# COMPARISON OF THE NUSPSC MOBILE RADWASTE PROCESSING SYSTEMS WITH THE GUIDELINES OF U.S. NRC REGULATORY GUIDE 1.143

Submitted to

DETROIT EDISON COMPANY

February, 1985

NUS Process Services Corporation
1501 Key Road
Columbia, South Carolina 29201

Prepared by:

Steven B. McCoy

Steven B. McCoy
Director
Support Services

Approved by:

Gerald P. Motl

Gerald P. Motl
General Manager

## I. INTRODUCTION

NUS Process Services provides mobile radwaste processing services to the nuclear power industry. These services include mobile solidification, filtration/ion exchange (TRANSFIX), radwaste transportation, liquid abrasive decontamination and radwaste disposal containers. The equipment used in these services is designed to be transported to the station, connected to the facility piping and begin processing operations in a relatively short period of time - usually in less than a week. Flexible hoses are typically used to connect the mobile equipment to plant systems to facilitate connection in a variety of plant layouts and piping configurations.

Mobile systems are often used to supplement or replace installed plant waste processing equipment for short to long time periods. Although it is recognized that U.S. NRC Regulatory Guide 1.143 provides design guidance for installed plant radioactive waste management systems, the regulatory guide provides a basis for the design of NUSPSC mobile systems as well. Due to the inherent differences between mobile and installed plant systems, deviation from some portions of Regulatory Guide 1.143 is considered necessary and justifiable. The regulatory guide is presented section by section with a comparison to NUSPSC design to assist the reviewer in evaluating these systems.

## II. COMPARISON

Regulatory Guide 1.143:

C. REGULATORY POSITION

1. SYSTEMS HANDLING RADIOACTIVE MATERIALS IN LIQUIDS

1.1 The liquid radwaste treatment system, including the steam generator blowdown system, downstream of the outermost containment isolation valve should meet the following criteria:

1.1.1 The systems should be designed and tested to requirements set forth in the codes and standards listed in Table 1 supplemented by regulatory positions 1.1.2 and 4 of this guide.

1.1.2 Materials for pressure-retaining components should conform to the requirements of the specifications for materials listed in Section II of the ASME Boiler and Pressure Vessel Code except that malleable, wrought or cast iron materials and plastic pipe should not be used. Materials should be compatible with the chemical, physical, and radioactive environment of specific applications during normal conditions and anticipated operational occurrences. Manufacturers' material certificates of compliance with material specifications such as those contained in the codes referenced in Table 1 may be provided in lieu of certified material test reports.

NUSPSC:

Referring to Table 1 of Regulatory Guide 1.143, pressure vessels are designed, fabricated and tested in accordance with ASME Section VIII, Division 1. Materials comply with ASME Section II and welding is performed by welders and welding procedures qualified to ASME Section IX.

Mobile atmospheric and 0-15 psig tanks, if employed, will be designed for the intended storage or processing service. Solidification and slurry dewatering liners, which could be considered atmospheric tanks, are designed to be compatible with industry standard radwaste shipping casks and are constructed of commercially procured carbon steel materials. Welders and welding procedures are qualified to ASME Section IX.

Heat exchangers, if employed, will be designed for the intended service and will be compatible with the fluids to be processed. Pressurized exchangers, e.g. liquid-liquid

exchangers, will be designed and fabricated in accordance with the applicable pressure vessel codes.

Piping and valves employed in NUSPSC solidification and TRANSFIX systems are commercially procured and of stainless steel construction. All welding is performed by welders and procedures qualified to ASME Section IX.

Pumps used in NUSPSC systems are commercially procured and of various materials compatible with the intended processing application.

Flexible, reinforced rubber hoses are not addressed by the regulatory guide, but are an important component of mobile processing systems. The use of hoses significantly reduces setup time and radiation exposure to personnel making connections to plant systems and mobile processing vessels and tanks. Hoses selected for use in NUSPSC systems are compatible with the physical and chemical composition of the waste to be processed. As a minimum, the hoses have a pressure rating equal to or greater than the system design pressure (pressure ratings for hoses are typically four times the burst pressure). All hoses are hydrotested in accordance with ANSI B31.1 to 1.5 times the system design pressure to verify the integrity of the hose and end-fittings.

Regulatory Guide 1.143:

1.1.3 Foundations and walls of structures that house the liquid radwaste system should be designed to the seismic criteria described in regulatory position 5 of this guide to a height sufficient to contain the maximum liquid inventory expected to be in the building.

