

NUCLEAR MONITOR SPECIAL EDITION:

February 2000

DECOMMISSIONING THE NUCLEAR POWER INDUSTRY:

RUBBLE, RUBBLE, TOIL AND TROUBLE

From 1957 to 1996, 131 nuclear power stations were licensed to commercially operate in the United States. Twenty-seven of those commercial reactors are now permanently closed. Because of accidents, exposes, deterioration of equipment and the tremendous costs associated with splitting the atom to boil water, all of these nuclear utilities were forced into closure before the expiration of their 40-year licenses. Overnight, the dangerous business of nuclear-generated-electricity is transformed into a timeless radioactive liability of colossal proportions.

Eventually, every nuclear power station will shut down. The generators, their federal and state regulators and the reactors' host communities are then faced with decisions regarding the future of the onsite accumulation of highly radioactive fuel, residues, massive quantities of radioactive equipment and components, mixed hazardous wastes and a mountain of contaminated concrete and debris making up the reactor building. Even the earth and groundwater beneath the facility must be surveyed for radiation contamination.

The long-term management and clean up of these closed nuclear power stations is known as "decommissioning." The various methods and timing for the decommissioning a nuclear power station can widely differ. Responsible decommissioning involves managing the closed radioactive facility and eventually dismantling and caring for the radioactive and hazardous wastes to ensure compliance with environmental and public safety standards. It involves a combination of technical, financial, and regulatory

challenges over processes that can adversely affect worker safety, public health, and environmental quality far into the future as the result of exposure to radiation.

THE METHODS OF DECOMMISSIONING

As with many aspects of the nuclear power industry, electric utilities moved to commercialize the technology before many fundamental questions and issues affecting public health and environmental protection were responsibly addressed. The industry, federal regulators and affected communities alike now face numerous problems involving the unresolved policy and technical issues of license termination and clean up within our communities and ultimately long term nuclear waste management. None of the currently recognized options for decommissioning adequately address all of the issues raised by nuclear waste. All of the current options provide that with the closure of the reactor on-site federal inspectors are removed from the nuclear site and any further on-site federal oversight activity is at the discretion of the electric utility.

There are three decommissioning methods being recognized by the NRC.

"SAFESTOR" is the process where the facility is essentially closed, locked down and guarded over a period of several decades to allow for radioactive decay to reduce future radiation worker and public exposure levels. A minimum of reactor decontamination is performed and the remaining facility is "moth balled." Under SAFESTOR, a major amount of contamination by radionuclides such as Cobalt-60 (5 1/2 year half-life) and Cesium-137 (30 year half-life) can be significantly reduced by waiting 30 to 60 years with an associated reduction in the amount of nuclear waste disposal space required. Immediately disturbing the facility increases the risk to workers and potentially releasing radioactivity into the environment (air and water) to communities surrounding the reactors and sends greater volumes of radioactive waste to communities located around

the nuclear waste dumps like Barnwell, South Carolina or Hanford, Washington. The industry claims the major disadvantages to SAFESTOR to include a growing uncertainty about the future availability and costs of nuclear waste dumps and the continuing costs associated with maintenance, security and surveillance of the reactor site.

“PROMPT or RAPID DISMANTLEMENT” (DECON) is the immediate cutting up, dismantling and demolition of the reactor for transport to radioactive waste dumps. The advantages of prompt dismantlement include quickly alleviating the utility’s nuclear waste liability by removing from the reactor site, elimination of the need for long term security, surveillance and maintenance, and availability of the site for further restricted or unrestricted public use. However, the DECON method constitutes the largest radiation exposures to workers and potential exposures to the public as a result of sloppy uncontrolled work or in the event of an accident at the site or along a nuclear waste transportation route. The prompt dismantlement of the small 179-megawatt Yankee Rowe nuclear power station in Western Massachusetts resulted in 70 releases of radioactive effluent into the Deerfield River. Plasma-torch procedures used for cutting up radioactive reactor components resulted in the “tracking” of radioactive hot particles into previously non-radioactive areas of the site such as the Administration Building and possibly beyond the site perimeter.

