

## NATIONAL RESEARCH COUNCIL BOARD RECOMMENDS RESTRUCTURING OF U.S. HLRW DISPOSAL PROGRAM

In July 1990, the National Research Council's Board on Radioactive Waste Management (BRWM), an international group of radioactive waste experts that advises the Federal Government on technical subjects related to waste administration, released a position statement assessing the current status of the nation's high-level radioactive waste (HLRW) disposal program. In the report, the Board acknowledges the worldwide consensus that permanent burial of HLRW in stable geologic depths is the safest option available and is within the bounds of science and engineering, but it argues that the United States' program — as presently designed — is likely to fail because current regulations block the construction and operation of any such site by demanding structural integrity for tens of thousands of years. The report notes that the U.S. program for disposing of HLRW is too "rigid," "inflexible," and "unrealistic" and may indefinitely prevent the underground disposal of HLRW unless major legal and regulatory conditions are relaxed.

The report focuses on the choice between disposing of HLRW underground or leaving it at the surface, where the risk of eventual public exposure is almost certainly much higher, and proposes the following general recommendations:

- The government should implement a more flexible regulatory approach that would incrementally allow for changes during the construction and operation of the repository as new information becomes available.
- Regulatory agencies should review their standards for licensing and operation of HLRW repositories.



*Remote Yucca Mountain in southwestern Nevada, the potential locale of the nation's first HLRW disposal site.*

Courtesy: U.S. Department of Energy

- Waste should be placed into facilities where the local geology and groundwater conditions will permit isolation of the waste for tens of thousands of years or longer and where waste materials will migrate very slowly if they should leak out of primary containers and come into contact with rock.

### Problems with U.S. Approach

The Board concludes that the U.S. approach is uniquely rigid in its insistence on defining advanced technical requirements for every part of the nuclear waste containment system and its requirement that a given site has to be endorsed as "safe" — according to standards of the Environmental Protection Agency (EPA) — for the long-

term before wastes are deposited there. The Board also recommends that the Nuclear Regulatory Commission (NRC) and the EPA should make their radiation exposure standards relating to HLRW disposal sites less stringent and more consistent. The impasse between the NRC and the EPA over this issue, the Board estimates, is contributing to the stalled HLRW disposal program.

The U.S. Government's demand for exacting safety standards, the Board concludes, presents a "scientific trap" for both the Department of Energy (DOE) and the public, "encouraging the public to expect absolute certainty about the safety of the repository for 10,000 years and encouraging DOE

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## The U.S. program for disposing of HLRW is too "rigid," "inflexible," and "unrealistic" and may indefinitely prevent the underground disposal of HLRW.

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program managers to pretend they can provide it." The report adds, "Engineers and scientists, no matter how well-trained, are unable to anticipate all of the potential problems that might arise in trying to site, build, and operate a disposal site, nor can science 'prove' in any absolute sense that a repository will be 'safe' as defined by EPA standards and NRC regulations."

The Board recommends that the U.S. should immediately construct underground test laboratories and suggests that designs and procedures should be modified to meet performance requirements at any step of construction and operation, based on new information collected along the way, with a strong consideration on monitoring and assuring the capability to solve unanticipated problems. "In that way, the possibility is minimized that unplanned or unexpected events will compromise the integrity of the facility," the report states. "A realistic and attainable goal is to assure the public that the likelihood of serious unforeseen events is minimal and that the consequences of such events will be limited. There are certain irreducible uncertainties about future risk."

The Board cautions that such an approach would require significant changes in how Congress, the DOE, and regulatory agencies do business. For example, the NRC, according to the Board's assessments, should leave the design of the repositories to the applicants as long as they meet the Commission's licensing standards. Furthermore, since some nuclear

waste remains radioactive for tens of thousands of years and the inherent risks of geologic disposal would be concentrated in very few geographic areas, the Board urges government agencies to conduct substantive dialogue with people living near proposed disposal sites, encouraging negotiation, persuasion, and generous compensation.

As the scientific community and the government grapple over the HLRW disposal issue, the current stockpile of radioactive spent fuel rods — totaling some 15,000 to 20,000 metric tons — is expected to double within the next decade, according to Steven P. Kraft, director of nuclear waste and transportation for the Edison Electric Institute in Washington, DC. With no licensed facility available to accept their accumulating wastes, nuclear utilities have been storing their fuel on-site on a continuing interim basis.