1.1.4 Equipment and components used to collect, process, and store liquid radioactive waste need not be designed to the seismic criteria given in regulatory position 5 of this guide.

NUSPSC:

NUSPSC mobile equipment is installed in customer-owned plant facilities. Qualification of plant facilities to seismic criteria was considered in the plant design by the architect/engineer.

Regulatory Guide 1.143:

1.2 All tanks located outside reactor containment and containing radioactive materials in liquids should be designed to prevent uncontrolled releases of radioactive materials due to spillage in buildings or from outdoor tanks. The following design features should be included for such tanks:

1.2.1 All tanks inside and outside the plant, including the condensate storage tanks, should have provisions to monitor liquid levels. Designated high-liquid-level conditions should actuate alarms both locally and in the control room.

1.2.2 All tank overflows, drains, and sample lines should be routed to the liquid radwaste treatment system.

1.2.3 Indoor tanks should have curbs or elevated thresholds with floor drains routed to the liquid radwaste treatment system.

1.2.4 The design should include provisions to prevent leakage from entering unmonitored and nonradioactive systems and ductwork in the area.

1.2.5 Outdoor tanks should have a dike or retention pond capable of preventing runoff in the event of a tank overflow and should have provisions for sampling collected liquids and routing them to the liquid radwaste treatment system.

NUSPSC:

All NUSPSC atmospheric tanks and vessels have provisions to monitor liquid levels and to prevent runoff in event of a spill. The NUSPSC Radwaste Solidification system employs high and hi-hi level alarms which automatically shutoff waste flow to the liner in which the waste is to be solidified. In addition, the operating technician continously observes the liner level via a TV camera mounted in the fillhead during the waste transfer and chemical addition operations.

TRANSFIX systems are pressurized, thus level monitoring is unnecessary to prevent overflows. NUSPSC does recommend, however, that floor drains be provided to prevent spread of an inadvertent leak from the process area.

Regulatory Guide 1.143:

2. GASEOUS RADWASTE SYSTEMS

(Sections 2.1 through 2.1.3)

NUSPSC:

NUSPSC waste processing equipment is not designed to process radioactive gases. Liquid waste which may have originally contained gases, e.g. reactor coolant letdown, is stripped of gases before it is pumped to NUSPSC systems.

Regulatory Guide 1.143:

3. SOLID RADWASTE SYSTEM

3.1 The solid radwaste system consists of slurry waste collection and settling tanks, spent resin storage tanks, phase separators, and components and subsystems used to solidify radwastes prior to offsite shipment. The solid radwaste handling and treatment system should meet the following criteria:

3.1.1 The system should be designed and tested to the requirements set forth in the codes and standards listed in Table 1 supplemented by regulatory positions 3.1.2 and 4 of this guide.

3.1.2 Materials for pressure-r .aining components should conform to the requirements of the specifications for materials listed in Section II of the ASME Boiler and Pressure Vessel Code, except that malleable, wrought, or cast iron materials and plastic pipe should not be used. Materials should be compatible with the chemical, physical, and radioactive environment of specific applications during normal conditions and anticipated operational occurrences. Manufacturers' material certificates of compliance with material specifications such as those contained in the codes referenced in Table 1 may be provided in lieu of certified materials in test reports.

NUSPSC:

Refer to the previous discussion presented after paragraph 1.1.2 of the regulatory guide.

Regulatory Guide 1.143:

3.1.3 Foundations and adjacent walls of structures that house the solid radwaste system should be designed to the seismic criteria given in regulatory position 5 of this guide to a height sufficient to contain the maximum liquid inventory expected to be in the building.

3.1.4 Equipment and components used to collect, process, or store solid radwaste need not be designed to the seismic criteria in regulatory position 5 of this guide.

NUSPSC:

NUSPSC mobile equipment is installed in customer-owned plant facilities. Qualification of plant facilities to seismic criteria was considered in the plant design by the architect/engineer.

Regulatory Guide 1.143:

4. ADDITIONAL DESIGN, CONSTRUCTION, AND TESTING CRITERIA

In addition to the requirements inherent in the codes and standards listed in Table 1, the following criteria, as a minimum, should be implemented for components and systems considered in this guide.

4.1 Radioactive waste management structures, systems, and components should be designed to control leakage and facilitate access, operation, inspection, testing, and maintenance in order to maintain radiation exposures to operating and maintenance personnel as low as is reasonably achievable. Regulatory Guide 8.8 provides guidelines acceptable to the NRC staff on this subject.

