ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

Report Number: NEDE-30878

Report Title: Transportable Modular Aztech Plant

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1.0 INTRODUCTION

In October 1981, the U. S. Nuclear Regulatory Commission (NRC) established a policy regarding the volume reduction of low-level radioactive waste. The policy statement addressed the need for volume reduction and the need for waste generators to minimize the quantity of waste produced. The General Electric Aztech process is one of a number of means available in the nuclear industry by which licensees can achieve volume reduction of radioactive waste.

In February 1985, General Electric Company submitted for NRC review and approval their Licensing Topical Report (LTR) NEDE-30878, "Transportable Modular Aztech Plant (Aztech System)," supplemented by (1) Revision No. 1 to the LTR dated April 15, 1985, (2) Revision No. 2 to the LTR dated June 28, 1985, and (3) responses to the NRC licensing review questions dated August 9, September 6, November 6 and December 9,

1985. Copies of the LTR with the NRC licensing questions and General Electric responses on waste form stability were transmitted to the States of South Carolina and Washington for their review and comment. These States have regulatory responsibility for the operation of low-level waste disposal sites at Barnwell, South Carolina, and Hanford, Washington. The State of Washington responded with no comment and the State of South Carolina responded with two comments (see Appendix A). Both comments from the State of South Carolina have been reviewed by the staff and the State's views have been incorporated into this Safety Evaluation Report (SER). EG&G Idaho, Inc., under a NRC technical assistance contract, has also reviewed the LTR for Aztech process and prepared a Technical Evaluation Report for NRC.

The Aztech System utilizes (1) a low temperature azeotropic vacuum distillation process to remove water from the various radioactive waste feed streams and (2) a polyester polymerization to solidify resulting slurries from the Aztech process into a homogeneous solid matrix in 55 gallon steel drums. The Aztech process, which is patented by the General Electric Company, provides the following two functions. It is designed to process Type A, B and C wastes as defined in 10 CFR Part 61.55. This covers wastes such as evaporator concentrates (sodium sulfate and boric acid solutions), spent bead and powdered ion exchange resins, decontamination solutions, and oil contaminated liquid radwaste in accordance with NRC Branch Technical Position, ETSB, 11-3. It is also designed to solidify the waste in accordance with the guidelines

provided in NMSS Branch Technical Position on Waste Form for offsite shipment to a licensed burial facility. During operation of the system, "wet" solid radwastes are evaporated in a mixer-evaporator, with vinyl toluene forming an azeotrope of water and vinyl toluene. In the Aztech process, vinyl toluene (an ingredient of the polyester resin) and liquid radwaste are introduced, mixed, and heated in the mixer-evaporator. Water and vinyl toluene are then removed by heat and vacuum induced azeotropic distillation. The distillation takes place between 120 to 200^{o}F at a pressure of 1.0 psia, without decomposition and in a fixed ratio of water and vinyl toluene (therefore azeotropic). When the vinyl toluene coated residue is free of water, a polyester and promoter mixture is introduced into the mixer-evaporator and mixed with the residue. The mixture is discharged into 55 gallon steel drums where a catalyst is added to initiate polymerization into a monolithic solid with relatively high leachability resistance. Because the azeotrope (compound) is more volatile than either of the incoming stream compounds, this leads to a reduction of waste volume.

The Aztech System, was reviewed in accordance with Section 11.4 of the Standard Review Plan and the NMSS Branch Technical Position on Waste Form. Specific items of review include piping and instrument diagrams, descriptive information on system operation, equipment descriptions,

process parameters, instrumentation and controls, process control program, quality assurance program, and Aztech product qualification for low-level waste form.

The capability of the plant radioactive waste treatment systems to meet the requirements of Appendix I to 10 CFR Part 50, due to the Aztech System operation, is site and plant dependent and will be evaluated for individual user's license applications. In addition, the packaging and shipping of all processed wastes, including waste classification in accordance with the applicable requirements of 10 CFR Parts 61 and 71, and 49 CFR Parts 170-178, will be also determined for individual user's license applications. The consequences of a tank and/or evaporator failure releasing radioactive materials to a potable water supply is also site and plant dependent and will be evaluated for individual user's license applications.