Nuclear industry officials and some politicians are concerned that the lack of progress in finding waste disposal sites could ultimately jeopardize the existence of nuclear power as an energy option. A federal regulation known as the "waste-confidence rule" specifies that the NRC can actually shut a plant if it has no on-going waste disposal program. State governments are also restricting the operation of nuclear facilities that do not have existing waste management systems. California, for example, has a statute prohibiting the licensing of any new nuclear plant until the nation's waste-disposal problem is solved.

### The Continuing Saga over Yucca Mountain

The problem of dealing with HLRW has been recognized since the inception of the U.S. nuclear program. In 1955, the National Research Council's Committee on Earth Sciences, the forerunner of the BRWM, examined the problem of HLRW disposal and recommended the strategy of burying and isolating the waste deep in dry, stable, geologic formations, such that it would not pose a threat to the biosphere.

After several decades without much progress, in 1982, Congress passed the Nuclear Waste Policy Act (NWPA) that gives the DOE the responsibility for designing and operating deep geological repositories for HLRW. The Act further specifies that such a site must be licensed by the NRC and must meet radionuclide release limits that would result in fewer than 1,000 deaths in 10,000 years — a standard set by the EPA that is based on risk estimation probabilities. The NWPA directed the DOE to perform scientific and technical studies to determine if several proposed sites located throughout the nation were suitable for HLRW disposal. Subsequently, the DOE proposed nine potential sites for HLRW burial, including Yucca Mountain, a barren ridge in southwestern Nevada.

In 1987, Congress approved DOE's recommendations and selected Yucca Mountain as the site for extensive testing. Initially, the DOE scheduled the Yucca Mountain site to be opened in 1998 pending federal approval. The DOE's plan was essentially to bury the wastes more than 1,000 feet underground in a rock repository, where there would be little chance of seepage of radioactive materials to underlying water tables. The initial engineering plans envisioned the repository to resemble a large underground mining facility. The waste was to be packed in reinforced steel containers large enough to handle 70,000 metric tons. As the NWPA had originally mandated, funds for the disposal site would

come from the Nuclear Waste Fund, which was established by utilities that use nuclear reactors. Federal officials advised the DOE that they must be assured that future earthquakes, volcanic eruptions, or climate changes would not threaten the repository.

Immediately following the selection of Yucca Mountain as a test site, the State of Nevada and the DOE began a series of antagonistic lawsuits and countersuits that continue to the present day (see box, p. 19A). To respond to the rising tide of criticism of its HLRW program from both Nevada officials and Congress, in late November 1989, the DOE announced dramatic revisions in its plans for site analyses and preconstruction testing at the Yucca Mountain site and in its long-term schedule for interring wastes. Though Congress had ordered the Federal Government to begin accepting HLRW by 1998, DOE stated that it could not offer a permanent disposal vault until 2010 at the earliest — and even that prospect rested on the suitability of the Yucca Mountain site. If the site proved to be unacceptable or unavailable, forcing the DOE to look elsewhere, DOE officials estimated that the earliest date for beginning permanent burial would be well beyond 2010. Thus, the DOE proposed to reorganize and reschedule the national HLRW disposal program accordingly.

Speaking at a November 1989 banquet of the American Nuclear Society and the Nuclear Energy Forum in San Francisco, California,

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DOE Deputy Secretary Henson Moore outlined the DOE’s new HLRW plan and said that repository operation could be successfully achieved by 2010 only under optimum circumstances. Pending approval of the site, he told the gathering, “Yucca Mountain would be a first-of-a-kind licensed permanent repository. We will be pushing science, engineering, and the regulatory process beyond present boundaries of experience.” Mr. Moore proposed a revised timetable for the Yucca Mountain project, calling for surface investigations to be well underway by 1991, underground analyses to be initiated the following year (pending the suitability findings of the surface studies), and repository design work to begin by 1996. Mr. Moore also assured the attendees, “We have no predetermined views concerning the site’s suitability; whatever decision is made will be made solely on the basis of solid scientific evidence. And if, at any time during the char-

acterization, the site is found to be unsuitable, we will immediately notify the State of Nevada and the Congress and discontinue evaluation.”

In a December 1989 letter to DOE, Nevada’s Governor, Robert Miller, sought to terminate the agency’s actions in his state by asserting that surface scientific analyses done by Nevada officials indicated that Yucca Mountain is unsuitable as a HLRW disposal site for the following reasons: the area is geologically young and unstable, there exists a potential for movement of contaminated groundwater, and nearby areas contain minerals.

