UNC NUCLEAR INDUSTRIES

A UNC RESOURCES Company
P.O. Box 490
Richland, Washington 99352
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May 16, 1984

Mr. Cecil O. Thomas, Chief
Standardization & Special
Projects Branch
Division of Licensing
U.S. Nuclear Regulatory
Commission
Washington, D.C. 20555

Dear Mr. Thomas:

NRC REQUEST NUMBER ONE FOR ADDITIONAL INFORMATION ON UNC-S-8000(P)

Enclosure 1 states UNC's proposed resolutions to your April 5, 1984 comments and questions regarding UNC's Licensing Topical Report, UNC-S-8000(P), UNC Portland Cement/Sodium Silicate Radwaste Solidification System.

Enclosures 2, 3, and 4 provide supporting information for Enclosure 1.

UNC will revise and resubmit the subject Topical Report based on your review and approval of our enclosed proposed resolutions.

Please address further correspondence regarding this matter directly to me, as Mr. J. B. Mason is no longer employed with this company.

Very truly yours,

Roy E. Dunn

Roy E. Dunn
Programs Assistant
Operations Division

RED:klr

Enclosures (4)

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Drawings
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Enclosure 1

UNC's RECOMMENDED RESOLUTIONS TO NRC COMMENTS

ON TOPICAL REPORT UNC-S-8000(P)

UNC's REPLIES TO NRC's COMMENTS ON UNC NUCLEAR INDUSTRIES

TOPICAL REPORT ON RADWASTE SOLIDIFICATION SYSTEMS

(UNC Document No. UNC-S-8000, Vol. I & II, January 1983)

Comments and Replies

1. Comment: "Section 20.311 of 10 CFR 20 became effective on December 27, 1983, and it establishes requirements for the transfer of radioactive waste destined for disposal at a land disposal facility. Specifically, Section 20.311 requires, among other things, waste in the shipment to be classified in accordance with Section 61.55 of 10 CFR 61 and to be in a form which meets the requirements of Section 61.56 of 10 CFR 61.
   "State your current programs, if you have any, for how you intend to comply with these requirements and also assist your customers (utilities) for them to meet the requirements."

   Resolution: The subject Topical Report, published in January 1983, reflects an as-delivered equipment configuration that meets the performance requirements specified by UNC's customers (utilities). UNC has no current contractual arrangements with any of its radwaste system customers to provide ongoing engineering, design, or consulting services to assist them in meeting new and revised regulatory criteria for waste form and shipping.

2. Comment: "Provide a process flow diagram that gives more detail than Fig. 2-1. It should include, for example, waste feed control and temperature, and show how additives are introduced into the system."

   Resolution: UNC concurs. A representative Process Flow Diagram (UNC drawing No. 77203 for the RSS delivered to the Marble Hill Nuclear Station) is provided in Enclosure 2.

3. Comment: "Provide a complete piping and instrumentation diagram (P&ID) for the radwaste solidification system (RSS). Indicate on the P&IDs all interfaces required between the RSS and plant liquid, gaseous and ventilation systems."

   Resolution: UNC concurs. A representative P&ID (UNC drawing No. 77202 for the RSS delivered to the Marble Hill Nuclear Station) is provided in Enclosure 2. An accompanying valve list (UNC drawing No. 77279) is also included for NRC's convenience.

4. Comment: "Provide a typical layout of the UNC system (i.e., more comprehensive than Fig. 4-1). It should contain approximate room dimensions, shield wall thicknesses, locations of TV cameras, radiation monitors, overhead crane coverage, location of the capping and swipe testing station, etc. It should designate radioactive and non-radioactive areas."

   Resolution: UNC concurs. A representative set of arrangement drawings (UNC drawings 77204 and 77205 for the RSS delivered to the Marble Hill Nuclear Station) is provided in Enclosure 2.

5. Comment: "Page 2-5, First Paragraph.
   "Provide more information on filling the waste mix tank. For example, what control does the operator of the radwaste solidification system have on the type of waste coming into the waste mix tank? It is not clear whether the waste mix tank is operated in a batch mode (i.e., isolated from further waste feed) or a continuous mode. Is the waste mixer operated continuously? Please clarify."

   Resolution: UNC concurs. The subject paragraph will be revised to include more information on the operation of the waste mix tank and to clarify that the system is operated in a batch mode. In general, the waste mix tank is filled with waste using plant (utility) operating procedures. The appropriate plant waste stream (evaporator bottoms, filter sludge, etc.) is selected by aligning plant valves. After filling the waste mixing tank with the waste batch, but before starting the solidification process, the plant operator selects the waste stream on the RSS control panel, which automatically establishes conditions in the RSS control logic to produce the proper valve sequences, feed rates, etc. for that particular waste chemistry. The waste agitator is turned on and runs throughout the process. The process runs until the waste mix tank is empty, at which time the process stops and a flush sequence is initiated.

6. Comment: "Page 2-5, Section 2.1.3.
   "Is the 'waste mixing pump' the same as the 'process mixing pump' in Figure 2-1?"

   Resolution: Yes, they are the same component. UNC will revise the subject Topical Report to standardize nomenclature throughout. In this instance, the preferred nomenclature for the component in question is "process mixing pump."

7. Comment: "Page 2-6, Table 2-1.
"The units for 'Design Flow' and 'Pump Speed Range' should be provided."

Resolution: UNC concurs. The units of measure (gpm and rpm, respectively) will be provided.

8. Comment: "Page 2-9, First Paragraph.
"Is the 'waste-cement mixing pump' the same as the 'waste mixing pump' mentioned above and the 'process mixing pump' in Figure 2-1? Is the 'rubber-lined sleeve valve' the same as the 'cement pinch valve' in Figure 2-1? Is the 'mixing chamber' the same as the 'waste mix tank' in Figure 2-1? (The tendency throughout the report to use different names for the same component is confusing.)"

Resolution: UNC concurs. The report will be revised to use consistent nomenclature throughout. Note, however, that much of this apparent "inconsistency" is due to the fact that different delivered systems have different nomenclature for the same components, due to preferences (and in some cases requirements) expressed by the customers' architect-engineers. In reply to the specific questions above, the answer to each question is yes, except that the "mixing chamber" referred to in the subject paragraph is not the same as the "waste mix tank." In the subject paragraph, "mixing chamber" will be revised to read, "waste-cement mixing chamber of the process mixing pump."

9. Comment: "Page 2-10.
"In the first paragraph, what precautions are taken to mitigate the consequences of spilling or overflowing the radwaste container; e.g., a catch basin with a drain?
"In the third paragraph, is the 'waste mixing pump' the same as the 'process mixing pump' in Figure 2-1?"