General Electric Company has provided, and the staff has accepted, a generic process control program (PCP) for the Aztech System to give reasonable assurance of complete solidification of processed wastes and of the absence of free water in the processed Aztech waste products. However, the PCP is plant specific and the user applicant must establish its own PCP that is based on (1) the user's radwaste system design and operation, (2) the plant's waste feed characteristics, and (3) General Electric's generic PCP. The staff will verify the process control parameters specified in the LTR during the performance test on the

as-built system at the General Electric's test facility, and will issue the test results in a supplement to this Safety Evaluation Report.

2.0 EVALUATION

The design and operation of the Aztech System is described in detail in the LTR, in its amendments, and in the General Electric responses to the NRC licensing review questions. In the staff's evaluation of the Aztech System, the staff considered:

(1) The system design criteria and design bases.

(2) The process capacity compared to implant waste volumes expected during normal LWR plant operation, including anticipated operational occurrences.

(3) The quality group classification and quality assurance program for the design, fabrication and testing of the system.

(4) Design provisions incorporated in the equipment and system design to reduce leakage and to control and monitor releases of radioactive effluents to the environment.

(5) Process control program to assure complete solidification of "wet" solid radwaste.

(6) Radiation protection design features to assure that the occupational radiation exposures are maintained as low as is reasonably acnievable (ALARA).

(7) Waste form stability to assure that the final solidified products meet the requirements of 10 CFR Part 61.

(8) The fire hazards associated with the solidifying reagents used in the Aztech System.

The Aztech System is composed of three prefabricated transportable modules. The modules are supplemented by a package of drum-handling equipment and shielding components, all of which are transportable on truck trailers or railroad cars. The modules are joined together into an integral system using quick-disconnect and easily joined mechanical, hydraulic, pneumatic, and electrical interfaces.

In the Aztech process, vinyl toluene is combined with liquid radwaste in a mixer-evaporator where it is mixed and heated. Water and vinyl toluene are removed by heat and vacuum-induced azeotropic distillation. A polyester and promoter are added to and mixed with the slurry residues in the mixer-evaporator tank. This mixture is then combined with a catalyst and discharged into a 55-gallon steel drum where it polymerizes into a monolithic solid for offsite disposal at a licensed burial site. Because the exothermic temperature of the mixture is considered to be a very good indication of polymerization, the temperature measurement is used as the primary indication to verify complete solidification.

2.1 Design Criteria

The design acceptance criteria for the solid radwaste system are specified in Section 11-4 of the SRP. They are based on meeting the relevant requirement of (1) General Design Criteria (GDC) 60, 61, 63 and 64 of Appendix A to 10 CFR Part 50 as they relate to the radioactive waste management systems being designed to control releases of

radioactive material to the environment, and to monitor radiation levels and leakage in and from the systems and (2) Sections 50.34a and 50.36a of 10 CFR Parts 50 as they relate to the provision of assurance that the releases of radioactive material to unrestricted areas are kept "as low as is reasonably achievable" level.

The Aztech System provides for removal of airborne radioactive particulates and iodine through an offgas filtration unit consisting of a demister, an electric heater, a prefilter, a 12-inch deep charcoal adsorber, and a HEPA filter. The offgas ventilation unit is designed, and will be tested, in accordance with the guidelines provided in Regulatory Guide 1.140. The staff has assigned a 99 percent removal efficiency for the charcoal adsorber with respect to all forms of iodine and a decontamination factor of 100 with respect to removal of airborne radioactive particulates for the HEPA filter. The staff has also assigned decontamination factors for the mixer-evaporator. For iodine the decontamination factor is 10^3, and for all other radionuclides, it is 10^4. These decontamination factors are consistent with those listed in NUREG-016 and NUREG-017. With these decontamination factors, the Aztech System is capable of meeting radioactivity release limits specified in Appendix B, Table II of 10 CFR Part 20.

