ENGINEERING A LOW LEVEL RADIOACTIVE WASTE DISPOSAL FACILITY: THE ILLINOIS DESIGN

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ABSTRACT

The purpose of this paper is to present the design and approach being implemented by Westinghouse Electric Corporation for the Illinois Low Level Radioactive Waste Disposal Facility. The discussion focuses on the engineered, multiple layered containment features with emphasis on monitoring. Included is an explanation of waste containers, vaults, and disposal area covers. The paper concludes with a description of how the public is participating in the review of the design and the project.

THE ILLINOIS APPROACH

The Illinois Department of Nuclear Safety's (IDNS) low level radioactive waste disposal program focuses on technical excellence, public participation, and political acceptability. Safety is the foremost objective of the Illinois team. Through this facility the host community also will realize substantial economic benefits. The program is being referred to as the SAFEST OPTION--Safely Achieving a Future Economy with Superior Technology.

The goal of the Illinois Low Level Radioactive Waste Disposal Facility is zero radiation release to the general public. The IDNS has established an exposure limit of one millirem per year at the outer boundary of the facility. To achieve this goal, the facility has been designed using multiple layers of protection, inspectability, monitoring, and retrievability of the wastes.

LICENSE APPLICATION DESIGN AND SCHEDULE

Current plans are to submit a preliminary license application design in the summer of 1989. The entire license application will be submitted in December of 1989. The Illinois Department of Nuclear Safety is preparing a document for licensing to guide Westinghouse in its submittal.

The Illinois Department of Nuclear Safety and Westinghouse are working toward approval of a license by July of 1990. Operation of the disposal facility could begin as much a year ahead of the January 1, 1993 federal milestone.

THE ENGINEERED APPROACH

The base concept for the system is the concrete module called the SUREPAK (Subsurface Recoverable Package) which is the first layer of protection. Packages containing solid waste are placed in SUREPAKs which are then grouted with cement and put in a reinforced concrete vault. The vault structure is covered by a highly impermeable plastic membrane and an earthen cap to protect the exterior of the vault. The vault will consist of structurally independent cells which will be constructed as needed for disposal.

THE SUREPAK CONTAINER

The standard SUREPAK module is constructed of steel reinforced Portland Cement concrete having a minimum compressive strength of several thousand pounds per square inch. The concrete mix as well as the reinforcement will be tailored to suit site-specific requirements.

The heavy SUREPAK cover has been designed to make the module a rugged, weathertight container. The concrete SUREPAK container provides a comprehensive shield between the waste package and the environment. Liners will also be used where appropriate.

The SUREPAK modules have undergone stringent testing for strength and durability. In the fire resistance test, the SUREPAKs show that they can withstand extreme heat (1300 degrees Fahrenheit) without a loss of integrity. Seismic tests also reflect the strength of the containers. Results indicate that the stacked modules will not topple during an earthquake and they will retain their integrity.

Impact penetration tests are performed where thirteen pound steel bars are dropped from varying heights onto the modules to test durability. Temperature extreme tests are also performed on the SUREPAK. Results indicate that the module integrity is not compromised by either the high or low temperatures.

SUREPAK DIMENSIONS

A standard SUREPAK module has a six-sided exterior of 83 inches across the sides of the hexagon and is 92 inches in height. The module interior has a circular cross-section with a 75-inch diameter and a height of 74 inches. This size will be adjusted as necessary to fit specific waste packages.

The wall thickness of the modules ranges from a minimum of four inches on the side to the maximum of almost nine inches at the corners. The modules weigh 19,000 pounds empty and up to 50,000 pounds when filled with waste and grouted. These weights are easily within the operating ranges of conventional trailers, forklifts and cranes.

SITE LAYOUT

The disposal site will encompass about 1000 acres which will be divided into two distinct areas. The outer area will be the buffer zone (about 700 acres) which may be used for growing crops, economic development, wildlife habitat or support facilities. The inner area will be a restricted area of approximately 300 acres which will be surrounded by a security fence.

The Waste Disposal Vaults, Empty SUREPAK Module Storage Area, Site Access Building, Waste Packaging Facility, and Maintenance/Storage Building will be located

within the restricted area. The Administration Building and Visitors Center will be in the unrestricted area. Attention will be paid to appearance and long-term durability of all facilities.

WASTE DISPOSAL VAULTS

The waste disposal units will be reinforced concrete vaults with an engineered earthen cover system to ensure long-term isolation of wastes and minimize the need for continuing active maintenance after site closure. The vaults will consist of an access aisle, individual cells for waste storage, cell moisture collection systems and monitoring tunnels. The cells will be structurally independent and arranged on both sides of a central access aisle. With this arrangement, as cells are completely filled with waste, they can be closed off at the aisle and the new adjacent cells will be built and used. SUREPAKs will be stacked in the cells three high. Each concrete module will be handled with a forklift.