Resolution: Catch basins, drains, etc., if used, would be customer-provided equipment and thus outside the scope of the subject Topical Report. UNC recommends that the customer provide some means for mitigating spillage, such as a catch basin, but does not recommend floor drains due to their tendency to clog. The RSS is provided with redundant, fail-safe overfill protection instruments within the waste container fillport, including a continuous-reading ultrasonic level monitor backed up by a contact-type detector. Further, if either of the level sensing instruments or their circuitry fails, an alarm is generated and the system automatically shuts down. Additionally, the fillport is equipped with a splash-proof flange that prevents radwaste from spattering around the radwaste container.

For the second part of the question, the answer is yes, the "waste mixing pump" and "process mixing pump" are the same component. (See resolution to comment No. 8, above.)

10. Comment: "Page 2-11, Section 2.2.1.
"Provide a list of all instruments, interlocks, and alarms which must be operational before processing radwaste. Note that Section C.1.2.1 of Regulatory Guide 1.143 requires both local and control room alarms for high-liquid-level conditions in tanks containing radioactive materials in liquids."

Resolution: UNC cannot provide a more specific list of all instruments, alarms, and interlocks because each system meets unique specifications. However, all UNC radwaste systems are equipped with standard process "permissives," which prevent system startup or operation if any condition develops that could result in radwaste spillage, component damage, or production of unsolidifiable product. These "permissives" are the process safety interlocks listed in paragraph 2.2.1. UNC will revise paragraph 2.2.1 to clarify that all of the safety interlocks, all of the sensing instruments that supply signals to the safety interlocks, control panel switch lineups, valve positions, and power distribution conditions must all be satisfactory before the system can be operated. It will be noted that manual bypass features are provided on some of these interlocks to facilitate system maintenance and troubleshooting, and that all systems are equipped with annunciator panels to inform operators of anomalous conditions (flow, temperature, pressure, level, power, etc.).

Terminal points are available to the customer for signal pickoff, so that he can monitor RSS operating parameters at local or remote control room stations. This would include waste tank and waste container high-level conditions.

11. Comment: Page 2-13, Section 2.3.2
"Discuss the swipe testing in more detail. How much of the container surface is covered? What guidelines are used? How are the results of the swipe testing used?"

Resolution: UNC concurs. More information will be provided in the subject paragraph. In general, all of the top of the container and 50% of the sides of the container can be covered by the swipe testing tool without moving the waste container. If it is necessary, the container can be rotated on the transfer cart using customer-supplied equipment so that the remainder of the container sides can be covered. It is not required to swipe the bottom of the container, since any smearable contamination deposition will occur during the filling and capping operation, which would affect the container top only. Criteria for acceptable smearable contamination are the customer's responsibility to interpret and use.

12. Comment: "Page 2-14, Section 2.3.4.
"Explain or elaborate on the 'inventory management and system control purposes' of the Radiation Monitoring System. Also, more detailed information is needed about this system. Include the basis for the types and ranges of instruments used, as well as any requirements for calibration and maintenance. The Radiation Monitoring System should be included in the Piping and Instrumentation Diagram. (See General Design Criteria 63 and 64 in 10 CFR 50). Near the end of the section, should 'columnating' be 'collimating?'"

Resolution: UNC concurs that the subject paragraph requires some clarification and elaboration, and the paragraph will be revised accordingly. Note, however, that the Radiation Monitoring System (RMS) is not an integral part of the RSS, but provided as additional equipment for some of UNC's customers. The type and range of instruments recommended by UNC are based on expected application, and always include a wider operational band than could reasonably be expected to be required. The 1×10^{-1} to 1×10^{7} mR/hr range identified in the subject paragraph provides an extremely wide range of coverage for the radwaste system -- under any anticipated normal or anomalous operating condition. Requirements for calibration and maintenance are covered in detail in the equipment instruction manuals provided with the system Operation & Maintenance Manual.

The Marble Hill Station did not order radiation monitors with their radwaste equipment. Therefore, UNC is providing a P&ID and arrangement drawing for the RSS provided to the Clinton Nuclear Station (Enclosure 3), which identify radiation monitors for the drum cappers and loadout area.

The radiation monitors provided by UNC meet design criteria 63 and 64 in Appendix A of 10 CFR 50. The equipment provided delivers a full range of capabilities required for the local monitoring and measurement of radiation fields in the radwaste solidification equipment modules and loaded radwaste containers. Note, however, that the customer is responsible for meeting the full range of 10 CFR 50 criteria.

The term "columnating" should read "collimating."

13. Comment: "Page 2-16, Section 2.4.1.
"In Item 2, is the 'waste mixing and dewatering tank' the same as the 'waste mix tank' in Figure 2-1?"

Resolution: Yes. See resolution to comment 6.

14. Comment: "Page 2-17, Item 3.
"How does the operator 'verify absence of any free-standing liquid in the waste container?' What observations does he make which enable him to make a judgement on the presence of free-standing liquid? Please list and discuss the specific criteria used by the operator for the solidified product."

Resolution: UNC does not feel that the subject paragraph should be expanded to include a further level of detail or explanation. The purpose of this paragraph is to identify the different steps in an operating sequence, and only the basic steps. To include "how to" instructions for each of the steps in this section would create an unwieldy and restrictive section. Detailed "how to" instructions for such procedures are developed by the customer in his own Process Control Procedures (PCPs), and are written to reflect the configuration of the actual installed system. In general, the operator verifies the absence of free-standing liquid by ensuring that the system is operated within the process parameters described in Section 3 of the Topical Report. Confidence in the process provides assurance that there will be no free-standing liquid in the solidified waste product. A gross error in formulation, or the presence of non-absorbable waste constituents would be visibly evident as free-standing liquid on top of the waste product surface. At the utilities discretion, validation of the product's dryness can be provided by: (1) direct visual inspection of uncapped drums, (2) inspection by closed-circuit television, and (3) destructive testing of filled and capped drums on a batch-sample basis.

15. Comment: "Page 2-19, Table 2-2.
"The data from this table should be extrapolated to show the capability of the UNC Radwaste Solidification System for handling the annual wastes from a full-size PWR or BWR. The table should also address the various types of radwaste that the system is capable of processing and how the processing rates differ for each type of waste."

