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July 31, 1986

TMI-2 Cleanup Project Directorate
Attn: Dr. W. D. Travers
Director
US Nuclear Regulatory Commission
c/o Three Mile Island Nuclear Station
Middletown, PA 17057

Dear Dr. Travers:

Three Mile Island Nuclear Station, Unit 2 (TMI-2)
Operating License No. DPR-73
Docket No. 50-320
Disposal of Processed Water

Technical Specification 3.9.13 requires Nuclear Regulatory Commission approval prior to disposal of certain water stored at TMI-2.

In our discussions with the Commission in Washington on January 14, 1986, the Commissioners expressed a desire to receive a recommendation on disposal of the stored water at TMI-2 by mid-year, rather than in early 1987 as previously planned. This letter provides our recommendation.

We have evaluated possible disposal methods and have narrowed candidate methods down to three technically acceptable alternatives. They are as follows:

1. Evaporation and burial of evaporator bottoms as commercial low-level waste
2. Direct solidification and on-site burial per 10 CFR 20.302.
3. Liquid discharge to the Susquehanna River

Careful evaluation of these options resulted in selection of Option 1, evaporation of the water and commercial burial of the residue. A primary consideration in selecting this option was removal from the TMI site of the

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small amount of radioactivity remaining in the stored water. Thus, permanent resolution of the matter is achieved. However, selection of this option assumed approval of a request for an additional burial ground waste volume allocation by the U.S. Department of Energy (DOE), as provided under the Low-Level Radioactive Waste Policy Amendments Act of 1985.

GPU Nuclear is requesting an additional volume allocation from the DOE concurrent with this submittal in anticipation of approval in principle of the recommended option. The support of the NRC in obtaining favorable DOE consideration of the additional allocation is solicited.

GPU Nuclear has prepared an evaluation that assesses each of the options in terms of regulatory compliance, environmental effects, cost and schedule, waste generated and other relevant issues. A copy of this evaluation is attached for your consideration in assessing the GPU Nuclear recommendation.

GPU Nuclear requests NRC approval of the evaporation disposal option by December 31, 1986, to permit timely implementation consistent with the current Recovery Program schedule.

Per the requirements of 10 CFR 170, an application fee of $150.00 is enclosed.

Sincerely,

F. R. Standerfer
Vice President/Director, TMI-2

FRS/RBS/eml

Attachment

Enclosed: GPU Nuclear Corp. Check No. 00025024

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Attachment

Enclosed: GPU Nuclear Corp. Check No. 00025024

DISPOSAL OF TMI-2 WATER

JULY 1986

DISPOSAL OF TMI-2 WATER

Executive Summary

An estimated 2.1 million gallons of processed TMI-2 water will have accumulated by the end of the TMI-2 cleanup program in 1988 which will require disposition in accordance with Technical Specification 3.9.13. Prior NRC approval of the method of disposition is required. This report deals specifically with disposition of that water.

From the beginning, there has been widespread agreement that this water should not be stored indefinitely on Three Mile Island. Disposal should be accomplished in an agreed-upon manner, in conjunction with the end of the cleanup program. Continued storage of the water at TMI poses a remote risk of inadvertent release to the environment. Controlled disposal of this water will eliminate this risk and will be a major step toward completion of the TMI-2 cleanup.

Each of the disposal options has technical merits and special requirements which must be met. The technical merits of the disposal options and their potential environmental impact were judged to be comparable and were not at issue in the selection process. However, the public perception that the water is uniquely hazardous because it is related to the 1979 accident at TMI-2 was a primary consideration.

GPU Nuclear recognizes the political and public sensitivities of what is, in fact, a water disposal dilemma: specifically, there is consensus that disposal of the processed TMI-2 water must be accomplished safely but no consensus on how that should be done. GPU Nuclear has approached this dilemma systematically, fully cognizant of the varying concerns. The purpose of this report is to recommend a technically feasible, safe water disposal option and explain the choices that were considered.

This report identifies three technically feasible, environmentally safe methods for disposing of the water. Each option will comply with applicable federal and state requirements for protecting the public health and safety.

The three options are 1) evaporation and burial of the residue as commercial low-level waste, 2) direct solidification and burial in an on-site land-fill, and 3) dilution and discharge to the Susquehanna River.

None of the options considered pose significant environmental effects and all would meet, with considerable margin, all regulatory requirements. The average total additional radiation exposure to any individual in the public would be approximately the same as the exposure from one hour of natural background radiation in the Harrisburg Area (i.e., approximately 0.01 millirems based on 100 millirems per year). However, all three options would involve low-level releases of tritium and minute releases of cesium-137 and strontium-90 to the environment.

For the evaporation option, the tritium release rate would be less than five percent of the federal limit for continuous releases based on TMI-2 specific meteorological conditions. For cesium and strontium, the release rate would be less than 1.5 percent of the allowable continuous release rate.

During solidification, the tritium release rate would be approximately seven percent of the continuous release limit. (NOTE: Solidification requires less time to complete than evaporation and, although only half of the tritium content would be released during solidification, the average tritium release rate will be higher.) No atmospheric release of cesium and strontium would occur. It is assumed that small amounts of the remaining radionuclides would leach from the land-fill into a specially designed leachate collection system.

For discharge of the diluted water to the Susquehanna River, the radioisotopic concentrations at the nearest downstream drinking water point (Brunner Island) would be less than six percent of the federal limit.

Description of the Processed TMI-2 Water

Prior to final disposal, the TMI-2 water will have undergone processing through the Submerged Demineralizer (SDS) and/or EPICOR II water purification systems. This processing reduces the average radionuclide concentrations with a concomitant reduction in the potential environmental effects.

The average characteristics of the processed water will be as presented in Table 1.

TABLE 1

PRE-DISPOSITION PROCESSED TMI-2 WATER CHARACTERISTICS
(Based on processing 40% of the total volume)

Volume		~2,100,000	Gallons
Tritium:	Concentration	1.3E-1	uCi/ml
	Total	1020	Ci
Cs-137:	Concentration	3.7E-5	uCi/ml
	Total	0.29	Ci
Sr-90:	Concentration	1.15E-4	uCi.ml
	Total	0.9	Ci
Boron:	Concentration	3000	ppm
	Total	150	Tons H_3BO_4
Sodium:	Concentration	700	ppm
	Total	11	Tons NaOH

These radionuclide characteristics are representative of the expected influent feed to the evaporator and are based on an assumed requirement to process approximately 40 percent of the water prior to evaporation. For the other options (i.e., solidification or discharge to the river), 100 percent of the water would be processed prior to disposal and the remaining total activity of strontium 90 and cesium 137 would be lower: 0.08 curies and 0.03 curies, respectively. For these options, other radionuclides are expected to be near or below lower limits of detection. While tritium (1,020 curies) is the dominant radionuclide in the TMI-2 water in terms of quantity, the most radiologically significant radionuclide is strontium 90. That is because strontium tends to concentrate in bone marrow and gives a larger, though insignificant in this context, dose compared to the whole body dose from tritium. In addition to the radioisotopic content described above, the water will contain approximately 150 tons of boric acid and 11 tons of sodium hydroxide.

Evaluations of Disposal Options

The disposal options have been evaluated by the TMI-2 staff on the basis of relative technical feasibility, environmental effect, costs, waste generated and the time required to accomplish. The off-site environmental effects are comparable and well below the regulatory limits, even for the conservative (over-estimated) assumptions applied in accordance with 10 CFR 50, Appendix I. The total dose to the hypothetical maximally exposed individual would range from 0.4 to 4 millirems bone dose and 0.6 to 2 millirems whole body dose, depending on the disposal option selected.

Reflecting more likely conditions, the average total dose would range from 0.002 to 0.02 millirems to the bone and 0.003 to 0.01 millirems total body, depending on the option selected.

The key characteristics associated with each option are:

1. Evaporation - Processing and evaporation of the water will be by an installed evaporation facility. Shipment and disposal of solidified residues at a licensed, commercial low-level waste disposal site will follow. Evaporation would require a supplemental disposal allocation from the U.S. Department of Energy to bury the residues at a commercial low-level waste burial ground. All of the tritium content (1,020 curies) would be released to the atmosphere and dispersed without significant environmental effect. This option would take approximately two-and-a-half years to complete and a total estimated cost of $6 to $14 million, depending on the volume of waste residues produced.

2. Solidification - Processing and solidification of the water in cement will be followed by burial in an on-site industrial land-fill. This option would require a finding by the NRC that the radioactive content of the solidified material is below regulatory concern per 10 CFR 20.302. In addition, a land-fill permit will be required from the Pennsylvania Department of Environmental Resources. This process would involve the release of an estimated 50% of the tritium to the atmosphere. The option would take approximately one year to complete at a total estimated cost of $5.6 million.