The potential for airborne radioactivity release to the environs from the Aztech System operation is through the vent gas stack. The stack is a 14-inch diameter pipe and it is approximately 20 feet long. The flow

in the stack will be approximately 6,800 cubic-feet per minute (CFM) at $70^{o}F$.

The vent gas radiation monitoring system consists of an isokinetic sample probe, flow control devices, a radiation recorder with high radiation alarms, a radiation level indicator, a noble gas monitor, and iodine and particulate samplers. The provisions for sampling and monitoring the vent stack release meet the guidelines given in Regulatory Guide 1.21 and ANSI N13.1-1969. The radiation monitor is provided with two alarm levels on the control panel. One radiation alarm (high) will be set below the allowable level. If this alarm level is tripped, corrective actions may be taken to prevert exceeding the allowable level. If the corrective actions are successful, the system operation may continue; otherwise, the process will be terminated. The second alarm level (high-high) will be set at the allowable level. Upon receipt of the second level alarm, the process will be isolated and shut down immediately.

The Aztech System design does not have any liquid radwaste releases to the environs. The decant solution from the sludge tanks and the mixer-evaporator condensate are returned to the user's plant liquid radwaste system for process and reuse. The system is also designed to collect and completely contain liquid radwaste spills up to the total volume of each tank containing the liquid radwaste. The spills and overflows are returned to the system's feed tanks.

The staff has reviewed quality assurance provisions for the Aztech System and the quality group classification used for system components. General Electric has established the GE Quality Assurance (QA) Program and Organization which is described in the NRC accepted Licensing Topical Report NEDE-11209 (Revision 04A, December 31, 1982). This QA program will be applied to the design, procurement, test and assembly of each modular Aztech System. The GE Quality Assurance Program and Organization conform to Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants" and the applicable portions of Appendix B to 10 CFR Part 50. The design, construction, and quality group classification of the Aztech System equipment is also in accordance with Regulatory Guide 1.143.

Based on the foregoing evaluation, the staff finds that the Aztech System design criteria and design bases meet the requirements of Sections 50.34a and 50.36a of 10 CFR Part 50, and GDC 60, 61, 63 and 64 of Appendix A to 10 CFR Part 50.

Appendix I of 10 CFR Part 50 establishes numerical guides for design objectives and limiting conditions for operation to meet the criterion of "as low as is reasonably achievable" for radioactive material in nuclear power plant effluents. The gaseous effluents from the Aztech System must be considered in conjunction with those from the remaining portions of the user's plant radwaste systems, and the impact from the total effluents must be within the guidelines of Appendix I. Therefore,

the capability of the user's plant radioactive waste treatment systems to meet the requirements of Appendix I to 10 CFR Part 50 due to the Aztech System operation is site and plant dependent, and will be evaluated for individual license and license amendment applications.

2.2 Radiation Protection

The Aztech System incorporates several features which are designed to maintain personnel occupational doses ALARA. Operation and monitoring of the system process are performed from a control room located in a low radiation area (less than 1 mR/hr.). Components containing large amounts of radioactive materials are located in individually shielded cubicles to maintain dose rates low in other areas of the system. Mechanical hardware, such as pumps and blowers, are separated from non-mechanical hardware by shield walls or individually shielded cubicles. This is done so that the complete system does not have to be decontaminated in the event that maintenance is required on the mechanical components. All equipment and components that may be in contact with radioactive waste or products have been located within the shielded compartments. The individually shielded cubicles are arranged so that all hardware contained in the cubicles can be accessed for maintenance or removed from the cubicles if necessary.

The Aztech System is designed to minimize the deposition and accumulation of crud in the system components. Piping carrying liquids is sized and routed to maintain a minimum velocity to minimize settling

out of suspended solids in the lines. Liquid piping is designed with drain valves at the low points and dead legs are avoided. Lines containing radioactive gases are routed as directly as possible with minimum bends.

