THE

ACCIDENT GENERATED WATER (AGW)

DISPOSAL

COMPLETION REPORT

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1.0 Introduction

This document demonstrates that the intent of the TMI-2 program to dispose of Accident Generated Water (AGW) by evaporation has been completed and no continuing unique limitations should be imposed on the processing and disposal of residual water.[1]

1.1 Background

The TMI-2 accident resulted in the radioactive contamination of large volumes of water. Direct releases of reactor coolant during the accident filled the Reactor Building basement to a depth of about three and one-half feet. Following the accident, water was added to this inventory by primary coolant leakage and inleakage of river water through the Reactor Building air coolers. A Programmatic Environmental Impact Statement (PEIS), completed in March, 1981, (Reference 1) stated that a decision on the ultimate disposal of the AGW could be deferred until after the water had been processed. Consequently, the NRC issued a Policy Statement on April 27, 1981 (Reference 2), which included a requirement that any future proposal for disposition of processed AGW shall be referred to the Commission and the Commission would reserve, unto itself, the right of approval. This resulted in an amendment to the TMI-2 plant Technical Specifications, which prohibited discharge of AGW without prior NRC approval.

In accordance with the TMI-2 Technical Specification, AGW is defined as:

"(a) Water that existed in the TMI-2 Auxiliary, Fuel Handling and Containment buildings, including the primary system, as of October 16, 1979, with the exception of water which as a result of decontamination operations becomes commingled with non-accident-generated water such that the commingled water has a tritium content of 0.025 μCi/ml or less before processing;

[1]Although AGW evaporation is not scheduled for completion until the 3rd quarter of 1993, this document is written from the perspective that evaporation is complete, i.e., the tanks and system piping are drained to the levels detailed in this report. GPU Nuclear will report to the NRC by letter when the evaporation of AGW has been completed.

(b) Water that has a total activity of greater than one μCi/ml prior to processing except where such water is originally non-accident water and becomes contaminated by use in cleanup;

(c) Water that contains greater than 0.025 μCi/ml of tritium before processing."

EPICOR II began processing of AGW from the Auxiliary Building in October, 1979. Processing of AGW from the Reactor Building using the Submerged Demineralizer System (SDS) was initiated in mid-1981. Since 1979, the total inventory of AGW increased to approximately 2.3 million gallons due to continued additions as a result of defueling and decontamination activities, condensation from the Reactor Building air coolers, rain and ground water inleakage and leakage from systems containing demineralized water.[2]

In 1987, the NRC completed Supplement No. 2 to the PEIS which addressed the disposal of AGW (Reference 3). In reviewing GPU Nuclear's proposal to dispose of AGW by forced evaporation to the atmosphere (References 4 and 5), the NRC evaluated nine alternatives including long-term and short-term discharge to the Susquehanna River.

The NRC concluded that no alternative was clearly preferable to GPUN's proposal for evaporation. While the quantitative estimates of potential impacts were found to vary for some of the alternatives, the differences were not judged to be sufficiently large to allow for either identification of a clearly preferable alternative or rejection of any of the 9 options evaluated. Following the completion of a contested hearing before the Atomic Safety Licensing Board, the NRC approved the GPU Nuclear plan to evaporate AGW (Reference 6) as an acceptable disposal plan. The TMI-2 Recovery Technical Specifications were revised to remove the prohibition on disposal of AGW and to allow disposal of AGW in accordance with NRC approved procedures.

Prior to the initiation of AGW disposal operations, most of the AGW had been processed to very low levels of radionuclide contamination; this AGW is commonly referred to as processed water. Processed water was recycled for use in cleanup activities and was subsequently reprocessed.

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[2]e.g., Nuclear Service Closed Cooling Water, Demineralized Water

In January, 1991 GPU Nuclear began disposal of AGW via the Processed Water Disposal System (PWDS). AGW disposal was completed during 1993. The PWDS disposed of an estimated 99% of the initial pre-processing volume of 2.3 million gallons. The residual volume is estimated to be approximately 18,500 gallons; <1% of the pre-disposal volume.

The GPU Nuclear method for disposal of AGW, as approved by the NRC, utilized a two-cycle evaporator/vaporizer system to process the water through a closed cycle evaporator, reheat the purified distillate, and discharge the vapor to the atmosphere. This process removed essentially all of the soluble material and particulate contamination (i.e., >99.9%) which was concentrated in the evaporator bottoms, collected and further concentrated to a dry solid that was shipped for disposal by burial at a commercial low level radioactive waste facility. The remaining radioactivity, including the tritium, was released as vapor. The effluent vapor discharge was monitored. Water that required additional processing to reduce its radionuclide concentrations prior to disposal was processed by ion exchange, filtration, or distillation. This pre-processing was accomplished using the existing EPICOR II System or by operating the evaporator in a closed cycle mode (i.e., no vapor release to the atmosphere), or both.