3. River Discharge - Processing and controlled, monitored discharge to the Susquehanna River would result in significant dilution of the processed water with non-accident water (i.e., at the plant and in the river by a factor of 220,000 times) and ultimate dispersal with no significant environmental effect. In addition to NRC approval, the discharge will require notification of the Pennsylvania Department of Environmental Resources (DER). This option presents the potential for the strongest public and institutional reaction. It would take approximately one year to complete at a total estimated cost of $2.6 million.

On the basis of overall technical merit, analysis indicates that the controlled discharge of the processed, diluted water to the Susquehanna River is the simplest, least costly option and involves insignificant environmental impact, as do the competing options. However, GPU Nuclear has opted not to recommend discharge to the river in recognition of an existing public perception that unique health risks are associated with this disposal option.

After considering the technical merits of each option, as well as public, institutional and political concerns, GPU Nuclear has selected evaporation as the preferred option for disposal of TMI-2 water. Evaporation, including solidification and shipment of evaporator residue to a low-level waste burial ground, will remove the small amount of remaining radioactivity from TMI. Successful implementation of this recommendation requires approval of an additional waste disposal allocation.

There is a common objective -- safe disposal of the processed water. Our recommended disposal method is technically feasible and environmentally safe. It should be found acceptable by the NRC, the public and other government agencies.

This report is submitted to provide the NRC with the GPU Nuclear recommendation concerning disposal of the TMI-2 water in accordance with Technical Specification 3.9.13 and to seek NRC approval by the end of 1986. Timely initiation of water disposal is in the common interest.

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1.0 PURPOSE, BACKGROUND, ORGANIZATION

1.1 Purpose

Technical Specification 3.9.13 requires NRC approval prior to disposal of certain waters stored at TMI-2. A major goal of the TMI-2 cleanup program is to completely and effectively disposition the approximately 2.1 million gallons of this processed water which is contained within the confines of TMI-2 and associated storage tanks. The purpose of this report is to evaluate the three options which have been identified for disposing of processed water. The three options are evaluated with respect to environmental impact, economics and schedule, and public reaction. The later is the most difficult to predict, and involves subjective rather than objective considerations. The three options have been evaluated on the basis of relative technical feasibility, environmental effects, costs, waste generated, and time required to accomplish. The three options evaluated in this report are:

1. Evaporation with off-site disposal of the generated waste;
2. Direct solidification for on-site disposal; and
3. Controlled discharge to the Susquehanna River.

For purposes of conducting this evaluation of the ultimate disposition options for processed water, several assumptions have been defined. The assumptions considered are the following:

1. The TMI-2 cleanup endpoint is defined as September 30, 1988.

2. A total of approximately 2,100,000 gallons of processed water is estimated to require disposition under this evaluation.

3. Any new water generated after the recovery endpoint will not be considered processed water and therefore its disposal would not be within the scope of this report.

4. Radioactive waste disposal allocations provided by the 1985 Amendment to the Low-Level Waste Policy Act of 1980 are the only commercial disposal allocations available to TMI-2 until 1993.

Additional (or special) allocations or non-commercial radioactive waste disposal may be required to implement the evaporation option.

1.2 Background

1.2.1 Lancaster Agreement

The disposition of the processed water received public and regulatory attention shortly after the March 28, 1979 accident. The Settlement Agreement with the City of Lancaster (Lancaster Agreement) was entered on February 27, 1980, as the settlement of the case of the City of Lancaster versus U.S. Nuclear Regulatory Commission (NRC) held before the U.S. District Court for the District of Columbia. The Lancaster Agreement defined accident generated water and prohibited the discharge of accident generated water into the Susquehanna River until the NRC completed its Programmatic Environmental Impact Statement (PEIS, Reference 1) or until the NRC completed such other environmental review regarding the discharge of accident generated water into the Susquehanna River.

Definition of Accident Generated Water. Accident generated water (hereinafter known as processed water) has been defined in the Lancaster Agreement as:

- 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 .025 uCi/ml or less before processing;

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

- Water that contains greater than 0.025 uCi/ml of tritium before processing.

PEIS. The final PEIS (Reference 1) was issued by the NRC in March, 1981. The PEIS addressed the environmental impact from the decontamination of TMI-2 and the disposal of radioactive wastes resulting from the cleanup of TMI-2. The NRC also evaluated, in the PEIS, various options for the disposal of the processed water, but deferred a decision on the ultimate disposal method. The NRC policy statement, accompanying the PEIS, stated that NRC approval of the disposal method is reserved for the NRC commissioners themselves.

1.2.2 TMI-2 License and Technical Specifications

Several NRC Orders and Amendments to the TMI-2 License (Facility Operating License No. DPR-73) have been issued relating to the processing and discharging of the processed water. In the October 18, 1979, Order for Modification of License, the NRC authorized operation of the EPICOR II system for processing of the processed water. In the Order of February 11, 1980, the NRC issued new Proposed Technical Specifications (PTS) which included Technical Specification 3.9.13 which prohibited the discharge of water processed by the EPICOR II system until approved by the NRC, and Technical Specification 3.9.14 which prohibited the processing and discharging of water in the reactor building sump and the reactor coolant system until approved by the NRC. In the Order of June 18, 1981, the NRC authorized the processing of contaminated water, including the water in the reactor building sump and in the reactor coolant system, using the Submerged Demineralizer System (SDS) with effluent polishing by the EPICOR II system, if necessary. The Amendment of Order of January 7, 1985, combined Technical Specifications 3.9.13 and 3.9.14 into one technical specification and defined accident generated water to be consistent with the Lancaster Agreement. Technical Specification 3.9.13, as revised in the January 7, 1985, Amendment of Order reads as follows:

> T.S. 3.9.13. Discharge of accident generated water shall be prohibited until approved by the NRC. Accident generated water shall be discharged in accordance with procedures approved pursuant to Specification 6.8.2.

Adherence to Technical Specification 3.9.13 ensures that:

1. The method of disposal for the accident generated water will be approved by the NRC since the PEIS issued in March, 1981, deferred a decision on the ultimate disposal of the accident generated water, and

2. The governing procedures issued by GPU Nuclear, to implement the selected disposal method, will be approved by the NRC prior to their implementation. These procedures will contain the necessary controls to satisfy the applicable regulations.

On January 27, 1986, the NRC amended the TMI-2 License (Facility Operating License No. OPR-73) to incorporate the PTS as Appendix A to the TMI-2 License.

1.3 Organization

Section 2 describes the current and projected volume of the processed water and the radioisotopic and chemical constitutents in the processed water.

Section 3 presents the applicable federal and state regulations that would be imposed on the disposal of the processed water.

Section 4 presents the evaluation of the evaporation option which results in controlled airborne releases and the solidification and off-site disposal of the generated waste.

Section 5 presents the evaluation of the solidification option which results in controlled airborne releases, potential liquid releases, and the disposal of the solidified processed water on-site.

Section 6 presents the evaluation of the discharge-to-river option which results in the controlled release of the processed water into the Susquehanna River.

Section 7 presents the safety evaluation to assess whether the disposal of the processed water is an unreviewed safety question as defined in 10 CFR 50.59.

Section 8 summarizes the evaluation presented in Sections 4, 5, and 6 and compares the options. In this section the recommended option and the basis used to determine the recommended option are given.

Section 9 lists the references used in this report.

2.0 STATUS OF PROCESSED WATER

2.1 Inventory

2.1.1 Water Inventory

The TMI-2 accident resulted in the production of large volumes of contaminated water, which became known as "accident generated water" (hereinafter known as processed water) (see definition in Section 1.2). Through mid-1981, when the SDS began operation to process water contained in the reactor building sump, approximately 1.3 million gallons of processed water existed at TMI-2. Of this volume, about 640,000 gallons was contained in the reactor building sump. Direct release from the reactor coolant system contributed 69% of the sump water, another 28% was river water introduced via leaks in reactor building air coolers, and the remaining 3% was added via the containment spray system during the first several hours of the accident. Subsequent to 1981, most of this water was processed by both SOS and EPICOR II to reduce radionuclide levels to very low concentrations.

In addition, approximately 570,000 gallons of water existed in auxiliary fuel handling building tanks, most of which had been processed by EPICOR II by mid-1981. The reactor coolant system contained an additional 96,000 gallons of water which also required processing by both SDS and EPICOR II.

Since 1981, the total inventory of processed water has increased to approximately 1.9 million gallons due to continued inleakage from support systems and condensation from the reactor building air coolers during summer months. GPU has exercised considerable care to minimize the inleakage of new water, and to ensure that commingling of non-contaminated water with the processed water is restricted, thereby minimizing the total volume of water requiring disposal. Processed water requires treatment by SDS and/or EPICOR II to reduce the radionuclide concentraton prior to storage or ultimate disposition.