“ENTOMBMENT” (ENTOMB) is a process that removes the irradiated fuel and encases the reactor’s radioactive systems, structures and components in concrete onsite. The entombed structure would then be monitored and maintained. Currently, the NRC requires that all decommissioning operations be completed within 60 years of the permanent cessation of operation. With entombment the federal agency is now considering a decommissioning alternative where the cost of maintaining and monitoring a buried nuclear power plant is extended out to 300 years. Under the ENTOMB scenario,

a utility would be allowed to bury and encase activated waste and long-lived radionuclides (including Greater-Than-Class-C Wastes) on-site. Such longer-lived nuclear waste would be stored below-grade in the reactor pressure vessel and in other areas of the containment building. In the past, the NRC has generally opposed this method for the obvious reasons that an entombment enclosure might fail and allow long-lived radioactivity to escape into the environment contaminating soil, water, air and life. With every nuclear power station in the United States located on a major river, lake, or ocean-front, radioactive contamination of water resources is a major concern. The NRC is now suggesting that with the ENTOMB process a 40% cost savings over DECON can be achieved by the nuclear utilities through avoided transportation and nuclear waste storage fees. If a utility can analytically demonstrate that its ENTOMB plan can isolate radioactive contamination and radiation exposures on-site kept below “acceptable” limits up to as high as 500 millirems/year, the utility can immediately suspend all its liability with the issuance of a license termination. After 10 years of license termination, the Nuclear Regulatory Commission would then cease to regulate the site altogether with the long term maintenance and oversight being transferred to a yet-to-be identified “third party,” ultimately the state or host community or potentially as an Environmental Protection Agency “Super Fund Site.” Currently, no licensee has opted for entombment.

Generally speaking, reactor operators are combining the SAFESTOR and DECON options. After a cessation of station operation, the licensee schedules the reactor for a short storage period for planning purposes. The licensee then strips the reactor of its large radioactive components (steam generators, reactor internals, large diameter piping, etc.) for transport to a radioactive waste dump. The remaining structures are placed into long term storage to finish decontamination and the dismantlement process at a future date at which they can apply to NRC for a license termination.

Under the SAFESTOR, PROMPT DISMANTLEMENT, or ENTOMB scenarios, all of the irradiated reactor fuel or “high-level radioactive waste” is removed from the core. The “high-level” radioactive fuel is constantly cooled and guarded for a minimum of five years underwater in on-site storage ponds. One NRC study published in 1997, “A Safety and Regulatory Assessment of Generic Boiling Water Reactors and Pressurized Water Reactors Permanently Shutdown Nuclear Power Plants,” identified that after the reactor vessel is defueled, the traditional accident sequences that dominate the operating plant risk are no longer applicable. However, new risks involve the even larger inventories of “spent fuel” placed into wet storage. Wet storage requires constant vigilance to assure that fuel cooling circulation and underwater radiation shielding are maintained. After sufficiently cooling the irradiated fuel to approximately 400 degrees Fahrenheit, the “high-level” nuclear waste is moved into concrete and steel dry storage casks and parked on-site. These Dry Storage Casks are licensed for 20 years with up to four license extensions to contain the nuclear waste hazard. Significant controversy over lack of federal regulatory oversight and numerous problems with the quality of fuel-loaded casks has already occurred after only several years of cask service. Under a streamlined NRC cask certification, licensing and oversight process, newer cask designs seek to accommodate both a dry storage function and an additional transportation function for removal from the reactor site to a yet-to-determined and potentially vulnerable “away-from-reactor” storage facility.

TAKING THE WRECKER BALL TO THE REACTOR BUILDING

In an effort to reduce decommissioning costs and potentially skim millions of dollars off of decommissioning funds, the industry is strategizing new techniques for dismantling or entombing the large concrete reactor containment buildings and managing its nuclear waste. One example is being explored by the Maine Yankee Atomic Power Company for the decommissioning of the Maine Yankee nuclear station in Wiscasset, Maine where the utility has proposed to “rubblize” the reactor building. “Rubblization” is described as the

partial decontamination and demolition of radioactively contaminated buildings at nuclear power stations. The interior concrete surfaces are only partially decontaminated and the entire structure (concrete, steel re-enforcement bar and other materials) is then razed to grade level into the foundation hole. The burial site is then covered over with a soil cap.