Resolution: UNC concurs in part. Each delivered radwaste system was designed to accommodate the anticipated waste stream described in the customer's procurement specifications. Enclosure 4, page 3-2, shows the design basis annual volume for the two 1130-MWe PWR reactors at Marble Hill Units 1 & 2 to be 14,000 ft^3/yr. Recent research data (EPRI NP-3370, "Identification of Radwaste Sources and Reduction Techniques," January 1984) indicate the plant's waste output may be in the range of 21,000 ft^3/yr. Even so, the UNC RSS provided to Marble Hill can conservatively process 31,200 ft^3/yr working one shift per day (156 ft^3/day) operating 200 days/yr.

The processing rates do not differ appreciably for different waste products, so UNC feels that it is not necessary to address that matter in the subject Table.

16. Comment: "Page 2-21, Third Paragraph.
"Is the 'cement-waste mixing pump' the same as the 'processing mixing pump' in Figure 2-1, or the 'waste-cement pump' at the end of the last paragraph on page 2-21?"

Resolution: In each instance, the component being addressed is the "process mixing pump." See resolution to comment 6.

17. Comment: "Page 2-23, Section 2.5.3.
"There should be a commitment that the waste in unacceptable containers will be repackaged in containers meeting the requirements of 10 CFR 71."

Resolution: Exception. UNC feels that such a commitment is an appropriate requirement, but cannot be properly made by UNC for its customers in this Topical Report. We will, however, revise the subject paragraph to clarify the requirement and to specify compliance with "applicable regulations governing waste containers."

18. Comment: "Page 3-1, Process Control Program.

"The PCP needs to be discussed in more detail.

(a) How does the process operator decide upon and select the appropriate mix proportions of waste, cement and sodium silicate?

(b) What sampling is done on the plant radwaste to know what type of waste is to be processed?

(c) What sampling is done on the waste mix tank contents to assure the operator that he has selected appropriate setpoints for each batch of waste?

(d) For what range of variations in waste composition does a given set of setpoint values hold?

(e) How does this process handle oil in the waste?

(f) Who determines if additives for pH adjustment are required in the waste mix tank? How are the amounts determined? How are they added?

(g) The word "laboratory" is used throughout the report. It is not clear whether a plant chemistry lab is being referred to or a UNC laboratory.

(h) What records are to be maintained on the sampling process and the results?"

18 (continued)

Resolution: UNC recommends the following actions:

(a) Add a statement to paragraph 3.1 indicating that the RSS automatically sets itself for the correct mix proportions when the system operator selects the desired waste stream. Mix proportions are automatically set by the programmed system logic, which selects the correct pump motor speed settings to produce the desired process mix ratios.

(b) No change to the Topical Report is recommended. Sampling to identify waste type is required by 10 CFR 20 - 10 CFR 60, but compliance is a customer responsibility. The radwaste system receives plant wastes from several discreet sources. Sampling is done according to plant procedures.

(c) No change to the Topical Report is recommended. UNC-provided radwaste systems do not include waste mix tank sampling equipment; such equipment and procedures are customer-provided.

(d) No change to the Topical Report is recommended. Volume II of the subject Topical Report provides detailed information on process formulations. Figures 3-1 and 3-2 in Volume II illustrate the successful ranges of waste mixes for both PWR and BWR waste products.

(e) Small quantities of oil may reasonably be expected to be present in LWR waste streams. The RSS process formulations have been laboratory tested for their ability to successfully solidify oil. The RSS performed very well in solidifying up to 1/4-gallon of oil per 50 gallons of waste product using a variety of other waste products representative of PWR and BWR waste streams. The Topical Report will be revised to include mention of the RSS ability to solidify small quantities of oil in normal waste solutions (Volume I, paragraph 3.1.1).

(f) No change to the Topical Report is recommended. pH sampling and correction are done using plant-supplied procedures. UNC does not provide pH sampling equipment as a normal part of its RSS, but has provided such hardware along with general operating procedures with those systems where required by customer specifications. Customers will develop and use their own detailed procedures and criteria for pH sampling and correction.

(g) UNC will specify either "plant chemistry laboratory" or "UNC laboratory" throughout the report.

(h) No change to Topical Report is recommended. Such records would be administratively controlled by the customer's own procedures.

19. Comment: "Page 3-9, Section 3.1.6.
"It is stated that, 'periodic tests of the liquid wastes are specified to establish that waste compositions remain within solidification limits.' This should be clarified to show that the PCP meets the RETS requirement in Section 4.11.3 of NUREG-0472 and NUREG-0473 that the PCP 'shall be used to verify the solidification of at least one representative test specimen from at least every tenth batch of each type of wet radioactive waste.' A general description of the verification procedure should be included in the PCP.

"What acceptance criteria have been established for the final waste product? What actions are taken if the acceptance criteria are not met?"

Resolution: UNC does not concur. The PCP is a customer-generated, customer-used document. It is the customer's responsibility to ensure that the use of the installed radwaste system meets all current and applicable regulatory requirements for waste form, effluent control, and quality verification. UNC provides with each delivered system a detailed Operation & Maintenance Manual containing a system physical description, process flow description, functional description, and detailed, step-by-step operating instructions. It is assumed that the customer will utilize this information in developing his PCP for system operation.

As to waste product acceptance criteria and actions taken if the criteria are not met, UNC does not feel that it would be appropriate to include such potentially restrictive requirements in this Topical Report, particularly since such guidance is outside the scope of our contractual agreements with all of our commercial customers. The acceptance criteria for the final solidified product are the regulatory requirements in force at the time that UNC's equipment delivery contracts were enacted. Those regulatory requirements are listed in Section 7 of the subject Topical Report. If the UNC-provided process parameters (Section 3 of Topical Report) are met, the waste product will reflect the definition of successful SOLIDIFICATION stated on page 103 of NUREG-0472/0473; i.e., a homogeneous, monolithic, free-standing, immobilized solid, with no free-standing liquid. If the process parameters are not maintained, then the waste form may not meet the acceptance criteria for shipment. In that case, the customer must select an appropriate disposition mode for the unacceptable waste, which could be reprocessing the waste, overpacking in high-integrity containers (HICs), or any method that is considered cost-effective by the customer and meets prevailing regulatory requirements.

20. Comment: "Page 3-9, Section 3.1.7
"The second paragraph states that the character of wastes 'must be determined on a case basis.' What constitutes a 'case?' Please provide a more specific description of what constitutes 'unusual' waste in contrast to usual or normal waste."

Resolution: UNC concurs. Will delete phrase "on a case basis," and define "unusual wastes" as meaning "waste substances not specifically identified in the equipment procurement specifications and anomalous concentrations of normally present waste substances."