Joseph Strolin of Nevada’s Nuclear Waste Project Office cites a Federal law that specifies that any site with a history of active geologic processes that might lead to future releases of radioactive waste must be disqualified. “We believe that the vast body of knowledge gained from existing studies [by the DOE, the U.S. Geological Survey, and state agencies] are valid and voluminous enough to disqualify Yucca from any intrusive analyses,” says Mr. Strolin. “They’ve already spent nearly a billion dollars on surface tests and lab studies, and there is enough compelling information on Yucca to indicate that it is too risky to place a waste burial there.”

In fact, some of the DOE’s own scientists — who have conducted surface evaluations of Yucca Mountain — have also found serious problems. Surface analyses performed by Jerry S.

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Szymanski, PhD, a geologist in the DOE's Yucca Mountain Project Office, Las Vegas, Nevada, revealed geologic evidence that the groundwater (thought to be a third of a mile below the surface) has periodically risen to the area where the proposed repository would be entombed. “Yucca Mountain is very young geologically,” says Dr. Szymanski. “There are young faults along its surface, and parameters like heat flow and groundwater flow system cannot be accurately predicted.” Furthermore, according to both Dr. Szymanski and Nevada state officials, there is a young, active volcano within seven miles from Yucca Mountain. DOE scientific data confirmed that there are, in fact, 32 active faults on the site itself.

Although DOE officials admitted that such issues could ultimately disqualify the Yucca Mountain site, they contend that assessment cannot be formally made until they can begin intrusive investigations into the mountain. According to John Bartlett, PhD, the new director of the Office of Civilian Radioactive Waste Management (OCRWM), a DOE branch that oversees the Yucca Mountain Project, Nevada state officials are disqualifying the site based on “very incomplete evidence with a very high degree of uncertainty.” In a November interview with *Nuclear News*, Dr. Bartlett wondered, “Could the faults produce earthquakes in the future or are they residue of things that occurred long in the past?” Dr. Bartlett added that he

“categorically rejected” the Nevada officials' position on Yucca Mountain's geologic unsuitability. “The information is too uncertain to make a judgement.”

### Future Prospects

According to the OCRWM, at present more than 1,400 DOE-contracted scientists and engineers are working at the Yucca Mountain site. While Nevada's refusal to grant environmental permits to the DOE prevents these technicians from conducting tests that would disturb the geology of the area, they can perform seismologic and hydrologic studies as well as examine already existing trenches, bore holes, and tunnels. The State of Nevada and the Federal Government continue to battle in court over the DOE's right to conduct surface-disturbance studies at Yucca Mountain. Meanwhile, the amount of HLRW generated by the U.S. nuclear community grows while no permanent disposal site will receive waste until at least the year 2010 and likely much later. Since Nevada authorities have doubted the scientific feasibility of HLRW burial at Yucca Mountain and have thwarted the DOE's attempts to thoroughly characterize the site, no immediate solution or compromise seems forthcoming.

Meanwhile, the nation's growing supply of HLRW remains warehoused in above-ground tanks alongside the plants that continue to generate them. According to John S. Sieg, senior staff

officer of the BRWM, the European community, in contrast to the U.S., is firmly committed to the principle of geologic disposal of HLRW. The Europeans are methodically gathering more scientific knowledge so that the technology will be optimum for waste burial. In the meantime, they are storing on site. Mr. Sieg says, “The Europeans seem to accept the inevitability of nuclear power, and appear set to [eventually] deposit the wastes in underground sites.” Adds David R. Brill, MD, chief of the section of nuclear medicine, assistant director of the department of special imaging radiology at Geisinger Medical Center, Danville, Pennsylvania, “The option of maintaining the waste on-site on an interim basis does have some merit.” First of all, the waste becomes easier to handle as its radioactivity steadily dissipates with the passage of time. Also, with the rapid progress of technology, it is expected that know-

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### Nuclear Medicine's Perspective on HLRW Disposal

Although radiopharmaceuticals used in nuclear medicine primarily generate low-level waste, there are parallels between the disposal of high- and low-level waste. “Although we are not explicitly involved with high-level waste issues, the nuclear medicine community has empathy for the nuclear plants that generate these wastes,” says William MacIntyre, PhD, staff physicist, Cleveland Clinic Foundation, Cleveland, Ohio. “The opposition of the local government in Nevada to [HLRW] disposal sites touches on the issue of the public's perception of anything having to do with radiation, and this is a topic that nuclear medicine has to be concerned about.” Adds Dr. Brill, “The general public's perceived risks associated with waste disposal is a matter all radiation sciences professionals should be sensitive to.”