Essentially, the utility is proposing that a so-called “low-level” radioactive waste dump can now be grandfathered on the former reactor site under an operational reactor license without any of the state and federal regulation and permitting processes. The decommissioning utilities will provide an analysis that can “assure” that no ground water movement will occur through the radioactive burial site providing a potential transport mechanism and potential radioactive exposure to the public and environment. The utilities will provide a “dose model” to “assure” the community that the radioactive site will pose no health risks to the present and future community. This analysis will also “assure” that no future human activity will disturb the site resulting in radioactive releases and exposures. Because of the hazardous life of the radionuclides generated during the operation of the nuclear power station, such “assurances” will need to stand a measure of time on the order of tens, hundreds and even hundreds of millions of years for the various radionuclides that will contaminate the rubble. Iodine-129 has radioactive half-life of 16 million years and a hazardous life of 160 million years. Despite the “assurances,” the nuclear utilities fail to point out that both Maine Yankee and Connecticut Yankee, once their license is terminated under 10 CFR Part 50.82, will no longer be responsible or liable for the radioactive site. The liability for any associated environmental or public health problems arising from such a de facto radioactive dump becomes an open question.

In fact, the two federal agencies responsible for public and environmental protection from nuclear power, Environmental Protection Agency and the NRC, have failed to come to agreement on a residual radioactivity standard for a license termination of a nuclear power plant decommissioning site. EPA continues to hold out for a 4 to 15 millirem per year limit on groundwater contamination while NRC insists on releasing a site within a

range of 25 millirems up to 500 millirems per year from all pathways. It is of significant concern that the proposal to rubble and bury contaminated buildings onsite is proceeding toward NRC approval with such a dispute and no memorandum of understanding between the two federal agencies. The rubbleization process is in fact a serious abrogation of law and environmental policy as currently evidenced by Maine and Connecticut legislation mandating that there will be no “low-level” radioactive waste site in those states without voter and legislative approval respectively.

DISMANTLING THE DEMOCRATIC PROCESS ALONG WITH THE REACTOR

It is essential that every affected reactor community in the radioactive effluent discharge pathway have an opportunity to meaningful participation in pollution prevention during the decommissioning process. However, the public’s participation as a check and balance on nuclear power activities also carries an economic cost to the electric utilities in schedule delays, added protective oversight and potential litigation over safety and environmental issues.

In an effort to accommodate the nuclear industry and expedite the decommissioning process, the Nuclear Regulatory Commission is curtailing and streamlining its regulations and dismantling the public’s right to meaningful participation in the oversight of the decommissioning process. The NRC actions have effectively curtailed the affected communities’ legal recourse to intervene in industry decommissioning plans and practices that potentially jeopardize public and worker safety and environmental quality.

In a controversial decommissioning rule change, NRC has now codified regulations to provide for nuclear utilities to circumvent what was formally an initial opportunity for a public hearing process in the decommissioning plan and process. NRC has redefined its regulations where a utility was required to change its license from an operating reactor license to a possession-only-license for decommissioning purposes and open up to public

scrutiny under the National Environmental Policy Act. The NRC has reclassified decommissioning as not constituting a major federal activity and an activity that can be conducted under the original operational license without the availability of a public hearing on any potential safety issues raised by a particular decommissioning process. Utilities are now allowed to submit vague plans without any public scrutiny of the actual chosen process.

Prior to the NRC rule change, the private utility operating of the Yankee Rowe Atomic Power Plant in Rowe, Massachusetts closed in 1991, piloted the controversial change in the federal oversight of decommissioning activities. Yankee Atomic Electric Company argued that waiting through a decommissioning plan approval process potentially attendant with a public hearing process might cost the utility valuable space at the Barnwell, South Carolina nuclear waste dump. Yankee then announced its intention to cut up and transport radioactive reactor components prior to the submittal of a decommissioning plan. The activity effectively removed 90% of the reactor's non-fuel residual radioactivity under regulations promulgated for the maintenance of an operating reactor. A local community activist group, the Citizens Awareness Network (CAN), formally challenged the company plan requesting that the NRC halt the "early component removal" program until a decommissioning plan was submitted, moved through a public notice and comment process, open to public hearings and approved by the NRC. Faced with intensifying company arguments as to how the NRC could interpret the component removal program in context of its own rules, the Commission adopted the licensee's interpretation of regulations in a split vote and approved the prompt dismantlement of the closed reactor without the submittal or approval of a decommissioning plan.

