DEVELOPMENT OF NEW LOW LEVEL RADIOACTIVE WASTE DISPOSAL SITES: A PROGRESS REPORT

Robert T. Anderson, George J. Antonucci, and Michael T. Ryan
Chem-Nuclear Systems, Inc.

ABSTRACT

The status of the development of three new low level radioactive waste disposal facilities for the Central Midwest (Illinois), Southeastern (North Carolina) and Appalachian (Pennsylvania) compacts is presented. These three sites will dispose of about 50-65 percent of the commercial low-level waste (LLW) generated in the U.S. annually.

Chem-Nuclear, as developer and proposed operator of all three sites has used a common approach to site development. This approach has been based on their twenty-plus years of operating experience and a standard technical approach. The technology employed is an above-grade, multiple engineered barrier design. The paper also contrasts actual progress at each site with a generalized project schedule. Areas of schedule delays are noted along with the steps being taken to accelerate schedule. Finally, we note that continued progress and timely start-up of operations of these new sites is critical on a national basis. This is due to the possibility of near-term closure of the existing LLW disposal sites.

INTRODUCTION

Chem-Nuclear Systems, Inc. (CNSI) of Columbia, S.C. is developing three new low level radioactive waste (LLW) facilities. These will be located in Illinois for the Central Mid-West compact; in North Carolina for the Southeast compact; and in Pennsylvania for the Appalachian compact. These new facilities, which are scheduled for start-up in 1993-96 will replace the existing commercial LLW disposal sites. Most of these facilities are scheduled for near-term closure. Hence, it is critical that the new sites be completed and made available on a timely basis. This paper presents an update on the technical and programmatic status of each new site development project. The intent is to show at each of the sites that substantial progress has been made.

The project status will be contrasted to an idealized schedule to highlight actual versus proposed accomplishment. Proposed areas for schedule improvement are also discussed.

Table I presents an overview of the projects, including data on the site location, rated disposal capacity (annual and total), disposal facility lifetime and estimated earliest start-up date. All of the projects will employ a comparable engineered barrier technology positioned at or above the natural grade of the site. This technology will augment the natural features of the selected disposal site. Note that engineered barrier technology is required, by state law, in each compact. However, the safety of the site selected must also be proven by detailed characterization studies. The characterization studies are detailed scientific investigations of the candidate sites. They examine such facts as hydrology, geology, seismology, ecology, etc. Finally, the characterization must show, intrinsic hydrogeologic safety relative to possible release of radioactive waste materials of the selected site.

PROJECT GOAL - COMMONALITY OF APPROACH

CNSI as operator of the existing Barnwell disposal facility has over 22 years of LLW disposal, processing, and transport experience. Based on this experience, the Corporate goal has been to develop each of these sites employing a common approach toward site design and operation. Following this, individual project goals, in common with all site projects, were established to ensure technical safety, and overall efficiency in development and operation. Attainment of these common project goals has presented a significant challenge since the state laws and interpretations are different for each compact. However, the CNSI approach of commonality in our technical and operating approach has many positive features. Its primary advantage is that it permits lessons learned in construction and operation to be applied in a uniform and timely manner. Real world lessons learned at one site can be readily transferred to all sites.

A summary of the approach taken towards meeting these common project goals is presented in the following paragraphs:

Common Technology

The CNSI technology employs three engineered barriers which are positioned at-or above the natural grade of the site:

- **Overpack** - All incoming waste containers are placed within a heavy wall (7-10 inch thick) concrete overpack, each with a total capacity of about 150-400 cubic feet of waste.
- **Module** - The concrete overpacks are placed and stacked within reinforced concrete modules (also called disposal units). Typically these modules have internal volumes of about 100,000 cubic feet and hold about 150-200 overpacks. This results in a disposal capacity of about 45-55,000 cubic feet of waste for each module.
- **Earthcap** - The disposal modules after being fully loaded are completely sealed with concrete and then covered with a multilayered engineered earthcap. The earthcap is about 7 to 10 feet deep.

Additional technical detail on the CNSI technology is presented.(1) Figure 1 presents a simplified view of the engineered barrier technology as designed for the Illinois facility. The NC and PA designs are comparable, but are more closely patterned to selected design features of the French national LLW disposal site at L'Aube. The L'Aube facility, which opened in late 1991, is widely believed to use the most up-to-date LLW disposal technology in the world.