The user can perform system or component decontamination prior to maintenance work on the Aztech System. The arrangement of components in individually shielded cubicles reduces the need for entire system decontamination prior to maintenance on individual components. The major process equipment and components are provided with decontamination flushing water to facilitate component decontamination.

In response to the staff's questions regarding annual person-rem estimates for occupational radiation exposures to operate the Aztech System, GE has provided an estimate of the dose rates, occupancy factors, and exposures associated with the operation, and maintenance of the system. GE estimates that the annual occupational dose due to normal system operation will be less than 4.4 person-rems. This is based on the assumption of 26 weeks per year, 168 hours per week, and a 1 mR/hr dose rate. Similarly GE estimates that the annual dose due to maintenance will be less than 2.7 person-rems, assuming exposures of 4 weeks per year, 168 hours per week, and a 4 mR/hour dose rate. The Aztech System is designed to operate for 26 weeks a year, with a scheduled annual 4 week downtime for required system maintenance. On the basis of limited operational experience of a prototype Aztech System at the GE testing facility, GE indicates that a realistic estimate of

the expected annual downtime of the system is 2 weeks for scheduled maintenance and 2 weeks for unscheduled activity. GE's exposure estimates meet the requirements set forth in Section 20.101 of 10 CFR Part 20. On the basis of the considerations discussed above, the staff concludes, that the general radiation protection design features for the Aztech System are also consistent with the guidelines of Regulatory Guide 8.8, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable". Therefore, the staff finds the radiation protection design features incorporated in the Aztech System design to be acceptable. The staff will assess occupational exposures on each plant for which the Aztech System is proposed.

2.3 Process Control Program (PCP)

The staff estimates the quantities of "wet" solid waste generated from a standard 3400 MWt LWR to be approximately 20,000 cubic feet per year for a BWR with a deep bed condensate polishing system, and 10,000 cubic feet per year for a PWR with a precoat condensate polishing system. These estimates are based on our cumulative review of the licensee's semi-annual effluent release reports. The Aztech System is designed to process any of the following typical annual accumulations in 150 days of 24-hour/day operation:

Sodium sulfate (20% solutions)	20,000 ft^3
Bead or powdered resins	17,000 ft^3
Boric acid (10% solutions)	10,000 ft^3

For a sodium sulfate feed which is the limiting design feed, 592 drums per year (148 batches of 4 drums each) will process 20,000 ft^3 of 20 weight percent solution. The minimum number of days to produce 592 drums would be 123 days, operating 24 hours per day, assuming a production rate of one batch of four drums in approximately 20 hours. Therefore, the staff concludes that the Aztech System can be operated to meet the liquid radwaste processing requirements of a 3400 MWt PWR or BWR.

General Electric has provided Attachment B to the LTR, "Process Control Program Guidelines for Transportable Modular Aztech Plant," to give guidance and to assist user utilities in the preparation of their plant specific PCP. The guidelines in this document are in accordance with the Standard Review Plan Section 11.4, "Solid Waste Management Systems," and Branch Technical Position ETSB 11-3, Revision 2, "Design Guidance for Solid Radioactive Waste Management Systems Installed in Light-Water-Cooled Nuclear Power Plants."

The GE Process Control Program specifically and quantitatively addresses (1) system prerequisites, (2) process variances and ranges, (3) product acceptance criteria, and (4) process control features. The PCP also describes the envelope within which processing and packaging of low-level radioactive wastes will be accomplished to provide reasonable assurance of compliance with low-level waste regulations and requirements. The NRC Branch Technical Position on Waste Form (TPWF) states that implementation of the waste form stability guidance be achieved through a PCP.

