THE FIRST STEP IN SOLVING THE NUCLEAR WASTE PROBLEM:

PROVIDING ADEQUATE SPENT FUEL STORAGE

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ABSTRACT

What are we going to do about the radioactive spent fuel that is piling up at power plants around the country?

Most utilities have found ways to expand spent fuel pool capacity, principally by installing new racks which permit closer spacing of spent fuel assemblies. This method, when fully exploited, usually allows about a three-fold increase in storage capacity.

To go beyond that, however, will require new storage techniques or construction of new facilities. In order of estimated cost, these include rod consolidation, dry cask storage, and construction of new spent fuel pools outside the reactor.

Ideally, such casks would also meet transportation requirements. Then, once the spent fuel was sealed inside the cask, it would not need to be opened before it reached a repository for permanent storage.

It has always been assumed that the government would at some point accept the waste for permanent storage in a federal repository.

Much as I hope that current plans will work out, there have been too many failures and delays in federal nuclear waste planning for me to be confident of any schedule. The new legislation will help provide impetus by setting up a mechanism to resolve state-federal differences. But even if these plans are realized, it would take some years for a repository to absorb the spent fuel in reactor storage pools.

My conclusion is that we had better plan on providing interim spent fuel storage for several decades.

We have seen that there is essentially no practical limit to the amount of spent fuel that could be stored at most reactor sites. This doesn't mean, however, that it would be a good idea, especially after the expiration of the site's operating license.

From the point of view of health and safety, I would prefer that the spent fuel be collected from the reactor sites, probably in dry storage casks, and stored at a central facility, where it would get better supervision and where it would not interfere with reactor operation.

The nuclear waste problem has become almost synonymous with the problem of providing a repository for permanently isolating the highly-radioactive products of power reactor operation. That, indeed, is the main problem addressed by the recently enacted Nuclear Waste Policy Act of 1982, and it is the waste problem on which the Nuclear Regulatory Commission has concentrated most of its attention. You will hear a good deal more about these subjects during this meeting and I will only touch on them here.

I would like, instead, to use this occasion to take up with you a question which is preliminary to permanent waste isolation, one which is easier to deal with, but which has, at the same time, great practical importance. That question is: What are we going to do in the meantime about the spent fuel that is piling up at power plants around the country? The storage pools at the plants are filling up and there is, at this point, no other place for the spent fuel to go.

It is instructive to start with a look at the history of the subject because, among other things, it tells us something about the effect of putting all our waste eggs in one basket.

Of course, there wasn't supposed to be a spent fuel storage problem. The original idea was that spent uranium fuel would be reprocessed, a year or so after it was discharged, to extract plutonium formed during irradiation. The plutonium in turn was to fuel a new generation of reactors -- fast breeders. So strong was the belief in this breeder-dominated future that the current generation of U.S. reactors was designed with only enough spent fuel storage capacity for a few years of operation. (By contrast, Canadian reactors were provided with up to 20 years of storage capacity.)

The American utilities were happy with this arrangement because it kept them out of the waste storage business. However, a number of problems were obscured by the general optimism surrounding nuclear power.

First, there were no breeder reactors to take the plutonium. Second, there was no commercial reprocessing. Two small reprocessing plants were failures and a larger plant, at the Barnwell facility in South Carolina, was caught up in a new government safety requirement that prohibited the transportation of liquid wastes. This meant that Barnwell would have to add a waste solidification plant, thereby doubling

the overall cost. Such a plant was never built. Third, the government was getting nowhere in providing a repository to accept the highly-radioactive waste for permanent storage.

Then, in October 1976, for international security reasons, President Ford decided that commercial reprocessing should not proceed until we were confident we could prevent diversion of commercial plutonium to bomb use. To keep our domestic policy in line with our international policy, he decided against a government subsidy for Barnwell's waste solidification facility. This effectively put an end to commercial reprocessing in the United States.

By 1977 it was clear that the nuclear waste storage problem had become a spent fuel storage problem, but the utilities still thought they could count on the federal government. Indeed, in 1977, the Department of Energy announced that it planned to accept spent fuel for storage at future government central storage facilities.

But the proposed legislation was never enacted and in 1981, a new Administration withdrew the 1977 promise and left the utilities to their own devices. (The new waste legislation contemplates government storage for only a tiny fraction of the projected spent fuel.)

In these circumstances it is natural to ask: Can plants expand their individual storage capacities sufficiently rapidly over the next few years to avoid curtailing reactor operation? And, to what extent can the industry count on the government's plans for permanent storage for the more distant future?

