated  
20 by modeling, such as those produced by DOE's annual site environmental reports. Independent  
21 studies have been undertaken to estimate the risk for cancer or other adverse health outcomes for  
22 people living or working in proximity to specific nuclear facilities in the United States. The Beir  
23 VII report provides a concise summary of many of these studies (international and US, published  
24 from 1990 to present).<sup>21</sup> Ecologic studies did not provide a direct estimate of risk relative to  
25 radiation dose or individual estimates of risk for populations living near nuclear facilities.  
26 However, a review of cohort studies and case-control studies found some instances of increased  
27 risk for specific types of cancer or cancer mortality.

28  
29 Outside of the Beir report, other studies intended to evaluate cancer mortality risk have yielded  
30 mixed results. Two studies provide an excellent example of both ends of the spectrum. Researchers  
31 at the International Epidemiology Institute of Vanderbilt University published a descriptive  
32 epidemiological study of cancer mortality in May 2006.<sup>22</sup> They found no conclusive evidence of  
33 increased cancer mortality for residents near the Hanford nuclear facility when compared to  
34 demographically similar counties in the area. These results are similar to those from other studies  
35 of the potential exposure risks and adverse health effects, especially on thyroid cancer, at Hanford.  
36 While most studies indicate that the incidence and/or prevalence of thyroid cancer is not elevated  
37 compared with non-exposed populations, a new analysis of these data appeared in early 2007.  
38 Researchers at the Center for Risk Analysis of SENES Oak Ridge, Inc., argue that the statistical  
39 methods used were inadequate, and that if different statistical assumptions were made, the study  
40 outcomes may have been different.<sup>23</sup> In general, study results are viewed as inconclusive.  
41 Additionally, public knowledge of possible spills and leaks can lead to adverse mental health  
42 effects that impact health and well-being.

43  
44 In other areas of environmental pollution, however, efforts at biomonitoring are underway by both  
45 the EPA and the Centers for Disease Control and Prevention. The latter currently releases a  
46 comprehensive report detailing the levels of approximately 200 chemicals, mainly heavy metals  
47 and pesticides.<sup>24</sup> Examples are available in the literature of other successful biomonitoring  
48 programs that involve nonhuman targets, such as trees and other vegetation.<sup>25</sup>

1 Task Force on Groundwater Contamination

2  
3 Several media reports have been published on tritium releases at both commercial and DOE-  
4 managed power plant sites. Tritium is a radioactive isotope of hydrogen. Because it reacts with  
5 oxygen in a fashion similar to hydrogen, it most commonly occurs in the environment in liquid  
6 form. It is odorless and colorless, and is readily absorbed by the body. The half-life of tritium is  
7 approximately 12 years. Tritium is 1 example of waste that can be released from a nuclear facility  
8 or waste site, contaminating ground water.<sup>21</sup>

9  
10 The NRC Web site lists reports of incidents at six of its sites. In March 2006 a task force was  
11 created of nuclear industry leaders who believe the problem of tritium groundwater contamination  
12 needs to be addressed. The task force met in June 2006 and developed guidelines for the creation  
13 of:

14  
15       ...a company/site specific action plan to help assure timely detection and effective  
16 response to situations involving inadvertent radiological releases in groundwater to prevent  
17 migration of licensed radioactive material offsite and quantify impacts on  
18 decommissioning.

19  
20 The public was invited to comment at these meetings, most recently on January 17, 2007.<sup>22</sup>  
21 Although most of the public meeting information is distributed via the NRC Web site, interested  
22 parties without Internet access may contact the "Public Document Room" to obtain information on  
23 upcoming meetings and proceedings. Archives of meeting agendas, reports, webcasts, and  
24 communications to the task force and meeting proceedings are all listed on the Web site and are  
25 available to the public. Guidelines for public participation in the NRC regulatory process, including  
26 information on rulemaking and licensing are also outlined on the site.

27  
28 Of the four sites that have been identified on the NRC Web site as leaking tritium, two are located  
29 in Illinois. In March 2006, the Illinois EPA cited Exelon Corporation (the operator of both leaking  
30 plants in Illinois) with violations, stating that the company had failed to take appropriate action to  
31 repair or stop tritium leaks that were first detected in 2004. Subsequently, in May of 2006, the NRC  
32 also cited Exelon for not addressing the leaks in a timely or efficient manner. A class action suit  
33 has been filed against Exelon on behalf of 14,000 Illinois residents whose groundwater was  
34 affected by these leaks. As considerable media attention has been given to these leaks, Exelon and  
35 the Illinois EPA are currently working together to transparently communicate clean-up efforts.