Selection of evaporation as the GPU Nuclear preferred method of AGW disposal was based in large measure on the public perception that AGW posed a unique hazard to public health and safety because it was related to the 1979 accident at TMI-2. The technical merits of the various disposal options, including discharge to the Susquehanna River and evaporation, and their potential environmental impacts were judged to be comparable and were not at issue in the selection process.

Having collected and disposed of the AGW by the evaporative process to the extent reasonably achievable consistent with ALARA, it is now proposed that the program to dispose of AGW by evaporation be considered complete and that the residual quantities of water remaining at TMI-2 be subject to no unique processing or disposal restrictions. GPU Nuclear believes that the residual TMI-2 water should be disposed in accordance with the same limits and conditions imposed on all other TMI waste water, i.e., discharged to the Susquehanna River in accordance with existing license condition and liquid discharge requirements.

1.2 Report Organization

Section 2 of this report discusses expected volumes, locations and isotopic content of the residual water. This section also addresses the extremely small risk of residual water discharge to the Susquehanna River.

Section 3 summarizes the evaporation process and the effort to remove and dispose of as much AGW as reasonably achievable from within TMI-2.

Section 4 summarizes the planned disposition of the residual water at TMI-2 including dilution and discharge of some volumes and long-term, natural, in-situ evaporation for other volumes.

Section 5 presents the conclusions reached by GPU Nuclear regarding the ultimate termination of the AGW evaporation process and acceptability of removing any special restrictions on the processing and disposal of the residual water.

2.0 Residual Water Description

When AGW processing is completed, a very small amount of contaminated water will remain in TMI-2 systems, piping and building sumps. Essentially all of this water is, by definition[3], not AGW. Therefore, for the purposes of this report, water remaining at TMI-2 after the completion of AGW processing will be referred to as residual water for which AGW disposal requirements are not applicable. The residual water is predominantly contained in the bottoms of tanks and sumps, and in piping from which additional water cannot be removed practically.

2.1 Location, Volumes and Content

Table 1 compares the locations and quantities of the residual water[4] in tanks to the initial volumes of AGW reported in January, 1986. In some locations, the final volumes are conservative estimates because of the physical configuration of the tank or level instrument inaccuracy at the near empty levels.

Table 2 provides the results of the system-by-system draindown to remove the maximum amount of AGW from system piping. The total estimate of residual water in the system piping is < 6550 gallons, isolated in a number of discrete locations and very small volumes.

The residual water volumes reported could not be drained because of physical or mechanical impediments, such as elevation, physical location or component failure. ALARA considerations also prevailed[5].

Calculations were based on known physical parameters including tank/vessel size, component capacities, water levels and pipe dimensions.

Estimated residual water volumes are based on a summation of calculated volumes in non-accessible components/piping that could not be verified as completely drained (e.g., small puddles of water remaining in horizontal piping, traps, instrumentation lines and pump casings). It has been confirmed that most

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[3]Analysis of residual water samples from the locations where the majority of the residual water is located, i.e., has shown that over 85% of the water in these locations does not meet the definition of AGW (Table 3).

[4]The residual water volumes listed in Tables 1 and Table 2 are conservative estimates based on the known physical dimensions of the component (tank or piping) or structure (sump) and, where possible, definitive level indication.

[5]In some systems (e.g. Pressurizer surge line drain), low-point drain valves were inoperable and the dose required to repair the valve and drain the residual water was not justifiable from an ALARA perspective.

systems are not completely drained. In some cases the difference in total calculated water volume versus the volume actually drained/collected was also used as an aid in determining estimated potential residual water remaining.

2.2 System Draining

Due to the variety of systems present in the plant, individual drain procedures were prepared for each system or, in some cases, part of the system to be drained. In order to ensure retrieval and processing of the maximum available quantity of AGW, existing TMI-2 plant systems containing AGW were drained to the extent reasonably achievable by gravity draining, air blowdown and/or by using existing or temporary pumps. Gravity draining was accomplished by isolating systems with closed valves, opening system high point vents and then draining the system via low drain points. Some piping was flushed with demineralized water to maximize AGW removal.

AGW removed from system piping and tanks in the Reactor Building (RB) was transferred to the Reactor Coolant Bleed Tanks and then sent to EPICOR II for processing prior to evaporation. AGW in the RB basement was removed using a submersible pump and processed through the Submerged Demineralizer System (SDS) prior to transfer to EPICOR II for processing. When the level of water in the RB basement became too low for collection by the submersible pump, AGW was drained from the RB sump to the Auxiliary Building where it was routed to EPICOR II via the Miscellaneous Waste Holdup Tank (MWHT).