The staff concludes that the GE generic PCP has provided adequate information in the LTR for user utilities to establish their own plant specific PCP. As a minimum, the user should address in their PCP, the following: (1) the plant's radwaste feed characteristics, (2) process control parameters with acceptable ranges, (3) product acceptance criteria, (4) process control features, (5) instrument calibration and surveillance requirements, and (6) a method for determining total solid contents in their waste streams. GE has proposed to calibrate process instruments at least once a year, or as recommended by the responsible process engineer. We conclude that initially instrument calibration should be performed more frequently and, based on actual experience, calibration may then be reduced to a less frequent basis. The waste form has been qualified on the basis of maximum permissible waste loadings. GE has proposed to determine the solids content of individual wastes on a semi-annual basis. We conclude in order to ensure compliance with the stability requirements, the utility should provide accurate solids content data for each batch of waste based on the actual characteristics of each batch. On the basis of the GE waste form stability test data provided in the LTR, the maximum permissible solid loadings in the Aztech products will be limited to those values shown in Table A of this SER.

The General Electric generic PCP guidelines provided in the LTR are in accordance with Branch Technical Position ETSB 11-3, SRP Section 11.4, and the TPWF. Therefore, the staff finds the GE generic PCP to be acceptable.

2.4 Waste Form

Low-level radioactive wastes shipped to near-surface disposal facilities must meet the requirements of 10 CFR Part 61 which specifically requires that:

(a) The waste be classified as per Section 61.55.

(b) The waste form have characteristics as per Section 61.56.

(c) Stability, where required, meet Section 61.7(b)(1) and (2).

Guidance to waste processors for meeting the stability requirements for Class B and Class C wastes is provided by the NRC TPWF. The objectives of the waste form and disposal site requirements are:

(a) Protection of the general population from releases of radioactivity.

(b) Protection of individuals during inadvertent intrusion.

(c) Protection of individuals during operation.

(d) Stability of the site after closure.

Waste stabilization can be achieved through radwaste solidification systems. The LTR contains test data for specific Aztech solidified wastes qualifying these products as suitable for near-surface land disposal.

The staff has conducted a detailed evaluation of the waste form qualification test data provided by the GE for their Aztech Solidification System. The evaluation was performed to determine if the product of the Aztech System meets the regulatory requirements of 10 CFR Part 61 and those of the States of South Carolina and Washington.

The waste streams covered by the test data include the following non-radioactive solutions or slurries simulating typical nuclear power plant low-level wastes:

Sodium sulfate, up to 60 weight percent

Boric acid, up to 50 weight percent

Mixed bed bead resins, up to 40 weight percent

Mixed bed powdered resins, up to 40 weight percent

Decontamination solution up to 40 weight percent

Combination bead resins, 4 weight percent

Sodium sulfate, up to 40 weight percent total solids

Oxidized powdered resins, up to 60 weight percent

2.4.1 Minimum Requirements of 10 CFR Section 61.56(a)

2.4.1.1 Packaging

The waste form is contained in a steel 55-gallon drum and thus satisfies the requirement.

2.4.1.2 Liquid waste

Liquid wastes are completely solidified in solidification operations. This satisfies the TPWF guidance of no more than 1 percent by volume of free standing liquid in unstabilized waste.

2.4.1.3 Free liquid

Water is completely removed by the Aztech process. Liquids fed to the process are completely polymerized, so that no free standing liquid remains. Each drum of product is to be checked for free standing liquid. The PCP also provides corrective measures to be used in the

event of failure to polymerize. This also satisfies the guidance that the volume of free standing water be no more than 1 percent.

2.4.1.4 Reactivity of product

On the basis of the information provided by GE, the waste form produced from normal power plant wastes does not contain any substances capable of explosive decomposition or reactions at pressures and temperatures anticipated during processing, transportation and disposal.

2.4.1.5 Gas generation

On the basis of the information provided by GE, the waste form also does not contain, nor is capable of generating, quantities of toxic gases, vapors or fumes harmful to persons transporting, handling or disposing the waste form.

2.4.1.6 Pyrophoricity

The waste form does not contain materials which are pyrophoric as defined in 20 CFR Section 61.2.

2.4.1.7 Gaseous wastes

This provision is not applicable to the Aztech waste form. The Aztech products are not in a gaseous form.