NUSPSC:

All NUSPSC mobile processing equipment is designed and operated to ensure that the potential for spills and leakage is minimized and that radiation exposures to operating personnel are minimized in accordance with Regulatory Guide 8.8.

As stated previously, all pressure-retaining components, such as vessels and piping, are designed and fabricated in accordance with applicable codes. Thus, release of radioactive material resulting from the loss of system integrity is minimized through proper design. At the completion of fabrication, all pressure retaining components are hydrotested to 1.5 times the system design in accordance with ANSI B31.1. Whenever the system pressure boundary is broken (for example: a hose coupling is disconnected), the system is leak tested prior to reinitiating waste processing operations.

The potential for spills of waste slurries and concentrates during waste transfer operations to the Solidification System is minimized by level indication with high and hi-hi level alarms which automatically shut off waste transfer. A TV camera mounted in the fillhead allows the technician to remotely monitor the transfer operation.

Lead and concrete shields are provided to attenuate gamma radiation in vessels and liners which contain radioactive materials. The shields undergo testing by gamma scan at the time of manufacture to ensure a uniform density and verify the absence of voids which could be formed as a result of improper pouring.

The TRANSFIX dewatering system incorporates several features to prevent the release of radioactive material during normal dewatering operations or during an upset if a break in the system integrity should occur. During normal operation, air is pulled through a coalescer and a high-efficiency filter, removing particulates in the process. Vacuum is used in the dewatering process to prevent leakage of radioactive material from the dewatering system. If a line break occurs, inleakage of air to the system will occur. For added conservatism, the process area should be exhausted to a monitored HVAC system.

To protect against the unlikely event that a spill should occur, NUSPSC specifies that the solidification or TRANSFIX process area must be suitable to contain the material. Access to the area must be radiogically controlled. The area should be exhausted to a monitored HVAC system and the drains must be directed to the facility waste collection system. Curbs or other means to contain waste or resin spills are also required, especially where radioactive material could flow out of the process area to uncontrolled areas.

Regulatory Guide 1.143:

4.2 The quality assurance provisions described in regulatory position 6 of this guide should be applied.

NUSPSC:

Refer to the discussion on quality assurance provisions following paragraph C.6 of the regulatory guide.

Regulatory Guide 1.143:

4.3 Pressure-retaining components of process systems should use welded construction to the maximum practicable extent. Process systems include the first root valve on sample and instrument lines. Flanged joints or suitable rapid-disconnect fittings should be used only where maintenance or operational requirements clearly indicate that such construction is preferable. Screwed connections in which threads provide the only seal should not be used except for instrumentation and cast pump body drain and vent connections where welded connections are not suitable. Process lines should not be less than 3/4 inch (nominal). Screwed connections backed up by seal welding, mechanical joints, or socket welding may be used on lines 3/4 inches or larger but less than 3 1/2 inches. For lines 2 1/2 inches and above, pipe welds should be of the butt-joint type. Nonconsumable backing rings should not be used in lines carrying resins or other particulate material. All welding constituting the pressure boundary of pressure-retaining components should be performed in accordance with ASME Boiler and Pressure Vessel Code Section IX.

4.4 Piping systems should be hydrostatically tested in their entirety except (1) at atmospheric tanks where no isolation valves exist, (2) where such testing would damage equipment, and (3) where such testing could seriously interfere with other system or component testing. In the case of (2) and (3), pneumatic testing should be performed. Pressure testing should be performed on as large a portion of the in-place systems as practicable. Testing of piping systems should be performed in accordance with applicable ASME or ANSI codes. The system is acceptable if pressure is held for 30 minutes with no leakage indicated.

4.5 Testing provisions should be incorporated to enable periodic evaluation of the operability and required functional performance of active components of the system.

NUSPSC:

NUSPSC uses welded construction on pressure-retaining components to the maximum extent possible, and flanged and quick-connect fittings where necessary to reduce radiation exposure to operating personnel. The use of threaded connections on waste lines is minimized and used only where necessary to connect to plant piping and to join piping to pump connections. Process lines are 1 1/2 inch nominal diameter or greater. Welds are primarily of the butt-joint type and backing rings are not used in lines carrying resins or other particulate matter. All welding of piping and components constituting the pressure boundary is performed by welders and procedures qualified to ASME Section IX.