AGW was removed from system piping and tanks in the Auxiliary Building by pumping directly to EPICOR II or draining the piping and tanks to the Auxiliary Building sump. Auxiliary Building sump water was transferred to EPICOR II via the MWHT.

AGW was removed from system piping and tanks in the Fuel Handling Building by either draining the piping to the Reactor Coolant Bleed Tanks in the Auxiliary Building or direct transfer to EPICOR II or the Auxiliary Building sump.

The final estimate of the total quantity of residual water that will remain after the completion of AGW processing is no more than 18,500 gallons. This volume is $< 1\%$ of the AGW inventory that existed in December 1990, i.e., prior to PWDS operation.

Table 3 lists the activity concentration in μCi/ml of the most significant radioactive isotopes in the MWHT, the Auxiliary Building Sump, the "A" Concentrated Drain Tank, and the RB Sump. This table indicates only a few locations of high activity water remain for volumes of greater than several hundred gallons

2.3 Hazard Analysis

The potential hazards of the storage and future processing of residual water at TMI-2 were reviewed. This review determined that the spill of 19,000 gallons of processed water during a transfer of the water from the Chemical Cleaning Building (EPICOR II) to a release pathway for ultimate discharge to the Susquehanna River is considered to be a maximum plausible accident involving the inadvertent release of residual water after the completion of AGW evaporation. For the purposes of this analysis, the spill is assumed to occur during the transfer of the water from the Chemical Cleaning Building to a discharge pathway, after the residual water has been processed. The residual water is assumed to be spilled onto the ground surface external to site buildings. The radionuclide concentrations in the spilled water are assumed to be equivalent to that of base case water (reference 4). A volume of 19,000 gallons was chosen because that is the capacity of the TMI-2 MWHT, the tank from which supply batches of residual water will be transferred to the Chemical Cleaning Building for processing after the completion of AGW evaporation. A portion of the residual water evaporates and delivers dose to the maximally exposed individual (MEI) via the acute inhalation pathway. The remainder of the water is absorbed into the ground and travels via the ground to the river.

The dose to the MEI from the postulated spill of 19,000 gallons of processed water is bounded by previous analysis performed by the NRC of the spill of 600,000 gallons of processed water (reference 4). The NRC concluded that a spill of 600,000 gallons (i.e., the volume of a Processed Water Storage Tank) of processed AGW was bounded by the instantaneous release of the entire 2.3 million gallon volume of AGW to the Susquehanna River. NRC analysis of the dose resulting from the release of the entire 2.3 millon gallons of AGW to the Susquehanna resulted in a bone dose of 3 mrem and a whole body dose of 0.4 mrem to the MEI. Thus, it can be concluded that the spill of 19,000 gallons of processed residual water will result in a dose to the MEI that is a small fraction of the 10 CFR 50 Appendix I guidelines (no more than 10 mrem to any organ and no more than 3 mrem whole body).

A spill of processed water was chosen for this hazard analysis instead of a spill of unprocessed RB sump water because there is no credible spill path for unprocessed water to be released. RB sump water is the most radioactive residual water that will remain after the completion of AGW evaporation. During the remainder of Mode 3 and PDMS it is credible that residual water in the RB sump may accumulate to a level that requires processing and disposal. R [illegible] water will be drained to the Building Spray sump and then pumped to the MWHT via the Auxiliary Building sump. The MWHT will be the holding tank for residual water awaiting processing.

An uncontrolled release of unprocessed RB Sump water is not a credible event. Any spillage during the transfer of RB Sump water from the Reactor Building to the MWHT will flow into either the Building Spray sump or the Auxiliary Building sump. Spillage that occurs during the transfer of the RB Sump water between the MWHT and the external wall of the Auxiliary Building will flow into the Auxiliary Building sump via the floor drain system. Spillage from the piping between the Auxiliary Building and the Chemical Cleaning Building has been determined by the NRC to be an incredible event (References 11 and 12) because the supply pipe from the MWHT to the Chemical Cleaning Building is enclosed by a 4" guard pipe which is embedded in concrete. A spill of unprocessed RB Sump water from the Chemical Cleaning Building to the external ground is not a credible event because the Chemical Cleaning Building was constructed as a concrete "bathtub" capable of retaining the entire contents of the 2 storage tanks (approximate total volume of 200,000 gallons) located within the building. Therefore, the only credible release of residual water as a result of processing and handling could occur when processed water is transferred from the Chemical Cleaning Building to a release pathway.

3.0 Evaporation Program

An estimated 2.3 million gallons of processed TMI-2 AGW accumulated by the end of the TMI-2 Clean Up Program in 1990 (Reference 6). The AGW required disposition in accordance with TMI-2 Recovery Technical Specification 3.9.13. Prior NRC approval of the disposal of this water by evaporation was required and received (Reference 7). As stated in section 1 of this report, AGW disposal via the Processed Water Disposal System (PWDS) was initiated in January, 1991.

