License Restrictions at Barnwell

Virgil R. Autry
S.C. Department of Health and Environmental Control
Bureau of Radiological Health

ABSTRACT.

The State of South Carolina was delegated the authority by the U.S. Nuclear Regulatory Commission to regulate the receipt, possession, use and disposal of radioactive material as an Agreement State. since 1970, the state has been the principal regulatory authority for the Barnwell Low-Level Waste Disposal Facility operated by Chem-Nuclear Systems, Inc. (CNSI).

The radioactive material license issued authorizing the receipt and disposal of low-level waste contains numerous restrictions to ensure environmental protection and compliance with shallow land disposal performance criteria. Low-Level waste has evolved from minimally contaminated items to complex waste streams containing high concentrations of radionuclides and processing chemicals which necessitated these restrictions. Additionally some waste with their specific radionuclides and concentration levels, many classified as low-level radioactive waste, are not appropriate for shallow land disposal unless additional precautions are taken. This paper will represent a number of these restrictions, the rationale for them, and how they are being dealt with at the Barnwell disposal -facility.

Barnwell, Licensing Background

In August 1969, CNSI, formerly Chem-Nuclear Services, submitted a license application to the South Carolina Board of Health for the disposal of commercial low level radioactive waste on property they had acquired near Barnwell, South Carolinians. This property is adjacent to the Savannah River Site and the Allied General Nuclear Fuel services (AGNS) processing facility which was under construction at that time. AGNS has since been decommissioned before it began operations.

The application for low level waste disposal was prompted in part by the Atomic Energy Commission's (AEC) moratorium placed on sea disposal of waste in the early sixties, and its closing of burial grounds at Oak Ridge, Tennessee and the National Reactor Test site in Idaho to commercial waste later in that decade. Although there were other commercial sites operating throughout the country, the State of South Carolina initially supported a commercial facility in the state since it was becoming heavily involved in the commercial Atomic Nuclear industry. It was perceived from an economic standpoint that this site would serve the state and surrounding states in the Southeast who were also developing commercial nuclear power. Little did we know at that time Barnwell would become the nation's number one commercial disposal facility. This prompted numerous political actions such as the Low Level Waste Policy Amendments Act of 1985 requiring all states to assume the responsibility for low level waste management and disposal.

An initial license was issued to CNSI on November 6, 1969. However, this license restricted them to receipt and possession of prepackaged waste for transfer to other authorized disposal facilities throughout the country. Twenty months later, following a lengthy review process by numerous state agencies and commissions, the AEC, and the U.S. Geological Survey, exchanging numerous documents and information in support of land disposal, and holding one public hearing on March 4, 1971, an amended license was issued to CNSI On April 13, 1971, authorizing disposal of waste at the Barnwell site. Also in April of that year, the land acquired by CNSI was deeded to the State of South Carolina and subsequently leased back to them. The original perpetual maintenance fee was a 8cents per cubic foot, later raised to 16 cents, and is currently $2.80 per cubic foot. There is over 40 Million Dollars in this interest bearing account to provide long term care and maintenance for the

site.

Evolution of Waste

The original license issued to CNSI authorized the above ground receipt and possession of 5000 curies of By-Product Material, 5000 pounds of Source Material, and Special Nuclear Material (U-235, U-233 and Pu) in quantities not to exceed unity. Due to the increased concentrations of waste and irradiated metal components, the license now allows the above ground possession of 50,000 curies, 60,000 pounds of Source Material and 3,500 grams of Special Nuclear Material. Transuranic waste with half-lives greater than 5 years is limited to less than 10 nanocuries per gram for Class A waste; and less than 100 nanocuries per gram for Class C waste, and only if the transuranics are incidental to the total radionuclide inventory. Radium waste is excluded unless in discrete concentrations.. The exclusion of transuranic and radium waste has caused disposal problems for generators with these waste steams.

In addition, restrictions have been imposed on waste with concentrations above Class C limits. Above Class C waste such as sealed sources are only allowed to be received following a caseby-case review and approval process. Irradiated metal components above class C are prohibited since the Department of Energy is responsible for their disposition; these waste forms are not appropriate for shallow land disposal. In earlier years of operations the facility received waste with low to moderate concentrations. In fact, in the original submittal for a license, waste containers were not to exceed 100 millirems per hour on contact. Today, stainless steel liners containing irradiated components have demonstrated 50,000 rems per hour on contact. Radiation levels are restricted to the shielding capacity of the transportation casks and operational limits imposed by the facility operator.

