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May 12, 1989 4410-89-L-0040/013&P

US Nuclear Regulatory Commission Attn: Document Control Desk Washington, DC 20555

Dear Sirs:

Three Mile Island Nuclear Station, Unit 2 (TMI-2) Dperating License No. DPR-73 Docket No. 50-320 Defueling Water Cleanup System Technical Evaluation Report, Revision 12

Pursuant to NRC letter dated February 4, 1980, attached for your information is the annual update to the Technical Evaluation Report (TER) for the Defueling Water Cleanup System (DWCS). This update addresses system modifications effected via approved design modification documents identified in the Summary of Change Section and deletes references to the Submerged Demineralizer System which is no longer in operation. The following changed pages are:

o DWCS TER, Pages 1 through 25;

- o DWCS TER, Attachment 1, Pages 7 and 10; and
- o DWCS TER, Attachment 2, Pages 2, and 6 through 25.

Additionally, this revision includes revised drawings 2-M74-OWCO2 and 2D-3525-1188 (Attachments 4 and 8, respectively).

Sincerely,

MBRide

M. B. Roche Director, TMI-2

RDW/emf

Attachments

cc: F. I. Young - Senior Resident Inspector, TMI
W. T. Russell - Regional Administrator, Region I
J. F. Stolz - Director, Plant Directorate I-4
L. H. Thomus - Project Manager, TMI Site

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Rev.	BUMMARY OF CHANGE	Approva1	Dat
0	Initial issue.	m	12/8
1	Revised to incorporate system design changes and comments on Revision 0.	an	1/8
2	Revised to incorporate comments on Revision 1.	an	1/8
3	Revised to incorporate comments on Revision 2.	ami	1/8
4	Revised to reflect addition of relief valves at the outlet of the defueling filter canisters, deletion of fuel pool cleanup system boronmeter and correction of minor typo- graphical errors.	s and	4/8
5	Revised to correct and clarify description of low level alarm setpoints for fuel transfer canal.	ann	5/8
6	Revised to reflect the potential for operation of portions of the DWCS prior to system being fully operational and to incorporate minor editorial changes.	m	6/8
7	Revised to incorporate Dewatering System inputs to DWCS and provide a general update of the DWCS TER.	mu	9/8
8	Revised to reflect capability to bypass the filter caniste	rs. gm	12/8
9	Revised to clarify site dose assessment for fuel transfer canal/spent fuel pool cleanup system.	m	1/9
10	Revised to incorporate system design changes per ECAs 3525-86-0313, 0328, 0356, 0377, 0388; 3255-86-0393; 3525-86-0395; 3255-86-0406; 3525-86-0416; 3255-86-0422; 3525-86-0429, 0438; 3525-87-0444, 0450, 4051, 0454, and 0455. In addition, the following modifications were incorporated: 1) "deep suctions," 2) variable post-filer micron ratings, 3) use of organic loaded ion exchanger, and 4) the use of deep bed filters (modified knockout canisters).	ann	4/8
11	Revised to incorporate system design changes per ECAs 3525-86-0322; 3525-87-0467, 0476, 0480, 3525-88-0503, 0504, MMAs 3525-87-0003, 0017, 0018, 0020, 0024, 0037; 3257-87-0046; and 3525-88-0068 and 0074. Revised to reflect current defueling tools/system which interact with the DWCS.	mu	7/8

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Rev.	SUMMARY OF CHANGE	Ap	proval	1		Da 1
12	Revised to incorporate system design changes per MMA 3525-88-0116; see Section 1.3.1 of Attachment 2. Added Section 8.0, "DWCS Flow vs. Allowable Pressure," to Attachment 2. Deleted reference to SDS (system removed from operation). Revised to incorporate MMA 3525-88-0132 (see Attachment 8). Also includes revised drawing 2-M74-DWCO2 (see Attachment 4). Revised Section 4.3 for person-rem due to DWCS operation.	0	i			5/1

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ISSUE DATE May 1989

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DIVISION

TECHNICAL EVALUATION REPORT FOR

Defueling Water Cleanup System

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ATTACHMENTS

- 1. Division II System Design Description of the Defueling Water Cleanup Reactor Vessel Cleanup System.
- 2. Division II System Design Description of the Defueling Water Cleanup Fuel Transfer Canal/Spent Fuel Pool Cleanup System.
- Piping and Instrument Diagram, DWC-Reactor Vessel Cleanup System, GPU Nuclear Drawing 2D-3525-1430.
- Fuel Transfer Canal/Spent Fuel Pool Cleanup System, Piping and Instrument Diagram, Bechtel Drawing 2-M74-DWC02.
- 5. Auxillary Systems, Piping and Instrument Diagram, Bechtel Drawing 2-H74-DHC03.
- 6. Fuel Handling Building, General Arrangement, Bechtel Drawing 2-POA-6401.
- 7. Reactor Building, General Arrangement, Bechtel Drawing 2-POA-1303.
- 8. DWCS, Coagulant/Filter-Aid Systems, GPU Nuclear Drawing 2D-3525-1188.

1.0 INTRODUCTION

1.1 General

The Defueling Water Cleanup (DWC) System is designed to remove organic carbon, radioactive ions and particulate matter from the Fuel Transfer Canal (FTC). Spent Fuel Pool (SFP) "A" and the Reactor Vessel (RV). The majority of the particulate matter is removed by processing the water through nominal 0.5 or 16 micron rated filter canisters. The low micron rating of the filter canisters assures very low turbidity as well as reduction of the particulate activity in the water. Cartridge type filters with different particle size ratings may be used in place of the filter canisters. In general, therefore, discussions concerning the filter canisters are also applicable to cartridge filters when used as replacements for filter canisters.

Removal of the radioactive ions (i.e., soluble fission products) and/or organic carbon is performed by processing a portion of the filter output through 4 x 4 liners (similar to those in use for EPICOR II) containing zeolite or organic material.

The installation and operation of the DWC System occurred sequentially such that portions of the system were operated prior to completion of the entire system. In addition, partial system operation required temporary interconnection(s) with other plant systems which are not specifically described in this Technical Evaluation Report (TER). Any such temporary modes of DWC System operation will be implemented in accordance with the safety criteria for the complete DWC System and will be bounded by the safety analyses described herein.

1.2 Scope

The scope of this document includes the operation of the DWC System, the components of the DWC System and its interfaces to existing systems and components. This TER also includes special modes of operation of the DWC System used to improve filtration operations. This TER is applicable only during the recovery mode as the DWC System is a temporary system required to support recovery operations and will be removed or reevaluated prior to plant restart. Evaluation of safety concerns related to the filter canisters is not within the scope of this TER and is addressed in Reference 8. Licensing of the ion exchangers for off-site shipments is outside the scope of this TER.

2.0 SYSTEM DESCRIPTION

2.1 General

The DWC System is designed to process water from the RV, FTC, SFP, and Dewatering System (DS) holdup tank DS-T-1. The system's major functions are given below.

- a. The DWC System filters the water to remove suspended solids down to a nominal 0.5 micron rating. This is done to maintain the clarity of the water.
- b. The DWC System removes soluble fission products by demineralization of the water using inorganic zeolites. This is done to reduce the dose contribution from the water.
- c. The DWC System removes organic carbon using specific resins or activated charcoal.

The DWC System is composed of two major subsystems which allow greater processing flexibility during post plenum removal operations. These two subsystems are the RV cleanup system and the FTC/SFP cleanup system. On-line sampling of both subsystems for pH is provided by the system design. On-line sampling for boron concentration and turbidity is provided for the RV cleanup system. Boron sampling for the FTC/SFP cleanup system will be done according to approved procedures. The detailed system description for the DWC RV cleanup system is provided in Attachment 1. Attachment 2 provides the detailed system description for the DWC FTC/SFP cleanup system. Also included as Attachments 3 through 8 are the following figures:

- Attachment 3 DWC Reactor Vessel Cleanup System, Piping and Instrument Diagram
- Attachment 4 Fuel Transfer Canal (FTC)/Spent Fuel Pool (SFP) Cleanup System, Piping and Instrument Diagram
- Attachment 5 Auxiliary Systems, Piping and Instrument Diagram
- Attachment 6 Fuel Handling Building, General Arrangement

Attachment 7 Reactor Building, General Arrangement

Attachment 8 DWC System Coagulant/Filter-Aid Systems

2.2 Quality Classification

The quality classification of the DWC System with exception of the filter canister units, which are not within the scope of this TER, is Important to Safety. Important to Safety as used here is defined in the TMI-2 Recovery Quality Classification List.

3.0 TECHNICAL EVALUATIONS

3.1 General

The DWC System is totally contained within areas that have controlled ventilation and area isolation capability. This limits the environmental impact of the system during normal system operations, shutdown or postulated accident conditions. The impact of postulated DWC System failures is provided below on a case-by-case basis. The system failures evaluated were loss of power, loss of instrumentation/instrument air, filter media rupture, and line breaks. The design of the system is such that none of the events results in unacceptable consequences. Other safety concerns evaluated with respect to operation of the DWC System were decay heat removal, criticality, boron concentration control, heavy load drops, and radioactive releases. Several system modifications may be used to ensure efficient filtration operations. These system improvements were evaluated for safety concerns, and the evaluations are summarized in Section 3.8. The interface of the DWC System with defueling tools such as the abrasive water jet, plasma arc torch, X-Y Bridge Flush System, etc., is addressed in Section 3.9. No unacceptable consequences were found to result from operation of the DWC System provided that proper administrative controls to prevent boron dilution are maintained.

3.2 Postulated System Failures

3.2.1 Reactor Vessel Cleanup System

3.2.1.1 Loss of Power

A loss of power to the entire system would simply shut the system down. A loss of power to the well pumps with an additional failure which results in simultaneous loss of level control in the ion exchangers would result in a flow mismatch. In this case, the system would be automatically shut down until power is restored. Loss of power to individual components would place that component in its safe mode. An air operated valve, for example, would fail to a position that ensures no damage to other components.

Loss of power to the control panel would cause the loss of all information and fail all control and solenoid operated valves. The system would be shutdown until power is restored.