3.1 Process Summary

The PWDS disposed of the AGW via a two-stage evaporation process. The PWDS consists of: (1) a vapor recompression distillation unit (main evaporator) that distilled the processed water in a closed cycle and collected the purified distillate for subsequent release by vaporization; (2) an auxiliary evaporator that further concentrated the bottoms from the main evaporator; (3) a flash vaporizer unit that heated and vaporized the purified distillate from the main evaporator and released the vapor to the atmosphere in a controlled and monitored manner; (4) a waste dryer that further evaporated water from the concentrated waste and produced a dry solid; and (5) a packaging system that prepared the dry solid waste in containers acceptable for shipment and burial in a commercial low level radioactive waste disposal site.

The influent quality was controlled to ensure effluent limits were achieved. The purified distillate released to the environment via the vaporizer contained a level of radioactive contaminants which did not exceed 1/1000 of the concentration of dissolved radioactive contaminants in "Base Case" water (see Reference 6). The level of contaminants released in the vapor also was maintained sufficiently low to ensure minimal environmental impact.

At least 99.9 percent of the dissolved radioactive contaminants contained in the base case evaporator influent were collected as dry solid waste. This waste was packaged onsite and transported for burial in a commercial radioactive waste disposal facility. The waste form was suitable for transportation and burial in accordance with the federal Department of Transportation and NRC regulations. GPUN chose to process the waste to a form that met the transportation requirements for Low Specific Activity (LSA) radioactive material. In addition, it conformed to the burial requirements for Class A waste. In general, LSA and Class A waste forms constitute the lowest level of radioactive waste material which originates from commercial nuclear power plants and is regulated for purposes of transportation and disposal.

At the outset, the PWDS disposed of water stored in various tanks in the plant. Most of the water disposed by the PWDS was processed through the Submerged Demineralizer System (SDS) and/or EPICOR II prior to PWDS processing. Some of the 2.3 million gallon inventory (e.g., the AGW in the Reactor Coolant System) required additional preprocessing before being disposed by the evaporator. This water was processed by the PWDS in the closed cycle decoupled mode[a] prior to being processed and disposed by the PWDS in a coupled mode. In all cases, the PWDS was operated in a manner such that the PEIS projections (Reference 4) of environmental impact were not exceeded.

3.2 Water Processed

The evaporation process was used to process and dispose of >99% of the 2.3 million gallons of AGW. The residual water, estimated volume of 18,500 gallons (see Tables 1 and 2), is distributed in numerous locations with no single location containing as much as 6,000 gallons.

3.3 Residual Water

While all reasonable efforts have been expended to collect and dispose of AGW, some residual water remains in tanks and piping volumes (Tables 1 and 2). In specific cases, additional effort was undertaken to open systems by removing components or by wet vacuuming where practical and consistent with sound ALARA practice. However, in many cases it was not considered ALARA to attempt to enter high radiation areas to gain access to additional small quantities in tanks and pipes, especially in the Reactor Building. For these reasons, residual water remains as described in Section 2.0.

The relatively small quantities of residual water which remain in numerous locations throughout the TMI-2 facility do not pose any threat to health and safety. This residual water is well contained and cannot effect the long-term safety and integrity of the facility. In fact, for the largest volumes of residual water, over 85% is not categorized as AGW, as defined in Section 1.17 of the Appendix A Technical Specifications. Because of the radiation fields and lack of accessibility at the residual water locations, additional radiation exposures to workers cannot be justified for the negligible benefit that might result from removal and disposition of this water. In accordance with the fundamental principles of good radiation control practices, occupational exposures to radiation should be kept as low as reasonably achievable (ALARA). It is prudent to forego any activity which does not provide a benefit commensurate with occupational

[a]When the PWDS was operated in the closed cycle decoupled mode, the main evaporator distilled the influent liquid which was then condensed and pumped to plant storage tanks. The PWDS did not process AGW through the vaporizer for disposal when operated in the decoupled mode.

exposures required to complete that activity. GPU Nuclear is convinced the point has been reached such that further water removal and disposal as AGW is an activity that clearly cannot be justified because of the occupational exposures required for negligible benefit.

Additional small volumes not drained include pipe runs with numerous instrument taps; seismic pipe (i.e., welded); pipe sections in high dose areas where access is inconsistent with sound ALARA practice; pipe sections in high contamination areas; and systems designed not to be drained.

Much of the AGW removed during final system draining was routed for processing through the Auxiliary Building sump to the MWHT. Following the completion of all AGW removal, both the MWHT and the Auxiliary Building[7] sump underwent a final fill, recirculation and flush evolution to maximize the removal of residual radioactivity. The residual water in each of these areas no longer meets the criteria for AGW after the fill, recirculation and flush cycles.