21. Comment: "Page 4-1, Item 3
"Is the cement day tank mentioned here and in Figure 4-1 the same as the 'surge hopper' in Figure 2-1?"

Resolution: In some systems, this component is called a surge hopper (see Marble Hill P&ID), and in others it is called a cement day tank. UNC feels that the preferred term for purposes of the Topical Report would be "surge hopper." The text will be revised to use this term consistently.

22. Comment: "Page 4-4, First paragraph
"Discuss requirements for a concrete pad with drainage to accommodate spills or leakage. Also see Regulatory Guide 1.143, Section C.1.2.2, 3, and 4."

In the third paragraph, is the 'cement live bin feeder' the same as the 'screw feeder' in Figure 2-1?"

Resolution: Equipment and facilities such as concrete pads and drains would be customer-provided equipment. See resolution to comment 9, above.

The cement live bin feeder is the same component as the surge hopper in Figure 2-1. Text will be revised accordingly.

23. Comment: "Page 4-7, Table 4-1
"The basis for the estimated exposures should be described in more detail. The maximum activity and radionuclide mix expected in the radwaste over the life of the plant should be considered."

Resolution: UNC concurs. Additional information about the dose rates, the types and quantities of radionuclides involved in typical PWR and BWR waste streams, and dose rate buildup over time will be discussed in a revised paragraph 4.2.1.

24. Comment: "Page 5-1, Section 5.2.
"Discuss provisions for operating this system in sub-freezing weather, including the manual flushing operation, or is the entire system contained in a temperature-controlled building? (Section 5.2.19.3 on page 5-27 refers to the 'heat-traced waste mixing tank and process piping,' but the purpose of the heat-tracing is not discussed.)"

Resolution: No provisions are made for sub-freezing weather operation because all delivered process lines have been specified for an indoor, temperature-controlled environment. As indicated in paragraph 5.2.1.1, the heat tracing on the waste mixing tank keeps waste solution temperature above 140°F to prevent precipitation of salts and to improve process performance. Paragraph 5.2.1.1 will be revised to include mention of heat tracing on the tank outlet line, and a reference to paragraph 5.2.1.1 will be added to paragraph 5.2.19.3.

25. Comment: "Page 5-8, Section 5.2.3.
"Is the 'cement day tank' the same as the 'surge hopper' in Figure 2.1? Is the 'live bin feeder' the same as the 'screw feeder' in Figure 2.1?"

Resolution: See resolution to comment 21, above.

26. Comment: "Page 5-11, Section 5.2.5.
"Is the 'live bin' the same as the 'surge hopper' in Figure 2.1?"

Resolution: See resolution to comment 21, above.

27. Comment: "Page 5-12, Section 5.2.6.
"Provide a more detailed description of the waste containers. What quality control requirements are placed on the suppliers of these containers? Provide evidence that the containers meet applicable requirements of 10 CFR 71."

Resolution: Exception. Selection, use, and handling of low-level radioactive waste containers is the customer's responsibility, and not within the scope of the subject Topical Report.

28. Comment: "Page 7-2.
"Branch Technical Position ETSB 11-3, used by this reviewer was Revision 2 dated July 1, 1981."

Resolution: UNC feels that the Topical Report should not be changed. The Report, as written, reflects only equipment that was designed and fabricated for the July 1, 1981 Revision 2 date. The 1975 revision of ETSB 11-3 is properly cited in Section 7 of the Report.

29. Comment: "Page 7-5, 10 CFR 50
"What is meant by VR-20? Is the phrase 'as low as practicable' intended to mean 'as low as is reasonably achievable?'"

Resolution: The term "VR-20" is a typographical error, and will be deleted. The affected sentence will be revised to read, "...release of radioactive materials in effluents will be maintained as low as reasonably achievable (ALARA), and will be well within the numerical guidelines specified in Appendix I to 10CFR50.36a."

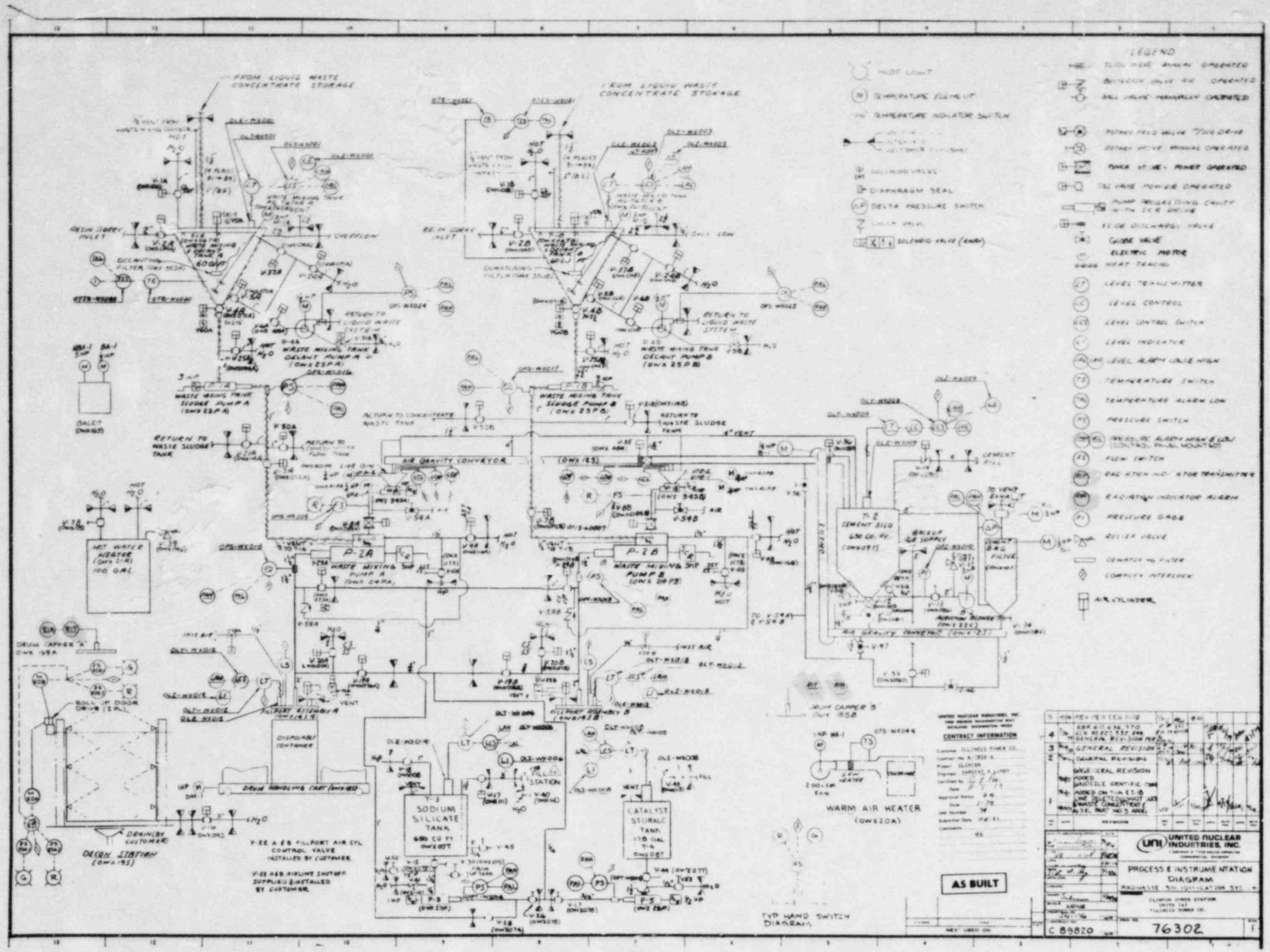
30. Comment: "Page 7-8, Regulatory Guide 8.8
"Revision 3 (June 1978) of Regulatory Guide 8.8 uses the phrase 'as low as is reasonably achievable' rather than 'as low as practicable.' Similar comment on Regulatory Guide 8.10."