A single type of vault will be used for disposal of all types of lowlevel radioactive wastes. The design of each vault will use the same basic configuration. Cells (120 in number) which are 52 feet wide by 286 feet long and 26 feet high will be utilized to dispose of the Class A, Band C and mixed wastes. Concerning actual placement of wastes, Class Band C wastes could be disposed of together and be segregated by cells as could mixed wastes. The floor of the cells will be sloped in the longitudinal direction for drainage at a 1% slope, away from the access aisle.

EARTHEN COVER

The earthen cover system will consist of a vegetative cover, native soil layer, two geotextile layers, drainage layer, clay layer and ageomembrane lining bonded directly to the exterior of the concrete vault. The depth of the engineered cover will be about six and one half feet.

MAINTENANCE/STORAGE BUILDING

The Maintenance/Storage Building will be a pre-engineered building and will consist of a truck bay, fire truck storage area, fire equipment/clothing storage area, and compressor/utility room. The building will be equipped with a five-ton overhead bridge crane, HVAC and fire protection system. The truck bay will have an electrically operated roll-up door.

WASTE PACKAGING FACILITY

The Waste Packaging Facility will be a custom designed building that will include a processing area and a support area. The processing area will be divided into two separate areas, low activity and remote handling. The arrangement for the remote handling area will include a truck bay, remedial action processing area, waste package storage area,inspection area, and two SUREPAK stations. The area will include two shielded access doors and one rolling steel door at the truck bay.The arrangement for the low activity area will include a truck bay,one truck dock, remedial action processing area, waste storage area,mechanical equipment room, underground controlled water storage vault,an equipment storage area and two SUREPAK loading stations. The area will have two rolling steel doors one at the truck bay and one at the truck dock.

The support area will include the radiochemistry laboratory and remedial area remote operating stations. The area will also house remote operating stations, an instrument shop and electrical equipment room.

The processing area and radiochemistry laboratory will have HEPA filtered ventilation. The processing areas will be equipped with a 15-ton overhead bridge crane, a 30-ton overhead bridge crane and a 5-ton remotely operated jib crane. All cranes will have remote and local control capabilities.

MOISTURE DETECTION AND MONITORING

The vaults will have primary and secondary moisture collection and monitoring systems. The moisture collection system will consist of a network of channels and drains which resist plant or animal intrusion in the floor of each cell. The floor drains will lead into a manifold located in the monitoring tunnel. The monitoring systems and drains will be constructed to allow moisture detection, collection and removal of any liquid that may have entered the system.

MONITORING TUNNEL

The monitoring tunnel will run longitudinally along both sides of each vault. The tunnel will enclose the collection manifold for the cell moisture collection systems and house the collection tank located at the end of the tunnel. Manhole access will be provided to the tunnels at both sides.

SUBGRADE PREPARATION

All brush, grass, roots, topsoil, and any loess material will be stripped from the areas to be occupied by the vault structures and from areas to be backfilled. Backfill will be required around buildings and disposal units and in areas where fill is required to attain subgrade elevations. Material may be available from approved onsite borrow areas. Sand backfill material will be used around underground piping and ductwork. Structural fill will be required to attain final foundation subgrade elevation beneath structures and disposal units where overexcavation is performed and may consist of approved onsite borrow material.

DRAINAGE

The disposal areas that are developed will be drained via a system of primary and secondary channels leading to the drainage retention pond. The drainage pond will have the capacity needed to retain drainage from the entire low level radioactive waste site property within the innersecurity fence for all rainfall conditions up to and including a one-in-100 year, 24-hour duration rain.

The pond bottom and side slopes will be lined with either a natural or man-made liner to prevent seepage into the ground. Water will be monitored before released to the local drainage system.

CONCRETE DURABILITY

Due to the long service lives of the disposal vaults, special considerations will be made to ensure the durability

of concrete. Degradation due to sulfate attack of the concrete and chloride attack of the steel reinforcement is being addressed.

The concrete cover over reinforcing steel on exterior faces will be designed for a long service life. The calculated time of onset of corrosion of the reinforcing steel will be evaluated in relationship with the service life of the vaults. The benefits from using moisture barriers and epoxy coated reinforcing will be examined.

COMMUNITY PARTICIPATION

Currently two communities in Illinois are under consideration for the project. Each of the candidate communities has one site undergoing extensive characterization at this time. One site is near Martinsville in Clark County and the other is near Geff in Wayne County. The City Council of Martinsville and its citizens advisory committee are reviewing the project at this time. The Wayne County Board and its citizens review committee are doing the same. Plans are to share preliminary licensing and designinformation with both communities for their comment. Community agreements will be drawn with both local jurisdictions on technical and economic issues prior to site selection by the State of Illinois.In general, public opinion about the proposed reference design has been very positive. Both communities have a high degree of confidence in the engineered approach that is planned. The multiple layers of protection that the SUREPAK and the concrete vaults offer are key to this degree of confidence. Much of the support, however, has come from the efforts of the Illinois Department of Nuclear Safety to keep both communities informed and involved in the project.

Public meetings, educational seminars, videotapes, written materials,and personal appearances by the Illinois Department of Nuclear Safety and contractor personnel have served to build community understanding and support for the facility. We are confident that when implemented this project will be the SAFEST OPTION for disposal of low level radioactive waste.