After the TMI-2 accident, approximately 640,000 gallons of water flooded the RB basement (Reference 10). This water was pumped to the SDS Tank Farm in 50,000 gallon batches using a sump pump. The Tank Farm water was processed in the Fuel Handling Building by the SDS.

After the initial AGW volume was removed to the extent achievable from the RB basement, the basement was partially refilled with processed water to reduce the dose rates on the upper elevations of the RB. The RB basement water volume was lowered when the RCS was depressurized and transitioned from the pressure control mode to the level control mode in preparation for defueling. Because of safety considerations,[8] the RB basement water volume was maintained below 70,000 gallons throughout the remainder of the cleanup program. Excess water was removed and processed by the SDS. The RB basement was drained during

[7]The water level in the Auxiliary Building sump is maintained above the floor drain discharge piping penetrations to limit the recontamination of AFHB cubicles via the floor drain system.

[8]After the March, 1979 accident, the TMI-2 reactor coolant was maintained with a relatively high soluble concentration of 3000-5000 ppm Boron. This ensured subcriticality of the core was maintained for even the most reactive core debris geometry. In order to be certain that, in the event an unisolable leak occurred in the Reactor Coolant System, the RB basement water could be safely recirculated through the Reactor Vessel, a limit of approximately 70,000 gallons was placed on the RB basement water volume. Assuming there was no dissolved boron in the RB basement water, an unisolable RCS leak would flow into the RB basement, mix with the basement water and be available for reflood of the Reactor Vessel. Because the Borated Water Storage Tank and the RCS together contained approximately 460,000 gallons of water with over 4950 ppm boron, the mixing of 70,000 gallons of unborated water would result in a RCS boron concentration of over 4000 ppm, significantly above the 3500 ppm post-accident RCS boron concentration.

the mid-1980's using a submersible pump that was placed in the incore pipe chase[9]. RB basement water was diluted during the summer months by the addition of over 10,000 gallons a month of non-AGW water via condensation[10]. Finally in 1992, the RB basement sump was subjected to an additional draindown via the 18" Decay Heat RB sump suction lines that connect to the RB Building Spray suction line[11]. An estimated residual volume of < 1,500 gallons remained in the RB sump after this draindown. The radioactivity content[12] of the remaining water is listed in Table 3.

The Reactor Building sump contains the largest volume of residual water with a significant amount of radioactivity (Table 3). The RB sump is constructed such that the sump is divided into two chambers separated by a weir. The RB floor drains feed into one of the chambers which, when full, overflows into the other chamber which can be level-monitored, sampled, and drained via the Decay Heat sump suction line to the RB Building Spray recirculation suction line.

The RB sump residual water is the remnant water that remains on the non-drained side of the weir in the sump after a series of decontamination and basement water processing evolutions that removed essentially all of the AGW. The residual water currently in the RB sump has a tritium concentration of less than 0.025 μCi/ml and a total activity of approximately 4 μCi/ml. Essentially all of the water currently in the RB sump was originally non-accident water that became contaminated as a result of cleanup operations. A comparison of the reported concentrations of H-3 (tritium), Cs-137 and Sr-90 in RB basement AGW immediately after the March, 1979 accident (Reference 9), to the current concentration of these isotopes is listed below.

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[9]This draindown left very little water on the RB basement floor. A rough estimate of the volume of water remaining in the RB basement after this draindown including the RB sump was less than 10,000 gallons.

[10]An air conditioning system called the RB Air Chiller System was installed at TMI prior to the initiation of defueling. The RB Air Chiller System was "piggy-backed" onto the RB Normal Air Cooler System. These combined systems were capable of maintaining the RB air temperature at an ambient temperature of 65 degrees F or less. The operation of the RB Air Chiller System resulted in a significant increase of water flowing to the RB basement because the cooler air temperatures caused the moisture in the air to condense and flow into the RB basement and RB sump. TMI-2 Liquid Radwaste Management reports (References 9 and 10) indicate that a monthly addition of 10,000 gallons was routine during chiller operations. Assuming that the chillers were operated for effectively 4 months a year from 1985 through 1991, operation of the chillers added as much as 240,000 gallons of non-AGW to the RB basement.

[11]The RB sump pumps (WDL P-2A and P-2B) are in an undetermined condition. They have not been refurbished since the March, 1979 accident. The RB sump was drained using the Decay Heat sump suction line which connects to the RB Spray System recirculation suction line.

[12]The wet side of the RB sump cannot be directly sampled. The reported concentrations of radioactivity are based upon samples of water drained from the dry side of the RB sump.