TABLE I

Overview Of Cnsi LLW Disposal Facility Projects

Compact	Sited State	Proposed Location	Operating Period, Years	Rated Capacity		Earliest Start-up Date
				Annual	Total	
Central Midwest	Illinois	Martinsville, Ill	50	Up to 200,000 CF	8.5-9.5 Million CF	1993
Southeast	North Carolina	Wake-Chatham County Richmond County	20	Up to 535,000 CF	Up to 32 Million CF	1995
Appalachian	Pennsylvania	(Not yet selected)	30	Up to 235,000 CF	7-7.5 Million CF	1996

Common Safety Provision And Licensing Methodology

Preparatory to construction of the facility, CNSI must submit and defend the facility licensing document to the cognizant state or federal agency. The license document defines the means of ensuring public safety. Again CNSI's approach in licensing has been to ensure that lessons learned in one project are uniformly applied to all projects. Numerous meetings have been held between the individual project licensing directors and technical personnel to ensure uniformity of approach and consistency in obtaining technical data.

The licensing document contains the results of the hydrogeological and other scientific studies performed in the characterization phase; the specific details of the engineered barrier disposal technology employed; and details on the performance assessment. The performance assessment is an analytical evaluation which evaluates the effect of a "worst case" radioactive material release to the environment. It is based on a source strength which assumes the projected maximum levels of radioactive material to be received for disposal and the actual physical characteristics of the selected site. It must verify that the radiological effect on public safety never exceeds regulatory limits (as noted below). In essence, the license document must show that each of the four key performance criteria required by both federal and state laws are met. In summary these are:

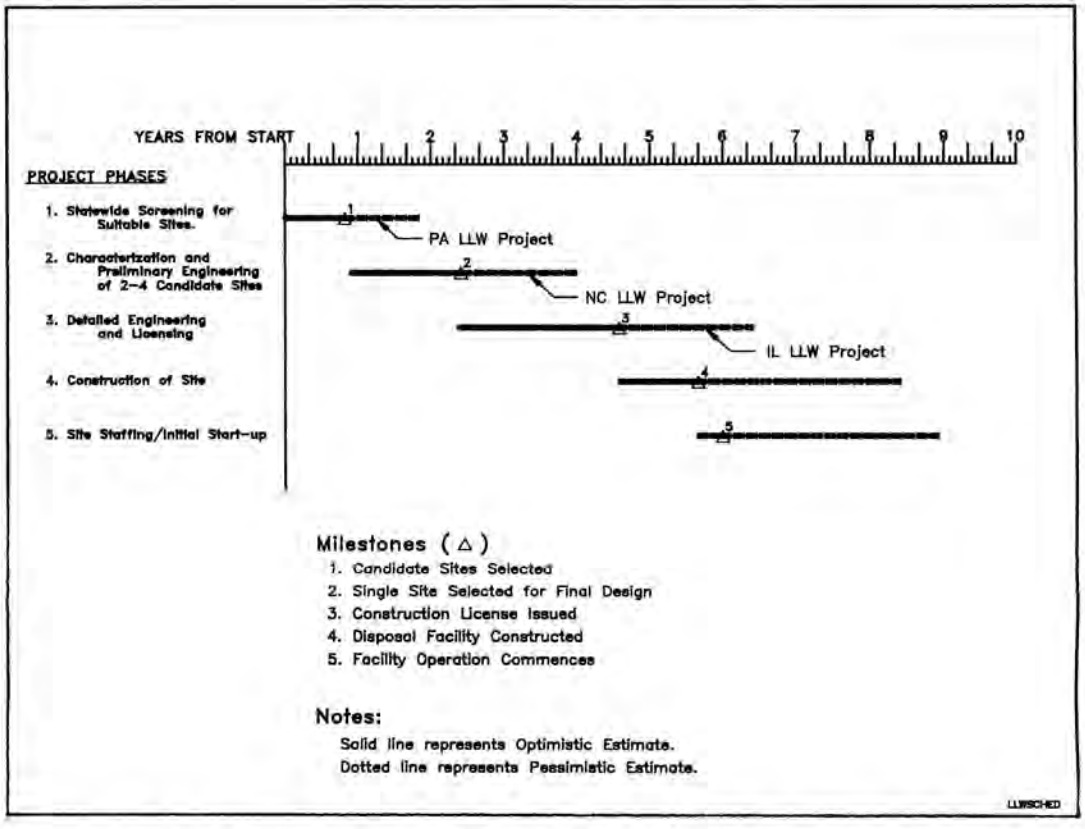

Fig. 1. Estimated duration of new LLW disposal facility development.