**F**ollowing the passage of the Nuclear Waste Policy Act (NWPA), the Chairman of the Senate Committee on Energy and Natural Resources, Senator Bennett Johnston (D-LA), asserted, "We've solved the nuclear waste problem." Senator Johnston's emphatic statement would prove to be premature because the State of Nevada and the Federal Government would become embroiled in a tangled web of hostile litigation

Courtesy: U.S. DOE



## The Legal Wrangles over Yucca Mountain

over Yucca Mountain that remains unresolved. Shortly after the federal mandate, the DOE began to apply for state environmental permits to begin intrusive testing at Yucca Mountain. Although such permits typically require 75 days to obtain, Nevada officials have yet to process even one. Subsequently, the DOE asked the Justice Department to bring suit against Nevada over the delay, but Nevada's Governor, Robert Miller, told federal officials that he has no intention of ever issuing those permits to the DOE.

In early 1989, two years after Congress had authorized the Yucca Mountain site for suitability studies, the State of Nevada formally refused to let DOE scientists perform any intrusive surface-disturbance on-site testing. The DOE, which had already spent hundreds of millions of dollars on off-site lab and field tests, countersued to be allowed to complete the job assigned it by Congress. By April of that year, Nevada lawmakers passed a joint resolution declaring the state unwilling to accept a nuclear repository. In July, Governor Miller passed a law that instituted a statutory prohibition against storing radioactive wastes anywhere within state borders.

In response to the state's actions, the DOE's jurisdictional staff in Washington contended that a state cannot veto a high-level radioactive waste (HLRW) repository unless the President has officially approved a site recommended by the DOE. Thus, they held that the Nevadans were overstepping their legal bounds by vetoing the Yucca Mountain site so prematurely. According to the DOE, the state law is curious because, as a result of years of underground nuclear detonations, a great amount of highly radioactive material already exists underground in Nevada. The law, furthermore, did not preclude nuclear weapons testing or require removal of byproduct material already in place.

Reacting to Washington's jurisdictional objections, Joseph Strolin, administrative planning director for Nevada's Nuclear Waste Project Office in Carson City, says that under the provisions of the NWPA, states have the right to veto a federal facility within their territory. "Yucca Mountain's selection as the only candidate for the nation's first licensed HLRW site was based wholly on political considerations. There were eight other sites around the country being considered, but Nevada was chosen by a Senate conference committee without any debate or discussion. We got railroaded. States like Washington and Texas were spared because they exerted

powerful political influences over the Senate, and Nevada did not," claims Mr. Strolin. "Scientific considerations did not play a role in the selection of Yucca Mountain. The DOE is obliged to find the site acceptable no matter what."

In an attempt to further prevent the DOE from continuing its plans at Yucca Mountain, on September 19, 1989, Governor Miller told the local press that "The state should no longer process any of DOE's

permit applications" since his state had vetoed the repository, and he contended that Nevada had no further obligation to discuss the matter with DOE. During this series of suits and countersuits, the nuclear utility industry was growing increasingly concerned about the \$5 billion already spent on the Yucca Mountain project.

On December 27, 1989, Nevada filed suit (in San Francisco's 9th Circuit Court of Appeals) against the Federal Government, claiming that the state has a right to veto the use of the Yucca Mountain site as an HLRW repository. The suit asked the court to validate Nevada's legislative actions vetoing the nuclear waste repository and also sought an injunction to stop further federal work on the Yucca Mountain project. On January 25, 1990, the DOE filed another countersuit against Nevada, claiming the state has no right to deny the DOE access permits to study the Yucca Mountain site, again arguing that Nevada can only veto the site as a repository following the completion of scientific studies.

The DOE's efforts to counter Nevada's obstructions were advanced when, on September 19, 1990, the U.S. Court of Appeals in San Francisco ruled that Nevada's challenge of the NWPA was without merit and affirmed the DOE's authority to explore the scientific feasibility of using Yucca Mountain as a repository site. This court ruling did not specifically allow the DOE to begin site exploration, but it may clear the way for the Nevada District Court to rule favorably for the DOE in its countersuit against Nevada for its refusal to grant site access permits. According to Mr. Strolin, the State of Nevada will appeal this decision and take the case to the U.S. Supreme Court.