Isotope	August, 1979	September, 1992
H-3	1.03 μCi/ml	0.018 μCi/ml
Cs-137	176.3 μCi/ml	3.2 μCi/ml
Sr-90	2.81 μCi/ml	0.45 μCi/ml

The continual addition of non-AGW to the RB basement sump, via condensation and draindown, diluted the AGW present in the sump to the extent that the tritium concentration is less than 0.025 μCi/ml.

4.0 Disposition of Residual Water

All reasonable and practical efforts have been completed consistent with sound ALARA practices to collect and process the AGW. The residual water represents < 1% of the original volume and is distributed in small volumes throughout the plant. No further efforts will be directed to remove and evaporate this small amount of residual water. The evaporator has been retired. The ultimate disposition of the residual water is anticipated as follows:

4.1 Periodic Dilution and Discharge

Some residual water volumes may be diluted during PDMS due to building atmospheric condensation, rain/groundwater inleakage and limited decontamination maintenance efforts. Liquid radwaste management systems are being maintained operable to deal with this water buildup and include both the Rad Waste Disposal Miscellaneous Liquid System and the Sump Pump Discharge and Drainage System. Portions of these systems are being maintained operable to prevent localized flooding as well as to provide proper disposal of liquid effluents.

As part of the Waste Disposal Liquid (WDL) System, portions of the Miscellaneous Liquid System remain operational. The operational status of the WDL provides assurance that significant quantities of liquid wastes will not accumulate in an uncontrolled manner in the Auxiliary Building and Containment. The WDL System achieves its objective by meeting the following criteria:

a. Existing sumps in the Auxiliary Building and Containment will be monitored and pumped, as required.

b. Tie-ins to the EPICOR II or other appropriate processing system will be maintained so that accumulated liquids can be processed, as necessary.

c. Liquid storage capabilities will be maintained for accumulation of inleakage and residual water until sufficient quantities are available for batch processing.

d. If required during PDMS, the operable portions of TMI-2 WDL System can receive liquids from the AFHB, assorted equipment in these buildings, and from the RB sump. This system has the capability to retain waste liquids to allow for radioactive decay, sampling, filtration or transfer for processing and/or disposal.

Because a majority of plant systems have been deactivated, drained and placed in a layup condition, there are a limited number of activities that can generate liquid waste. Liquid waste in the remaining operable systems and accumulated inleakage will be adequately handled by periodic batch processing using the operational portions of the WDL System through EPICOR II or an equivalent system; discharge will be via approved pathways in accordance with existing liquid release limits. This ensures minimum exposure to plant personnel and minimizes releases to the environment in accordance with 10 CFR 20 and 10 CFR 50 Appendix I.

Water entering the active sumps from floor drains in some areas of the plant is generally not contaminated. However, these sumps, within the Turbine Building, Control Building Area, Control and Service Buildings and Tendon Access Gallery, are equipped with recirculation and sample lines to allow sampling for radioactivity.

Monitoring of the levels in the various sumps by remote means and/or visual inspections ensures that accumulated leakage is transferred for processing and disposal in a timely manner before sumps overflow potentially contaminated water onto building basement floors. Sampling quantifies radioactive content and ensures proper waste stream processing. Therefore, the various building sump sampling and discharge capabilities ensure liquid waste streams generated during PDMS are appropriately transferred for ultimate processing and disposal.

Maintaining the various building sumps operational assures that water buildup does not cause adverse localized flooding. These sumps will contain water that either meets or exceeds release criteria. Radioactive water that exceeds release criteria will be routed for processing, then re-sampled and analyzed. Processed water that meets release criteria will be discharged via approved pathways. Water that meets release criteria and does not require processing will be routed to the IWTS and released in accordance with 10 CFR 20 and NPDES regulations via approved pathways.

4.2 In-Situ Evaporation

The majority of the remaining locations containing the residual water described in Section 2.1 will not be accessed during PDMS; some of that water will evaporate by natural processes. The off-site dose consequences are considered inconsequential because the residual water is less than 1% of the original volume which was forcibly evaporated. In addition, the majority of the radioactivity in the residual water will be left behind after natural evaporation occurs, much like salt is left when seawater evaporates.

5.0 Conclusions

The vast majority of AGW has been disposed by evaporation in accordance with the TMI-2 Recovery Technical Specifications. The evaporation process was selected by GPU Nuclear from among several environmentally safe options, including discharge to the Susquehanna River, in order to minimize the public reaction based on a perception of the existence of a unique hazard associated with AGW. Over 99% of the AGW has been disposed of; the intent of the GPU Nuclear proposal to evaporate the AGW has been met within the limits of reasonableness, practicality and ALARA. However, GPU Nuclear is faced with management of a small volume of residual water that cannot be recovered and evaporated practically without unwarranted occupational dose and unreasonable effort.

