isotope programs were proceeding (see *Newsline*, June 1993, pp 49N and 51N; January 1994, p. 12N). The Brookhaven Linear Accelerator (BLIP) is still on schedule, with some 1994 funds, the upgrade due in fiscal 1996. The BLIP will make the same accelerator-produced isotopes as the NBTF but without the educational and research features; the upgrade will allow the facility greater capacity and longer production runs.

The Los Alamos Meson Physics Facility (LAMPF) is operating now with 1994 funds and still has 1995 funding. Last year, the LAMPF appeared destined for closing (see *Newsline*, June 1993, p. 51N), which would have jeopardized supplies of ^{67}Cu, ^{68}Ge, and ^{82}Sr, the parent isotope of ^{82}Rb, but continued funding has kept the old accelerator opened until alternatives are ready. As to Los Alamos' Omega West project, Mr. Lowe conceded that "from my perspective, it is not going to happen." Omega West had been the department's plan to produce a domestic supply of ^{99}Mo, but safety concerns arose after a reactor coolant loop pipe break, making the facility too expensive for this plan. Instead, "the Annular Core Research Reactor at Sandia Labs looks more attractive" as the preferred reactor for ^{99}Mo, Mr. Lowe said. He is waiting to see if 1995 funds will be available in October 1994 to begin an environmental assessment. Within three to four months of beginning this study, the department should be able to determine whether there will be "no significant impact" on the environment from converting the reactor; and if there is no significant impact, Mr. Lowe said, conversion will take about two years from the beginning of funding. But the reactor "is our new favored son," he said, "and it looks good."

Lantz Miller

LLRW Generators Feel Barnwell's Closure

After the Southeast Compact closed its facility to outsiders, most states are left without a site for their low-level radioactive waste

When the Barnwell, South Carolina low-level radioactive waste storage facility closed its doors to generators outside the Southeast Compact states on July 1, 1994, many of those generators, including nuclear medicine departments, felt the effects of no access to disposal. States of the Northwest and Rocky Mountain compacts still have disposal access, but much of the nation is left in a bind (Table 1). Although there have not been reports of negative affects on clinical nuclear medicine from the closing, research of all kinds has to face new decisions about how much radioactive materials to use in light of growing limits on expensive on-site storage. Many facilities foresaw and planned for the Barnwell closing well in advance but admit that no amount of planning could forestall the problems of having no recourse to permanent disposal.

"We started a long time ago—the early 80's—on massive volume waste reduction, and reduced volume by 95% over the years," said Ed Gershey, PhD, director of laboratory safety at Rockefeller University. But there was still a major effect at his facility—they must store "animal carcasses, because in New York City one cannot incinerate these. So we ended up with a certain amount of animals containing long-lived radioisotopes." Rockefeller University thus had to devise an on-site storage system for animal carcasses contaminated with long-lived isotopes like tritium or ^{14}C in freezers. "That is a long-term commitment," Dr. Gershey said. "Essentially forever"—adding that, luckily, "We are mostly a small-animal facility," so more carcasses can be stored in a given area.

Cutting Back Research

As on-site storage is costly, and space and funds are limited, many research departments in hospitals and other facilities are finding that they have to discourage some research. The radiation safety office of Mt. Sinai Medical Center has to limit the number of long-lived isotopes that researchers can now use, as this facility must store wastes on-site that it has not stored before. According to Rockefeller's Dr. Gershey, "We have been encouraging alternatives to long-lived isotopes. The problem is, there are areas of research that cannot cut back on long-lived isotopes. This becomes a factor that researchers are starting to look at because of the disposal costs for these materials." However, his campus has been "very responsive" to his

office's requests for using alternatives.

Also in preparation for the limited space of on-site storage, many institutions have been gearing up with waste compaction or incineration systems to reduce volume of solid LLRW. Such a system may involve initial waste separation by half-life and by material type, such as glass or liquid. It also means purchase of costly compaction equipment and its placement on-site and operations, besides the problem of where to store the residue. Some facilities, however, already purchased compacting equipment, not only to decrease solid waste volumes headed for central off-site disposal but in anticipation of those sites' closures.

Compact or State	Host	Siting	License Application	Facility Open
Appalachian	PA	Process underway	Early 1997	Mid-1999
Central	NE	Site selected	Submitted	Sept. 1998
Central Midwest	IL	Process underway	Nov. 1997	July 2000
Midwest	OH	Enabling legislation expected 1995	4.25 years after enabling legislation	7.25 yrs. after enabling legislation
Northeast	CT NJ	Process underway Plan under public review	July 1997 July 1997	Dec. 1999 late 1999
Northwest	WA	*Facility operational since 1965; license reissued May 1992.*		
Rocky Mountain	*Contract with Northwest Compact for disposal at Washington facility.*			
Southeast	NC SC	Site selected *Facility operational since 1966; license issued April 1971.*	Submitted	early 1996
Southwestern	CA	Site selcted	Issued Sept. 1993	mid-1997
Texas (incl. VT & ME)	TX	Site selected	Submitted	mid-1997
District of Columbia	—	*Not siting a facility.*		
Massachusetts	—	Process underway	Jan./Feb. 1998	2000/2001
Michigan	—	*No active site selection process.*		
New Hampshire	—	*Not currently planning a facility.*		
New York	—	Process underway	June 1999	Nov. 2001
Puerto Rico	—	*Not currently planning a facility.*		
Rhode Island	—	*Not currently planning a facility.*		

Source: Low-Level Waste Forum, July 1994; printed in ACURI, August 1994.

Table 1. Commercial Low-Level Radioactive Waste Disposal Capacity

(Some institutions may have no recourse to incineration because of local laws, as in New York City.)