SPENT FUEL STORAGE AT REACTOR SITES

Realizing that they would have to provide for themselves, most utilities have found ways to expand spent fuel pool capacity, principally by installing new racks which permit closer spacing of spent fuel assemblies. This method, when fully exploited, usually allows about a three-fold increase in storage capacity. Just about every U.S. nuclear plant has reracked, some of them three and four times. Out of 97 applications for reracking, 84 have been approved so far by the Nuclear Regulatory Commission. In addition, two utilities that had run out of space at one reactor received permission to ship spent fuel to another reactor in their system.

The utilities have been able to exercise sufficient ingenuity and the NRC has been able to review and approve applications for expansions sufficiently quickly, that no power plant has had to curtail operation because of inadequate spent fuel storage capacity.

At times this has meant dipping into the plant's full core reserve -- the storage capacity maintained to permit emptying the entire reactor core if necessary for inspection or repairs. Maintaining such a reserve is obviously good practice, but it is not an NRC safety requirement.

In any case, through application of these measures, almost all plants will get by until at least 1990.

NEW TECHNIQUES: ROD CONSOLIDATION AND DRY CASKS

To go beyond that, however, will require new storage techniques or construction of new facilities. In order of estimated cost, these include rod consolidation, dry cask storage, and construction of new spent fuel pools outside the reactor.

Rod consolidation involves dismantling or cutting apart the fuel assembly -- which in a pressurized water reactor contains two to three hundred fuel rods -- and putting the fuel rods closer together in about half the original space. The cost is relatively modest. However, this process involves a good deal of mechanical work on the fuel underwater in the spent fuel pool, and reliability and safety need to be proved. Maine Yankee has submitted an application to NRC for permission to consolidate spent fuel, and several other utilities are considering it.

More expensive, but still cheaper than building a new pool, is putting spent fuel, which has cooled for 5 years or more, in large dry casks. A typical cask might hold 10 tons of spent fuel, weigh close to 100 tons, and cost about one million dollars. Cask capacity could be roughly doubled if the fuel were first consolidated. Ideally, such casks would also meet transportation requirements. Then, once the spent fuel was sealed inside the cask, it would not need to be opened before it reached a repository for permanent storage. In the meantime, the cask could remain at the reactor site or at some interim location. We have received an application from the Virginia Electric Power Company for such a storage scheme at Surry.

I am especially optimistic about this approach to our storage problems at reactors. If approved and adopted, it would essentially solve the problem of how to store spent fuel safely at reactor sites so as to avoid interrupting reactor operations. So far as I can tell, there would then be no practical limit to the amount of spent fuel that could be stored at most reactor sites.

LONG TERM WASTE DISPOSAL

It is intended, of course, that the government will at some point accept the waste for permanent storage in a federal repository. The process by which this is to happen is covered in the new waste legislation which lays out a Congressionally-mandated timetable.

The trouble with relying entirely on this schedule is that the government's record in this field is not a good one. You are no doubt familiar with the plan in the 1960's for a repository in underground salt formations which was switched in the early 1970's to a plan for a surface repository, which in turn was abandoned in the next administration in favor of a return to the underground approach. Since then, the details have varied from administration to administration with the result that we are still not in sight of a repository.

Some progress has been made. The first, procedural, part of the NRC's regulations on repository licensing was published in final form in February, 1981. The other part, the set of technical performance standards to be met by the repository, was published for comment in July, 1981, and is now being put in final form by the Commission. The

repository design has to be approved by the NRC from the point of view of public health and safety, and protection of the environment. NRC requirements must be consistent with overall standards set by the Environmental Protection Agency.

The Department of Energy is of course charged by law with developing the needed technology and building a repository. Our rule calls for a detailed study of each site, including use of underground exploration. A minimum of three sites, including at least two kinds of underground media, must be studied. DOE intends to do this in basalt at Hanford, Washington; in tuff at the weapon test site in Nevada; and in salt at a location yet to be picked. DOE expects to sink shafts at these sites in 1983 or 1984, and to select a repository location by 1987 or 1988. The schedule calls for a construction authorization by about 1990 and a repository ready for business in the late 1990's.

The new legislation essentially confirms the current DOE schedule for the first repository and sets up a mechanism for resolving state-federal differences over the placement of a repository. Needless to say, no state is particularly enthusiastic over the prospect of hosting such a repository. The states, having had some unpleasant experiences, simply don't trust the federal government on this issue.