3.2.1.2 Loss of Instrumentation/Instrument Air

Loss of a single instrument channel will result in the loss of indication for that channel and, for those channels that have control features, a flow mismatch.

This flow mismatch will result in an automatic shutdown of the affected portion of the system.

Loss of the internals indexing fixture (IIF) level indication system (bubbler) will result in an erroneous level indication which will be noted when compared with a redundant level indication system. Since this system has no control features, no adverse system conditions will result. Loss of instrument air will take the individual components to their fail safe position. Flow mismatches induced by loss of air will result in automatic trips. Loss of air to the IIF level monitoring system will initiate a low air supply pressure alarm and a pump trip on IIF low level.

3.2.1.3 Filter Media Rupture

A failure of the filter media in the filter canister could potentially release fuel fines to the ion exchange portion of the system and/or the dilution water supply to the coagulant and filter-aid systems. The post filter, located downstream of both filter trains in the line to the ion exchangers and dilution water supply, will trap any fuel fines which would be transported past the filter canisters in the event of filter failure. The post filter is sized to be critically safe. A gross rupture in a filter canister may be detected by an increase in the post filter differential pressure. Turbidity meters located on the return lines to the RV will aid in the detection of gross filter media rupture by detecting changes in water clarity.

Upon detection of a filter canister filter media rupture the filter trains will be isolated, including isolation of water supply lines to ex-vessel defueling [i.e., valves DWC-V-357, 358, 363, and 501 (if installed)] involved with the pressurizer defueling system. The ruptured filter will be identified by observing the differential pressure versus flow for each individual canister with flow being recirculated to the RV or maintaining effluent turbidity. A lower differential pressure for a given flow or a higher effluent turbidity will indicate which filter is ruptured. The ruptured canister or canisters and the post-filter cartridge would then be replaced as required and the system restarted.

The DWC System may be operated in a mode that bypasses the filter canisters. During this mode of operation the post filters will be providing the required system filtration upstream of the demineralizers. In order to preclude the rupture of the post filter's filter media when it is providing system filtration, if the post filter differential pressure reaches 18 psi, further system operation will be prohibited. The post filters are designed for a maximum differential pressure of 45 psi. Even if a rupture of the post filter media occurred, it is not expected that significant quantities of fuel would accumulate downstream of the filter. This conclusion is based on the following:

 The bypass filtration mode will be used only when the turbidity is low, during ex-vessel operations as required or to recirculate the RCS as necessary; therefore, it is not expected that significant fuel fines will be suspended in solution during the bypass operation. Consequently, it is not expected that large amounts of fuel will normally be found in the post filter.

- The holding capacity of the post filter, prior to reaching the maximum pressure differential, is small (approximately 5 lbs.).
- The differential pressure, measured across the post filter, can be used to detect a ruptured post filter media, which would initiate operator action to prevent further accumulation downstream.
- o If it is necessary to process the post filter effluent through the DWC ion exchangers, it will be done under the control of a process control plan with adequate provisions to accurately assess the quantity of fuel material deposited on the ion exchange media.

3.2.1.4 Line Break

The principal consequences of any line, or hose break in the RV cleanup system are a loss of RV inventory and the spread of contamination in the area of the break. The system is designed to mitigate the consequences of such an incident to the extent possible.

In case of a hose rupture or line rupture downstream of the RV pumps, the system will trip these pumps on IIF low level and alarm at control panels in the control room and Fuel Handling Building (FHB). This could deliver approximately 500 to 1000 gallons of RV water to the area of the break. The potential areas affected would be the Reactor Building (RB), the annulus, and the FHB, each of which has sumps to contain the spill.

Siphoning of RV water could take place if any of the lines connected to the well pump suction or return hoses, or if the hoses themselves, are damaged or ruptured. The two, 4 inch suction connections provided in the Westinghouse work platform will be provided with two, 3/4 inch holes, or in the case of the 2 inch deep suction one 3/4 inch hole, drilled 18 inches below the water level which will act as siphon breakers. The three 2 inch return lines will be equipped with spargers, which are holes drilled into the pipes. The first holes are drilled 18 inches below the water level which will act as siphon breakers. The sample return line will terminate 18 inches below the water level. Also, isolation valves will be provided in the Westinghouse supplied piping which could be used to manually terminate the siphoning. Therefore, a maximum of approximately 3000 gallons of RV water would spill into the FTC following a hose rupture. Approximately half of this water would be contained in the New Fuel Pit.

The recovery from these events would be accomplished by isolating the ruptured section and replacing the ruptured hose/pipe.

3.2.2 Fuel Transfer Canal/Spent Fuel Pool Cleanup System

3.2.2.1 Loss of Power

A loss of power to any portion of the system would shut that portion of the system down. Loss of power to individual components would place that component in its safe mode. An air operated valve, for example, would fail to a position that ensures no damage to other components.

3.2.2.2 Loss of Instrumentation/Instrument Air

Loss of a single instrument channel will result in the loss of indication for that channel and, for those channels that have control features a flow mismatch. This flow mismatch will result in an automatic shutdown of the affected portion of the system.

Loss of either the SFP or FTC level monitoring system will be noted when compared with the other. The readings should normally be the same (within 6-7" due to pressure differential) since both water bodies are in communication via the fuel transfer tubes. Neither system has control features.

Loss of instrument air will take the individual components to their fail safe position. Flow mismatches induced by loss of air will result in automatic trips.

3.2.2.3 Filter Media Rupture

A failure of the filter media in the filter canister could potentially release fuel fines to the ion exchange portion of the system. Flow may be routed to DWC lon exchanger K-2 which has a filter upstream to trap migrating fuel fines.

Ion exchanger K-2 has a cartridge type post filter (F-8) upstream of it which is in a critically safe canister. Differential pressure is measured across the filters to indicate ruptured filter media.

Upon detection of a filter media rupture in a filter canister the filter trains will be isolated and the ruptured filter will be identified by observing the differential pressure versus flow for each individual canister with flow being recirculated to the fuel pool, or by monitoring effluent turbidity. A lower differential pressure for a given flow or an increased effluent turbidity will indicate which filter is 1

ruptured. The affected canister or canisters and/or the filter canister post filter cartridge would then be replaced as required and the system restarted.

The DWC System may be operated in a mode that bypasses the filter canisters. During this mode of operation the post filters will be providing the required system filtration. In order to preclude the rupture of the post filter's filter media when it is providing system filtration, if the post filter differential pressure reaches 18 psi, further system operation will be prohibited. The post filters are designed for a maximum differential pressure of 45 psi. Even if a rupture of the post filter media occurred, it is not expected that significant quantities of fuel would accumulate downstream of the filter. This conclusion is based on the following:

- Significant quantities of fuel are not expected to be found in either the FTC or the SFP, therefore it is not expected that large amounts of fuel will normally be found in the post filter.
- The holding capacity of the filter, prior to reaching the maximum pressure differential, is small (approximately 5 lbs.)
- o The differential pressure, measured across the post filter, can be used to detect a ruptured post filter media, which would initiate operator action to prevent further accumulation downstream.
- If effluent is to be processed through DWC ion exchangers, it will be done under a process control plan which adequately assesses the quantity of fuel material deposited on the ion exchange media.

3.2.2.4 Line Break

If a rupture occurred in the FTC/SFP cleanup system, the DWC System SFP pumps could deliver FTC and/or SFP water to the RB, the annulus, or the FHB. This action would lower the level in the canal and the pool. A drop of one inch in canal/pool level is approximately equivalent to 1250 gal. A level loss would be detected by redundant level indicating systems, one each for the FTC and SFP, which are provided with low level alarms in the main control room. The low level alarm will actuate at El. 327'-1". Upon receipt of either low level alarm, the system will be manually shut down.

Process water hoses are employed in three services in this system; filter canister inlet/outlet, skimmers to well pumps, and downstream of penetration R-539.

If a filter inlet/outlet hose ruptures, that filter will be isolated and the hose replaced. Hoses connected to the filter canisters are submerged in the SFP, this results in no net water loss.

If a hose connecting the skimmer to the well pumps breaks, then the ability to surface skim will be hampered or lost, but pump capacity will not be diminished as the hose is routed underwater to the pumps and a pump suction supply will continue to be available.

If the hose on the FTC return line downstream of penetration R-539 breaks, then process water will be lost to the RB sump. The resulting loss in level would be detected and alarmed by the canal/pool monitors. Check valves are provided to prevent siphoning the FTC if the hose (or connecting line) breaks. Furthermore, the normal return path is to the SFP; thus this hose is not normally used. When not in use this hose should be isolated by closing valves to minimize the effect of a hose break.

A break of the FTC pump discharge line which uses penetration R-524 would cause process water to be lost to either the RB or the FHB. The water loss would be detected both by a decrease in the monitored flowrate returned to the fuel pool or FTC and also by the drop in fuel pool and/or transfer canal level.

When the FTC pumps are not in use, the discharge valves will be closed. This will prevent a siphoning of the FTC when the pumps are not in use.

3.3 Decay Heat Removal

Decay heat removal is currently performed by heat loss to ambient. No change in this mode of operation is required to operate the DWC System. The large exposed surface of the open RV and the FTC will significantly enhance the removal of decay heat.

3.4 Criticality

Subcriticality of the core is maintained by a high concentration of boron in the Reactor Coolant System (RCS). Subcriticality of the fuel within the filter canister will be assured by design and is addressed in Reference 8. The design of the FTC/SFP pumps and the RV cleanup pumps do not allow an accumulation of a significant quantity of fuel. The system piping and the post filter have been designed to prevent a possible critical configuration of fuel debris. This is accomplished by restricting the size and configuration of components. Furthermore, the post filter will not accumulate significant quantities of fuel unless filter canister filter media rupture occurs (see Sections 3.2.1.3 and 3.2.2.3). Other system components will have critically safe dimensions.

3.5 Boron Dilution

The only credible means of attaining criticality of the fuel contained in the vessel is through deboration of the RCS water. The approach described in References 6 and 7 for prevention of deboration will be followed for operation of the DWC System. Specific system evaluations with respect to deboration control were performed prior to DWC System operation. Boron dilution during defueling has been addressed in the "Hazards Analysis: Potential for Boron Dilution of Reactor Coolant System" (Reference 9).