To help skirt the barrier of litigation impeding the progress of on-site characterization work at Yucca Mountain, in October 1990, Energy Secretary James Watkins asked Senator Johnston to enact enforcement legislation that would prevent the imposition of any further legislative roadblocks and interference from the State of Nevada. In his letter to Senator Johnston, Secretary Watkins estimated that it would take two more years of ongoing litigation to force the State of Nevada to allow siting work at Yucca Mountain. Legislatively, no progress can be made until 1991 when the Senate Energy Committee — the driving force behind the HLRW program — reconvenes.

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## NEWS BRIEFS

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### Medical Physicist Proposes New Radiation Unit

In response to the general public's widespread fears and misconceptions about exposure to small amounts of ionizing radiation, John Cameron, PhD, Professor Emeritus in the departments of medical physics, radiology, and physics at the University of Wisconsin, Madison, has recommended a new radiation measuring unit, the "Background Equivalent Radiation Time" (BERT), as a supplement to milliRem (mRem) and milliSievert (mSv) for the lay public.

The BERT unit would represent the number of days, weeks, or months of natural background radiation that would impart the same amount of radiation as that emitted by a given radiologic procedure. For example, assuming that an average adult receives 1 mRem (0.01 mSv) from naturally occurring radiation per day, a chest X-ray procedure would be equivalent to about two weeks of exposure to natural

radiation (BERT = 2 weeks). Similarly, a mammogram would impart about three months of exposure to natural radiation (BERT = 3 months). Thus, according to Dr. Cameron, "instead of coping with abstract concepts like milliRem and milliSievert, the general public would be provided with an understanding of radiation exposure through the more familiar idea of time." Continues Dr. Cameron, "if a patient asks a doctor how much radiation he was exposed to following some chest X-rays, and the physician replies '10 milliRem' [0.1 mSv], the patient is unlikely to comprehend what that really means. But if he is told that the exposure he received was equivalent to, say, two weeks of naturally occurring background radiation, that gives him something more tangible and understandable."

"Neither patients who undergo radioactive procedures in hospitals nor people who work in nuclear plants have an understanding of radiation or the scientific language behind it," explains Dr. Cameron. "I am not ad-

vocating that we do away with milliRem and milliSievert at all, nor am I saying that the BERT should be used in the scientific literature. Rather, I am interested in publicizing the BERT to the radiation sciences community to encourage its use in informal situations. In the long run, we hope to show the public that small amounts of radiation exposure are not something to be feared." Dr. Cameron further points out that "the conversion to the BERT is simple because if one knows the EDE [estimated dose equivalent] in the milliSievert or milliRem, one can estimate the days, weeks, months, or years of equivalent natural radiation exposure." Dr. Cameron has recommended that manufacturers of X-ray products label their units with BERT figures for the most common radiologic procedures.

Newly proposed radiation units in the United States must go through The National Commission on Radiation Protection (NCRP) and the International Committee on Radiation Units

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### HLRW

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ledge about repository design and scientific characterization of a geologic site will increase, thereby, improving our ability to safely store the waste in a more methodical, thoughtful manner, rather than going about it frantically." In fact, in 1984, the International Council of Scientific Unions recommended that the secure storage of solidified HLRW on-site for up to 100 years might be beneficial since in that duration of time, the wastes' heat content would decrease rapidly, thus reducing its thermal output and making it possible to use less underground space for disposal. The

BRWM report advises, however, that while on-site capacity to maintain HLRW should be sufficient for 100 years, "[that] alternative may be irresponsible for the long run... due to uncertainties associated with maintaining safe institutional control over [HLRW] at or near the surface for centuries." Dr. Brill cautions that "On-site storage of these wastes is only a temporary stopgap measure."

Stanley J. Goldsmith, MD, director of the department of physics-nuclear medicine, Mt. Sinai Medical Center, New York City, a member of New York State Low-Level Waste Siting Commission, states "Opponents of

geologic disposal have not properly considered the consequences of *not* burying the waste. Critics of the plan are citing risks of extremely low probability as an argument against it." "There is no real debate concerning the technical validity of geologic disposal of [HLRW]," concludes Dr. Brill. "The problems are more of a socioeconomic nature, and that is clouding the entire issue. Sooner or later someone is going to have to take the responsibility of dealing with this issue. The waste is not going to just go away. I see no alternative to geologic disposal."

*Palash R. Ghosh*