The small amount of residual water remaining at TMI-2, less than 1% of the original volume, poses no significant impact in terms of offsite radiological exposure, i.e., the worst case offsite release is estimated at less than the annual 10 CFR 50 Appendix I limits for radiation exposure to any organ or to the whole body. GPU Nuclear has pursued every reasonable course in disposing of the bulk of the AGW, reducing residual water volumes to <6,000 gallons in any single location. It is, therefore, concluded that no further effort to collect and evaporate or segregate the residual water is warranted. The remaining locations and volumes of residual water can be managed in accordance with the normal provisions for liquid waste discharge at TMI without preserving any unique requirements for disposal.

AGW disposal is complete. The information presented in this report, provides the basis for concluding that the purpose of the AGW disposal program (i.e., collection and disposal to the extent reasonably achievable consistent with sound ALARA practices) has been met. Further, it is concluded that deletion of Recovery Technical Specification 3.9.13, which establishes the unique effluent limits for AGW, is appropriate. In summary, GPU Nuclear has concluded that it is not appropriate to continue the special processing and disposal of residual TMI-2 waste water or to require unique limitations and conditions for its discharge. Residual water at TMI-2 should be processed and discharged in a manner consistent with existing liquid discharge limits and regulations for TMI. Thus, Sections 1.17, 3.9.13 and 3/4.9.13 should be deleted from the TMI-2 Recovery Technical Specifications.

TABLE 1

TANK DESCRIPTION, INITIAL AND FINAL WATER VOLUME

STORAGE LOCATION	DESCRIPTION	01/01/86 VOLUME (GALLONS)	FINAL VOLUME (GALLONS)[13]
PWST-1	Processed Water Storage Tank No. 1	109,000	0
PWST-2	Processed Water Storage Tank No. 2	480,000	0
BWST	Borated Water Storage Tank	459,000	150
SFP-A	"A" Spent Fuel Pool	205,000	0
SFP-B	"B" Spent Fuel Pool	242,000	0
COT-1A	"A" Condensate Storage Tank	102,000	0
FTC	Fuel Transfer Canal	59,000	0
RCS	Reactor Coolant System (RV, A&B Steam Generators, Pressurizer)	67,000	200
RB Sump	Reactor Bldg. (Containment) Sump/Overflow	43,000	1,400
RCBT-A	"A" Reactor Coolant Bleed Holdup Tank	3,800	0
RCBT-B	"B" Reactor Coolant Bleed Holdup Tank	4,400	0
RCBT-C	"C" Reactor Coolant Bleed Holdup Tank	57,000	0
CC-T-1	PWDS Inf./Eff. (EPICOR off-spec) Tank	21,000	0
CC-T	EPICOR Receiving Tank	17,000	0
MWHT	Miscellaneous Waste Holdup Tank	3,700	3,000
WDL-T-9A	"A" Evaporator Condensate Test Tank	5,600	0
WDL-T-9B	"B" Evaporator Condensate Test Tank	2,200	0
WDL-T-8A	"A" Neutralizer Tank	8,700	0
WDL-T-8B	"B" Neutralizer Tank	8,600	0
WDL-T-11A	"A" Contaminated Drain Tank	1,900	1,000
WDL-T-11B	"B" Contaminated Drain Tank	800	0
Aux. Sump	Auxiliary/Fuel Handling Building Sump	5,900	6,000
CCB Sump	Chemical Cleaning Bldg. (EPICOR II) Sump	1,700	200
SDS-T-1A	"A" SDS Monitor Tank	400	0
SDS-T-1B	"B" SDS Monitor Tank	500	0
RB Misc.	Miscellaneous Reactor Building Storage	16,000	0
CWST	Concentrated Waste Storage Tank	6,500	0
SRST-A	"A" Spent Resin Storage Tank	900	0
SRST-B	"B" Spent Resin Storage Tank	300	0
	1986 AGW VOLUME	1,932,900[14]	11,950

[13] Volumes listed are estimates and are representative of the tanks/vessels only. Residual water volumes in associated system piping, instrument lines, etc. are provided in Table 2. Tanks listed as having "0" gallons of residual water are either empty or have only a very small amount of water.

[14] The volume of AGW increased from the 1986 volume of 1,932,900 gallons to 2,300,000 gallons by January, 1991 (Reference 6) when the PWDS began operation. The additional water was generated as a result of defueling and decontamination activities and condensation from the Reactor Building air coolers.