Resolution: UNC concurs. "ALARA" is now the accepted phrase throughout the industry. The subject Topical Report will be revised to used the term ALARA consistently.

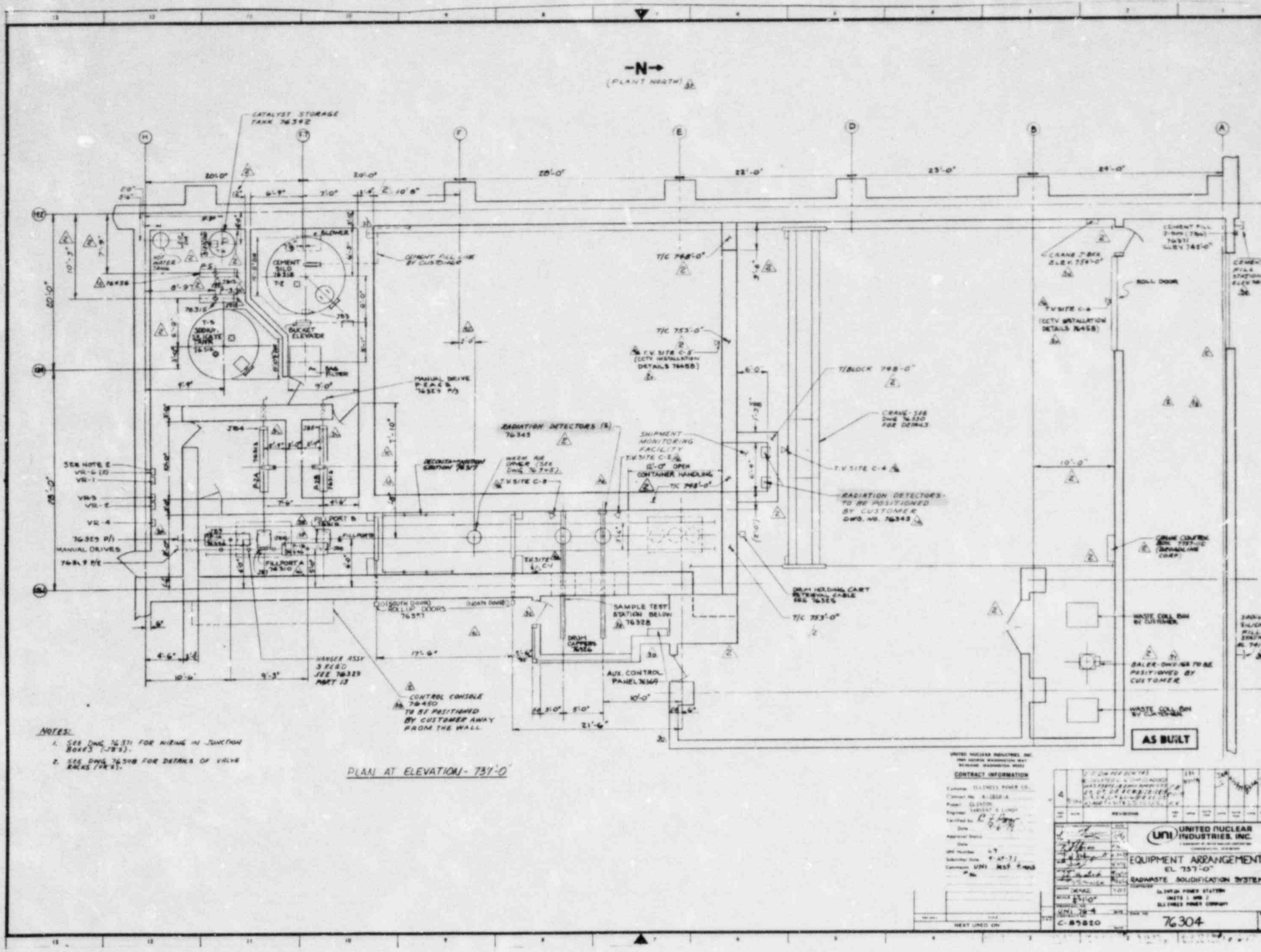
ENCLOSURE 3

ENGINEERING DRAWINGS SHOWING RADIATION MONITORS INSTALLED WITH A UNC RADWASTE SYSTEM

UNC Drawing No.	Title
76302	Process and Instrumentation Diagram
76304	Equipment Arrangement