- **Public Safety** - Radiation exposure to the general public must never exceed annual doses of 25 mR to the whole body, 75 mR to the thyroid, and 25 mR to any other organ.
- **Operational Safety** - Operational radiation exposure must be limited to As-Low As Reasonably Achievable. CNSI has targeted an average annual rate for site radiation workers of 250 mR.
- **Site Stability** - The physical features of the disposal technology should have structural stability to ensure the proper functioning of the disposal facility following closure without active maintenance.
- **Inadvertent Intruder Protection** - Provision must be taken to prevent unknowing intruders from accessing the disposed waste following site closure.

In verifying that the site meets regulatory requirements for safety, the licensing document becomes very detailed. It includes considerable information on environmental monitoring, description of the contractor's Quality Assurance Program, and discussion of the construction and operational techniques and the final closure methodology to be employed.

Common Operational Basis

The procedures for processing, packaging and transport of waste is expected to evolve in manner similar to trends evidenced over the last 25 years. The new LLW sites will have the capability of receiving waste in most of the approved waste containers and transport casks currently operational. This should ensure that there is no disruption in waste generator operations. There are however, new and innovational operational features, that will be employed at these new facilities, specifically:

- **Central Waste Packaging** - The transfer of the incoming waste containers to concrete overpacks will all be accomplished in a single building, designated as the Waste Packaging Building. All radioactive waste handling operations will be performed in a closed, controlled environment.
- **Computerized Waste Tracking System** - All of the waste will be placed in pre-designated locations within the disposal modules. The location and disposition of the waste will be tracked and recorded at all times on an "on-line" computerized data base system. This system will be augmented by bar-coding of individual waste containers.
- **Continuing Construction** - The construction of a portion of the disposal waste facility including, loading-and-closure of the module, and placement of the engineered earthcap will be performed annually. Significant staff labor will be allocated to these construction tasks and they will continue during the entire disposal period.

Common Closure Methodology

The closure of the waste modules occurs continuously through the operating period. Hence, most of the facility closure is complete at the cessation of waste receipt.

A key aspect of closure is the control of water infiltrated through the earthcap by specially designed drain systems. The operational basis of the drain systems serves to keep surrounding water away from the nuclear waste *containers* during both the operational period and for hundreds of years thereafter:

- **Active Drain System** - Each of the modules is monitored during the operational period by a drain collection and monitoring system. The system can be locally accessed and examined. This system provides positive control of all liquids that could conceivably come into direct contact with the concrete waste overpacks. Any water that infiltrates through the earthcap and leaks through the concrete modules would be drained to a common sump. The sump water is sampled to ensure that no radioactivity is present prior to its discharge to local surface waters.
- **Passive Drain Systems** - At some point in the closure period, which may exceed one hundred years following site closure, the active system will be switched to a passive drain. The passive system, like the active, totally relies on gravity flow and the use of natural construction materials. However, the passive system, which is typically a drain field, requires no human intervention. It is designed to be integrated with the unique hydrologic characteristics of the selected site.

At final closure, all site buildings will be removed and the site returned to essentially its original condition. The only visual feature will be above grade earth mounds forming the engineered cap. The earthcap requires no maintenance. It is designed to ensure that no significant cap deterioration resulting from worst case storm water erosion, earthquakes, tornadoes, etc. occurs.

PROJECT ACCOMPLISHMENTS AND STATUS

The basic project milestones are common to all of the new LLW disposal projects. A generalized project schedule has been developed and is shown as Fig. 2. The current time-line position on the project schedule is shown for each project. As noted, the total project duration extending from the site screening phases to initial date of operation may require 5 to 9 years. However, two to five years of this time span is typically non-controllable delay. Schedule delay has previously been occasioned by local and state lawsuits, state mandated changes in project direction, special judicial hearings, and resolution of special site safety/licensing problem areas. We believe that the actual project tasks are well defined and normal project cost and schedule controls can be implemented if all events were under the total control of the project contractor. However, at the initiation or conclusion of events such as site screening, characterization, and licensing, etc., there are many opportunities for protracting the project. Areas of project acceleration are available, however They involve the use of parallel performance of certain engineering and licensing work tasks, development of standardized operational procedures, etc. Also maximum schedule benefit is obtained from the commonality of design features from site-to-site.