TABLE 2

ESTIMATED RESIDUAL WATER INVENTORY IN SYSTEM PIPING FOLLOWING DRAINING

SYSTEM	RESIDUAL WATER[1] (GALLONS)
Reactor Coolant System (RCS)	<800
Decay Heat Removal System (DH)	<1200
Core Flood System (CF)	<480
Make-Up Reactor Coolant & Purification System (MU)	<300
Spent Fuel Cooling System (SF)	<320
Reactor Building Spray System (BS)	<70
Radwaste Disposal Reactor Coolant Liquid System (WDL)	<380
Radwaste Disposal Miscellaneous Liquid System (WDL)	<1150
Radwaste Disposal Reactor Coolant Leakage Recovery System (WDL)	<370
Chemical Addition System (CA)	<30
Sampling Nuclear System (SN)	<15
Defueling Water Cleanup Reactor Vessel Cleanup System (DWC/RV)	<200
Defueling Water Cleanup Fuel Transfer Canal/Spent Fuel Pool Cleanup (DWC-FTC/SFP)	<240
Processed Water Storage and Recycle System (PW)	<200
Sludge Transfer System (STS)	<10
Radwaste Disposal Solid System (WDS)	<60
Auxiliary Building Emergency Liquid Cleanup System (ALC)	<125
Temporary Nuclear Sampling System (SNS)	<15
Submerged Demineralizer System (SDS)	<80
Radwaste Disposal Gas (WDG)	<5
Reactor Coolant Pump Oil Shield Drain Tanks	<500
TOTAL FOR SYSTEM PIPING	<6,550

[1] Residual water estimates were conservatively determined using known physical parameters including water levels, piping isometrics, known capacities and measured volumes drained from systems. When the quantity of water in piping could not be determined prior to draining, the piping was assumed to be full. The volume of water reported is the difference between the estimated volume prior to draining and the amount drained.

TABLE 3

Activity Concentration Summary for Residual Water Storage by Location

Location	H^3	Co^{60}	Sr^{90}	Sb^{125}	Cs^{134}	Cs^{137}	Eu^{154}	Gross Alpha	Residual Water Volume
RB Sump[16]	1.8E-2	3.7E-4	4.5E-1	<6.2E-3	1.2E-2	3.2E0	<7.93E-3	<5.0E-6	1400
MWHT[17]	1.62E-2	9.13E-5	6.13E-2	<8.68E-4	6.21E-4	1.91E-1	<1.93E-5	<9.57E-6	3000
Aux. Bldg. Sump[18]	1.62E-2	9.13E-6	6.13E-2	<8.68E-4	6.21E-4	1.91E-1	<1.93E-5	<9.57E-6	6000
Contaminated Drain Tank "A"[19]	9.85E-3	2.98E-6	N/A	<5.94E-6	1.55E-6	5.29E-4	<9.09E-7	N/A	1000

Note: All units for isotopic activity, including gross alpha, are in μCi/ml. Water volume is in gallons.

[16]RB sump water radioactivity is inferred from a sample taken June 25, 1992 from the RB sump water drained to the "C" Reactor Coolant Bleed Holdup Tank via the MWHT.

[17]TMI-2 Sample Analysis Summary Sheet dated April 11, 1993 from sample taken on April 9, 1993 from MWHT.

[18]Based on MWHT sample taken on April 9, 1993 after MWHT received transfer from Auxiliary Building sump.

[19]Based on WDL-T11A sample taken on June 25, 1993.

6.0 References

1. USNRC, NUREG-0683, "Final Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Radioactive Wastes Resulting From March 28, 1979 Accident," Three Mile Island Nuclear Station, Unit 2, March, 1981.

2. USNRC, "Statement of Policy Relative to the NRC Programmatic Environmental Impact Statement On the Cleanup of Three Mile Island Unit 2," April 27, 1981.

3. USNRC, NUREG-0683 Supplement No. 2, Final Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Radioactive Wastes Resulting From March 28, 1979 Accident Three Mile Island Nuclear Station, Unit 2 Final Supplement Dealing with Disposal of Accident Generated Water," June, 1987.

4. Letters, GPUNC to NRC, "Disposal of Processed Water," July 31, 1986 and October 21, 1986.

5. GPUNC, "Processed Water Disposal System Technical Evaluation Report," originally submitted October 7, 1988.

6. USNRC to GPUNC, "Issuance of Amendment and Approval of the TER on Processed Water Disposal System," September 11, 1989.

7. GPUNC TPO/TMI-137, "Technical Plan Liquid Radwaste Management Third Quarter 1984," August, 1984.

8. GPUNC TPO/TMI-141, "Technical Plan Liquid Radwaste Management Fourth Quarter 1984," October, 1984.

9. GPUNC TPO/TMI-27, "Reactor Building Basement - History and Present Conditions," November, 1982, Getachuw Worku.

10. USNRC, NUREG-0683, "Draft Programmatic Environmental Impact Statement related to the decontamination and disposal of radioactive wastes resulting from March 28, 1979 accident Three Mile Island Nuclear Station, Unit 2," July, 1980.

11. USNRC, NUREG-059', "Environmental Assessment Use of EPICOR-II At Three Mile Island, Unit 2," August 14, 1979.