Current Volumes - January 1986

Table 2-1 presents a summary of processed water inventories in each available TMI-2 storage location. Inventories at five (5) different dates were compared in order to assess the net accumulation rate for projections to the end of the recovery program. The water volumes indicated for January 1986, are defined as the baseline processed water status for purposes of this document. Waste from the concentrated waste storage tank will not be considered for evaluation of disposition options since this material will be solidified directly for disposal as radioactive waste.

Inleakage

From the data presented in Table 2-1, an upper bound of new water inleakage to TMI-2 has been approximately 0.11 gpm. In the past, much of this inleakage has originated from reactor building chiller condensation during summer months. Actions taken to reduce this inleakage source have been successful, therefore, the projected inleakage over the next several years should be less than the inleakage experienced in the past. To be conservative, however, an inleakage rate of 0.11 gpm has been assumed to exist from January 1986 to October 1988, the defined recovery endpoint.

Projected Volumes - October 1988

Using the total inventory on hand in January 1986, and projected accumulation rate of 0.11 gpm, it is estimated that approximately 2,100,000 gallons of processed water requiring disposition will be available at the end of the recovery period. This quantity represents approximately 85% of the storage capacity available for processed water. All future evaluations of disposition options will consider this quantity as the baseline quantity.

2.1.2 Tritium Inventory

The PEIS estimated 2,910 curies of liquid tritium present in TMI-2, decay corrected to September 30, 1980. Tritium is naturally removed by

INVENTORY SUMMARY (1/01/86)

TABLE 2-1

LOCATION (values in gallons)	1/01/84	7/02/84	1/02/85	6/03/85	1/02/86
RCS level inches (RCL100)	74	72	144	145	148
Level minus Reference (84")	-10	-12	60	61	64
REACTOR COOLANT SYSTEM	29,920	50,000	66,624	66,789	67,286
PWST-1 (PROCESSED WATER)	290,985	320,053	320206	324,031	109,081
PWST-2 (PROCESSED WATER)	480,997	437,166	435178	374,823	480,134
CDT-1A (CONDENSATE STORAGE)	116,188	115,155	114398	114,398	101,518
WDL-T-9A (EVAP COND)	9,066	9,911	6532	10,295	5,610
WDL-T-9B (EVAP COND)	10,141	9,143	8298	10,295	2,231
CCT-1 (EPICOR II OFF SPEC)	76,072	35,743	35050	62,634	20,500
CCT-2 (EPICOR II CLEAN)	29,004	25,330	0	4,405	16,887
SPENT FUEL POOL B	241,698	241,698	241698	241,698	241,698
SDS-T-1A (SDS MONITOR)	5,596	373	684	11,379	373
SDS-T-1B (SDS MONITOR)	10,384	497	497	2,518	497
WDL-T-1A (RCBT-A)	72,250	72,790	22524	2,234	3,910
WDL-T-1B (RCBT-B)	1,320	23,100	72844	17,150	4,420
WDL-T-1C (RCBT-C)	9,540	5,050	48736	58,172	57,116
BORATED WATER STORAGE TANK	343,828	386,037	445477	458,241	458,915
WDL-T-8A (NEUTRALIZER)	1,328	2,280	1575	8,605	8,675
WDL-T-8B (NEUTRALIZER)	1,397	2,280	1575	8,145	8,605
TANK FARM (UPPER)	0	0	0	0	0
TANK FARM (LOWER)	17,720	0	0	0	0
WDL-T-2 (MAINT)	10,429	1,178	6772	8,687	3,712
WDL-T-11A (CONT. DRAINS)	158	820	820	1,377	1,931
WDL-T-11B (CONT. DRAINS)	158	1,030	2018	90	820
CHEM CLEANING BLDG SUMP	1,530	880	1080	1,380	1,880
CONCENTRATED WASTE	4,246	4,390	0	0	1,225
RECLAIM BORIC ACID TANK	0	0	0	0	0
AUXILIARY BLDG SUMP	3,442	6,752	4248	5,855	5,917
REACTOR BLDG BASEMENT	27,400	51,898	20865	23,732	43,082
SUBTOTALS	1,798,793	1,803,352	1,857,499	1,815,113	1,845,723
SPENT FUEL POOL A	0	0	0	0	205,234
SUBTOTAL	1,798,793	1,803,352	1,857,499	1,815,113	1,850,957
DEEP END OF TRANSFER CANAL	0	0	0	0	58,685
TOTAL	1,798,793	1,803,352	1,857,499	1,815,113	1,909,642
NET INCREASE (GAL) since 1/1/84		8,559	60,706	18,320	112,849
ACCUMULATION RATE(GPM)		.02	.11	.02	.11
RATE (GAL/MONTH) since 1/1/84		1075.25	4982.34	1058.98	4624.94
PROJECTION TO 10/1/88					
MONTHS		51 months	45 months	40 months	33 months
GALLONS		1,858,190	2,080,804	1,857,473	2,062,265
DATE AT WHICH FREEBOARD IS LESS THAN PROCESSED WATER STORAGE TOTAL		5/02/2033	9/02/94	2/03/2034	8/02/95

radioactive decay (12.3 year half-life) and by evaporation losses. Therefore, decay corrected to March 1979, the PEIS estimate would yield a tritium inventory of 3,180 curies at the time of the accident.

An approximate reconciliation of tritium present in January 1986, and referenced back to March 1979, is presented in Table 2-2. Measured evaporation releases from the station vent, decay corrected to March 1979, total approximately 1,433 curies. When added to the inventory of tritium in January 1986, the total tritium which can be accounted for, decay corrected to March 1979, is approximately 3,160 curies. This estimate compares very favorably to the decay corrected PEIS estimate of 3,180 curies.

Historically, the average yearly liquid tritium discharge from PWRs in the U.S., as reported in Reference 2, has ranged from a high of 3,452 curies in 1970 to a low of 297 curies in 1980. Individually, the highest yearly discharge of tritium was from 7,400 curies to a low of 0.0 curies.

Environmentally, the background tritium concentrations in the Susquehanna River average approximately 1.5E-7 uCi/ml (150 pCi/l). This background tritium concentration can be translated to a curies-per-year flow past TMI under various river conditions. The historical average flow of the Susquehanna River (measured at York Haven) is 34,410 cubic feet per second. This translates to 4,650 curies of background tritium flowing past TMI during an average year. The 1,021 curies of tritium in the processed water (decayed to 10/01/88) represents approximately 24% of the total curies of background tritium that flow past TMI in an average year.

2.2 Radionuclide Activity

Current

Radionuclide analysis for each source of processed water as of late 1985 or early 1986 are presented in Tables 2-3 and 2-4. The actual sample dates

TABLE 2-2

TRITIUM RECONCILIATION

Tritium Released From

TMI-2 Vents

Period	Curies Released	Curies Decay Corrected To March 1979
1979, 4Q	0.0	0.0
1980, 1Q	699	734.6
2Q	247.0	263.25
3Q	9.43	10.19
4Q	7.29	7.99
1981, 1Q	32.9	36.58
2Q	7.82	8.82
3Q	7.45	8.52
4Q	17.4	20.18
1982, 1Q	46.4	54.58
2Q	11.2	13.36
3Q	30.3	36.66
4Q	23.9	29.33
1983, 1Q	15.5	19.29
2Q	17.9	22.59
3Q	7.9	10.11
4Q	7.39	9.59
1984, 1Q	5.0	6.58
2Q	2.04	2.72
3Q	4.94	6.69
4Q	2.33	3.20
1985, 1Q	1.79	2.49
2Q	2.81	3.97
3Q	2.91	4.17
4Q	12.3	17.87
Total Released (Corrected to 3/79)		1,433.3
1/1/86 Total (Corrected to 3/79)		1,728.5
Total Existing Plus Released (Corrected to 3/79)		3,161.8

are indicated in the tables. Measured concentration values for all radionuclides with positive (i.e., greater than LLD) values are presented in Table 2-3, while Table 2-4 presents the total activity present in each source volume. The data in these two tables represent the actual liquid source terms present at TMI-2 in March 1986, approximately 7 years after the accident.

Reprocessing Considerations

Prior to ultimate disposition, it is likely that a considerable percentage of the processed water at TMI-2 will require processing to minimize radioactive contaminants. The major purpose for this processing (reprocessing for some of the water) is to further reduce the radionuclide levels, thereby minimizing the total release of activity to the environment. Of particular concern is the need to reduce the total quantity of Sr-90 present in processed water. The reprocessing activities to reduce total Sr-90 activity has been determined to be desirable to minimize the environmental consequences of several disposition options and to enhance GPU's ability to obtain NRC approval per 10 CFR 20.302 for potential on-site disposal of direct solidification.