All NUSPSC system equipment is hydrotested in accordance with ANSI B31.1 at the completion of fabrication. Typical design pressures are 150 psig for NUSPSC systems, which are hydrotested for 30 minutes at 225 psig (1.5 times the design pressure). After assembly and prior to each waste processing operation at a customer site, the equipment is leaked tested to re-verify the system integrity.

Regulatory Guide 1.143:

5. SEISMIC DESIGN FOR RADWASTE MANAGEMENT SYSTEMS AND STRUCTURES HOUSING RADWASTE MANAGEMENT SYSTEMS

(Sections 5.1 through 5.3)

NUSPSC:

NUSPSC mobile equipment is installed in customer-owned plant facilities. Qualification of plant facilties to seismic criteria was considered in the plant design by the architect/engineer.

Regulatory Guide 1.143:

6. QUALITY ASSURANCE FOR RADWASTE MANAGEMENT SYSTEMS

Since the impact of the these systems on safety is limited, the extent of control required by Appendix B to 10 CFR Part 50 is similarly limited. To ensure that systems will perform their intended functions, a quality assurance program sufficient to ensure that all design, construction, and testing provisions are met should be established and documented. The following quality assurance program is acceptable to the NRC staff. It is reprinted by permission of the American Nuclear Society from ANSI N199-1976/ ANS-55.2, "Liquid Radioactive Waste Processing System for Pressurized Water Reactor Plants."

4.2.3 Quality Control. The design, procurement, fabrication and construction activities shall conform to the quality control provisions of the codes and standards specified herein. In addition, or where not covered by the referenced codes and standards, the following quality control features shall be established.

4.2.3.1 System Designer and Procurer

(1) Design and Procurement Document Control - Design and procurement documents shall be independently verified for conformance to the requirements of this standard by individual(s) within the design organization who are not the originators of the document. Changes to these documents shall be verified or controlled to maintain conformance to this standard.

(2) Control of Purchased Material, Equipment and Services - Measures to ensure that suppliers of material, equipment and construction services are capable of supplying these items to the quality specified in the procurement documents shall be established. This may be done by an evaluation or a survey of the suppliers' products and facilities.

(3) Handling, Storage, and Shipping - Instructions shall be provided in procurement documents to control the handling, storage, shipping and preservation of material and equipment to prevent damage, deterioration or reduction of cleanness.

4.2.3.2 System Constructor

(1) Inspection. In addition to required code inspections a program for inspection of activities affecting quality shall be established and executed by, or for, the organization performing the activity to verify conformance with the documented instructions procedures, and drawings for accomplishing the activity. This shall include the visual inspection of components prior to installation for conformance with procurement documents and the visual inspection of items and systems following installation, cleanness and passivation (where applied).

(2) Inspection, Test and Operating Status. Measures should be established to provide for the identi-fication of items which have satisfactorily passed required inspections and tests.

(3) Identifications and Corrective Action for Items of Nonconformance. Measures should be established to identify items of nonconformance with regard to the requirements of the procurement documents or applicable codes and standards and to identify the action taken to correct such items.

In Section 4.2.3.2(3), "items of nonconformance" should be interpreted to include failures, malfunctions, deficiencies, deviations, and defective material and equipment.

Sufficient records should be maintained to furnish evidence that the measures identified above are being implemented. The records should include results of reviews and inspections and should be identifiable and retrievable.

NUSPSC:

All mobile radwaste processing equipment is designed, fabricated and operated in accordance with strict quality assurance requirements as defined in the NUSPSC Quality Assurance Manual. This manual in conjunction with the quality assurance plan for radioactive packaging has been approved by the NRC (Docket No. 71-0496).

Design and procurement documents are independently reviewed and verified for conformance to applicable requirements. Changes to these documents are verified and controlled in accordance with established NUSPSC procedures.

Fabricators of major system components are evaluated and/or surveyed to ensure that the fabricators have the capability of providing the items to the specified quality. It is generally considered unnecessary to survey suppliers of commercially available materials, supplies, and items used in equipment fabrication.

Instructions for handling, storage and shipping are provided to suppliers where prudent to prevent damage, deterioration or reduction in cleanliness.

As required by project and procurement control documents, Quality Assurance inspection of purchased items and fabricated components is performed to verify conformance with purchasing and fabrication documents. Items which satisfactorily pass required inspections and tests are appropriately tagged to indicate acceptance.

Items of nonconformance are identified in accordance with NUSPSC quality assurance procedures. Documentation of the nonconformances and corrective actions taken are maintained.