Low level waste received at the Barnwell site has evolved over the years from minimally contaminated dry active waste, evaporator concentrates ion exchange resins and filter media. As the operational life-time of the commercial reactors grew, the waste stream loadings began to increase in radionuclide concentrations. Replacement of metal reactor components, power level monitors, poison curtains, and other metal fixtures, also contributed to a new waste stream of high activity radionuclides such as Cobalt-60 with extremely high radiation levels. Due to these increased concentrations, and high activity components, new restrictions were required to provide enhanced protection of the burial environment from migration of radionuclides, transportation and protection of site workers. Some of these restrictions were administrative in nature for better management controls, but others required innovative measures on the part of waste generators and their contractors to meet these new regulatory requirements. For the most part, generators had the ability to comply, With the requirements. Some took longer than others to affect changes in their waste programs. Eventually all generators complied, although some of them did to “kicking and screaming" during the process of change. However the S.C. Department of Health and Environmental Control (DHEC) Bureau of Radiological Health worked very closely with the burial facility operator, the waste generators, and the NRC to formulate these requirements. 10 CFR Part 61 reflects many of these restrictions which were vanguarded by the State of South Carolina.

Chronological History of Major Restrictions

1. October 1974 - During the period May 1972 to October 1974, CNSI was authorized to receive bulk shipments of liquids for on-site solidification prior to disposal. This allowance was made due to the under design of evaporators at most of the regional reactor sites. During that era, many waste generators did not have the capability to solidify large volumes of water which were slightly contaminated. Therefore, they were allowed to ship these liquids in large tankers for processing at the burial site. This concept became quite controversial from a transportation standpoint and would have severe repercussions if an accident

occurred and large quantities of liquids were released. This practice was reviewed and determined not to be in the best interest of the state from a public health standpoint, thus the requirement to solidify liquids at the point of origin was initiated.

The reactor sites vehemently objected to this decision. However, mobile solidification units were designed and put into operation at the reactors, and permanent solidification units eventually built. The generators were able to comply with this restriction although it was expensive through the use of contractors. Urea formaldehyde was selected as the media of choice and was eventually disallowed as a solidification media due to its extensive hazardous and corrosive properties.

2. April 1979 - Following the accident at Three Mile Island (TMI) a public statement was made that in effect said "any waste resulting from the accident would probably be disposed at Barnwell." This evoked a public and political outcry. Little was known at that time about the amounts of waste, what the waste would contain, and the concentrations. Therefore, an immediate ban was imposed to prevent any waste from this facility from being disposed at Barnwell. This decision was later supported by the analysis of certain waste that contained large concentrations of fission products and transuranics. This action also caused a rethinking of low-level waste, and that stricter requirements would be necessary. Since then however, TMI waste has been accepted at Barnwell an a selective and qualified basis. The ability for TMI to comply with their restriction is still being evaluated.

3. May 1979 - The ban on organic liquids such as scintillation fluids containing hazardous chemicals was imposed to avoid environmental consequences from their chemical properties and mobility. It was also to reinforce the long-standing restriction that the radioactive hazard had to outweigh the chemical hazard to be acceptable for disposal. Clearly, scintillation fluids with slight quantities of tritium and Carbon-14 were overwhelmingly, chemically hazardous. This proved to he a major decision because later, mixed wastes under the provisions of the Resource Conservation and Recovery Act (RCRA) were prohibited from disposal at all sites. This decision was not taken well by a number of generators performing research using these compounds. However, new regulations were promulgated which allowed disposal of these fluids by other Methods. It also brought about the Use of nonhazardous fluids and recycling of the hazardous "cocktail" mixtures.