The volume of water requiring processing prior to ultimate disposition is dependent upon the final method selected by GPUN for disposal of processed water. For the river discharge and direct solidification options, essentially all of the water will require initial processing, or reprocessing, through SDS and EPICOR II prior to disposition. For the evaporation option, because of the concentrating effects of the evaporator, only an estimated 37% of the total volume will require SDS and/or EPICOR II processing before evaporation to reduce the activity levels influent to the evaporator. Additional water processing may be performed as needed.

Projected

To develop projected liquid processed water source terms at the end of the recovery (i.e., 10/01/88), the current source terms in Table 2-3 were adjusted as follows.

TABLE 2-3

TMI-2 PROCESSED WATER SOURCE TERMS

*** ACTUAL SOURCE TERMS ***

STORAGE	DESCRIPTION	VOLUME GALLONS	SAMPLE DATE	RADIONUCLIDE CONCENTRATION H-3 µCi/ml	Sr-90 µCi/ml	Cs-137 µCi/ml	Cs-134 µCi/ml	Sb-125 µCi/ml	Co-60 µCi/ml
RCS	REACTOR COOLANT SYSTEM	67,286	3/7/86	1.20E-01	1.80E+00	2.60E-01	7.40E-03	3.60E-02	9.40E-03
PWST-1	PROCESSED WATER STORAGE	109,081	2/22/86	3.00E-01	1.60E-05	6.80E-06			
PWST-2	PROCESSED WATER STORAGE	480,134	2/24/86	2.80E-01	5.30E-05	4.40E-06			
CO-T-1A	CONDENSATE STORAGE	101,518	3/3/86	5.60E-02	1.80E-04	4.40E-06			
WDL-T-9A	EVAP.COND. TEST TANK	5,610	4/12/83	1.30E-01	2.58E-05	9.40E-06	9.40E-07		9.00E-07
WDL-T-9B	EVAP.COND. TEST TANK	2,231	4/17/83	1.30E-01	8.80E-05	5.00E-06	3.50E-07		
CC-T-1	EPICOR II OFF-SPEC	20,500	3/5/86	1.30E-01	5.80E-04	1.80E-04	5.00E-06	4.90E-05	
CC-T-2	EPICOR II CLEAN	16,887	11/15/85	8.80E-02	3.00E-04	1.50E-04		1.10E-04	6.50E-06
SFP-B	SPENT FUEL POOL "B"	241,698	3/2/86	4.50E-02	3.30E-05	3.60E-06			
SDS-T-1A	SDS MONITOR	373	3/14/86	7.60E-02	5.30E-03	9.80E-04		6.60E-04	
SDS-T-1B	SDS MONITOR	497	3/8/86	7.30E-02	9.70E-04	1.00E-03		9.40E-04	6.90E-05
WDL-T-1A	RC BLEED HOLDUP	3,810	2/24/86	8.50E-02	3.30E-02	9.30E-03	2.70E-05	4.60E-04	9.00E-05
WDL-T-1B	RC BLEED HOLDUP	4,420	3/7/86	1.30E-01	1.70E+00	2.00E-01	5.60E-03	3.40E-02	6.60E-03
WDL-T-1C	RC BLEED HOLDUP	57,116	10/31/85	1.70E-01	2.50E+00	1.70E-01		8.10E-02	6.50E-03
BWST	BORATED WATER STORAGE	458,915	3/4/86	6.60E-02	3.80E-04	1.30E-04	8.90E-06		2.70E-06
WDL-T-8A	NEUTRALIZER	8,675	2/28/86	9.00E-02	1.40E-01	1.90E-01	5.30E-03		
WDL-T-8B	NEUTRALIZER	8,605	3/1/86	6.80E-02	7.70E-02	1.80E-01	5.30E-03		
WDL-T-2	MISCELLANEOUS WASTE HOLDUP	3,712	2/28/86	6.90E-02	7.80E-02	1.70E-01	4.90E-03		
WDL-T-11A	CONTAMINATED DRAINS	1,931	3/1/86	2.10E-05	2.70E-05	4.20E-05	9.30E-07		
WDL-T-11B	CONTAMINATED DRAINS	820	3/1/86	1.40E-05		1.10E-05			
	CHEM CLEANING BLDG SUMP	1,680	3/2/86	4.50E-02	1.10E-03	8.80E-04		3.40E-03	7.90E-06
	AUXILIARY BLDG SUMP	5,917	10/4/85	1.30E-01	1.20E-01	2.30E-02			
	REACTOR BLDG BASEMENT	43,082	4/26/85	2.60E-02	1.60E+00	4.90E+00			
SFP-A	SPENT FUEL POOL "A"	205,234	2/27/86	2.60E-01	3.20E-02	8.80E-03	2.40E-04	2.60E-03	2.50E-04
	DEEP END OF TRANSFER CANAL	58,685	3/12/86	3.00E-01	2.60E-02	8.60E-03	2.20E-04	2.90E-03	2.50E-04
	TOTAL AS OF 1/1/86	1,908,417							
	AVERAGE CONCENTRATIONS		µCi/ml =	1.64E-01	1.84E-01	1.29E-01			

(BLANKS INDICATE L.D VALUES OR DATA NOT AVAILABLE)

TABLE 2-4

TMI-2 PROCESSED WATER SOURCE TERMS

*** ACTUAL SOURCE TERMS ***

TANK	DESCRIPTION	VOLUME GALLONS	DATE	TOTAL RADIOACTIVITY H-3 Ci	Sr-90 Ci	Cs-137 Ci	Cs-134 Ci	Sb-125 Ci	Co-60 Ci
RCS	REACTOR COOLANT SYSTEM	67,286	3/7/86	3.06E+01	4.58E+02	6.62E+01	1.88E+00	9.17E+00	2.39E+00
PWST-1	PROCESSED WATER STORAGE	109,081	2/22/86	1.24E+02	6.61E-03	2.81E-03			
PWST-2	PROCESSED WATER STORAGE	480,134	2/24/86	5.09E+02	9.63E-02	8.00E-03			
CO-T-1A	CONDENSATE STORAGE	101,518	3/3/86	2.15E+01	6.92E-02	1.69E-03			
WDL-T-9A	EVAP. COND. TEST TANK	5,610	4/12/83	2.76E+00	5.48E-04	2.00E-04	2.00E-05		1.91E-05
WDL-T-9B	EVAP. COND. TEST TANK	2,231	4/17/83	1.10E+00	7.43E-04	4.22E-05	2.96E-06		
CC-T-1	EPICOR II OFF-SPEC	20,500	3/5/86	1.01E+01	4.50E-02	1.40E-02	3.88E-04	3.80E-03	
CC-T-2	EPICOR II CLEAN	16,887	11/15/85	5.62E+00	1.92E-02	9.53E-03		7.03E-03	4.15E-04
SFP-B	SPENT FUEL POOL "B"	241,698	3/2/86	4.12E+01	3.02E-02	3.29E-03			
SDS-T-1A	SDS MONITOR	373	3/7/86	1.07E-01	7.48E-03	1.38E-03		9.32E-04	
SDS-T-1B	SDS MONITOR	497	10/10/85	1.37E-01	1.82E-03	1.88E-03		1.77E-03	1.30E-04
WDL-T-1A	RC BLEED HOLDUP	3,810	2/24/86	1.23E+00	4.76E-01	1.34E-01	3.89E-04	6.63E-03	1.30E-03
WDL-T-1B	RC BLEED HOLDUP	4,420	3/7/86	2.17E+00	2.84E+01	3.35E+00	9.37E-02	5.69E-01	1.10E-01
WDL-T-1C	RC BLEED HOLDUP	57,116	10/31/85	3.68E+01	5.40E+02	3.68E+01		1.75E+01	1.41E+00
BWST	BORATED WATER STORAGE	458,915	3/4/86	1.15E+02	6.60E-01	2.26E-01	1.55E-02		4.69E-03
WDL-T-8A	NEUTRALIZER	8,675	2/28/86	2.96E+00	4.60E+00	6.24E+00	1.74E-01		
WDL-T-8B	NEUTRALIZER	8,605	3/1/86	2.21E+00	2.51E+00	5.86E+00	1.73E-01		
WDL-T-2	MISCELLANEOUS WASTE HOLDUP	3,712	2/28/86	9.69E-01	1.10E+00	2.39E+00	6.88E-02		
WDL-T-11A	CONTAMINATED DRAINS	1,931	3/1/86	1.53E-04	1.97E-04	3.07E-04	6.80E-06		
WDL-T-11B	CONTAMINATED DRAINS	820	3/1/86	4.35E-05		3.41E-05			
	CHEM CLEANING BLDG SUMP	1,680	3/2/86	2.86E-01	6.99E-03	5.60E-03		2.16E-02	5.02E-05
	AUXILIARY BLDG SUMP	5,917	10/4/85	2.91E+00	2.69E+00	5.15E-01			
	REACTOR BLDG BASEMENT	43,082	4/26/85	4.24E+00	2.61E+02	7.99E+02			
SFP-A	SPENT FUEL POOL "A"	205,234	2/27/86	2.02E+02	2.49E+01	6.84E+00	1.86E-01	2.02E+00	1.94E-01
	DEEP END OF TRANSFER CANAL	58,685	3/12/86	6.66E+01	5.78E+00	1.91E+00	4.89E-02	6.44E-01	5.55E-02
	TOTAL AS OF 1/1/86	1,908,417		1182.75	1331.17	929.49			