2.4.1.8 Hazardous wastes

The waste form does not contain biological, pathogenic or infectious material. Wastes are hazardous if so designated in 40 CFR Part 261 by the Environmental Protection Agency (EPA). The designation may result from (a) having the characteristics of ignitability, corrosivity,

reactivity or toxicity, or (b) being listed in Subpart D of 40 CFR Part 261. The wastes proposed for solidification are the normal power plant wastes. None of these are listed as hazardous wastes.

However, some of the substances which contribute to the production of the waste form may be designated as hazardous, even though they are not specifically listed by EPA. For example, although toluene and benzene are listed as toxic in 40 CFR Section 261.33(f), vinyl toluene and vinyl benzene (styrene) are not. Similarly, naphthaquinone is listed as toxic, but hydroquinone is not. On the other hand, maleic anhydride and phthalic anhydride are both specifically listed. The feed materials to the Aztech process are, according to the LTR, completely polymerized to a solid that is resistant to leaching by water. While the residual amounts of reactants are expected to be very small, and their potential leach rates if contacted with water are also very low, it appears that such leach tests have not been made. Sections 40 CFR 261.30 - 261.33 note that the presence of any quantity of a listed substance makes the waste hazardous. Section 40 CFR 261.11, however, specifies conditions under which this finding would not be made. These conditions include the quantities of waste involved, low concentration of listed constituents, migration potential, and the plausible types of improper management of listed constituents. A corresponding provision in 10 CFR 61.56(a)(8) is that waste containing hazardous material must be treated to reduce, to the maximum extent practicable the potential hazard from non-radiological materials. Polymerization constitutes such a treatment. Therefore, the waste form satisfies the requirement of 10 CFR Part 61.

2.4.2 Stability Requirements of 10 CFR Section 61.56(b)

2.4.2.1 Structural stability

The waste form must exhibit structural stability under expected disposal conditions. Structural stability means that it must generally maintain its physical dimensions and its form. Expected disposal conditions include the weight of overburden and compaction equipment, the presence of moisture and microbial activity, and internal factors such as radiation effects and chemical changes. The Aztech product will be contained in a steel drum, but no credit for stability will be taken for the drum. The evaluation of this criterion is presented in Section 2.4.3 of this SER.

2.4.2.2 Free liquid

Water is completely removed from the waste before encapsulation and all liquid reactants are considered to be completely polymerized before exiting the process. The guidance that free liquids be no more than 0.5 volume percent for the stabilized waste is satisfied. Free liquids were not observed in the qualification testing.

2.4.2.3 Void spaces

Drums containing the waste forms will be filled to 95% capacity while the waste form is still fluid. Polymerization then takes place in the container. Therefore, void spaces within the waste and between the waste and the container are reduced to the extent practicable.

The polymerization reaction does not involve formation of gaseous byproducts which might create gas-filled voids within the solidified waste form.

2.4.3 Branch Technical Position on Waste Form

2.4.3.1 Compressive strength

The specimens tested were nominally 1 inch in diameter by 2 inches long and were prepared by casting in plastic containers. The test compression used was ASTM C 39 as provided in the TPWF. The minimum required compressive strength is 50 psi.

In all cases, the compressive strength of the laboratory specimens ranged from 1,700 psi to 10,550 psi. While there was significant variability between the compressive strengths of duplicate specimens, all the data were considerably in excess of the 50 psi strength requirement. The Aztech process, therefore, satisfies the guidelines provided in the TPWF; namely, that the waste form exhibit more than the minimum acceptable compressive strength of 50 psi.

2.4.3.2 Radiation resistance

The data for compressive strength, after irradiation for all waste types tested, fall in the range of 3,700 to 11,000 psi. The specimens were exposed to 100 millirad (Mrd) cumulative dosage from a gamma irradiator,

as provided in the TPWF. It appears that gamma irradiation actually increased the mean compressive strengths by factors ranging from 1.0 to 3.0. The TPWF guideline of 50 psi is satisfied.

2.4.3.3 Biodegradability

The TPWF guideline states that after exposure to bacteria and fungi in accordance with ASTM G 21 and G 22, respectively, there should not be any visible culture growth and the specimens should have a compressive strength greater than 50 psi.