4. October 1979 - Through DHEC's inspection efforts, it was determined that many waste forms arriving at the burial facility contained large quantities of freestanding liquids, and occasionally these liquids were found to be corrosive to the carbon steel burial containers. Not only did this cause concern for the potential of radionuclide migration, it presented a problem during transportation due to leaking containers. Therefore, a freestanding liquid restriction of no more than 0.5% non-corrosive liquids by waste volume was imposed. Further, due to the increased concentrations of radionuclide in ion exchange resins and other filter media, all waste containing radionuclides with half-lives greater than five (5) years having a specific activity of one (1) microcurie per cubic centimeter or greater required stabilization by an approved solidification media. Previous to this, ion exchange resins were allowed to be "dewatered"; however, this earlier process left large amounts of residual liquids in the containers.

   These new restrictions caused considerable controversy throughout the nuclear industry and DHEC was besieged with concerns of the ability of generators to meet these new sanctions. Even the NRC expressed their concerns. DHEC considered these objections and formulated a phase-in schedule to allow the generators time to comply and acquire the equipment and/or services. For those utilities who failed to make progress, they were prohibited from shipping their waste. The results of these restrictions were quite profound, and went a long way to provide credibility for shallow land disposal. By January 1, 1981, these restrictions were fully implemented.

5. November 1979 -It was becoming increasingly evident that the Barnwell site had become the major commercial low level waste site in the nation accepting over 75% of waste transferred for disposal (not generated). This was viewed by the political leaders of the state as an unacceptable situation. Therefore, Governor Richard Riley requested DHEC to impose a volume limitation an Barnwell. This decision was twofold: not only was there concern about the public's health from the impact of increased transportation, but the capacity for South Carolina generated waste was being jeopardized. Earlier, in January 1978, a volume restriction had been imposed not to exceed 2.4 Million cubic feet per year. The November 1979 restriction established a declining schedule that limited the site to no more than 189,000 cubic feet per month and by October 1981, the site could only receive 100,000 cubic feet per month. This is now the permanent restriction of 1.2 million cubic feet per year.

   This plan also required a prior notification condition and an allocation scheme to insure that South Carolina's interests were preserved and its waste given priority. CNSI was responsible to administer the allocation program based on the historical waste disposals made by all the generators.

   The volume limit restrictions had a considerable impact and the nuclear industry, and almost created a panic situation; more so than the present eventuality that the Barnwell site will close at the end of 1992. However, waste generators again took innovative measures to solve this problem confronting them. Better waste management practices were devised such as segregation and compaction. Advancements were made in waste processing such as extrusion, evaporation, and solidification. Ion exchange resins were regenerated and loadings became heavier. However, there were some negative consequences to this. Waste became higher in radionuclides and more hazardous from a handling, transportation, and disposal standpoint. This required further restrictions concerning containment of waste, and improving handling techniques during disposal operations.

6. October 22, 1980 - Due to increased concentrations of radionuclides in waste forms such as ion exchange resins and other filter media, certain utilities were having problems meeting the stabilization requirements previously established. In order to allow an alternative to solidification, DHEC conceived the idea to allow disposal in containers that could act as a secondary barrier within the disposal trench, and contain waste in a manner superior to solidification. There has always been controversy concerning solidification, and the various media and their processing problems. Therefore, DHEC issued its criteria for the High Integrity Container (HIC). This caused serious repercussions from vendors supplying solidification services for the utilities because they viewed this as an. encroachment on their business interest. on June 1, 1981, the first HIC was approved and a 90 day allowance was granted to phaseout carbon steel dewatering liners for Class A Stable and Class B and C wastes.

   The use of HIC's proved to be a successful alternative to solidification and went far to improve ALARA at the reactors and the disposal site. However, a controversy arose in the late 80's from the use of polyethylene as a HIC material. It wasmthe position of the NRC that this material did not meet the stability criteria and that the containers would deform under the trench backfill and crack, causing the release of radionuclides. Although DHEC did not totally agree with this postulation, concrete overpacks are now used for the emplacement of polyethylene HIC's in the burial trenches to provide stability... This of course increased burial expenses significantly, but it did provide a reasonable solution to the perceived problem.