For source volumes indicated with an asterisk in Table 2-5 additional processing through SDS and/or EPICOR II will be performed prior to disposition. The total volume processed is 100% of the projected volume of the processed water. Thus, 100% processing/reprocessing would be performed prior to either the direct solidification or the river discharge option. The resultant radionuclide concentrations were expected to be 1.0E-5 uCi/ml for Sr-90, 4.0E-6 uCi/ml for Cs-137 and below LLD for the remaining fission or corrosion products. These values have been consistently achieved at the effluent of EPICOR II. Tritium would not be affected by processing and therefore, the actual concentration in March 1986 would change via natural decay only.

For all volume sources and nuclides, decay corrections were performed from the sample date listed in Table 2-3 to 10/01/88. The resulting radionuclide concentrations following 100% processing or reprocessing projected to exist in processed water on 10/01/88 are presented in Table 2-5. Total activity for each nuclide present, and its average concentration for all the processed water are presented in Table 2-6.

The source terms presented in Tables 2-5 and 2-6 have been defined as the base, processed water source terms for purposes of evaluating the environmental impacts for the river discharge and solidification disposition option.

Due to the concentrating effect of the evaporator, thereby requiring the solidification of the evaporator concentrates for radioactive waste disposal, only approximately 40% of the processed water will require processing through SDS and EPICOR II before evaporation. The water sources requiring processing prior to evaporation are identified with an asterisk in Table 2-7. Tables 2-7 and 2-8 present the radionuclide concentrations and total activity, respectively, projected to exist on 10/01/88 after processing approximately 40% of the processed water. Additional processing

TABLE 2-5

TMI-2 PROCESSED WATER SOURCE TERMS

TANK	DESCRIPTION	VOLUME GALLONS	REPROCESS 10/1/88	H-3 µCi/ml	Sr-90 µCi/ml	Cs-137 µCi/ml	Cs-134 µCi/ml	Sb-125 µCi/ml	Co-60 µCi/ml
	*** PROJECTED SOURCE TERMS *** 100% PROCESSING			RADIONUCLIDE CONCENTRATION					
RCS	REACTOR COOLANT SYSTEM	67,286	*	1.04E-01	1.00E-05	4.00E-06			
PWST-1	PROCESSED WATER STORAGE	109,081	*	2.59E-01	1.00E-05	4.00E-06			
PWST-2	PROCESSED WATER STORAGE	480,134	*	2.42E-01	1.00E-05	4.00E-06			
CO-T-1A	CONDENSATE STORAGE	101,518	*	4.84E-02	1.00E-05	4.00E-06			
WDL-T-9A	EVAP. COND. TEST TANK	5,610	*	9.55E-02	1.00E-05	4.00E-06			
WDL-T-9B	EVAP. COND. TEST TANK	2,231	*	9.56E-02	1.00E-05	4.00E-06			
CC-T-1	EPICOR II OFF-SPEC	20,500	*	1.12E-01	1.00E-05	4.00E-06			
CC-T-2	EPICOR II CLEAN	16,887	*	7.48E-02	1.00E-05	4.00E-06			
SFP-B	SPENT FUEL POOL "B"	241,698	*	3.89E-02	1.00E-05	4.00E-06			
SDS-T-1A	SDS MONITOR	373	*	6.58E-02	1.00E-05	4.00E-06			
SDS-T-1B	SDS MONITOR	497	*	6.32E-02	1.00E-05	4.00E-06			
WDL-T-1A	RC BLEED HOLDUP	3,810	*	7.34E-02	1.00E-05	4.00E-06			
WDL-T-1B	RC BLEED HOLDUP	4,420	*	1.12E-01	1.00E-05	4.00E-06			
WDL-T-1C	RC BLEED HOLDUP	57,116	*	1.44E-01	1.00E-05	4.00E-06			
BWST	BORATED WATER STORAGE	458,915	*	5.71E-02	1.00E-05	4.00E-06			
WDL-T-8A	NEUTRALIZER	8,675	*	7.78E-02	1.00E-05	4.00E-06			
WDL-T-8B	NEUTRALIZER	8,605	*	5.88E-02	1.00E-05	4.00E-06			
WDL-T-2	MISCELLANEOUS WASTE HOLDUP	3,712	*	5.96E-02	1.00E-05	4.00E-06			
WDL-T-11A	CONTAMINATED DRAINS	1,931	*	1.82E-05	1.00E-05	4.00E-06			
WDL-T-11B	CONTAMINATED DRAINS	820	*	1.21E-05	1.00E-05	4.00E-06			
	CHEM CLEANING BLDG SUMP	1,680	*	3.89E-02	1.00E-05	4.00E-06			
	AUXILIARY BLDG SUMP	5,917	*	1.10E-01	1.00E-05	4.00E-06			
	REACTOR BLDG BASEMENT	43,082	*	2.14E-02	1.00E-05	4.00E-06			
SFP-A	SPENT FUEL POOL "A"	205,234	*	2.25E-01	1.00E-05	4.00E-06			
	DEEP END OF TRANSFER CANAL	58,685	*	2.60E-01	1.00E-05	4.00E-06			
	SUBTOTAL	1,908,417	100%	(PERCENT FOR INITIAL OR REPROCESSSING BEFORE DISPOSITION)					
	ADDITIONAL WATER TO 10/88	153,848		1.82E-05	1.00E-05	4.00E-06			
	TOTAL FOR DISPOSITION	2,062,265		(ACTIVITIES DECAYED TO 10/1/88)					

TABLE 2-6

TMI-2 PROCESSED WATER SOURCE TERMS

*** PROJECTED SOURCE TERMS ***
100% PROCESSING

TANK	DESCRIPTION	VOLUME GALLONS	TOTAL RADIOACTIVITY H-3 Ci	Sr-90 Ci	Cs-137 Ci	Cs-134 Ci	Sb-125 Ci	Co-60 Ci
RCS	REACTOR COOLANT SYSTEM	67,286	2.64E+01	2.55E-03	1.02E-03			
PWST-1	PROCESSED WATER STORAGE	109,081	1.07E+02	4.13E-03	1.65E-03			
PWST-2	PROCESSED WATER STORAGE	480,134	4.39E+02	1.82E-02	7.27E-03			
CO-T-1A	CONDENSATE STORAGE	101,518	1.86E+01	3.84E-03	1.54E-03			
WDL-T-9A	EVAP. COND. TEST TANK	5,610	2.03E+00	2.12E-04	8.49E-05			
WDL-T-9B	EVAP. COND. TEST TANK	2,231	8.07E-01	8.44E-05	3.38E-05			
CC-T-1	EPICOR II OFF-SPEC	20,500	8.72E+00	7.76E-04	3.10E-04			
CC-T-2	EPICOR II CLEAN	16,887	4.78E+00	6.39E-04	2.56E-04			
SFP-B	SPENT FUEL POOL "B"	241,698	3.56E+01	9.15E-03	3.66E-03			
SDS-T-1A	SDS MONITOR	373	9.29E-02	1.41E-05	5.65E-06			
SDS-T-1B	SDS MONITOR	497	1.19E-01	1.88E-05	7.52E-06			
WDL-T-1A	RC BLEED HOLDUP	3,810	1.06E+00	1.44E-04	5.77E-05			
WDL-T-1B	RC BLEED HOLDUP	4,420	1.88E+00	1.67E-04	6.69E-05			
WDL-T-1C	RC BLEED HOLDUP	57,116	3.12E+01	2.16E-03	8.65E-04			
BWST	BORATED WATER STORAGE	458,915	9.91E+01	1.74E-02	6.95E-03			
WDL-T-8A	NEUTRALIZER	8,675	2.55E+00	3.28E-04	1.31E-04			
WDL-T-8B	NEUTRALIZER	8,605	1.91E+00	3.26E-04	1.30E-04			
WDL-T-2	MISCELLANEOUS WASTE HOLDUP	3,712	8.38E-01	1.40E-04	5.62E-05			
WDL-T-11A	CONTAMINATED DRAINS	1,931	1.33E-04	7.31E-05	2.92E-05			
WDL-T-11B	CONTAMINATED DRAINS	820	3.76E-05	3.10E-05	1.24E-05			
	CHEM CLEANING BLDG SUMP	1,680	2.47E-01	6.36E-05	2.54E-05			
	AUXILIARY BLDG SUMP	5,917	2.46E+00	2.24E-04	8.96E-05			
	REACTOR BLDG BASEMENT	43,082	3.49E+00	1.63E-03	6.52E-04			
SFP-A	SPENT FUEL POOL "A"	205,234	1.75E+02	7.77E-03	3.11E-03			
	DEEP END OF TRANSFER CANAL	58,685	5.77E+01	2.22E-03	8.88E-04			
	ADDITIONAL WATER TO 10/88	153,848	1.06E-02	5.82E-03	2.33E-03			
	TOTAL FOR DISPOSITION	2,062,265	Ci = 1020.61	0.08	0.03			
	AVERAGE CONCENTRATIONS		µCi/ml = 1.31E-01	1.00E-05	4.00E-06			