The current progress and status of each of the projects is noted below:

Illinois - Central Midwest Compact

The following project milestones were achieved in the last 9-12 months:

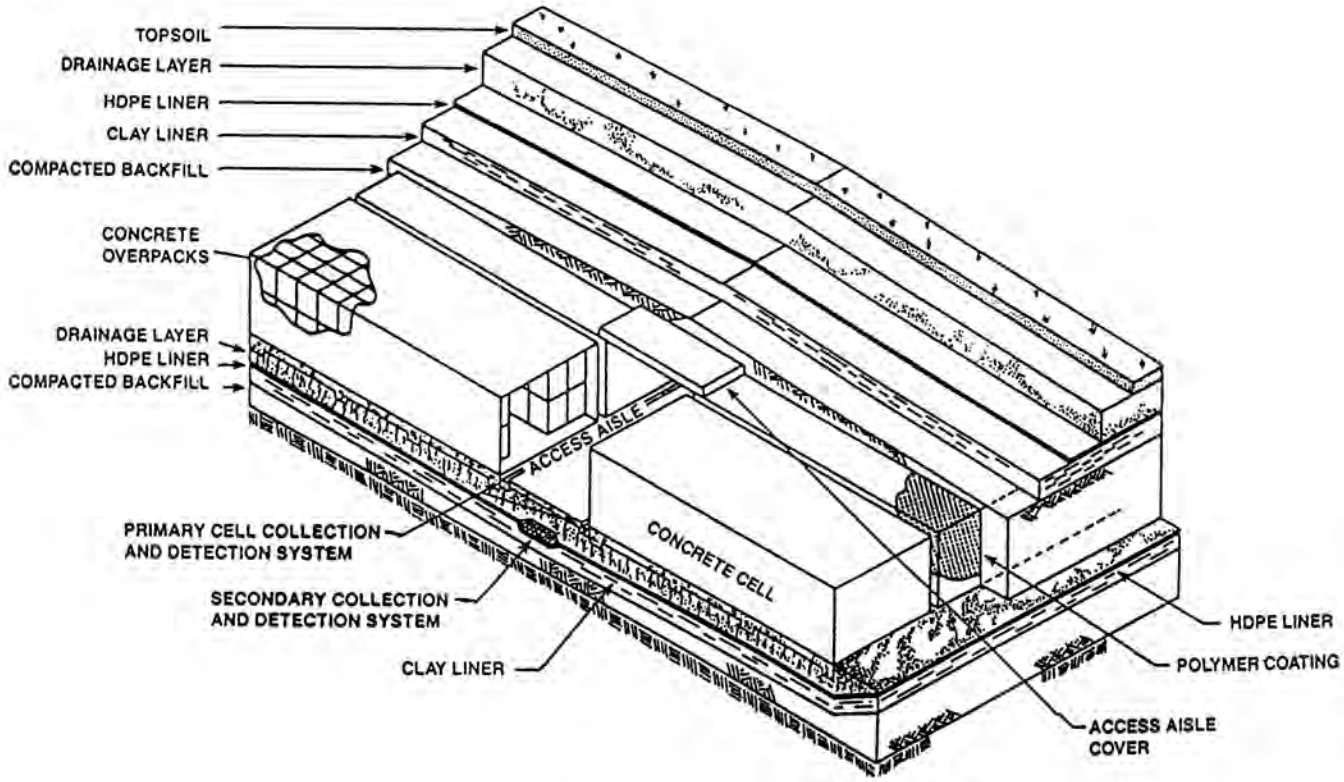

Fig. 2. Disposal vault cut-away.

- **February '91** - Selection of the designated 1100-1200 acre site in Martinsville, Illinois.
- **May '91** - Submittal of the site license document to Illinois Department of Nuclear Safety (IDNS).
- **March '91** - Commencement of pre-operational environmental monitoring.
- **June '91** - Commencement of the state judicial hearing on site safety.
- **November '91** - Receipt of first round of licensing questions from IDNS.
- **February-March '92** - Completion of pre-construction facility design.
- **March '92** - Submittal of first responses to IDNS on licensing questions.