36  
37 Relevant AMA Policy

38  
39 Several AMA policies relate to Resolutions 402 and 417 (A-06), and more specifically to nuclear  
40 facilities, radioactive waste, and environmental health and safety, and several policies relate to high  
41 and low level radioactive waste. Policy H-135.961 (AMA Policy Database) advocates for the  
42 inclusion of AMA representatives and state medical societies or associations as advisors to the  
43 NRC on the high level waste site Yucca Mountain, and asks this Council to continue monitoring  
44 the topic of high level waste. Our AMA offers medical support for task forces associated with the  
45 transport and disposal of radioactive waste in Policy H-135.964. Our AMA also favors legislation  
46 to facilitate interstate compacts related to radioactive waste disposal (Policy H-135.986), and urges  
47 the NRC to reject site applications unless all regulations are fulfilled (Policy H-135.971). In  
48 general, the AMA supports the responsible development of nuclear energy, with research on public

1 health and safety (Policy H-455.994). In addition, our AMA called for oversight of DOE facilities  
2 by an external agency in the late 1990s (Policy H-135.987).

3  
4 Summary and Conclusion

5  
6 Resolution 402 (A-06) calls for our AMA to advocate for the “development of a transparent,  
7 comprehensive national policy and plan for the disposition of United States Department of Energy  
8 [DOE] radioactive and chemical waste based on sound science that ensures the health and safety of  
9 the public.” The Nuclear Waste Policy Act of 1982 does provide a plan and guidance for high-level  
10 nuclear waste, but guidelines for the storage and disposal of low-level nuclear waste are less clear.  
11 Given the fragmentation of the oversight system among several different agencies, and the  
12 separation of oversight between NRC- and DOE-managed sites, a comprehensive system is  
13 lacking. The industry as a whole, however, is highly regulated.

14  
15 Resolution 402 (A-06) also urges that our AMA “recommend that the DOE hold a national  
16 stakeholder forum with broad public participation from elected representatives, regulatory officials,  
17 Native American tribes, non-governmental organizations and the general public.” Currently,  
18 stakeholder forums are in existence, which in essence accomplish this goal of Resolution 402.  
19 Several organized programs coordinate the regulation of what are considered “Atomic Energy Act  
20 materials,” and promote communication between the states and the NRC. Most of these  
21 organizations hold annual meetings and also participate in one another’s annual meetings. These  
22 include:

- 23
- 24 • The National Materials Program
    - 25 ○ Integrated Materials Performance Evaluation Process
  - 26 • Office of State and Tribal Programs
    - 27 ○ Regional state liaison officers (nonagreement states)
    - 28 ○ Regional state agreement officers (agreement states)
  - 29 • Conference of Radiation Control Protection Officers
  - 30 • Organization of Agreement States
- 31

32 In addition, the DOE Environmental Management Office holds public meetings and workshops in  
33 almost every state on a frequent basis. These include meetings of local and state advisory boards,  
34 public hearings, and annual meetings.

35  
36 Resolution 417 (A-06) calls for an independent third party to conduct environmental testing or  
37 environmental study on areas surrounding all facilities, both commercial and federally run.  
38 Although several independent federal and state organizations monitor environmental standards and  
39 radiation levels, there is no one comprehensive and consistent report on both health status and  
40 environmental quality nationally.

41  
42 Lastly, Resolution 417 suggests the need for additional “legislation, regulation and oversight of all  
43 nuclear facilities, including a process that mandates the reporting of spills, leakages, and airborne  
44 emissions of radioactive materials to the appropriate federal and state environmental protection  
45 agencies.” It appears that, while not coordinated under one agency, these reporting guidelines are in  
46 place. It is unclear if additional regulations would improve communications among federal  
47 agencies, commercial plants, and the states.

1 RECOMMENDATIONS

2

3 The Council on Science and Public Health recommends that the following statements be adopted in  
4 lieu of Resolutions 402 and 417 (A-06) and the remainder of the report be filed:

5

6 That our American Medical Association:

7

8 1. Advocate for the development of a transparent, comprehensive national policy and plan for  
9 the disposition of US Department of Energy (DOE) radioactive and chemical waste.  
10 (Directive to Take Action)

11

12 2. Support independent, comprehensive environmental testing at all nuclear facilities  
13 throughout the country and with the results of any testing made available to the public.  
14 (Directive to Take Action)

15

16 3. Urge the appropriate federal and state agencies to monitor and/or evaluate the health status  
17 of residents in the area of leaking nuclear facilities to accurately determine any adverse  
18 impact on health status by leakage of radioactive materials, and make public these results.  
19 (Directive to Take Action)

20

21 4. Support measures that strengthen the coordination and oversight of nuclear facilities.  
22 (Directive to Take Action)

Fiscal Note: \$1,000

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