7. December 27, 1983 - 10 CRF Part 61 conditions were implemented at the Barnwell Site. This had a significant impact on waste generators concerning the proper classification of their waste streams. Prior to the implementation however, DHEC required all waste streams to be properly quantified and qualified, and accurately account for the radionuclide concentrations. Therefore, the generators had established databases

and formalized their process control programs to assure proper classification. Many generators were assisted by vendors who developed elaborate computer codes. The impact of 10CRF Part 61 on burial facility operations was somewhat minimal due to the fact that many of the restrictions had been put in to affect in phases by the state previously, and it was not a tremendous problem for the generators to comply with the new restrictions.

Legislative Restrictions

On July 1, 1980, the State Of South Carolina's Low Level Waste Transportation and Disposal Act was enacted. This state legislation was very unique and somewhat controversial to waste generators. For the first tine in regulatory history, persons transporting waste were required to secure a transport permit, provide financial liability, and give three-day advance notice of their shipments. This legislation also subjected them to enforcement sanctions by the state in the form of civil penalties and permit suspensions for noncompliance with federal and state regulations. In an effort to minimize the impact on waste generators, the state devised a permitting and notification system that was reasonable and somewhat simplified. This program has been extremely effective in the management of low-level waste and regulatory compliance.

Examples of LLW Restrictions at Barnwell

1. Liquid radioactive waste in any form. ALL liquids must be solidified in approved media. Allowances made for incidental free-standing liquids in solidified waste forms and dewatered resins. There are no liquid allowances for other waste forms. Absorbents may not be used as a substitute for solidification. Absorbents only allowed for incidental liquids such as condensation.

2. Scintillation fluids, e.g. toluene, xylenes, dioxane or other similar organic liquids or solids to include empty vials, bottles, glassware, etc. which have contained these fluids.

3. Unsolidified sludge, aqueous filters, filter sludges, evaporator bottoms, and ion exchange resins. Allowances made for dewatered resins less than 1 uCi/cc.

4. Radium, except for small quantities in biological waste, dials of instruments, compasses, watches, etc. NO technologically enhanced radium sources, contaminated sail, rubble, unless specifically approved by the Department an a case-by-case basis.

5. Transuranic waste (PU-239, AM-241, etc.) Limited to mixed radionuclides; 10nCi/gr - Class A, 100 nCi/gr. Class C. Waste primarily contaminated with transuranic at or below limits is prohibited.

6. Waste containing chelating agents with concentrations greater than 8% weight by volume.

7. Radioactive Waste containing toxic or hazardous chemicals where an evaluation has determined that the hazard posed by the chemical or chemicals exceeds that of the radioactive constituents.

8. Radioactive waste capable of producing toxic gases, vapors, or fumes.

9. Pyrophoric radioactive waste and reactive materials.

10. Contaminated oil or petroleum based material in any form. Allowances made for incidental absorbed oil less than it by waste volume.

11. Untreated or improperly packaged waste containing biological, pathogenic, or infectious material.

12. Any dispersable radioactive waste such as incinerator ash, residuals or powders unless solidified or specifically approved packaging.
13. Uncontained or bulk radioactive waste. ALL waste must be,-packaged in acceptable closed containers.

14. Waste which exceeds Class C limits. Sealed sources with concentrations that exceed Class C limits are reviewed on a case-by-case basis.

15. Gaseous radioactive material other than Krypton 85 and Xenon 133.

16. Unencapsulated sealed sources or special form radioactive materials greater than 5 curies.

Additional Requirements

1. Solidification media must have an approved topical report by the NRC and final approval by state. All solidified waste must meet NRCIs Branch Technical Position an waste Forms and stability requirements of the license.

2. High integrity containers (HICs) used as an alternative to solidification or encapsulation must be approved by state. As of March 1, 1986, all HICs received must have passive vent system, approved by the Department.

3. Waste with concentrations at or greater than 1 uCi/cc total with half-lives greater than 5 years must meet stability requirements of Class B-C waste.

Conclusion

Low level waste has experienced a considerable evolution over the past twenty years requiring numerous restrictions for shallow land disposal. The ability of waste generators to comply with these restrictions has been quite extensive and costly, but there was a workable solution to each problem that arose. This is due in part to the cooperation throughout the nuclear industry and a reasonable approach taken by the regulatory agencies.

Today we are faced with even more challenges under the Low Level Waste Policy Amendments Act of 1985. It is yet too early to predict the outcome of this major restriction.