The data presented in the LTR indicate that bacterial growth was not found on any of the test specimens. The compressive strength after exposure to bacterial attack was in the range of 2,900 to 11,000 psi.

Similar results were obtained for fungal attack, with the exception that the two pairs of specimens containing 60 weight percent sodium sulfate were reported as showing fungal growth at level 1 (less than 10%). Specimens at 50 weight percent sodium sulfate did not show any growth. Compressive strengths following fungal exposure were in the range of 2,000 to 10,800 psi. The specimens reported as showing fungal attack had strengths in the range of 4,000 to 10,800 psi, although the latter value may have been affected by the presence of 10% additional vinyl toluene.

Therefore, the guideline of the TPWF on biodegradability is satisfied for up to 50 weight percent sodium sulfate.

2.4.3.4 Leachability index

The TPWF guideline is that leach indices obtained in accordance with ANS 16.1 should be greater than 6 and that the leach testing should include 90-day results.

Data are presented representing tests with deionized water and synthesized sea water using three non-radioactive tracers - cesium, strontium, and cobalt. All samples satisfied the TPWF guideline. All leach indices exceeded 7.1, with many test leak indices in the range of 10.0 to 15.2.

2.4.3.5 Immersion resistance

The TPWF states that test specimens of the solidified waste form shall retain compressive strengths of at least 50 psi following immersion for 90 days in water. Specimens from leach testing may be used. The data presented include results from immersion in deionized water and in sea water.

The data indicate that the compressive strength generally decreases with increased waste loading, sometimes sharply. Because of the large relative standard deviations found in many cases, attention was focused on the minimum values. In all but three cases, the minima were well over 1,000 psi, far in excess of the 50 psi required. In two of these exceptions, the minimum of 50 psi was satisfied. The remaining exception involved bead resins with 4 weight percent sodium sulfate loaded to the 40% total solid level in the waste form. In this case,

the GE reported compressive strength was less than 50 psi after immersion in deionized water. This waste stream showed a compressive strength of 2,600 psi at a 30 weight percent loading. The staff concludes, therefore, that the Aztech product meets the immersion resistance guideline in the TPWF.

2.4.3.6 Thermal cycling resistance

The TPWF states that solidified waste forms should retain a minimum compressive strength greater than 50 psi after 30 thermal cycles between 60°C and -40°C, as per ASTM B 553.

GE data show compressive strengths after thermal cycling to be in the range of 2,000 to 11,500 psi. Therefore, the TPWF guideline is, satisfied.

2.4.3.7 Free liquid

Water is completely removed from the waste before encapsulation and all liquid reactants are believed to be completely polymerized before exiting the process. The requirement that free liquids be no more than 0.5 volume percent of the stabilized waste is satisfied. Free liquids were not observed in the qualification testing.

2.4.3.8 Full-scale results

The TPWF states that test data from sections or cores of the full-scale products be correlated with test data from laboratory specimens. The full-scale Aztech waste form is a 55-gallon size product. These

correlation tests were performed on Aztech samples from the 60 weight percent sodium sulfate waste stream. Correlation means that results obtained for samples cut from full-scale specimens are comparable to results from laboratory samples.

Correlation was demonstrated to the extent that all of the compressive strength values are well above the 50 psi minimum.

With respect to the leach index data, the data for the cut samples are in agreement with the laboratory scale data in that all leach indices are greater than 6.0. Therefore, the TPWF guideline, is satisfied.

2.4.3.9 Homogeneity

Data for twelve cut samples from the full scale specimen showed compressive strengths within a range of 2,900 to 8,700 psi. After a 90-day immersion in deionized water, the range of strengths was from 1,880 to 8,800 psi; for sea water immersion, the range was from 800 to 7,550 psi. Homogeneity, therefore, was achieved in that all compressive strengths were well above the 50 psi minimum.

2.5 Fire Protection

The entire Aztech plant (three transportable modules) is provided with a system that contains smoke and heat sensors and alarms. Sprinkler systems are provided in the chemical handling, chemical storage, and sludge operating areas and in each operating cell. All working areas

contain fire extinguisher equipment suitable for use on any chemicals or combustible materials.