TABLE 2-7

TMI-2 PROCESSED WATER SOURCE TERMS

*** PROJECTED SOURCE TERMS ***
APPROXIMATE 40% PROCESSING

TANK	DESCRIPTION	VOLUME GALLONS	REPROCESS 10/1/88	RADIONUCLIDE CONCENTRATION H-3 µCi/ml	Sr-90 µCi/ml	Cs-137 µCi/ml	Cs-134 µCi/ml	Sb-125 µCi/ml	Co-60 µCi/ml
RCS	REACTOR COOLANT SYSTEM	67,286	*	1.04E-01	1.00E-05	4.00E-06			
PWST-1	PROCESSED WATER STORAGE	109,081		2.59E-01	1.50E-05	6.40E-06			
PWST-2	PROCESSED WATER STORAGE	480,134		2.42E-01	4.98E-05	4.14E-06			
CO-T-1A	CONDENSATE STORAGE	101,518		4.84E-02	1.69E-04	4.15E-06			
WDL-T-9A	EVAP. COND. TEST TANK	5,610		9.55E-02	2.26E-05	8.29E-06	1.54E-07		4.38E-07
WDL-T-9B	EVAP. COND. TEST TANK	2,231		9.56E-02	7.72E-05	4.41E-06	5.78E-08		
CC-T-1	EPICOR II OFF-SPEC	20,500		1.12E-01	5.45E-04	1.70E-04	2.14E-06	2.57E-05	
CC-T-2	EPICOR II CLEAN	16,887		7.48E-02	2.80E-04	1.40E-04		5.34E-05	4.45E-06
SFP-B	SPENT FUEL POOL "B"	241,698	*	3.89E-02	1.00E-05	4.00E-06			
SDS-T-1A	SDS MONITOR	373		6.58E-02	4.99E-03	9.24E-04		3.48E-04	
SDS-T-1B	SDS MONITOR	497		6.32E-02	9.12E-04	9.43E-04		4.93E-04	4.92E-05
WDL-T-1A	RC BLEED HOLDUP	3,810	*	7.34E-02	1.00E-05	4.00E-06			
WDL-T-1B	RC BLEED HOLDUP	4,420	*	1.12E-01	1.00E-05	4.00E-06			
WDL-T-1C	RC BLEED HOLDUP	57,116	*	1.44E-01	1.00E-05	4.00E-06			
BWST	BORATED WATER STORAGE	458,915		5.71E-02	3.57E-04	1.23E-04	3.80E-06		1.92E-06
WDL-T-8A	NEUTRALIZER	8,675	*	7.78E-02	1.00E-05	4.00E-06			
WDL-T-8B	NEUTRALIZER	8,605	*	5.88E-02	1.00E-05	4.00E-06			
WDL-T-2	MISCELLANEOUS WASTE HOLDUP	3,712	*	5.96E-02	1.00E-05	4.00E-06			
WDL-T-11A	CONTAMINATED DRAINS	1,931		1.82E-05	2.54E-05	3.96E-05	3.96E-07		
WDL-T-11B	CONTAMINATED DRAINS	820		1.21E-05		1.04E-05			
	CHEM CLEANING BLDG SUMP	1,680		3.89E-02	1.03E-03	8.29E-04		1.78E-03	5.62E-06
	AUXILIARY BLDG SUMP	5,917	*	1.10E-01	1.00E-05	4.00E-06			
	REACTOR BLDG BASEMENT	43,082	*	2.14E-02	1.00E-05	4.00E-06			
SFP-A	SPENT FUEL POOL "A"	205,234	*	2.25E-01	1.00E-05	4.00E-06			
	DEEP END OF TRANSFER CANAL	58,685	*	2.60E-01	1.00E-05	4.00E-06			
	SUBTOTAL	1,908,417	37%	(PERCENT FOR INITIAL OR REPROCESSSING BEFORE DISPOSITION)					
	ADDITIONAL WATER TO 10/88	153,848		1.82E-05	2.54E-05	3.96E-05	3.96E-07		
	TOTAL FOR DISPOSITION	2,062,265		(ACTIVITIESDECAYED TO 10/1/88)					

TABLE 2-8

TMI-2 PROCESSED WATER SOURCE TERMS

*** PROJECTED SOURCE TERMS ***
APPROXIMATE 40% PROCESSING

TANK	DESCRIPTION	VOLUME GALLONS		TOTAL RADIOACTIVITY H-3 Ci	Sr-90 Ci	Cs-137 Ci	Cs-134 Ci	Sb-125 Ci	Co-60 Ci
RCS	REACTOR COOLANT SYSTEM	67,286		2.64E+01	2.55E-03	1.02E-03			
PWST-1	PROCESSED WATER STORAGE	109,081		1.07E+02	6.21E-03	2.64E-03			
PWST-2	PROCESSED WATER STORAGE	480,134		4.39E+02	9.05E-02	7.53E-03			
CO-T-1A	CONDENSATE STORAGE	101,518		1.86E+01	6.50E-02	1.59E-03			
WDL-T-9A	EVAP. COND. TEST TANK	5,610		2.03E+00	4.81E-04	1.76E-04	3.28E-06		9.30E-06
WDL-T-9B	EVAP. COND. TEST TANK	2,231		8.07E-01	6.52E-04	3.72E-05	4.88E-07		
CC-T-1	EPICOR II OFF-SPEC	20,500		8.72E+00	4.23E-02	1.32E-02	1.66E-04	1.99E-03	
CC-T-2	EPICOR II CLEAN	16,887		4.78E+00	1.79E-02	8.97E-03		3.41E-03	2.85E-04
SFP-B	SPENT FUEL POOL "B"	241,698		3.56E+01	9.15E-03	3.66E-03			
SDS-T-1A	SDS MONITOR	373		9.29E-02	7.04E-03	1.30E-03		4.91E-04	
SDS-T-1B	SDS MONITOR	497		1.19E-01	1.72E-03	1.77E-03		9.28E-04	9.26E-05
WDL-T-1A	RC BLEED HOLDUP	3,810		1.06E+00	1.44E-04	5.77E-05			
WDL-T-1B	RC BLEED HOLDUP	4,420		1.88E+00	1.67E-04	6.69E-05			
WDL-T-1C	RC BLEED HOLDUP	57,116		3.12E+01	2.16E-03	8.65E-04			
BWST	BORATED WATER STORAGE	458,915		9.91E+01	6.21E-01	2.13E-01	6.60E-03		3.34E-03
WDL-T-8A	NEUTRALIZER	8,675		2.55E+00	3.28E-04	1.31E-04			
WDL-T-8B	NEUTRALIZER	8,605		1.91E+00	3.26E-04	1.30E-04			
WDL-T-2	MISCELLANEOUS WASTE HOLDUP	3,712		8.38E-01	1.40E-04	5.62E-05			
WDL-T-11A	CONTAMINATED DRAINS	1,931		1.33E-04	1.86E-04	2.89E-04	2.89E-06		
WDL-T-11B	CONTAMINATED DRAINS	820		3.76E-05		3.22E-05			
	CHEM CLEANING BLDG SUMP	1,680		2.47E-01	6.58E-03	5.27E-03		1.13E-02	3.58E-05
	AUXILIARY BLDG SUMP	5,917		2.46E+00	2.24E-04	8.96E-05			
	REACTOR BLDG BASEMENT	43,082		3.49E+00	1.63E-03	6.52E-04			
SFP-A	SPENT FUEL POOL "A"	205,234		1.75E+02	7.77E-03	3.11E-03			
	DEEP END OF TRANSFER CANAL	58,685		5.77E+01	2.22E-03	8.88E-04			
	ADDITIONAL WATER TO 10/88	153,848		1.06E-02	1.48E-02	2.30E-02	2.31E-04		
	TOTAL FOR DISPOSITION	2,062,265	Ci =	1020.61	0.90	0.29			
	AVERAGE CONCENTRATIONS		µCi/ml =	1.31E-01	1.15E-04	3.71E-05	8.97E-07	2.32E-06	4.82E-07

may be performed, as necessary, prior to evaporation. Therefore, the environmental impacts and the costs associated with evaporation will be evaluated based on the processing of 40% and 100% of the processed water.