Other potential dilution events have been evaluated and are protected against by red-tagged isolation barriers when DWC System is shut down for any reason. The X-Y Bridge flush jets are administratively controlled to assure adequate mixing of water sources prior to returning the water to the lower vessel region (approximately elevation 301'). Mixing adequacy is analyzed in Reference 16.

The Y Trolley Flush System obtains its supply from either the DWC System or the RV directly. When using the RV directly, it is connected to a dedicated system with no external interfaces. When connected to the DWC System, it utilizes the same supply and administrative controls as the X-Y Bridge flush jets.

The Cavitating Water Jet operates at high pressure, low flow (12 gpm max.) and can be used at any elevation inside the RV. The cavijet is isolated from the introduction of unborated water by the establishment of triple barrier isolation when the DWC System is shut down.

3.6 Heavy Load Drops

In-containment load handling will consist of the transfer of the DWC filter canisters from the deep end of the FTC to the FHB via the fuel transfer system. Load handling within the FHB will consist of the movement of SDS ion exchange liners, the DWC System liners, the DWC filter canisters and transfer casks. The heavy load drop analysis for the SDS casks is given in reference 3. The DWC System liners will be moved using the existing casks for the EPICOR II system. The handling of heavy loads in containment and in the FHB is addressed in Reference 11.

The radiological concerns associated with a load drop of the SDS ion exchange liners and the DWC System liners are bounded by the analysis in Reference 4. The radiological concerns associated with a load drop of a filter canister are bounded by the accident analysis in Reference 12. These analyses show that the health and safety of public is not endangered as a result of these hypothetical accidents.

3.7 Radioactive Releases

The operation and design of the DWC System was reviewed with respect to radioactive releases. No direct radioactive release paths to the environment exists for the system. Local spillage of contaminated water

from the DWC System will result in a local contamination problem. Since the specific activity of the water is essentially that of the FTC and SFP, no significant radioactive releases above those from the open pools can occur when processing pool water. Defueling activities have the potential of significantly increasing the specific activity of the RV water. To preclude any significant releases during these periods the operating procedures associated with processing RV water shall include requirements to ensure isolation of the system should a line break or massive system leakage occur.

During shutdown of the DWC System filter trains, radiolytic decomposition of the water in the post filters and filter canisters will cause the production of hydrogen and oxygen. In order to prevent the overpressurization of the filter canisters, an ASME Section VIII pressure relief valve is installed in the outlet pipe from each of the four DWC System filter canisters. The valves provide pressure relief in the event that the isolation valves in the DWC System filter inlet and outlet pipes are closed and pressure builds up within the filter canister as a result of radiolytic decomposition. Radiolytic decomposition of water in the post filters will be minimized by the limited holding capacity of the filters.

The filter canisters should not normally be isolated for extended periods; however, if they were, the maximum rate of hydrogen and oxygen generation within the canister based on conservative assumptions is estimated to be 0.029 scf/day. (Note: later analyses have resulted in a maximum hydrogen generation rate that is approximately a factor of 10 lower). At the higher calculated rate of gas generation, the pressure inside the canister would not reach the canister design pressure (150 pslg) for at least 90 days. The relief valve will release the pressure buildup before this pressure is exceeded with approximately 0.3 scf of hydrogen and oxygen released from each canister. The relief valves will continue to relieve pressure at about 15 day intervals, releasing a maximum of about 0.3 scf hydrogen and oxygen per canister per relief. The relief valves discharge to the open volume of the containment above the FTC or to the operating level of the FHB. Since both of these areas are continuously or regularly vented and since the maximum volume of hydrogen released is small, a buildup of hydrogen to a combustible concentration is not credible. Any particulate releases during the operation of the relief valves would be bounded by the line breaks discussed in sections 3.2.1.4 and 3.2.2.4.

3.8 Operational Improvements

The DWC System is intended to maintain RV water clarity using the filter canisters. During operation of the DWC System, unexpected concentrations of suspended solids have blinded the filters and reduced their performance. To alleviate this problem various modifications may be made to the system. Modifications to the original DWC System installed or planned include: use of filter-aids, use of coagulants, use of cartridge filters, use of series filters and/or demineralizers, the use of modified knockout canisters as deep bed filters, and the installation of suction tubes taking suction much deeper than originally designed, which allow continued use of the shallow suction and have the provision to be backflushed. These modifications will be discussed in further detail in Attachment 1.

3.8.1 Filter Aid

Modifications to the DWC System may employ the use of a filter aid material, which is added to the filter media in the filter canister. The filter aid is intended to prolong the life of the filter canisters by preventing small suspended solids from reaching and plugging the filter media in the canisters.

The filter aid material is introduced as a low solids slurry into the filter by two methods: Body feed method, which is a continuous, low flow rate injection of the slurry into the process water upstream of the filter canisters, or precoat method, which consists of an initial batch of high flow rate (accelerated) body feed delivered to the filter also by way of the process stream. Continuous body feed may be used after the initial precoat, or the two methods may be used independently. The material currently considered for use as a filter aid is diatomaceous earth.

The use of diatomaceous earth as the filter aid material in the DWC System has been evaluated and the following safety concerns were identified and are addressed below:

- o criticality control
- o catalyst operation

Filter aid systems use water to form a slurry of the filter aid material. The water used will nave a minimum boron concentration of 4350 ppm to prevent unacceptable dilution of boron in the RV, and will come from SPC-T-4 or from the effluent of DWC-F-5.

To determine the criticality safety consequences of using diatomaceous earth as a filter aid material, an evaluation was performed to assess the moderating ability of diatomaceous earth. Diatomaceous earth is primarily SiO₂ (approximately 90%), and its moderating ability was found to be significantly less than that of water. Based on this result, it was concluded that the addition of diatomaceous earth to a defueling canister does not present a criticality concern during use, storage or shipment of the canister.

The results of the above evaluation are also applicable to the situation where diatomaceous earth becomes intermixed with the fuel within the RCS. That is, since diatomaceous earth is a poor moderator, when compared to water, the addition of diatomaceous earth to the RCS will not cause unacceptable increases to the RCS neutron multiplication. Diatomaceous earth has shown no propensity to remove or absorb boron during previous reactor coolant filtration operations and will not, therefore, cause a decrease in the reactor coolant boron concentration.

In the event of a filter canister rupture, the DWC System post filter will collect filtered material, diatomaceous earth, or filter media that is carried through the failed canister. The post filter is inherently critically safe by design, thus no criticality safety concern exists within the post filter.

The use of diatomaceous earth as a filter aid material will not inhibit the performance of the catalyst in the defueling canisters. Diatomaceous earth is inert and thus would not chemically react with the catalyst. Additionally, the very characteristics and consistency of diatomaceous earth which make it an ideal filter aid material, that is, its porosity under wet and dry conditions, prevent it from isolating the catalyst from generated hydrogen and oxygen, even if the diatomaceous earth were to settle on the catalyst retainer screens or on the catalyst material.

Other materials may also be used as a filter aid. However, prior to their use the materials will be reviewed to ensure that there are no unacceptable effects on the defueling canisters or the RCS.

3.8.2 Coagulants

The use of coagulants in the reactor coolant is intended to prolong the operating life of the filter canisters by coagulating the colloidal suspension in the water into larger particles. The formation of these larger particles will allow the material to be collected in the filter canister without plugging the filter media, thereby prolonging the operating life of the filter canisters. Coagulants may be added in the process path upstream of the filters.

The specific chemicals to be used for this option have criteria which must be met in order to be introduced to the RCS and defueling canisters. The safety issues which must be addressed before a coagulant can be used include as a minimum:

- o effect on neutron multiplication,
- o precipitation of soluble boron,
- o effect on boron detection capability.
- adherence to technical specification requirements for RCS water, and
- o effect on operability of the canister catalyst material.

For the coagulants used to date, References 13, 14, and 15 address the safety issues identified above to show that their use would not adversely impact previous evaluations or RCS water specifications.

3.8.3 Cartridge Filters

If cartridge filters are used in the DWC System they will serve as either a replacement for or an enhancement to the filter canisters. The cartridge filter to be used will have critically safe dimensions (diameter <8 inches). A single cartridge filter cannot contain a mass of fissile material in a critical arrangement, hence neutron poison is not required in the cartridge filters. Disposal of the cartridge filters will be in accordance with approved procedures.

Schematically, the cartridge filter would replace or be in series with the filter canisters. Cartridge filters may be used in the RV cleanup system and the FTC/SFP cleanup system. Thus if the cartridge filter media fails, a filter located downstream of the cartridge filter will trap fuel material before it reaches the DWC System. Cartridge filter failure will be detected and mitigated in the same manner as a filter canister failure.

The DWC System can be configured to bypass the ion exchangers. This would eliminate the safety concern associated with the transport of fuel to the post filter or the ion exchangers, since the process water would be returned directly to the RV or the FTC/SFP. However, filter media could in this case be transported to the RV after a postulated gross filter failure. An earlier study (Reference 10) has demonstrated that foreign material (e.g., cartridge filter media) which cannot intermix with the fuel in such a manner as to become interstitially dispersed within the fuel, can be added to RV without causing a criticality concern.

3.8.4 Series Filters

DWC RV manifold piping may be modified to allow the two filters in the train to be used in-series with the required instrumentation to monitor the individual filters. This modification would allow use of two different filters in series (i.e., one as a "roughing" filter and the second as a polishing filter).

3.8.5 Series Ion Exchangers

Piping in the FHB has been modified to allow series operation of the two DWC RV cleanup ion exchangers. This modification allows the water being processed to be demineralized by the first ion exchanger to remove gross activity before passing through the second organic carbon removing "ion exchanger." The non-zeolite media will be tested prior to use, to ensure it does not alter RCS grade specifications for water chemistry. In the case of activated carbon, the media is borated before placing in service to prevent its removing boron from the flowstream.

3.8.6 DELETED

3.8.7 Deep Suction

The suction tubes for both A and B pumps have been tee'd to allow use of shallow and/or deep suction and extended to reach elevation 297' in the RV annulus, allowing better circulation and filtration

during RCS processing. Excessive vessel drain-down is prevented by siphon breakers located 18" below the water level (327'-6") as noted in 3.2.1.4. Boron dilution concerns have been controlled administratively. Fuel pickup has been limited by the installation of an 850 micron screen with appropriate backflushing capabilities and appropriate administrative controls.