Even if these plans are realized, it would take some years for a repository to absorb the spent fuel in temporary reactor storage. So, for at least the next twenty years, the nuclear waste problem is the problem of where to store the spent fuel. The cumulative amount, to the year 2000, is estimated by DOE to be about 70,000 tons, or nearly ten times the amount already discharged. A typical reactor, by the way, discharges about 30 tons of fuel a year, so the hundred or more reactors expected to operate twenty years from now would add over 3000 tons per year to the DOE total.

In planning for the interim, how much confidence can we have in the government's plans for permanent storage of nuclear waste? Or, how long do we expect the spent fuel to remain in temporary storage?

I've had to give these questions a good deal of thought recently because the NRC Commissioners were asked by the Court of Appeals, in effect, whether we are confident that spent fuel will be removed from reactor sites by the expiration of their operating licenses?

The Commission is in the process of providing the Court with an answer. Let me tell you what I think.

Much as I hope the current plans will work out, there have been too many failures and delays in federal nuclear waste planning for me to be confident of any schedule. The recent legislation helps provide impetus and might help resolve state-federal disputes in a reasonable time. But we still have a long way to go. Public attitudes on this subject are volatile, and many political accommodations remain to be reached. For example, if a State vetoes the President's repository site selection, both houses of Congress would have to override it to continue with that site. My conclusion is that we had better plan on providing interim spent fuel storage for several decades.

WHAT ABOUT THE INTERIM?

We have seen that there is essentially no practical limit to the amount of spent fuel that could be stored at most reactor sites. This doesn't mean, however, that it would be a good idea to leave it there, especially after the expiration of the site's operating license. The utilities are in the power business, not in the waste storage business, and we cannot depend on all of them to ensure adequate protection of the spent fuel when their sites are no longer producing power. Moreover, leaving spent fuel in a reactor storage pool after final shutdown complicates cleanup and decontamination.

I would say that it is better not to retain the spent fuel even at an operating reactor if there is a reasonable alternative. There are already enough things to distract station managers from their principal responsibility -- the safe and reliable operation of the reactor.

From the point of view of health and safety, I would prefer that the spent fuel be collected from the reactor sites, probably in dry storage casks, and stored at a central facility, where it would get better supervision and where it would not interfere with reactor operation.

The new legislation does contain some provisions for spent fuel storage away from reactors -- but only for about 3 percent of the expected inventory in the year 2000. This is a kind of "last resort" storage; I would make provision for central storage of the bulk of the spent fuel.

The argument is made that if such an interim storage facility is seen to be able to handle spent fuel storage for some time, all the steam will go out of the effort to build a federal repository for permanent storage. But such an observation could be made as well about extended storage at reactor sites. Another factor working against a central spent fuel storage facility is the strong opposition to moving spent fuel around and a consequent inclination to put this off as long as possible. Finally, no one seems to want to host a site for such a central storage location, any more than they want to host a site for a permanent repository. What worries people most, I think, is that waste dumps of all sorts are often neglected, and they fear this is also likely to be the case for nuclear waste, particularly in view of the frequent changes in policy in this field.

Which brings me to the latest policy switch that affects the provision of adequate spent fuel storage -- the government's renewed commitment to reprocessing and its encouragement of the commercial use of plutonium fuel in place of uranium. This amounts to a reversion to the policy of the 1960's.

REPROCESSING

Whatever may have been the case before, reprocessing no longer makes any commercial sense. Given the high cost of reprocessing, plutonium can only compete with uranium when uranium becomes very expensive. But there is much more uranium than anyone thought years ago, and the number of reactors expected to use it is much diminished. As a consequence, the price of uranium has in fact been falling. So much so, that Congress has talked about limiting imports. No commercial reprocessing plant will operate without massive federal subsidies.

The Administration's embrace of reprocessing complicates the perfectly straightforward problems of providing for spent fuel storage. For example, the Administration withdrew support for an interim storage facility because it "would detract from efforts to stimulate commercial reprocessing." DOE insists that reprocessing is the solution to the spent fuel storage problem. They are talking about commercial reprocessing being available as early as 1992, even though they must know this can't happen because the subsidies required are not going to be forthcoming. All this is bound to introduce confusion in spent fuel storage planning by utilities.

Entangling spent fuel storage with reprocessing is how we got into trouble in the first place. We allowed the apparent inevitability of fast breeders to dictate the size of spent fuel pools in light water reactors. This time around, let's not permit spent fuel storage to be hostage to grandiose nuclear schemes. Whatever else we do, let's make sure we have adequate spent fuel storage.