CAN took the NRC to First Circuit Federal Court of Appeals in Springfield, Massachusetts where Chief Judge Juan Torruella found in CAN's favor that the NRC's

adoption of the YAEC interpretation was an abandonment of the federal agency's duly-promulgated law and "utterly irrational" in denying citizens requests for public hearings. Despite this ruling which remanded the Yankee Rowe decommissioning back to NRC and a subsequent similar ruling from the Appellate Court in Boston, Massachusetts, NRC formally adopted these major changes to its decommissioning regulations in 1996. Through its own rule making process, NRC effectively cut the public out of meaningful hearings to intervene on utility decommissioning plans and processes. Neither the public nor the States can challenge the utility plans until after all decommissioning activities are finished. The new rule has essentially turned decommissioning regulation over to the nuclear utilities requiring them to provide no more than an outline of what their planned activity will be.

Under current NRC rules, the public has lost its right to review and intervene in utility processes that can amount to economic short cuts and sloppy radiation controls resulting in excessive contamination to workers, the site, and uncontrolled releases into the environment. The public battle continues on a democratic participatory process to hold utilities accountable to responsible cleanup standards that a utility and the NRC must first meet before a license can be terminated.

WHAT PRICE DECOMMISSIONING?

The NRC currently requires nuclear utilities to make regular contributions into special trust funds established in external accounts amounting to between one-tenth and two-tenths of a cent per kilowatt-hour from electric ratepayers. The federal agency requires a licensee operating a pressurized water reactor (PWR) to accrue a minimum of \$289 million (1998 dollars) into such funds and \$359 million for a boiling water reactor (BWR). Financing the cost of decommissioning has long been a controversial and contentious issue. Public interest and environmental groups have protested and contended

that the regulators and utilities have done more to intentionally bury the true costs of managing nuclear power plants after closure.

In fact, estimates for nuclear power station decommissioning costs remain largely unpredictable and historically inaccurate. Current government estimates for decommissioning costs run as high as \$300 million to \$400 million for a typical 1000-megawatt pressurized water reactor with a total cost to decommission reactors in the United States at a minimum of \$30 billion. However, with the early retirement of the 179-megawatt Yankee Rowe pressurized water reactor in 1991, the projected cost of completing decommissioning increased from its original \$120 million price tag to currently \$450 million. The New York Times reported on November 4, 1994 that Yankee Atomic Electric Corporation, operators of the small reactor, "acknowledged for the first time that they expect to raise electric rates in New England to help pay the cost of closing the reactor." In another example, the historical estimates produced by the industry's most sought after expert on decommissioning, TLG Engineering, when reviewed over the past twenty five years demonstrates cost escalations of 600 percent.

Further complicating the issue, regulators and utilities have based the amortizing of the full amount for decommissioning funds over the projected 40-year license of a reactor. The actual industry experience reflects operational periods of 15 to 30 years. While two licensees have filed for a license extension of twenty years onto the original license, the Calvert Cliffs and Oconee nuclear power stations are optimistically making their application on average of 15 years in advance of cessation of their current license. Given the current industry experience of early closures, the 40-year amortization appears to be a dubious assumption for an industry facing accelerated deterioration in the material condition of the reactors, mounting maintenance costs and increased competition.

Concerns over financial shortfalls in funding of adequate and safe decommissioning operations loom larger as utilities face increased competition under restructuring of the electricity industry. In the May, 1999, the General Accounting Office report, "Nuclear Regulation: Better Oversight Needed to Ensure Accumulation of Funds To Decommission Nuclear Power Plants," GAO analyzed the status of decommissioning funding as of December 31, 1997 for 76 licensees owning all or part of 118 operating and retired power reactors. The GAO reported "We performed this analysis because NRC had not, for its own regulatory purposes, systematically collected and analyzed information on its licensees' decommissioning funds. Our analysis showed that, under likely assumptions about future rates of cost escalation, net earnings on the investments of funds, and other factors, 36 of the licensees had not accumulated funds at a rate that is sufficient for eventual decommissioning." Under more pessimistic assumptions, GAO concluded that 72 of 76 licensees studied failed to accumulate sufficient funds. Additionally the report stated that NRC was opposed to accelerating decommissioning funding to make up for potential shortfalls citing a myriad of difficulties and that such action would result in substantial costs to stockholders and ratepayers. Of further concern, current bankruptcy law does not prioritize decommissioning costs above other creditors. A review of the early plant closures (Yankee Rowe, Maine Yankee, Trojan and the two Zion nuclear power stations) indicates that electricity consumers paid for only portion the decommissioning from the utility accrued trust funds. As much as 50% of the remaining projected final costs are left to future ratepayers or taxpayers not receiving one watt from the retired nuclear power stations. In a deregulated energy market, it must be of concern whether future state legislatures, public utility commissions and federal officials will continue to bail out nuclear utility financial short falls for cleaning up radioactive sites.