LEGEND
FROM LIQUID WASTE CONCENTRATE STORAGE
RESIN SLURRY INLET
OVERFLOW
WASTE MIXING TANK DECANT PUMP A (OWX 25PA)
WASTE MIXING TANK DECANT PUMP B (OWX 25PB)
WASTE MIXING TANK SLUDGE PUMP A (OWX 23PA)
WASTE MIXING TANK SLUDGE PUMP B (OWX 23PB)
RETURN TO LIQUID WASTE SYSTEM
RETURN TO CONCENTRATE WASTE TANK
RETURN TO WASTE SLUDGE TANK
AIR GRAVITY CONVEYOR
P-2A
WASTE MIXING SHIP PUMP A (OWX 24PA)
P-2B
WASTE MIXING SHIP PUMP B (OWX 24PB)
HOT WATER HEATER (OWX 21A) 100 GAL
T-2 CEMENT SILO 650 CU. FT. (OWX09T)
CEMENT FILL
AIR CYLINDER
DISPOSABLE CONTAINER
DRUM HANDLING CART
DECON STATION (OWX 19S)
DRAIN (BY CUSTOMER)
T-3 SODIUM SILICATE TANK 650 CU FT OWX 05T
CATALYST STORAGE TANK 118 GAL T-4 OWX 06T
FILL STATION
WARM AIR HEATER (OWX 20A)
DRUM CAPPER "A" OWX 15SA
DRUM CAPPER "B" OWX 15SB
TYP HAND SWITCH DIAGRAM
V-22 A & B FILLPORT AIR CYL CONTROL VALVE INSTALLED BY CUSTOMER
V-23 A&B AIRLINE SHUTOFF SUPPLIED & INSTALLED BY CUSTOMER
CONTRACT INFORMATION
AS BUILT
UNITED NUCLEAR INDUSTRIES, INC.
PROCESS & INSTRUMENTATION DIAGRAM
RADWASTE SOLIDIFICATION SYS.
CLINTON POWER STATION UNITS 1&2 ILLINOIS POWER CO.
C 89820
76302

81105.1


-N→
(PLANT NORTH)
CATALYST STORAGE TANK 76342
CEMENT SILO
BUCKET ELEVATOR
CEMENT FILL LINE BY CUSTOMER
MANUAL DRIVE
RADIATION DETECTORS
SHIPMENT MONITORING FACILITY
T.V. SITE C-4
RADIATION DETECTORS TO BE POSITIONED BY CUSTOMER DWG. NO. 76343
CRANE-SEE DWG 76330 FOR DETAILS
T/BLOCK 748'-0"
CCTV INSTALLATION DETAILS 76458
ROLL DOOR
CEMENT FILL STATION
DRUM HOLDING CART
SAMPLE TEST STATION BELOW 76328
AUX. CONTROL PANEL
CONTROL CONSOLE 76450 TO BE POSITIONED BY CUSTOMER AWAY FROM THE WALL
HANGER ASSY
SEE NOTE 2
MANUAL DRIVES
WASTE COLL. BIN BY CUSTOMER
BALER-OWENS TO BE POSITIONED BY CUSTOMER
AS BUILT
NOTES:
1. SEE DWG 76371 FOR WIRING IN JUNCTION BOXES (JB'S).
2. SEE DWG 76348 FOR DETAILS OF VALVE RACKS (VR'S).
PLAN AT ELEVATION - 737'-0"
CONTRACT INFORMATION
UNITED NUCLEAR INDUSTRIES, INC.
EQUIPMENT ARRANGEMENT EL 737'-0"
RADWASTE SOLIDIFICATION SYSTEM
CLINTON POWER STATION
ILLINOIS POWER COMPANY
76304
C-89820
NEXT USED ON

81105.3

ENCLOSURE 4

WASTE CHARACTERISTICS FOR A REPRESENTATIVE PWR POWER PLANT

(Excerpt from Sargent & Lundy Procurement Specification Y-2772, for purchase of the Marble Hill Station Radwaste Solidification and Handling System.)

301.9 All equipment shall possess safety features and devices which shall prevent potentially hazardous situations from developing and protect materials and components in a fail-safe manner. Malfunction alarms shall be annunciated on the local console(s) annunciator.

301.10 All equipment mountings shall have provision for floor anchoring at the plant site.

301.11 Ventilation and drain systems will be provided for all areas, where required, by the Purchaser, except that the Contractor shall provide for clean up of air that becomes or might become dust laden during process. The ventilation and drain systems provided by the Purchaser will be designed to handle radioactive effluents (liquids and gases) including decontamination fluids. Vents emanating from process equipment shall not be dust laden or in excess of 50% relative humidity. Pump bedplate drains, equipment and other drains shall be free flowing at ambient conditions, i.e., less than 100 SSU viscosity. Otherwise, the Contractor shall furnish a separate system for collecting and processing such drains.

301.12 Machinery shall be given one shop coat of standard machinery gray paint prior to shipment. Carbon steel pipe and vessels shall have exterior surfaces hand cleaned by Method 3, Form 1790, and primed and painted in accordance with Table 90-2 of Form 1790. Stainless steel pipe and vessels shall not be painted.

302. <u>DRUMMING REQUIREMENTS AND DESIGN PARAMETERS</u>

302.1 Contractor shall furnish at least two drumming facilities for packaging evaporator concentrates and demineralizer resins in standard metal 55-gal. drums or any other proposed waste containers that meet all the requirements of 49 CFR 178. Contractor shall specify the most efficient container for his system. In addition, Contractor shall also furnish a drumming station for spent filter element assemblies. The following are the total wastes expected:

		Design Basis Annual Volume	Normal Daily Rate	Max. Daily Rate
a.	Evaporator Concentrates	100,000 gal.	300 gal.	2200 gal.
b.	Demineralizer Resins	465 ft^3	0	100 ft^3
c.	Filter Element Assemblies	350 ft^3	0	60 ft^3

302.2 It may be assumed that the maximum daily rate of evaporator concentrates will not be coincident with the maximum daily rates indicated for the other wastes. The maximum daily rates indicated for demineralizer resins and filter assemblies, however, shall all be assumed to be coincident with the normal indicated daily rate for evaporator concentrates. The equipment shall be expected to operate continuously at full capacity with maximum reliability and integrity.

302.3 The evaporator concentrates shall consist mainly of three types of operation:

a. Normal nonradioactive steam generator blowdown (Article 302.11 below).

b. Radwaste drains and regenerants (Article 302.12 below).

c. Radioactive steam generator blowdown (Article 302.14 below).

302.4 In all, there are five evaporators (includes two Boric Acid Recycle Evaporators supplied by Westinghouse). The concentrates to be drummed will come from all five evaporators via the concentrates tank.

302.5 The evaporators are located directly above the drum fill area at Elevation 401 ft.-0 in. in the Auxiliary Building as shown on Consulting Engineers' Drawing M-8.

302.6 The slurry densifier associated with each radwaste evaporator will have a 2 in. line and valve at the discharge piping from the slurry densifier recirculation pumps. The Contractor shall furnish and mount on the control console, a hand switch for operating the 2 in. solenoid actuated, air operated valve furnished by others.