A facility start-up date of late 1993/early 1994 is feasible if all open licensing areas are expeditiously resolved.

North Carolina - Southeastern Compact

The following project milestones were achieved in the last *9-12* months:

- **May '91** - Approval of site characterization plan by NC State Board.
- **August '91** - Initiated characterization studies of Wake-Chatham County site.
- **December '91** - Initiated characterizations studies of Richmond County site.

The characterization studies were delayed in 1990-91 by the need for extensive rework of the characterization plan, and CNSI/NC involvement in various litigation actions. The characterization period which has recently started, is estimated to span 15-18 months for each site. Completion of characterization for both sites is estimated for early-to-mid 1993. In order to expedite the total project schedule, various engineering and licensing efforts are being performed in parallel with characterization. An assessment has been made of the minimum site construction period. It is believed that this can be expedited by employing "year-round" construction activities following the receipt of the site license.

Pennsylvania - Appalachian Compact

The following key project milestones were achieved in the last 9-12 months:

- **October '91** - Approval of the Site Screening Plan by the PA - Department of Environmental Resources.
- **December '91** - Completion of first of three sequential site screening phases.
- **February '92** - Completion of second of three sequential screening phases.

It is anticipated that the *site screening* process will have progressed so that by August 1992, selection of 2-3 suitable alternative sites is possible.

FUTURE PROJECT DIRECTION

The preceding discussion of CNSI project status illustrates the problems which can occur in trying to attain straightforward accomplishment of the project according to a defined schedule. As expected, the most common difficulty in meeting planned milestones relate to public concern and outcry over the suitability of site selected. Legal and political

action has been taken by intervening groups to prevent development - - - or even testing at proposed sites. The strategies and arguments used to stall or stop development falls into generic categories:

- **Land Values** - The site is either on land too valuable to dedicate to waste disposal; too close to population centers or the developer has taken advantage of a region with a low income/high unemployment population.
- **Siting Safety** - The characterization plan has either insufficient testing data or the resulting studies were not adequately performed or purported site deficiencies were ignored.
- **Local Involvement** - The site screening did not properly involve the expertise and concerns of the surrounding local populace.

We are obviously keenly aware of these concerns. However, CNSI has not only been aware, but also has been proactive in ensuring that these contentions have no factual basis. In the development of these sites, CNSI has endeavored to accommodate these concerns in a thorough and consistent manner. Considerable attention has been directed toward compliance with detailed plans. The quality program has been audited by external parties and the state agency to ensure that the site screening and characterization studies have been performed in a scientific and comprehensive manner. Every effort has been made to not only allow, but to encourage, public involvement.

Even though considerable effort is being made to adhere to or even improve the project schedule, still unavoidable delays have occurred. These delays are not only costly, they also jeopardize the project and the entire LLW disposal program. However, we are confident that real progress can be made in each project by rigorously performing all of the project tasks in a thorough and professional manner.

CONCLUSIONS

In summary, the development of three new LLW sites is proceeding in accordance with well documented and reviewed plans. Programmatic excellence in all technical facets of the project is being pursued. CNSI's program emphasizes commonality in the technical approach including the use of a state-of-the-art disposal technology. This technology considerably enhances the operating and post closure safety of the site and will be a significant improvement in LLW technology advancement. Strict attention has been given towards making all schedular milestones. Also, considerable effort has been directed towards ensuring that the site screening, selection, and characterization process have been accomplished in a technically superior and fair manner.

However, delays resulting from litigation have ensued. These are being overcome by dedicated work by the project teams. In performing our tasks, CNSI has been encouraged by the evidence of support and enthusiasm of various radioactive material users groups located in these compacts. They, like CNSI, recognize the critical national and regional importance of maintaining consistent progress in the development of these sites. These groups have been a significant factor in providing a "compact-wide" basis of public support for ensuring the progress of these projects.

REFERENCES

1. R. ANDERSON, V. BARNHART, and M. RYAN, "Advanced Disposal Technologies For New Low-Level Waste Disposal Compact Sites - Proceeding of Waste Management '90 - Volume 2, pg. 179-186.