3.8.8 Other Modifications

Other system modifications may be made to the DWC System without revising this TER provided that the safety concerns associated with the changes are bounded by approved licensing documents.

3.9 Interface with Defueling Tools

The known chemistry and intended high quality (e.g., low turbidity and isotopic concentrations) makes DWC System water ideal for use as process water for some of the defueling tools. Additionally an operational advantage for using the DWC System as a source of process water is that no new water will be introduced to the RV, thus additional makeup and letdown monitoring of the RV will not be required. The ability to detect a deboration event is reduced when using defueling tools because DWC System water is returned to the lower head adjacent to the remaining fuel. However, due to the low probability of a dilution event occurring in this configuration, the overall probability of a deboration event falls within the acceptable range of risk as described in the Hazards Analysis (Reference 9). Originally, when the DWC System was installed, water was returned to the IIF. Presently, when the Automated Cutting Equipment and Cavitating Water Jet System tooling is used, the water is returned to the lower head region in the vicinity of the remaining fuel.

Presently, a number of tools/systems have been identified which will use the DWC System as a source of process water. The tools/systems currently identified are the abrasive water jet (ADMAC pump), the cavitating pulsating water jet system, the multiple jet/vacuum retractor flushing pump, and various flush systems associated with the Automated Cutting Equipment System (e.g., Plasma Arc Torch, X-Y Bridge Flush System, the Y Trolley Flush System). The DWC System will also be used to supply water to various ex-vessel defueling operations, such as pressurizer defueling, and to filter the same water as it returns to the RV. Other tools or uses may be identified in the future which will use the DWC System as a process water source without revising this TER, provided safety concerns are bounded by approved licensing documents.

4.0 RADIOLOGICAL AND ENVIRONMENTAL ASSESSMENT

4.1 Off-Site Dose Assessment

Operation of the DWC System could reduce the off-site doses which would result if the system were not available. Without operation of the DWC System specific activity of the water in the pools would slowly increase. This could lead to an increase in the local airborne concentration available for release via the plant ventilation system.

However, operation of the DWC System will maintain the reactor and fuel pool water at very low specific activity, thereby minimizing this as a potential release source. Since the source available for release from the SDS during processing of accident water from the RB basement greatly exceeds that available from the DWC System, the off-site dose analysis provided in the SDS TER (Ref. 4) bounds those of the DWC System.

4.2 On-Site Dose Assessment

4.2.1 Reactor Vessel Cleanup System

The potential exists that defueling may significantly increase the specific activity in the RV water. This could possibly occur during defueling through disturbance of the core debris. Material greater than nominal 0.5 microns would be captured in the system filters, either through use of 0.45 micron filter canisters or 25 micron filter canisters which have been precoated. In the latter case, some material greater than 0.5 micron may be passed through the filter until an adequate layer of precoat is built up. The soluble fission products, particularly cesium-137 and strontlum-90, would be removed by processing through the associated lon exchange media. The filter canisters are located underwater at a depth greater than four feet in the RB and. therefore, do not represent a radiological problem. As indicated earlier (see Section 3.2.1.3 and 3.2.2.3) it is not expected that significant quantities of fuel will accumulate in the post filters. Consequently, the post filters are not expected to be a radiological hazard. However, if the dose rates from these filters begin to increase, appropriate measures (e.g. shielding, personnel relocation) will be taken to ensure acceptable dose rates to personnel. The water to be processed is piped through a RB penetration to the ion exchange media at 20 to 60 gpm (max. 30 gpm/ion exchanger) depending on the specific activity of the RV water. These process lines and the liners for the ion exchange media represent potential radiological hazards.

To assess the radiological hazards, the dose rates from DWC System piping and components during operation were evaluated. Sources in the water were assumed to be fuel particles and dissolved radioactive materials. The design basis concentrations of these sources are 1 ppm suspended solids and a concentration of soluble materials equivalent in dose rate to 0.02 uC1/ml of cesium-137. During operation at the design basis concentrations, the dose rate from a long 3" diameter unshielded hose is 0.2 millirem/hour at a distance of 2 feet.

During defueling operations both the solubles and suspended solids concentrations in the water may increase. To assess increases in dose rates during upset water conditions, a combination of a 20 curle ceslum-137 spike and an instantaneous release of approximately 35 ib of suspendable fine debris to the RV volume is postulated. A long 3" diameter hose carrying water at the resulting concentrations would result in a dose rate of 9 millirem/hour 2 feet from the hose. Process lines which are downstream of the filters do not contain the suspended solids concentrations postulated for the upset water conditions. A 3" diameter hose downstream of the filters would produce a dose rate of 2 millirem/hour at a distance of 2 feet, due to the soluble radioactive materials remaining in the water.

Shielding of lines upstream of the filters may be used to reduce dose rates in areas of personnel occupancy.

Dose rates from solubles are based on the specific activity of cesium-137. Other isotopes which may contribute significantly to gamma dose rates are cesium-134 and antimony-125. The cesium-134 concentration is normally an order of magnitude less than that of cesium-137. Antimony-125 is not removed by the DWC System ion exchangers with a reliable decontamination factor. However, the dose rate for antimony-125 is less than that of cesium-137 for a given concentration. If antimony-125 in the DWC System becomes a significant dose contributor to workers, the reactor coolant may be processed through the EPICOR II system in a batch processing mode. Batch processing will be used because chemical adjustment of the coolant is required. EPICOR II will remove the antimony-125 with a satisfactory decontamination factor.

Three zeolite ion exchangers are needed to handle the flow from the DWC System. Two are needed for the RV cleanup system to provide a 60 gpm flowrate through the ion exchangers. One is used for FTC/SFP cleanup.

The shielding requirements for the DWC System liners were based on a homogenized 500 curie source in a 4 x 4 liner, similar in construction to those used for EPICOR II. Since change-out of liners will be based on radiation level, and since the 500 curie loading is conservatively high (actual loading should be approximately 100 curies, see Section 4.3), the calculated shielding requirement is considered acceptable.

The contact dose rate on the side of the liner for a homogenized 500 curie source is approximately 185 rem/hr. The liners are shielded to limit the shield contact dose rate at the side and on top of the liner to a maximum of 5 millirem/hr. The concrete floor reduces the dose rates on lower elevations to less than 5 millirem/hr. Shielded dose rates represent an upper bound, and would not pose any undue operational constraints if actually attained.

Other DWC System components not specifically discussed above will be shielded as necessary.

If hoses or piping in the DWC System break, water will be released in the RB or the FHB. This water may contain suspended fuel particles and dissolved radioactive materials. The specific activity of the DWC System water will be maintained as low as

possible, so that personnel access to the spill area will not always be precluded, however, a DWC-RCS spill may present personnel access problems due to high beta dose rates. After the removal of the spilled water, the area may require decontamination to reduce loose surface contamination to acceptable levels. Thus there are no safety concerns associated with the breakage of DWC System hoses or pipes.

4.2.2 Fuel Transfer Canal/Spent Fuel Pool Cleanup System

The FTC/SFP cleanup system processes water through the DWC ion exchanger K-2. The water in the pools will be maintained by this system at .01 to .02 uCi/ml of equivalent cesium-137, excluding antimony. A flowpath to EPICOR II via the RCBT's is provided to remove antimony-125 in the event that high antimony-125 levels are encountered. These are significantly lower concentrations than water processed by SDS. The analysis provided in Section 4.2.1 for normal dose rates from the RV cleanup system bounds the dose rates from the FTC/SFP cleanup system during normal operation.

The accident analysis provided in the SDS TER, Reference 4, bounds the doses possible from the FTC/SFP cleanup system in the event of an accident.

4.3 Occupational Exposures

Operation of the DWC System will reduce the occupational exposure during defueling operations by maintaining low specific activities in the FTC, SFP and RV. The DWC System is designed to maintain the maximum cesium-137 concentration in the water to between .01 and .02 uCi/ml. This will result in a contribution to general area dose rates of 10 to 20 millirem/hr from the water.

It is estimated that approximately 42, 4x4 liners each loaded with 52 curies of cesium-137 will be required for the RV cleanup system. The occupational dose to workers during each change-out is estimated to be less 0.1 person-rem. Therefore the total accumulated dose for change out of the estimated 42, 4x4 liners is 4.2 person-rem.

The following table provides an estimate of the person-hours and person-rem associated with the installation, operation, maintenance, modification, and removal of the in-containment and FHB portions of the DWC System. These estimates are based upon current person-hour projections.

IN-CONTAINMENT

Activity	Person-Hours	Dose Rate (mR/hr)	Person-Rem
Installation	2,100	30	63
Operation	1,200	30	36
Maintenance	100	35	3.5
Modifications	3,700	25	92.5
Removal	1,000	30	30

FUEL HANDLING BUILDING

Activity	Person-Hours	Dose Rate (mR/hr)	Person-Rem
Installation	5,600	2.2	12.3
Operation	26,280	0.3	7.9
Maintenance	125	3.0	0.3
Removal	17,200	0.3	5.2

The estimated total person-rem attributable to the operation, maintenance, modification, and removal of the DWC System is approximately 250 person-rem. As of December 31, 1988, installation, operation, and maintenance of the DWC System has resulted in approximately 200 person-rem. This figure does not include person-hour or person-rem values for interface with defueling tooling discussed in Sections 3.8 and 3.9.

5.0 SAFETY EVALUATION

5.1 Technical Specifications/Recovery Operations Plan

No additional Technical Specifications/Recovery Operations Plan changes are required to install and operate the DWC System.

5.2 Safety Questions (10 CFR 50.59)

10 CFR 50, Paragraph 50.59, permits the holder of an operating license to make changes to the facility or perform a test or experiment, provided the change, test, or experiment is determined not to be an unreviewed safety question and does not involve a modification of the plant technical specifications.

A proposed change involves an unreviewed safety question if:

- a. The possibility of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report may be increased; or
- b. The possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report may be created; or
- c. The margin of safety, as defined in the basis for any technical specification, is reduced.