Despite the uncertainties over final costs and financing short falls associated with decommissioning, there is activity among utilities to buy up aging reactors with the prospect that retiring a reactor can be made profitable. The Associated Press reported February 9, 2000, that the chief executive officer of New Orleans-based Entergy Corporation told its employees that the company is making sound purchases as it buys

older nuclear plants. "You could theoretically shut the plant down and make money on it, because there is more money in the decommissioning fund than it costs to close the plant," he said.

Its merely a matter of how clean is clean enough to walk away from the site.

It is our concern that such motivation can result in adverse costs to local and state governments and to the public health and the environment that far outweigh any industry economic benefit.

Clearly the NRC has a major role to play in the both the determining final cost of decommissioning and the environmental quality after site clean up. Unfortunately, the agency's track record is already smeared with problems at numerous sites around the country as a result of inadequate regulatory oversight and the various licensees' interpretations and implementation of procedures and regulations.

The General Accounting Office Report "Nuclear Regulation: NRC's Decommissioning Procedures and Criteria Need to Be Strengthened," dated May, 1989, identified a number of significant weaknesses in federal oversight of decontamination of NRC facilities and cleanup once a license is terminated. On the basis of a review of eight of NRC's fuel cycle licensees, GAO found that NRC fully or partially released two sites for unrestricted use with significant radiation contamination problems; in one case, contamination was up to 320 times higher than NRC guidelines.

The GAO report's principle findings included:

- 1) "Licensees do not adequately decontaminate their facilities." GAO found that information on licensee surveys showing cleanup activities were incomplete, ambiguous, or simply did not exist. Additionally, NRC did not always inspect to confirm or refute licensees' findings on buildings, land, and equipment that had been reported decontaminated.

- 2) For almost 25 years, between 1957 and 1981, the NRC (and its predecessor, Atomic Energy Commission) allowed its licensees to bury radioactive waste on site without prior NRC approval, without submission of burial records to NRC, and without a time requirement for the retention of burial records. At four sites, GAO found contamination to result from buried waste--- at one such site ground water was contaminated 400 times the EPA drinking water standard. Under revised NRC regulations, licensees can still bury waste onsite, but must provide a description of the quantity and type of materials, levels of radioactivity, proposed disposal method with an environmental assessment, a ground and surface water assessment, and procedures to minimize the risk of unplanned release.
- 3) NRC lacks regulations to require cleanup after terminating a license. After a license is terminated and subsequent events show that contamination is evidenced, NRC regulations do not address the actions that NRC can take.
- 4) Federal residual radiation criteria are lacking.

A CLOSING WORD

It is without dispute from any quarter that the permanent closure of nuclear power reactors significantly reduces the risks to public health and safety and the environment. We must continue to fight for the early closure of the nuclear industry.

Once a reactor is closed, however, it would be foolish to suggest or believe that the danger is sufficiently reduced that the vigilance for our environmental protection and public safety can be relaxed. It is as foolish and slavish to believe that we can entrust the future of our communities around these closed reactors to the “better judgement” of the Nuclear Regulatory Commission and the nuclear industry. Nothing can be farther from the actual case. The exit strategy for a failed nuclear power industry is just as divisive and deceitful as its entrance strategy. The false promises of affordable, safe and clean energy are now replaced with yet another promise for the contaminated sites to be cleaned up to “green fields.” The fight for our land, our lives and our democratic process must continue even after we have closed the reactors down.