302.7 Of the three waste evaporators, two will normally process nonradioactive steam generator blowdown and shall be henceforth referred to as the Blowdown Evaporators. The one called the Radwaste Evaporator, will normally process chemical drains, floor and equipment drains, and spent regenerants. All three evaporators will, however, be cross-tied for back-up purposes.

302.8 If the wastes are low in radioactive content such that the radioactive drumming criteria are not exceeded, the concentrates may be concentrated to a 50% by weight crystalline slurry. This slurry will consist of a magma (precipitated matter) and a saturated liquid phase. The slurry will be drummed from the concentrates holding tank.

302.9 The three evaporators will retain the capability of discharging the concentrates into one Purchaser supplied concentrates tank at less than 20% by weight solids, preferably before any solid precipitation. This feature will be exercised whenever there is danger of massive solidification in the evaporators due to loss of heating steam, failure of the recirculation pump, etc., or whenever the radioactive content of the bottom is in danger of exceeding drumming limits.

302.10 The Concentrates tank shall be located at elevation 419 ft-0 in. directly above the drum fill area. The wastes from this tank may be drummed directly or returned to the evaporator for further thickening. If drummed, the slurry shall be pumped into the drum fill station beneath. It is expected that these wastes will be at a concentration ranging from 10% to 20% by weight, which is below the solubility limit at the slurry temperature.

302.11 The nonradioactive steam generator blowdown concentrates will have the following composition:

SiO_2	4000 ppm
chloride	600 ppm
suspended solids	4000 ppm
NH_3	trace
others	5000 ppm

302.12 The concentrates from the Radwaste Evaporator shall consist mainly of the following: Na_2SO_4, $Na_2B_4O_7$, H_3BO_3, plus traces of hydrazine, potassium chromate and dichromate, lithium hydroxide, ammonium hydroxide, alkali hydroxide, and hydrochloric acid.

302.13 The proportion of main constituents Na_2SO_4, Na_2HPO_4, $Na_2B_4O_7$, and H_3BO_3 will depend on the amounts of each of the feed streams into the evaporator.

The Na_2SO_4 will be mostly from the spent demineralizer regenerants.

The H_3BO_3 will be from Auxiliary Building drains while the $Na_2B_4O_7$ will be from the chemical reaction of the boric acid with basic substances in the wastes. Chloride content in the concentrates may reach 600 ppm.

302.14 In the case of a 1 gal/min. steam generator primary to secondary leak, the blowdown through the evaporators will be increased to capacity for a period of 14 days. It is during this time when the load to the drumming station will be maximum, but the discharge of concentrates from the Radwaste Evaporator is assumed not to be perturbed by the leak. For this purpose, the drumming station shall be capable of drumming 2200 gal. of concentrates per day.

302.15 Blowdown concentrates under leak conditions will contain $Na_2B_4O_7$ at its solubility limits. It is not expected that the radioactive contents of these wastes will allow drumming at a higher concentration.

302.16 As a guide, Exhibit "A" tabulates the isotopic activity levels of the evaporators in µCi/cc.

EXHIBIT "A": CONCENTRATE ISOTOPIC ACTIVITY LEVELS ($\mu Ci/CM^3$)

ISOTOPE	CONCENTRATES HOLDING TANK
H-3	1.54×10^{-1}
Br-84	7.83×10^{-4}
Rb-88	3.79×10^{-2}
Rb-89	9.74×10^{-4}
Sr-89	9.00×10^{-4}
Sr-90	4.92×10^{-4}
Sr-91	5.67×10^{-4}
Sr-92	6.70×10^{-5}
Y-90	5.29×10^{-4}
Y-91	1.67×10^{-2}
Y-92	1.50×10^{-4}
Zr-95	1.88×10^{-3}
Nb-95	1.95×10^{-3}
Mo-99	6.75
I-131	5.00
I-132	4.19×10^{-1}
I-133	2.31
I-134	1.35×10^{-2}
I-135	4.70×10^{-1}
Te-132	3.59×10^{-1}
Te-134	6.96×10^{-4}
Cs-134	8.65×10^{-1}
Cs-136	3.40×10^{-1}
Cs-137	4.35
Cs-138	1.81×10^{-2}
Ba-140	9.70×10^{-3}
La-140	7.97×10^{-3}
Ce-144	9.70×10^{-3}
Pr-144	9.70×10^{-3}
Mn-54	2.22×10^{-3}
Mn-56	2.54×10^{-3}
Co-58	7.04×10^{-2}
Co-60	2.18×10^{-3}
Fe 59	2.89×10^{-3}
Cr-51	2.41×10^{-3}

302.17 The exhausted demineralizer resins to be drummed shall be collected in the 5000 gal. Spent Resin Storage Tank located at Elevation 426 ft-0 in. in the Auxiliary Building, as shown on the Consulting Engineers' Drawing M-7. The resins are generally of the strong-base anion and strong-acid cation type, with quaternary ammonium or nuclear sulfonic functional groups on a polystyrene matrix.

302.18 Expected isotopic activity levels are listed for each demineralizer resin in Exhibit B, along with the annual volume of each resin to be drummed. All resins may be held in the 5000 gal. spent resin storage tank for 90 days prior to drumming, in which case the activity level will be somewhat lower than as listed in Exhibit B. The resins may be drummed individually if it is advantageous to separate low level resins from high level resins.

302.19 The spent resin flow to the drum fill area will be 33% (by volume) resin beads. Spent resins shall be dewatered before solidification. Dewatering can take place before, during or after filling of the drum with the spent resins. The amount of dewatering shall depend upon the solidification process to be used. A centrifuge shall not be used for dewatering. Dewatered fluid shall be returned to the spent resin tank.

302.20 The filter elements and baskets to be drummed are positioned in cubicles at various locations below Elevation 401 ft.-0 in. in the Auxiliary Building. These elements and baskets will be transported in a shielded container to the filter handling area of the container fill area where they will be loaded into containers. Contractor shall furnish this shielded filter transfer vehicle as described in Article 304.2 below.

302.21 When the assembly is not radioactive, only the filter elements will be encapsulated while the filter baskets shall be reused. When radioactive, the entire assembly will be drummed. The Exhibit "C" gives the curie content of the various filters upon disposal.

302.22 The containers may be pre-filled around all sides (up to the top) and on bottom with from 3 to 6 in. of concrete before filter loading. The prefilling will be done either in the cement mixing room or at the filling station to be hereinafter specified.

302.23 The filter elements as received in the filter handling areas will be wet but will not require dewatering. After loading in the pre-filled container, the filter elements or baskets shall be completely encapsulated in concrete. The final solidified product shall be able to retain its shape after disintegration of the container.