The DWC System does not increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in a safety analysis report. The system failures evaluated are presented in section 3.2 of this report. No failures of the DWC System were found which would increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety. In addition, operation of the DWC System will be performed under strict administrative procedural

control to further ensure safe operation. The procedures used for operation of the DWC System will be reviewed and approved prior to use in accordance with Technical Specification 6.8.1.

The possibility of an accident or malfunction of a different type than previously evaluated in the safety analysis report is not created by the installation and operation of the DWC System. The DWC System is essentially a liquid radwaste system utilized to maintain clarity and low specific activity in the RV, FTC, and SFP water. As such, the possibility of an accident or malfunction is of the same type as previously evaluated for other liquid radwaste systems.

Operation of the DWC System does not result in a reduction in the margin of safety as defined in the bases for the Technical Specifications. Liquid effluents will not be released to the environment directly from DWC System operations. The effluents from operation of the DWC System will be returned to the sources in order to maintain proper water levels. Any gaseous effluents resulting from DWC System operations will traverse existing gaseous effluent flow paths. The gaseous effluents will be less than those generated during processing of the water from the RB basement by SDS. The results of the radioactive release analysis presented in the SDS TER therefore bound the releases from the DWC System. Since no change in the maximum permissible concentrations or the instrument configuration or setpoints specified in Appendix B of the DWC System operation is bounded by the SDS operation, no changes are required for DWC System operation.

Based on the above, the installation and operation of the DWC System does not present an unreviewed safety question as defined in 10 CFR 50.59.

6.0 REFERENCES

- 1. Recovery Program System Description, SD-3526-004, Auxiliary Building Emergency Liquid Cleanup System (EPICOR II).
- Technical Evaluation Report (TER-3527-006) for the Submerged Demineralizer System, Revision 5.
- 3. Letter from G. K. Hovey, GPU, to B. J. Snyder, NRC, dated September 30, 1981, "Control of Heavy Loads". GPU Nuclear Letter LL2-81-0227.
- 4. Same as Reference 2.
- Safety Evaluation Report (SER) for the Refurbishment of Fuel Pool "A", Revision 1, June 1983, GPU Nuclear Letter 4410-83-L-0156 dated July 29, 1983.
- SER for Removal of the TMI-2 Reactor Vessel Head, Revision 5, GPU Nuclear Letter 4410-84-L-0014 dated March 9, 1984.

- SER for the Operation of the IIF Processing System, Revision 3, GPU Nuclear Letter 4410-85-L-0112 dated May 17, 1985.
- 8. TER for Defueling Canisters, (3527-016).
- Hazards Analysis: Potential for Boron Dilution of Reactor Coolant System, Revision 2, September 1985.
- Report on Limits of Foreign Materials Allowed in the TMI-2 Reactor Coolant System During Defueling Activities, 15737-2-N09-002, Revision 1, September, 1985.
- SER for Heavy Load Handling Inside Containment, Revision 3, GPU Nuclear Letter 4410-86-L-0084 dated June 2, 1986.
- 12. SER for Defueling of the TMI-2 Reactor Vessel, Revision 10, GPU Nuclear Letter 4410-86-L-0049 dated May 15, 1986.
- SER for the Addition of Coagulants to the Reactor Coolant System, GPU Nuclear Letter 4410-86-L-0213 dated December 15, 1986.
- Use of Coagulants, GPU Nuclear Letter 4410-86-L-0716 dated December 31, 1986.
- Criticality Safety Evaluation for Coagulants, GPU Nuclear Letter 4410-87-L-0021 dated February 20, 1987.
- Mixing Analysis for Deboration Scenarios, GPU Nuclear memorandum dated April 26, 1988, Gaithersburg, DEOE-1380, File: 0295/10450.

- 44. ECA No. 3525-87-0480, DWCS Coagulant/Filter Aid '8' System.
- 45. ECA No. 3525-87-0482, DWC Forwarding Pumps Exhaust Modification.
- 46. HMA 3525-87-0003, DWCS Reactor Vessel Suction Modification.
- 47. MMA 3525-87-0017, DWCS Hose Replacement Modification.
- 48. MMA 3525-87-0018, Air Dryer for DWC Forwarding Pumps
- HMA 3525-87-0020, DWCS Reactor Vessel Cleanup Suction Flush Modifications.
- MMA 3525-87-0023, Installation of Throttling Valves on the DWCS Return Lines (not currently implemented).
- 51. MMA 3525-87-0024, DWCS Coagulant Addition Isolation Valves.
- MMA 3525-87-0037, Flush Water to the Coagulant Addition Metering Pumps.
- 53. MMA 3525-87-0046, CLD System Installation from DWCS.
- 54. MMA 3525-88-0068, DWC IX Forwarding Pumps Changeout.
- 55. MMA 3525-88-0074, DWC Crossconnect (DWC-V-385) Isolation.
- MMA 3525-88-0118, DWC-K-3 IX Bypass (not currently implemented).
- 1.3 Detailed System Description
- 1.3.1 Description

The RV cleanup system is a liquid processing system which will process water from the RV. The system is shown schematically on Drawing 2D-3525-1430 and 2D-3525-1188, and associated Drawings 2-M-74-DWCO2 and 2-M74-DWCO3. (NOTE: Some valves identified herein have been given an instrument designator as well as a valve number. When this occurs, the instrument designator is shown in parentheses after the valve number.)

The system has two submersible type pumps (deep well pumps), P-2A and 28, which are housed in wells and located in the fuel storage pit in the shallow end of the Fuel Transfer Canal (FTC) in the Reactor Building (RB). Each pump has a 220 gpm capacity and will process 200 gpm from the RV and recirculate 20 gpm. The suction from the RV is through the Westinghouse work platform via pipes which connect the nozzles provided on the work platform to the wells.

The system has four particulate filters, F-1, 2, 3, and 4, each capable of filtering a flow of 100 gpm. The filters are composed of sintered metal filter media which is contained in

the FHB atmosphere. The S-2 inlet dampers should be adjusted to maintain a 100 to 140 feet/minute face velocity at the sample box 2 hood.

This system provides the operator with the capability to periodically monitor the effectiveness of the system. Also, the turbidity of the effluent from the filters is constantly monitored by nephelometers and displayed at the local control panel. The radiation levels of the ion exchange influent and the boron concentration and pH of the lon exchange effluent are also constantly monitored and displayed at the local control panel.

Several inlets have been provided on the Defueling Water Cleanup (DWC) System through which borated water can be gravity fed from the standby reactor pressure control system storage tank to operate the filter-aid and coagulant systems, in addition to filling and backflushing the system. The CLD booster pump (CLD-P-1) may also be used as an aid in filling and backflushing the system. The system will be backflushed when radiation levels in the piping are determined to be excessive and prior to maintenance or as required to remove debris from suction screens.

A path to allow flow to the reactor coolant bleed tanks is provided to allow for system inventory reduction. Also, batch processing to remove Sb-125 will be performed by EPICOR-II from a RCBT as required. This flow path uses a portion of the submerged demineralizer system.

1.3.2 System Components

P-2 A/8 Reactor Vessel Cleanup Pumps

Type: Vertical Submersible Deep Well Pump Model: Goulds VIS 9AHC/2 Material: Stainless Steel Bowl and shaft with a bronze impeller Motor: Franklin Electric 25 hp, 460 Volt, 3 phase Rating: 264 FT TDH at 220 gpm Minimum Flow: 20 gpm

F-1/2/3/4 Reactor Vessel Filters

Type: Pleated Sintered metal media Model: Pall Trinity special product contained in a critically safe canister Rating: 0.5 or 16 micron Nominal Removal Rating Flow: 100 gpm

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- f. 2-P70-CLD01 Canister Loading and Decontamination System, Fuel Handling Building.
- 23. TER 3527-016, TMI-2 Division Technical Evaluation Report for Defueling Canisters.
- 24. ECA No. 3525-87-0476, Transfer Canal/Fuel Pool Tie-in to Reactor Vessel Filtration.
- 25. ECA No. 3525-87-0482, DWC Forwarding Pumps Exhaust Modification.
- 26. MMA 3525-87-0018, Air Dryer for DWC Forwarding Pumps.
- 27. ECA No. 3635-86-0322, FCC-LAHL-103 Alarm Modifications.
- 28. MMA 3257-87-0046, CLD System Isolation from DWCS.
- 29. ECA 3525-88-0503, DWC FTC/SFP Body Feed and Coagulant System
- 30. ECA 3525-88-0504, DWC FTC/SFP Body Feed and Coagulant System
- 31. MMA 3525-88-0068, DWC IX Forwarding Pumps Changeout
- 32. MMA 3525-88-0116, DWC-F-9 Bypass Modification
- 33. MMA 3525-88-0132, Install Orifice on Discharge of DWP-P-15.
- 1.3 Detailed System Description
- 1.3.1 Description

The FTC/SFP cleanup system is a liquid processing system which can process water from the SFP and/or the FTC. For the corresponding P&ID's see references 4, 5, and 6. Some valves identified herein have been given an instrumentation designator as well as a valve number. When this occurs, the instrument designator is shown in parentheses after the valve number.

The SFP and the deep end of the FTC will be filled with water to a level of 327'-3"+8". A dam with top elevation 328'-2"-2" separates the shallow and deep ends of the FTC.

Two vertical submersible well pumps, P-3A/B, are located in the FTC. Each is capable of pumping a net 200 gpm. A 20 gpm continuous recycle protects the pump motor. P-3A/B take suction from trough-type skimmer U-7 via a 6 inch flexible hose. A secondary, 4 inch, subsurface inlet below the skimmer will prevent pump starvation due to skimmer congestion. Pumps P-3A/B discharge to the FTC/SFP filter canisters via Reactor Building (RB) penetration R-524. The internals of check valve SF-V190 are removed to make use of existing piping connected to R-524.

Two vertical submersible well pumps, P-4A/B, identical to P-3 A/B in the FTC, are located in the SFP. P-4A/B take suction from trough-type skimmer, U-8, similar to U-7.