2.3 Chemical Concentrations

For each of the sources of processed water, chemical analyses were performed to characterize the non-radioactive nature of the water. Of particular interest was the boron concentration in each source since boron will directly influence any of the diposition options either through discharge limits to the environment (via NPOES release limit of 25 ppm boron), increased concentrates requiring solidification from the evaporation option, or the necessity to add stabilizing agents to ensure proper solidification.

The results of the characterization are presented in Table 2-9. It has been assumed that the chemical nature of sources requiring processing before disposition will not change during processing, and that additional water added to the inventory will not contain appreciable quantities of boron. Several tanks reflect assumed chemistry parameters, which are based on the best information available.

From Table 2-9, it can be seen that most of the processed water has a near-neutral pH, with varying levels of conductivity and sodium. Boron ranges from less than 100 ppm for contaminated drains and new water, to over 5,000 ppm for RCS and BWST water. The average concentration is approximately 3,050 ppm, and is equivalent to approximately 150 tons of boric acid which will be addressed during evaluation of each disposition option.

TABLE 2-9

TMI-2 PROCESSED WATER SOURCE TERMS

TANK	DESCRIPTION	VOLUME GALLONS (1/1/86)	SAMPLE DATE	WATER CHEMISTRY pH	COND µmho	BORON ppm	Cl ppm	TOC	PO4	SO4	Na
	*** ACTUAL SOURCE TERMS *** CHEMICAL CONCENTRATIONS										
RCS	REACTOR COOLANT SYSTEM	67,286	3/7/86	7.61	3610	5309	1.7	43			1375
PWST-1	PROCESSED WATER STORAGE	109,001	2/22/86	7.76	3180	4625		11.2			1480
PWST-2	PROCESSED WATER STORAGE	480,134	2/24/86	7.67	6.65	1620	0.11	2.1			0.35
CO-T-1A	CONDENSATE STORAGE	101,518	3/3/86	5.77	24.7	1845		1.1			0.02
WDL-T-9A	EVAP. COND. TEST TANK	5,610	4/12/83 *	5.5		842					
WDL-T-9B	EVAP. COND. TEST TANK	2,231	4/17/83 *	5.5		842					
CC-T-1	EPICOR II OFF-SPEC	20,500	3/5/86	5.07	6.2	1430		15.3			
CC-T-2	EPICOR II CLEAN	16,887	11/15/85	4.85	6.9	1840	0.23				
SFP-B	SPENT FUEL POOL "B"	241,698	3/2/86	8.67	1805	686		0.99			500
SDS-T-1A	SDS MONITOR	373	3/14/86	7.66	1300	1650	41	32	25	28	400
SDS-T-1B	SDS MONITOR	497	10/10/85	7.86	1090	1680	43.5		32	24.5	360
WDL-T-1A	RC BLEED HOLDUP	3,810	2/24/86	7.59	3230	5040	1.38				1320
WDL-T-1B	RC BLEED HOLDUP	4,420	3/7/86	7.55	3800	6360	1.33		2.1		1220
WDL-T-1C	RC BLEED HOLDUP	57,116	10/31/85	7.61	3704	5274	2	2.3			1480
BWST	BORATED WATER STORAGE	458,915	3/4/86	7.56	3505	5090	1.6	3			1350
WDL-T-8A	NEUTRALIZER	8,675	2/28/86	7.77	17	1500		49			280
WDL-T-8B	NEUTRALIZER	8,605	3/1/86	7.8	1330	1635		46			280
WDL-T-2	MISCELLANEOUS WASTE HOLDUP	3,712	2/28/86	7.65	2375	1624	42.5				310
WDL-T-11A	CONTAMINATED DRAINS	1,931	3/1/86	7.65		65		8.7			140
WDL-T-11B	CONTAMINATED DRAINS	820	3/1/86	7.25	538	40		28			98
	CHEM CLEANING BLDG SUMP	1,680	3/2/86	6.79	230	2023		84			50
	AUXILIARY BLDG SUMP	5,917	10/4/85 *	7.65	2375	1624	42.5				310
	REACTOR BLDG BASEMENT	43,082	4/26/85 *			3500					
SFP-A	SPENT FUEL POOL "A"	205,234	2/27/86	7.71	8645	4915	0.82	4.7			1480
	DEEP END OF TRANSFER CANAL	58,685	3/12/86	7.62	8645	4925	0.43				1500
	ADDITIONAL WATER TO 10/88	153,848				0					0
	TOTAL FOR DISPOSITION	2,062,265									
	AVERAGE CONCENTRATIONS					3047	ppm			ppm Na	722.4
	TOTAL TONS SOLIDS					150	tons BA			tons Na_2O	10.80

(*NO INFORMATION AVAILABLE, VALUES REPORTED ARE ASSUMED)

3.0 APPLICABLE REGULATIONS

The disposal options for processed water have been evaluated to ensure compliance to applicable regulatory requirements including:

- o Nuclear Regulatory Commission (NRC) regulations in Title 10 of the Code of Federal Regulations (CFR)
- o Environmental Protection Agency (EPA) regulations in Title 40 of CFR
- o Department of Transportation (DOT) regulations in Title 49 of CFR
- o Pennsylvania Department of Environmental Resources (PaDER) regulations.

3.1 Requirements on Radioactive Effluents

All three options will cause the release of radioactive material to the environment, therefore, the three options shall comply to regulations relating to the release of radioactive material. Regulations regarding the discharge of radioactivity into the environment are specified in 10 CFR 20.106 which limits radioisotopic concentrations in unrestricted areas to the values given in Appendix B to 10 CFR 20, Table II, Columns 1 and 2 for air and water, respectively. These criteria are implemented by the TMI-2 Environmental Technical Specifications (ETS), Appendix B to the TMI-2 Facility Operating License (DPR-73). The EPA regulations in 40 CFR 141 limit the radioisotopic concentrations in drinking water. Although the EPA limits are not a constraint on water discharges, these limits will be met at all downstream potable water intakes.

3.1.1 Gaseous Effluents

Gaseous effluents result from either the solidification or the evaporation option. The gaseous effluents from the solidification option are a "by-product" of solidification with the quantity of release expected to be much less than the evaporation option. Separate ETS have been written to address gaseous and particulate release rate limitations. The gaseous release rate limitations given in the ETS are applicable to noble gas releases. However, since tritium is not a particulate, and its volatile

nature is more analogous to noble gases than to particulates; the ETS for gaseous effluents will be applied to tritium release rates. Thus, tritium and particulate releases are evaluated separately.

Tritium. ETS 2.1.2a limits the instantaneous release rate of tritium so that the resulting tritium concentration at the site boundary is less than or equal to its maximum permissible concentration (MPC) given in 10 CFR 20, Appendix B, Table 2, Column 1. ETS 2.1.2c limits the quarterly average release rate of tritium so that the resulting tritium concentration is less than 16% of its MPC value at the site boundary. The allowable gaseous release rate is dependent on the tritium concentration in the processed water and the meteorological conditions at the time of release. For a conservative estimate of the limiting tritium release rate the annual average ground level atmospheric dispersion factor (X/Q), at the site boundary, in the SSE sector (5.6E-5 sec/m^3) is used. The SSE sector is used since the annual average ground level X/Q is greatest in this sector (Reference 3). Therefore, the continuous tritium release rate to the atmosphere is limited to 570 uCi/sec based on an X/Q of 5.6×10^{-5} sec/M^3 to comply to ETS 2.1.2c. The release rates from the evaporation and solidification options are evaluated in Sections 4.2 and 5.2, respectively, to show compliance to the limiting H-3 release rate.

Particulates. ETS 2.1.2b limits the instantaneous release rate of total particulates to less than or equal to 0.3 uCi/sec. ETS 2.1.2d limits the quarterly average release rate of total particulates to less than or equal to 0.024 uCi/sec. The particulate release rate from the evaporation option is evaluated in Section 4.2 to show compliance to the ETS 2.1.2d release rate limit.