EXHIBIT "B": RESIN ISOTOPIC ACTIVITY LEVELS (MCI/CM3)

	SPENT FUEL PIT MIXED BED 60 ft^3/yr	RADWASTE MIXED BED 65 ft^3/yr	LET DOWN MIXED BED 60 ft^3/yr	LET DOWN CATION UNIT 40 ft^3/yr	THERMAL REGENERATION DEMINERALIZER 140 ft^3/yr	CVCS EVAP. FEED ION EXCHANGER 60 ft^3/yr	CVCS EVAP. COND. DEMIN. 40 ft^3/yr
BR-84		.258588-20	.518609+01	.000000	.444522-01	.179306-01	.119425-07
RB-88		.347889-29	.446245+03	.569675+01	.000000	.154287+01	.000000
RB-89		.165813-34	.132667+02	.169363+00	.000000	.458691-01	.000000
SR-89		.334604-05	.465858+03	.131069+02	.000000	.574361+02	.000000
SR-90		.630557-08	.258785+01	.856162-01	.000000	.437356+00	.000000
SR-91		.874818-09	.279124+00	.356329-02	.000000	.965057-03	.000000
SR-92		.260600-11	.893979-01	.114125-02	.000000	.309088-03	.000000
Y-91		.112150-07	.862672+01	.249155+00	.000000	.111991+01	.000000
Y-92		.775149-13	.265912-02	.339462-04	.000000	.919377-05	.000000
ZR-95		.213888-07	.356345+01	.103141+00	.000000	.466441+00	.000000
N8-95		.214264-07	.374930+01	.109906+00	.000000	.502939+00	.000000
I-131	.182+03	.428622-04	.297443+04	.000000	.249558+02	.699586+02	.458741-04
I-132		.687246-07	.112474+03	.000000	.963979+00	.396393+00	.123347-05
I-133		.699096-05	.881761+03	.000000	.755796+01	.304873+01	.144705-04
I-134		.906496-14	.723641+02	.000000	.620263+00	.250195+00	.383833-06
I-135		.440507-06	.290498+03	.000000	.248998+01	.100438+01	.426702-05
TE-132		.218781-05	.156393+03	.000000	.133787+01	.784991+00	.264751-05
TE-134		.862474-17	.349760+01	.000000	.299794-01	.120928-01	.138136-07
CS-134	.186+01	.108742-04	.000000	.133820+04	.000000	.678968+03	.000000
CS-136		.320841-05	.000000	.461105+02	.000000	.109317+02	.000000
CS-137	.57+01	.556344-04	.000000	.755229+04	.000000	.385790+04	.000000
CS-138		.589341-19	.000000	.150887+02	.000000	.408652+00	.000000
BA-140		.914232-07	.693229+01	.130151+00	.000000	.304655+00	.000000
LA-140		.171853-07	.134077+01	.233544-01	.000000	.466706-01	.000000
CE-144		.910002-08	.943976+00	.000000	.000000	.843971-01	.000000
PR-144		.377106-11	.413805-01	.000000	.000000	.176693-03	.000000
MN-54		.212349-07	.222626+01	.541877-01	.000000	.201723+00	.000000
MN-56		.105649-09	.362424+01	.462669-01	.000000	.125306-01	.000000
CO-58	.42+01	.803589-06	.141388+03	.414809+01	.000000	.190035+02	.000000
CO-60		.283081-07	.112254+02	.370389+00	.000000	.188738+01	.000000
FE-59		.319340-07	.426870+01	.115562+00	.000000	.488213+00	.000000
CR-51		.255995-07	.263193+01	.633805-01	.000000	.232610+00	.000000
TOTAL ACTIVITY LEVEL (MCI/CM3)	.193+03	.126703-03	.561549+04	.897616+04	.380003+02	.470749+04	.689022-04

Note: Numbers are in exponential format hence, .193+03 means 193.0

EXHIBIT "C": SUMMARY DISPOSABLE FILTER ELEMENT ISOTOPIC INVENTORIES

SERVICE AND ISOTOPIC INVENTORY IN CURIES

NUCLEAR STEAM SUPPLY SYSTEM FILTERS (INVENTORIES LISTED ARE FOR TWO FILTERS)

ISOTOPE	REACTOR COOLANT	SEAL WATER RETURN	SPENT FUEL PIT	SPENT FUEL PIT SKIMMER	SEAL WATER INJECTION	RECYCLE EVAPORATOR FEED	RECYCLE EVAPORATOR CONCENTRATES	RECYCLE EVAPORATOR CONDENSATE
I-131								$4.30x10^{-2}$
I-132								$2.0x10^{-4}$
I-133								$8.2x10^{-3}$
I-134								$5.0x10^{-3}$
I-135								$1.42x10^{-3}$
Co-58	17.8	3.56	3.56	3.56	2.34	3.56	$4.4x10^{-2}$	
Co-60	3.62	.72	.72	.72	.46	.72	$9.0x10^{-3}$	
Cs-134	3.92	.78	.78	.78	.52	.78	$9.6x10^{-3}$	
Cs-137	19.56	3.92	3.92	3.92	2.58	3.92	$4.8x10^{-2}$	

LIQUID RADWASTE FILTERS

INVENTORIES LISTED ARE PER FILTER

ISOTOPE	S.G. BLOWDOWN	CHEMICAL DRAINS	DEMINERALIZER REGENERANT WASTE DRAINS	TURBINE BLDG. FLOOR DRAINS	AUXILIARY BLDG. EQUIPMENT DRAINS	AUXILIARY BLDG. FLOOR DRAINS	LAUNDRY WASTES
I-131				10^{-5}			
I-132							
I-133							
I-134							
I-135							
Co-58	.132	1.78	.0132		1.78	.178	$1.78x10^{-6}$
Co-60	.0278	.362	.00278		.362	.0362	$3.62x10^{-7}$
Cs-134	.03	.392	.003		.392	.0392	$3.92x10^{-7}$
Cs-137	.150	1.956	.015		1.956	.1956	$1.96x10^{-6}$

ENCLOSURE 2

ENGINEERING DRAWINGS FOR THE MARBLE HILL STATION

RADWASTE SYSTEM

UNC Drawing No.	Title
77202	Process & Instrumentation Diagram
77203	Process Flow Diagram
77204	General Arrangement Process Equipment, Elevation 383'0"
77205	General Arrangement and Piping, Storage Area, Elevation 397'0"
77206	Tunnel Arrangement
77207	Waste Mixing Tank T-1A & T-1B Assembly and Details
77279	Valve List