The system has four particulate filters, each capable of filtering a flow of 100 gpm. The filters are contained in modified fuel canisters submersed in the SFP to provide the appropriate radiation shielding. These filters are capable of removing debris, mainly fuel fines (UO_2) and core debris (ZrO_2), down to a 0.5 micron rating. Since the canisters contain fuel fines, they are designed to prevent a criticality condition from existing when they have been loaded.

The four pumps and four filters are normally manifolded so one pump from each source discharges to one pair of filters. Therefore, the filtration portion of the system is divided into two trains. The A train is the perferred train for operation, it contains pumps P-3A and P-4A and filter canisters F-9 and F-10. Train B contains pumps P-3B and P-4B and filter canisters F-11 and F-12. In the normal mode the system filters 400 gpm from the FTC and returns the filtrate to the SFP. The system can be manifolded to filter 200 gpm from the FTC and 200 gpm from the SFP or 400 gpm from either source. This pump arrangement provides both flexibility in operations and the redundancy to permit continued operation during pump maintenance.

The system may also be configured to bypass a set of filter canisters and to route water directly to the post filter and ion exchanger. This may be done by valving out the F-9 filter and opening bypass valve DWC-V-417; filter F-10 is then isolated. This configuration will also allow the system to recirculate back to either the FTC or SFP-A.

A filter canister is used until the differential pressure reaches a set point (See section 2.2). At this point the system is shutdown and then, after a waiting period of approximately 5 minutes, it is restarted. The differential pressure is noted and if it returns to a low value the system will be run again to the pressure setpoint. This process is repeated until the differential pressure at restart reaches a value near the shutdown setpoint. When this occurs within one hour of restart, the train is shutdown and the filters are replaced.

Coagulant and filter-aid may be injected into the process flow to enhance filter performance by DWC-P-14 and DHC-P-15. The coagulant is injected into the DWC skinmer (U-8) when

operating DWC-P-4A or via SF-V-238/239 when operating DWC-P-3A. Filter-aid is injected into the residence coil which provides sufficient residence time for the coagulant and body feed to react prior to reaching the filter (DWC-F-10).

Loaded canisters are expected to generate small quantities of oxygen and hydrogen gas due to radiolysis of water. Pressure relief valves R-8, R-9, R-10 and R-11 are provided on the filter canister outlet lines upstream of their isolation valves. Their purpose is to prevent overpressuring the filter canisters when isolated due to the small quantities of H₂ and O₂ produced (approximately 0.029 ft³/day).

The filter canisters are connected to inlet and outlet manifolds via 2-1/2 inch flexible hoses with cam and groove couplings.

Once the water has been filtered, all, or a portion of the flow can be returned to its source (either the SFP or the FTC). The amount of water pumped from its source is controlled by manually adjusting globe valves VO97 A/8. The return path to the FTC uses RB penetration R-539. At each source the return path splits into two 2-inch returns to provide back pressure to valves VO97 A/8. One two inch return is used for 200 gpm operation; both are used for 400 gpm operation.

A portion of the flow not returned directly to source can be further processed through the DWC ion exchanger K-2, or used for makeup/dilution water for the coagulant/filter aid system (see Attachment 9). The DWC ion exchanger K-2 can process 30 gpm. The ion exchange media is a bed of zeolite resin which will remove Cs-137. The resin is contained in a 4 x 4 liner, similar to those used in EPICOR II. K-2 influent is regulated by flow control valve VO8S (FV-15) while K-2 effluent is regulated by level control valve V070 (LV-46). If either high or low levels occur in K-2, LSH-40 or LSL-40 will trip both isolation valve V069, halting influent, and solenoid valve V156, shutting off air supply to DWC forwarding pump P-7, thus halting effluent.

Two post filters are provided. Filter canister post filter F-8 protects K-2 from suspended solids in the event of a canister filter media rupture. DWC post filter F-7 is located downstream of the forwarding pump to prevent the migration of resin fines. DWC forwarding pump P-7, an air driven reciprocating diaphram pump, provides the head to return flow to either source. The air supply to the pump has been modified to include a dessicant air dryer, and the pump exhaust has been manifolded and routed to a floor drain to prevent contamination due to diaphram rupture. In the event of high Sb-125 levels, the return flow from K-2 can be routed to the reactor coolant bleed tanks for batch processing through EPICOR II.

Sample points are provided upstream and downstream of each filter train. These samples are routed to sample box 1, a glove box located in the FHB. The glove box has a self contained blower and HEPA filter which discharge to the FHB ventilation system. Sample points are also provided upstream and downstream of ion exchanger K-2. These samples are routed to sample box 2, a laboratory hood located in the FHB. The hood is connected to combination blower/prefilter, HEPA filter package S-2 and discharges to the FHB atmosphere. The S-2 inlet dampers should be adjusted to maintain a 100 to 140 feet/minute face velocity at the sample box 2 hood.

1.3.2 System Components

F-7/8 Filter Canister Post Filter and DWCS Post Filter

Type: Disposable Cartridge Model: Filterite No. 921273 Type 18M503C-304-2-FADB-C150 Rating: 0.45 to 30 micron nominal removal rating Flow: 20 to 30 gpm

F-9, F-10, F-11, F-12 Fuel Transfer Canal/Spent Fuel Pool Filters Type: Pleated sintered metal media Model: Pall Trinity special product contained in a

criticality safe canister Rating: 0.5 or 16 micron Nominal Removal Rating Flow: 100 gpm

K-2 Ion Exchanger

Type: Zeolite resin contained in a 4' x 4' HIC Model: Nuclear Packaging 50 ft³, Enviralloy, Demineralizer/HIC

Flow: 30 gpm

<u>P-3 A/8 Fuel Transfer Canal Pumps</u> Type: Vertical, 2 stage, submersible pump; Goulds model VIS, size 9AHC, 5.56 in impeller Metalurgy: Stainless steel bowl, bronze impeller, 416SS shaft Motor: Franklin Electric 25 HP, 3550 rpm, 460V, 3 phase Rating: 220 gpm at 264 ft Shutoff head: 289 ft. Min Flow: 20 gpm (recirculation)

P-4A/B Spent Fuel Pool Pumps Identical to P-3A/B

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<u>P-5 DWC Booster Pump</u> Type: Regenerative turbine, 2 stage, SIHI model AEHY 3102 BN 112.42.4 Metalurgy: 316SS casing with 316SS shaft, impeller, and internals Motor: 5 HP, 1750 rpm Rating: 15 gpm at 250 ft Shutoff head: 390 ft (at min flow) Min Flow: 5 gpm Seals: Mechanical, John Crane type 1 with tungsten carbide seal faces

P-7 Forwarding Pump

Type: Air driven double diaphragm pump Model: B.A. Bromley Heavy Metal Pump Model No. H25 or Warren Rupp Sandpiper Model SA-2A Rating: 60 feet TDH at 60 gpm

P-14 Filter-Aid Pump

Type: Progressing Cavity Pump Model: Moyno 6M2-CDQ-AAA Motor: 3/4 HP, 115/230 VAC Capacity: 4 to 30 gph

P-15 Coagulant Addition Pump

Type: Hydraulically Actuated Dlaphragm Pump Model: Neptune 535-A-N5 Motor: 1/6 HP 115/230 VAC Capacity: 0-18 gph

PCV-26 Pressure regulator, SDS bypass Capacity: 25 gpm Model: Fischer Controls No. 98H

<u>PSV R-1 Relief Vaive</u> Model: Anderson Greenwood No. 81PS88-8 Capacity: 30 gpm Orifice: Size E, 0.196 in² Set Pressure: 150 psig

<u>PSV R-8, R-9, R-10, R-11 Relief Valves</u> Model: Anderson Greenwood No. 83MS46-4L Orifice: Area: 0.049 in² Set Pressure: 130 psig

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Sample Box 1 Type: Glove Box Mfgr: Labconco Model: No. 50002, Radioisotope Glove Box Material: Fiberglass-reinforced polyester Built-in Blower: 115 volt, 1/15 HP, variable speed Filters: Prefilter, HEPA filter Dimensions: 50" x 30" x 37"

Sample Box 2 Type: Laboratory Hood Mfgr: Labconco Model: No. 47810, Radioisotope-47 Laboratory Hood Material: 316SS Dimensions: 47" x 29" x 59" Recommended Face Velocity: 100-140 ft/min

<u>S-2 Sample Box 2 Filtration Module</u> Mfgr: General Dynamics, Reactor Plant Services Model: PFB(H)-1000 Filters: Prefilter and HEPA Filter Blower: 230 VAC, 5 HP, 20 AMP, 3450 rpm Rated Capacity: 1000 CFM

For further information on valves and instrumentation, refer to the Valve List (Reference 15) and the Instrument Index (Reference 14). For a listing of all equipment see the Mechanical Equipment List (Reference 16). For piping information see the Standard for Piping Line Specifications (Reference 17).

1.4 System Performance Characteristics

The system is designed to function in any of the modes of operation shown in Table 1.

TABLE 1

FUEL TRANSFER CANAL/SPENT FUEL POOL CLEANUP SYSTEM OPERATIONAL CONFIGURATIONS

Filter Flow (GPM)		K-2 Flow (GPM		
From FTC	From SFP	From FTC	From SFP	
400 [200]	0	0	0	
400 [200]	0	0	0	
400 [200]	0	30	0	
400 [200]	0	30	0	
0	400 (200)	0	0	
0	400 (200)	0	0	
0	400 (200)	0	30	
0	400 (200)	0	30	
200	200	0	0	
200	200	0	0	
200	200	0	0	
200	200	30	0	
200	200	0	30	
200	200	0	30	
200	200	30	0	
0	0	0	0	
0	0	0	0	
0	0	30	0	
0	0	0	30	
0	0	30	0	
0	Ō	0	30	

(numbers in brackets indicate 1 pump operation)

The operational mode is determined based upon which source needs to be processed. Normally, 30 gpm from the FTC will be processed through the ion exchanger and returned to the SFP (no filtration). During periods of high Cs-137 loading. If the visibility in either source becomes too poor for defueling operations or exceeds an NTU valve of 5, processing should be discontinued until visibility is restored and the NTU valve is below 5. This would be done by filtering from the proper source, through the train without the bypass hose piece.