The Aztech System design and operation meet NRC Branch Technical Position CMEB 9.5-1. The staff finds the Aztech System design features for fire hazards acceptable. However, the staff will review the individual user's applications to ensure that the process chemicals are not stored in a building housing any safety-related equipment.

3.0 CONCLUSION

Based on the foregoing evaluation, the staff finds the GE Topical Report NEDE-30878, "Transportation Modular Aztech Plant," dated January 1985, and amended as of June 1985, to be acceptable for reference in future license applications or license applications for light water reactors. The basis for the staff acceptance is the staff's conclusion that the Aztech System is designed in accordance with the following current guidance and requirements of regulatory guides, Standard Review Plans, Branch Technical Positions, and Federal Regulations:

(1) Standard Review Plan Section 11.4, "Solid Waste Management System".

(2) Standard Review Plan Section 12.4, "Radiation Protection Design Features".

(3) 10 CFR Part 20, Section 20.101, "Radiation Dose Standards for Individuals in Restricted Areas", and Section 20.106, "Radioactivity in Effluents to Restricted Areas".

(4) 10 CFR Part 50, Criterion 60, "Control of Releases of Radioactive Materials to the Environment," Criterion 61, "Fuel Storage and

Handling and Radioactivity Control," Criterion 63, "Monitoring Fuel and Waste Storage," and Criterion 64, "Monitoring Radioactivity Releases".

(5) 10 CFR Part 61, Section 61.56, Waste Characteristics".

(6) Branch Technical Position, ETSB 11-3, "Design Guidance for Solid Radioactive Waste Management Systems Installed in Light-Water-Cooled Nuclear Power Reactor Plants".

(7) Branch Technical Position on Waste Form.

(8) Regulatory Guide 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable".

(9) Regulatory Guide 1.140, "Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants".

(10) Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants."

The staff also concludes that the Aztech System, although site and plant dependent, is capable of being operated consistent with the as low as reasonably achievable requirements for onsite and offsite radiological exposures of 10 CFR Part 50, Appendix I. In addition, the packaging and shipping of all processed wastes, including waste classification in accordance with the applicable requirements of 10 CFR Parts 61 and 71, and 49 CFR Parts 170-178, will be determined for individual license applications and license amendments. The consequences of a liquid radwaste feed tank and/or evaporator failure releasing radioactive materials to the atmosphere and to a potable water

supply is also site and plant dependent, and will be evaluated for individual license or license amendment applications.

The acceptance for the Aztech product waste form is subject to the following limitations:

(1) Waste loadings are limited to those in Table A.

(2) The waste forms produced are limited to those made from the reactants specifically identified in the LTR as those used to prepare the test specimens on which the data were obtained.

(3) The maximum total radionuclide loading in the waste forms shall be such that the cumulative dosage to the waste form shall not exceed 100 Mrd.

(4) The waste forms shall be contained in 55-gallon steel drums.

Any licensing application incorporating this LTR by reference should include the following information:

(1) Any exceptions or deviations from the GE Licensing Topical Report, NEDE-30878, dated June 1985;

(2) Interfaces between the plant and the Aztech System;

(3) Location and layout drawings of the Aztech System in the plant;

(4) A waste classification program to demonstrate that the solid waste product is classified in accordance with 10 CFR 61, Section 61.55 and NRC Branch Technical Position on Waste Classification;

(5) A plant specific process control program (PCP); and

TABLE A

MAXIMUM PERMISSIBLE WASTE LOADINGS IN THE AZTECH PRODUCT

Waste	Maximum Permissible Loading-Weight %
Bead resins	40
Bead resins + 4% sodium sulfate	30
Sodium sulfate	50
Powdered resins	40
Oxidized powdered resins	60
Boric acid	50
Decon solution	40

(6) The capability of the plant radioactive waste treatment system to meet the requirements of Appendix I to 10 CFR Part 50 due to operation of the Aztech System.