Nuclear medicine's fellow LLRW generators, specifically utilities, are also feeling the crunch after the Barnwell closure. Chris Keyes, nuclear engineer at the Calvert Cliffs nuclear power plant in Maryland, noted that her facility "a long while ago made future plans for storage" and constructed a materials processing facility. Although Calvert Cliffs has reduced LLRW volume to one-third of the original amount since instigating this processing project and can now store on-site about five years of waste, it was built with an eye toward the opening of the Appalachian compact's disposal site. Now that Barnwell has closed, the clock is running for Calvert Cliff's on-site storage.

State Responsibilities

Although a few states do not currently face a problem with permanent LLRW disposal, opinions vary as to the effectiveness of the 1985 amendment to the 1980 LLRW Policy Act, requiring states and compacts to store their own wastes (or if no action is taken, the state itself essentially owns the waste). Donald Margouleff, MD, chief of nuclear medicine at North Shore University Hospital (Manhasset, LI), and member of the New York Citizens Advisory Committee on LLRW disposal, described how the community near a former high- and low-level radioactive waste disposal site at Ashford, NY (West Valley), proposed that the state's new LLRW facility be built there and potentially boost the local economy. But the state legislature delayed until the West Valley citizens threatened to withdraw their proposal. "The legislature didn't act on lifting the exemption on getting the land surveyed," Dr. Margouleff said, referring to an exemption that pressure groups had earlier requested on the land in the early 1980's. "No one has the political courage to take the handle and lift it." With similar such problems across the nation over the years, "I believe about a half billion dollars has been spent in various states for the purpose of siting, to very little result. Most of the low level wastes we're talking about have very reasonable half-lives and they're going to be [quickly] gone. The science of this is not that difficult."

Dr. Gershey directly faults the 1985 amendment: "The problem started with the bill that said low level waste was a state problem. Politically this was disastrous." Educating a vast array of legislatures as to the nature of LLRW and of the science involved has become a problem in itself, especially up against some disposal-site

opponents, who are particularly strong in some regions. "The idea of a single federal site is very palatable," Dr. Gershey said. "I cannot see that this is a regional problem. It is easier to think about it globally, and it might be easier to find a single site."

Stanley J. Goldsmith, MD, clinical director of nuclear medicine, Memorial Sloan-Kettering Cancer Center, said that this whole process of having to store LLRW on-site "is a great disappointment in terms of the states' repsonse to the problem. It is a disservice to the community that uses radioactive material and the community that benefits from its use. Nevertheless, the biggest impact is on biomedical investigators." Furthermore, the controversy "helps to poison the emotional atmosphere against radioactive material."

Congressional Members Take Action

Yet the Barnwell closure may have increased the pressure to open the Ward Valley, CA site and other LLRW sites. Congressional members from outside California stepped into the act first with letters to the Clinton Administration. Rep. John Dingell (D-MI), chair of the Committee on Energy and Commerce, wrote that the Department of Interior's delay in transferring the Ward Valley land to the state of California was "troubling," and the federal government should not impede federal law that enjoins states to dispose of their own LLRW. At least three other Congress members have voiced similar admonishment.

Among them, Sen. J. Bennett Johnston (D-LA) has gone further, introducing a bill, S. 2151, "The Ward Valley Transfer Act," which he plans to move on once Los Angeles County Superior Court Judge Robert O'Brien rules on all pending litigation challenging the site's license. The bill would force Interior to make the land sale.

Interior Secretary Bruce Babbitt has delayed the land transfer until there are further hearings on the site's suitability, especially to answer concerns of the "Wilshire Reports," unofficial studies of Ward Valley's hydrogeology. A Needles, CA meeting, July 7-9, of sixteen scientists appointed by Sec. Babbitt to study these questions did not resolve the dilemma, but the final report on these environmental issues is due by the end of the year.

After the Barnwell closure, the eight states of the Northwestern Compact and four states of the Rocky mountain will continue using the Richland, Washington site. But other states, such as the Southwest Compact, the Northeast Compact, and the Central Compact, etc., are on their own. "We will have about 200 individual storage sites—hospitals, industries, utilities," said Doug Eldridge, general counsel for the New York Siting Commission. New York is not affiliated with a compact. "There are some bills in the legislature, but they do not appear to offer any immediate help. Intermediate storage will not be on-line until the end of the decade." In the meantime, generators will have to spend extra dollars for temporary storage.

Lantz Miller

COMMENTARY

EIGHT YEARS' EXPERIENCE WITH A FILMLESS ALL-DIGITAL NUCLEAR MEDICINE DEPARTMENT

Gerald M. Kolodny, MD

THE NUCLEAR MEDICINE division of our department of radiology has been an all-digital, filmless, imaging division since 1986, perhaps the longest continuous experience with an entirely filmless imaging department using digital images from multiple vendor image acquisition equipment. What principles have we learned from eight years of a picture archiving and communication system (PACS) environment? The answer deserves our rationale for PACS development; a description of our nuclear medicine PACS; enumeration of the advantages of a filmless department; and a description of the principles that should apply to widen PACS application. This experience can serve as a useful model in other departments considering a PACS program.

Digital Requirements

There are four major considerations when analyzing the design requirements of PACS: acquisition, networking, display, and storage. To garner the economic advantages of an all-digital environment, any PACS system proposed must use software and hardware that is widely available, and thus can spread its development and manufacturing costs over a wider market than medical imaging.

The display must equal or surpass film technology for it to be acceptable in the routine interpretation of all imaging studies. While we routinely use 512 x 512 video frame grabber images