1.5 System Arrangement

References 7 and 8 present the positioning of equipment. Well pumps P-3 A/B, are submersed in 10 inch diameter wells in the north end of the FTC in the RB. The wells are connected by a 6" flexible hose to skimmer U-7 located at the dam separating the deep and shallow ends of the FTC. Well pumps P-4A/B are submersed in the northeast end of SFP "A" in the Fuel Handling Building (FHB). These wells are connected by a 6" flexible hose to skimmer U-8 located at the south end of the SFP.

The discharge of pumps P-3A/B and P-4A/B is routed to the filter canisters inlet manifold near the northeast end of the SFP. The filter isolation valves, vent valves, and manual control valves V090A/B (HV-64A/B) are also located there. The filter outlet manifold is adjacent to the inlet manifold.

Filter canisters F-9, F-10, F-11, and F-12 are submersed in the SFP in the north end of the dense pack fuel rack. They are connected to the inlet and outlet manifolds by 2-1/2 inch flexible, coded hoses equipped with cam and groove couplings. The coupling at the fuel canister is modified for long handled tool operation.

From the filter outlet manifold the water is routed either directly back to source or to the DWC ion exchanger K-2 for further processing. The DWC ion exchangers are located behind appropriate shielding in the northwest end of the FHB. The forwarding pump P-7 is located near K-2.

Sample box 1 is located at the southeast end of the SFP A and sample box 2 is on the DWCS platform near the DWC ion exchangers.

The system uses the following existing penetrations which have been modified for their temporary function. Armored hose is used downstream of penetration R-539 to the FTC.

Penetration No.	System	Modified Function
R-524	Spent Fuel	Discharge Fuel Tra

Discharge from Fuel Transfer Canal Pumps

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Penetration No.

System

Modified Function

R-539

Decay Heat Closed Cooling Water

Return to Fuel Transfer Canal

- 1.6 Instrumentation and Control
- 1.6.1 Controls

The components of this system are located in accessible areas of the FHB and the RB. With the exception of the DWC ion exchanger loop, valve alignment and adjustment is performed manually to achieve the proper flows to and from the various sources.

The flow to DWC ion exchanger K-2 is regulated automatically by flow control valve V085 (FV-15). K-2 effluent is regulated automatically by level control valve V070 (LV-46).

1.6.2 Power

The pump motors are supplied with 480V power through a motor control center which is energized by an existing unit substation located in the Auxiliary Building. A stepdown transformer will provide 120 VAC for valve operation and the control panel.

1.6.3 Monitoring

Monitoring equipment is provided to evaluate the performance of the system and to aid in proper operation of the system.

PI-25 monitors the Booster Pump discharge pressure to verify the correct operation of both the pump and the bypass pressure regulator, V122 (PCV-26)

FI-15 and FQI-15 monitor the flowrate and total flow of filtered water routed to DWC ion exchanger K-2

AE-16 monitors the pH in the water leaving K-2

FI-23A and FQI-23A monitor the flowrate and total flow of filtered water returned directly to the FTC

FI-23B and FQI-23B monitor the flowrate and total flow of filtered water returned directly to the SFP

DPI-22A/B monitor the differential pressure across the filter canisters to determine degree of loading and therefore time of replacement

LI-46 monitors the liquid level in DWC ion exchanger K-2

FCC-LI-102 and SF-LI-102 monitor the water level in the FTC and SFP. They are panel mounted in the control room. The level indication system is a bubbler type system. A high or low level in the FTC will alarm FCC-LAHL-102 and a high or low level in the SFP will alarm SF-LAHL-102 at the panel in the control room. Additionally, there is a joint FTC/SFP high-low level alarm (FCC-LAHL-103) that is locally mounted and alarms on a high or low level in the FTC or SFP.

PI-81 and PI-82 monitor the pressure in the two instrument air manifolds in the FHB.

The process fluid conditions can be sampled to determine the effectiveness of the system. The capability to obtain grab samples of process fluid has been provided at the inlet and outlet piping of the FTC/SFP Filter Trains A and B. Grab samples may also be taken on the inlet/outlet lines to the DWC ion exchanger.

In line flow indicators are provided in the return lines from the Sample Boxes to SFP A. Their purpose is to confirm that flow exists through the sample box piping, and therefore, provide a means of assuring that a representative sample has been taken by showing that there has been flow long enough to flush out the stagnant water.

1.6.4 Trips

Low or high liquid levels in DWC ion exchanger K-2 will terminate flow to and from K-2. Both LSL-40 and LSH-40 trip closed the inlet isolation valve V069 and P-7 air supply isolation valve V156.

A locally mounted switch is provided at K-2 to override the level trips to fill and drain the ion exchanger. A signal alarm at the DWC control panel will notify the operator that the override is engaged.

1.7 System Interfaces

Those systems interfacing with the DWC are as follows:

- a. Standby Reactor Pressure Control System
 - Use: Provide a source of borated water for backflushing and filling system
 - Tie-in: A single connection from SPC-T-4 downstream of SPC-VI to the inlet manifold piping for the FTC/SFP Filters, Trains A and B
- Instrument Air System
 Use: Provide source of instrument air to equipment.
 Tie-in: At existing valves AH-V220 and IA-V171

- c. Service Air System
 - Use: Provide a source of service air to the forwarding pump P-7.

Tie-in: Service Station 87 plus another station if needed

- Dewatering System
 Use: Allow periodic use of DWC ion exchanger K-2 for the
 Dewatering System.
 Tie-in: Upstream of filter canister post filter F-8.
- e. Canister Loading and Decontamination System Use: Provide borated water for system fill/flush. Tie-in: At Valves DWC-V321, V322, and V323.
- 1.8 Quality Assurance

The defueling water cleanup system is classified according to the safety functions of its parts. There are three classifications in this system:

- a. Portions of the system associated with ion exchange processing are considered to be a radioactive waste processing system; therefore, these portions of the system shall be subject to the quality assurance guidelines contained in NRC Regulatory Guide 1.143.
- b. The filter canisters are classified as nuclear safety related and are designed to prevent a condition that could result in a return to nuclear criticality of the fuel retained in the filters.
- c. The remaining portions of the system are subject to the BNAPC non-safety-related quality assurance program.

The TMI-2 Recovery QA Plan will be applicable for work performed on site.

2.0 SYSTEM LIMITATIONS, SETPOINTS, AND PRECAUTIONS

2.1 Limitations

The system is flow limited to 200 gpm through each filter train and 30 gpm through the DWC ion exchanger K-2.

The main filter canisters are limited to 60 psid as read on DPI-22A/B. F-10 can be run at a greater ΔP because of the additional pipe additional for filter-aid addition.

At this point an alarm on a local panel will inform the operator of the need to monitor the filters for removal or replacement. The filter canister post filter (F-8) is limited to 18 psid. The ion exchanger post filter (F-7) is limited to 45 psid. Filters are considered full and ready for change out when either the maximum pressure differential is reached or when the performance (flow) drops 20% below the design flow.

The system should not be started and stopped frequently since the canister filter precoat is lost during a shutdown; thus it may be necessary to reestablish a precoat on starting up before processing through K-2.

2.2 Setpoints

DPSH-22A or DPSH-228 Trips alarm at 55 psi pressure differential across either FTC/SFP filter train A or B.

LSL-40 and LSH-40 Trip alarm, trip closed inlet isolation valve V069 and trip closed P-7 air supply valve V156, shutting down P-7. Low level set point is 10 inches below top of ion exchanger. High level set point is 4 inches below top of ion exchanger (i.e., \pm 3" from normal liquid level).

PSV-R-8, R-9, R-10, and R-11 Set to relieve at 130 psig with 10% overpressure to protect the filter canisters from hydrogen/oxygen build up.

Level indicators FCC-LI-102 and SF-LI-102 for FTC and SFP "A" levels, respectively, are located on control panel SPC-PNL-3 on the main control panel. In addition, high-low alarms FCC-LAHL-102 and SF-LAHL-102 are provided on SPC-PNL-3 for the FTC and SFP. High level setpoint is 327'-11" and low level set point is 327'-1".

Level indication switches SF-LAHL-102 and FCC-LAHL-102 also actuate a common alarm FCC-LAHL-103 located on panel DWC-LCP1 on high or low levels in the SFP or FTC. High level set point is 327'-11" and low level set point is 327'-1".

2.3 Precautions

Due to the use of quick disconnect couplings, extra care should be taken to ensure that the couplings are properly connected and that they are connected in the proper locations.

The filter canisters operate by a surface filtration method, and their efficiency increases as a cake is built up on the surface of the media. Therefore, the build up of this cake is an important part of the filtration process. To prevent the migration of fines to the post filter, the ion exchange portion of the system should not be started until a cake has begun to be formed on the media. This can be verified by observing the turbidity of the filter effluent. When the filter train is started up, there will be an initial turbidity spike caused by smaller particles passing through the media. As the cake is built, these particles are stopped and the turbidity decreases. Once the turbidity reaches a level of 5 NTU or less, the ion exchange portion of the system can be started. Also, to prevent the breakdown of the cake, the system should not be started or stopped unnecessarily.

Caution should be taken during a change of pump feeding a filter train. The new pump should be started and put on line before shutting down the existing pump to protect the filter cake. Note that outside of this brief exception no more than one pump should feed one filter train.

The portion of the startup procedures concerning the well pumps should be strictly adhered in order to prevent the rapid filling of an empty manifold. This situation could cause a harmful pressure wave to develop which might damage the canister filter media.

The RB penetrations R-524 at elevation 293 ft-6 in and R-539 at elevation 320 ft are both below the water level of 327'-3"+8-2. When in use the connecting piping/hose should be periodically checked since a line break will cause water to be lost from the system. When not in use, the hose should be isolated by closing valves V117A/B and V-099 (see discussion in section 4.5).

Periodically the face velocity across the sample box 2 hood should be checked to verify it is within the range of 100 to 140 feet/min. If the face velocity is too low the S-2 inlet dampers should be readjusted accordingly.

3.0 OPERATIONS

3.1 Initial Fill

To initially fill the SFP and FTC borated water from the Spent Fuel Cooling System may be pumped from the borated water storage tank, DH-T-1, by the spent fuel cooling pumps, SF-P-1A/B. To fill the FTC the water may be routed through penetration R-524 and into the FTC through the 3 inch fill line downstream of the P-3A discharge check valve. To fill the SFP, V087A/B and V0978 are opened and the borated water may be routed through the filter canisters and through the normal return process path to the SFP.

The system is filled initially by borated water from the standby reactor coolant pressure system through the backflushing system provided (see section 3.7). The filters are filled to the inlet and outlet manifolds.

To initially fill the DWC ion exchanger K-2, the level switch LSL-40 must be overrode (see section 1.6.4) until low level is attained. At this time the override switch should be returned to normal operation for further filling.

3.2 Startup

Prior to starting the system, the suction valve alignment is verified for the mode of operation selected. The valves to the ion exchange portions of the system are also verified to be closed. The pump discharge isolation valves are closed and the cross-tie valves are closed. The pump for one train is started and allowed to operate on minimum recirculation flow. The isolation valve for this pump is slowly opened. Then the hand control valve V090 A or B (HV-64 A or B) is opened 10% and any trapped air vented through manual vent valves located on the inlet and outlet manifolds. After venting, V090 (HV-64) is opened fully. Once this has been accomplished, the appropriate outlet cross-tie valve(s) (V096 A/B and V095) are opened. Flow is started by slowly opening the appropriate hand operated control valve (V097 A or B) until the desired flow is obtained. Note that V097 A/B are provided for flow control of the system. Once one train has been started, the other train, if desired, may be brought into service in the same manner.

Filter performance will initially increase with time as a cake forms on the filter surface. Therefore, the filtered water should be returned directly to source without further processing until this cake forms, as evidenced by a decrease in turbidity. A turbidity below 5 NTU is sufficient to route to K-2.

The DWC ion exchanger K-2 should always be brought to normal operating liquid level prior to operation of this portion of the system. Either borated flush water or filtered water of less than 5 NTU can be used. If the liquid level is below the low level trip, the level switch trip override must be engaged until low level is established (see section 3.1). Once normal level is established, the air supply solenoid valve VI56 is opened. Pressure regulator VI57 (PICV-58) is then manually adjusted to the pressure required to maintain the desired flowrate. Flow is slowly started to K-2 by opening flow control valve V085 (FV-15) until the desired flowrate to K-2 is obtained. K-2 effluent is automatically controlled by level control valve V070 (LV-46).

The sample box 2 filtration module inlet dampers should be adjusted to create a 140 feet per minute face velocity across sample box 2.

3.3 Normal Operation

Normal operation of the system is in one of the modes shown in Table 1 of Section 1.4. The mode of operation is chosen based on what source is to be processed and what the particulate and radioactivity concentrations of the sources are.

3.4 Shutdown

The steps to bring the system to a shutdown condition are basically the reverse of the startup procedure. The ion exchanger flow is brought to zero gradually by remote operation of upstream control

valve V085 (FV-15). Correspondingly, level control valve V070 (LV-46) will gradually terminate flow from K-2. After termination of flow the inlet isolation valve V069 is closed and the P-7 air supply isolation valve is closed. Following this, the well pumps are switched off and the pump isolation valves and the cross-tie valves are closed.

3.5 Draining

The majority of the system can be drained to the SFP. The filter canisters can not be drained, since they are submerged in the SFP. The piping to/from penetrations R-524 and R-539 must be drained to the Auxiliary Building sump since the penetration elevation is below the SFP water level. The DWC ion exchanger K-2 can be pumped out to either source, FTC or SFP, or to the reactor coolant bleed tanks via a portion of the SDS. A switch is provided to override the low level switch for pumping out K-2.

3.6 Refilling

The fully drained system may be refilled in the same manner that the system was initially filled. A partially drained system may be refilled by using either the back flush system (see section 3.7) or the well pumps (see section 3.2).

3.7 Infrequent Operations

Flushing of the system may be performed when the internai contamination level gets high or prior to internal maintenance work. The system is shutdown (see Section 3.4) prior to flushing.

One flushing option is gravity flush from SPC-T-4. Borated water is stored in the charging water storage tank, SPC-T-4, located at the 347 ft. elevation in the FHB. This tank is connected to the DWCS. If desired, the CLD booster pump (CLD-P-1) may be used to assist in backflushing. Either filter train may be flushed without stopping flow through the other.

Flushing may be accomplished by opening one of the inlet valves from the flushing system (depending on which portion of the system is to be flushed) and then routing the flow to the FTC or the SFP. After sufficient time has been allowed to flush the system, the inlet valve from the flushing system is closed, and the system is then restarted following the procedures in Section 3.2.

3.8 Transient Operations

The results of loss of pumps or filter train misalignment are flows not returning to the proper source. However, since this is the normal operational mode of the system and since the sources are connected by the fuel transfer tubes, the results of these transients are negligible. Vent or drain valve misoperation would have the same effect as a line break (see section 4.5) but could be more readily rectified.

4.0 CASUALTY EVENTS AND RECOVERY PROCEDURES

4.1 Loss of Power

A loss of power to any portion of the system would shut that portion of the system down. No adverse conditions would result.

4.2 Loss of Instrumentation/Instrument Air

Loss of instrumentation would hamper operations due to loss of monitoring capability but no adverse conditions would result and the system could be safely shut down until the problem is resolved.

Loss of a single instrument channel will result in the loss of indication for that channel and, for those channels that have control features a flow mismatch. This flow mismatch will result in an automatic shutdown of the affected portion of the system.

Loss of either the SFP or FTC level monitoring system will be noted when compared with the other. The readings should normally be the same since both water bodies are in communication via the fuel transfer tubes. Neither system has control features.

Loss of instrument air will take the individual components to their fail safe position. Flow mismatches induced by loss of air will result in automatic trips.

On loss of instrument air, level control to the ion exchanger would be lost. But both the inlet isolation valve V069 and the outlet level control valve V070 (LV-46) would fail closed isolating the ion exchanger.

4.3 Deleted

4.4 Filter Media Rupture

A failure of the filter media in the canister could potentially release fuel fines to the ion exchange portion of the system. The SDS is equipped with a sand prefilter which has borosilicate glass to control reactivity (see ref. 12) and the DWC filter canister post filter precedes DWC ion exchanger K-2. There are differential prossure gauges supplied on the filters to determine if they are loading.

The recovery procedure is to isolate the filter trains and find the ruptured filter by observing the differential pressure versus flow and/or effluent turbidity for each individual canister. Lower differential pressure for a given flow or increased effluent turbidity will indicate that this filter is ruptured. That canister or canisters and the post filter cartridge would be replaced and the system restarted. The system may be operated in a mode that bypasses the filter canisters. During this mode of operation, the filter canister post filter will be providing the required system filtration. In order to preclude the rupture of the post filter's filter media during operation, the maximum differential pressure that will be permitted across the post filter will be 18 psid. The post filters are designed for a maximum differential pressure of 45 psid.

4.5 Line and Hose Break

If a rupture occurred in the system, the pumps could deliver FTC and/or SFP water to the FHB or the RB. This action would lower the level in the canal and the pool. A drop of one inch in canal/pool level is approximately equivalent to 1250 gal. A level loss would be detected and alarmed (see setpoints section 2.2) by at least one of the two redundant level monitors provided for the canal/pool. The operator would then shut the system down.

Process water hoses are employed in three services in this system; filter canister inlet/outlet, skimmers to well pumps, and downstream of penetration R-539.

If a filter canister inlet/outlet hose ruptures, that canister will be isolated and the hose replaced. Since these hoses are submerged in the SFP, this results in no net water loss.

If a hose connecting the skimmer (U-7 or U-8) to the well pumps breaks, then the ability to surface skim will be hampered or lost, but pump capacity will not be deminished nor will there be a loss of water.

If the hose on the FTC return line downstream of penetration R-539 breaks, then process water will be lost to the RB sump. The resulting loss in level would be detected and alarmed by the canal/pool monitors. Check valves V-235A/B are provided to prevent siphoning the FTC if the hose (or connecting line) breaks.

Furthermore, the normal return path is to the SFP; thus this hose is not normally used. When not in use this hose will be isolated by closing valves V117A/B and V099 to minimize the effect of a hose break.

A break on the P-3A/B discharge line which uses penetration R-524 would cause process water to be lost to either the RB or the FHB. The water loss would be detected both by a decrease in the monitored flowrate returned to the fuel pool or FTC and also by the drop in fuel pool and/or transfer canal level. When the FTC pumps, P-3A/B, are not in use, the discharge valves VO02A/B and valve SF-V103 should be closed. This would prevent a syphoning of the FTC when the pumps are not in use.

5.0 SYSTEM MAINTENANCE

The maintenance procedures are the recommended practices and intervals as described by the equipment vendors.

6.0 TESTING

6.1 Hydrostatic Testing

All piping and hose will be hydrostatically pressure tested. Testing of hose will be done after couplings have been attached. Pipe will be tested outside the buildings.

6.2 Leak Testing

All accessible connections will be initial service leak tested after the piping is assembled.

6.3 Instrument Testing

All instruments will be initially calibrated by vendors. Complete electric/pneumatic loop verification will be done during start-up. Calibrations will be maintained by the Plant Maintenance Deparatment.

7.0 HUMAN FACTORS

Filter canister hoses are coded for quick identification of inlet versus outlet.

Extensive use of hoses is made, especially in the RB, allowing quick installation and use of existing radiation shielding. Hoses expected to be frequently disconnected are equipped with quick disconnect couplings for ease of removal and replacement.

The following human factors guidelines have been incorporated into the design of the DWCS control panel:

- The panel includes all controls and displays required for normal operation.
- Displays provide immediate feedback that the system has responded appropriately to an operator's action.
- o Controls and displays are laid-out for a left to right flow path.
- Mimic lines are used to clarify flow paths.
- o Control devices are mounted to 3 to 6 feet above the floor.
- o Each control device has a nameplate.
- o Light bulbs are replaceable from the front of the panel.

- Recorders are grouped on the right side of the panel away from the flow path.
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Adjustments to recorders and controllers can be performed from the front of the panel.

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