3.1.2 Liquid Effluents

The liquid effluents result from the river discharge option. TMI-2 ETS 2.1.1a limits the concentrations from radioactive liquid effluents to MPC, given in 10 CFR 20, Appendix B, Table 2, Column 2, at unrestricted areas. The expected radioisotopic concentrations at the plant discharge are dependent on the radioisotopic concentrations in the waste stream being

discharged, the flow rate of discharge, and the available TMI-2 discharge flow rate from the Mechanical Draft Cooling Tower (MDCT) for dilution to the river. Since 100% of the processed water will be processed or reprocessed prior to its discharge into the river, Table 2-5 gives the projected radioisotopic concentrations in the processed water sources prior to discharge to the river. Inspection of Table 2-5 shows that the deep end of the transfer canal would contain the greatest concentration of radioisotopes for the processed water sources available for release to the Susquehanna River. Table 3-1 shows that the radioisotopic concentration of this processed water source is 120.2 MPC. Therefore a plant dilution of 120.2 is required to ensure that the radioisotopic concentration at the plant discharge is at or below 10 CFR 20 limits, (i.e., 1.0 MPC), from any of the processed water sources. The plant dilution factor is defined by the expression

$$Dp = Fp/Fw \quad \text{where}$$

Dp = plant dilution factor ($\geq$ 120.2)
Fp = plant discharge flow rate at the MDCT (gpm)
Fw = discharge flow rate from a processed water source (gpm)

Section 6.2 addresses this required plant dilution to comply with 10 CFR 20 and ETS 2.1.1a.

In addition to the NRC regulatory limits on liquid effluents, the resulting radioisotopic concentrations in the Susquehanna River must comply with the EPA drinking water interim standards for radioisotopic concentrations given in 40 CFR 141. The limiting radioisotopes for liquid concentrations are tritium and strontium-90. The 40 CFR 141 concentration limits are 20,000 pCi/l and 8 pCi/l for tritium and strontium-90, respectively, for which tritium is the most limiting for the concentrations in the processed water. The 40 CFR 141 limits are at the nearest downstream user. For TMI the nearest downstream user is the Brunner Island power plant. The radioisotopic concentrations at the TMI-2 plant discharge would be diluted by the river flow rate prior to reaching Brunner Island. Using

the past four years of data, the average monthly river flow rate varies from a minimum of about 5,000 cubic feet per second (cfs) to a maximum of about 100,000 cfs. For this evaluation the minimum river flow rate of 5,000 cfs is conservatively assumed.

To meet the 40 CFR 141 limit of tritium at Brunner Island a river dilution of 13,000 is required, assuming the H-3 concentration given in Table 3-1. River dilution is defined by the expression

$$D_R = F_R/F_W \qquad \text{where}$$

D_R = river dilution factor ($\geq$ 13,000)
F_R = river flow rate (cfs)
F_W = discharge flow rate from a processed water source (CFS)

Section 6.2 addresses this required river dilution to comply with 40 CFR 141.

3.2 Requirements on Off-site Exposure

10 CFR 20.1 requires licensees to maintain radiation exposures and release of radioactive materials in effluents to unrestricted areas as-low-as-reasonably achievable (ALARA). 10 CFR 50.34a and 10 CFR 50.36a refer to the guides set out in Appendix I to 10 CFR 50 as providing numerical guidance on design objectives and limiting conditions for operation to meet the requirement that radioactive materials in effluents released to unrestricted areas are kept ALARA. As such, TMI-2 ETS limit the dose to off-site personnel to the values given in Appendix I to 10 CFR 50. Those dose limits will assure that the dose received by the public during the TMI-2 cleanup, and specifically for disposal of processed water, is equivalent to or less than that from a normal operating reactor. The evaluation of each disposal option includes the estimation of the dose to the maximally exposed hypothetical off-site individual and shows that these doses are all well within the 10 CFR 50, Appendix I limits.

TABLE 3-1

RADIOISOTOPIC CONCENTRATION IN DEEP END OF THE TRANSFER CANAL AFTER PROCESSING

ISOTOPE	CONCENTRATION[1] (uCi/cc)	MPC[2] (uCi/cc)	MULTIPLE OF[3] MPC
H-3	2.6E-1	$3x10^{-3}$	86.7
Sr-90	1.0E-5	$3x10^{-7}$	33.3
Cs-137	4.0E-6	$2x10^{-5}$	0.2
Total	--	--	120.2

Notes:

1. Taken from Table 2-5

2. Taken from 10 CFR 20, Appendix B, Table II, Column 2

3. Column 1/Column 2

In addition, 40 CFR 190.10(a) limits the annual dose equivalent to 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials to the general environment from uranium fuel cycle operations and to direct radiation from these operations. The expected doses to a member of the public from any of the disposal options being evaluated will be shown to be insignificant compared to background radiation exposures and would not contribute significantly to the dose limits specified in 40 CFR 190.

3.3 Requirements on Transportation and Burial of Radioactive Material

The evaporation option will cause the generation of radioactive wastes that require shipping to a commercial radioactive waste burial site. Regulations regarding the transportation and burial of radioactive wastes are given in Titles 10 and 49 of the Code of Federal Regulations. The objective of the evaporation option is to generate a waste form which would be classified as Low Specific Activity (LSA) material (49 CFR 173.403 and 10 CFR 71.4) and buried as Class A waste (10 CFR 61.55).

3.4 Requirements for On-site Disposal of Radioactive Material

The objective of the solidification option is to generate a waste form suitable for on-site disposal. On-site disposal of this solidified waste form requires NRC approval per 10 CFR 20.302. Upon approval by the NRC, the proposed method of disposal (i.e., a concrete landfill) requires approval from the PaDER. This PaDER approval involves two departments within PaDER, namely,the Bureau of Radiation Protection and the Department of Solid Waste Management. This on-site disposal option would not render Three Mile Island a permanent radioactive waste disposal site, provided that the radioactivity levels in the solidified waste are "below regulatory concern." Section 10 of the Low-Level Radioactive Waste Policy Act, amended 1985, required the NRC to establish standards and procedures for acting upon petitions to exempt specific radioactive waste streams from regulation due to the presence of radionuclides in such waste streams in sufficiently low concentrations or quanitites as to be below regulatory

concern. The NRC has approved the submittals from various licensees for on-site disposal of very low-level radioactive wastes. From IE Information Notice 83-05, February 24, 1983, it is apparent that NRC approval of a 10 CFR 20.302 submittal is predicated upon the estimated radiological exposures to on-site personnel and to members of the public. Section 5.3 shows that the estimated radiological consequences are negligible for both occupational and non-occupational exposures. Therefore, on-site disposal of the processed water in a cement landfill, can be demonstrated to be "below regulatory concern."

3.5 Requirements on Chemical Discharges

The discharge-to-the-river option must also comply to the National Pollutant Discharge Elimination System (NPDES) Permit No. PA 0 009920 issued to GPU Nuclear by the PaDER Bureau of Water Quality Management. This permit limits the quantity of chemical releases and the pH of the effluent to the Susquehanna River as well as identifies the sources of release. The most restrictive limit given in the NPDES permit for the discharge of the processed water into the Susquehanna River is the boron limit. The permit limit for boron is 25 ppm. Thus, assuming that the boron concentration in the processed water is 6,000 ppm (maximum allowable per TMI-2 Technical Specifications for the reactor coolant system), a plant dilution (defined in Section 3.1.2) of 240 is required. The evaluation of the discharge-to-river option, given in Section 6, addresses this required plant dilution and the NPDES pH limit.

4.0 OISPOSITICN EVALUATION OF EVAPORATION

Under this alternative, the disposal of the processed water would be by a monitored discharge of vapor to the atmosphere via forced evaporation. This would be accomplished by the use of a vendor-supplied, transportable evaporator system. Operation of the evaporator in an open cycle would allow the vapors and aerosols to be discharged to the atmosphere. This discharge could either be directly from the evaporator exhaust or through existing plant waste gas disposal flow paths.

The use of an evaporator for processing and disposal of the processed water will provide a mass reduction factor of approximately 10 to 20. The contaminants in the liquid influent to the evaporator will be concentrated in the evaporator bottoms, which will ultimately be disposed of as a solid radioactive waste at a commercial, low-level waste burial facility. Current regulations require the immobilization of boric acid concentrates prior to disposal.

Immobilization of the evaporator bottoms will be accomplished by solidification using vendor services, incorporating the use of large liners and cement or a binder that is compatible with the waste form. For this evaluation, a cement solidification binder was assumed. It is not necessary for the solidification binder to meet the stability requirements of the NRC Branch Technical Position on Waste Form since the binder is merely to immobilize the free-standing liquids and create a free-standing monolith. The solidification binder, however, will have to be one that is approved for use per the burial ground license. It will be noted here that the bituminization processes, included with most transportable evaporator systems, may not be acceptable for immobilization of the evaporator bottoms because of regulatory uncertainties regarding the use of asphalt as a solidification binder.

4.1 Process Description

4.1.1 Equipment and Operation

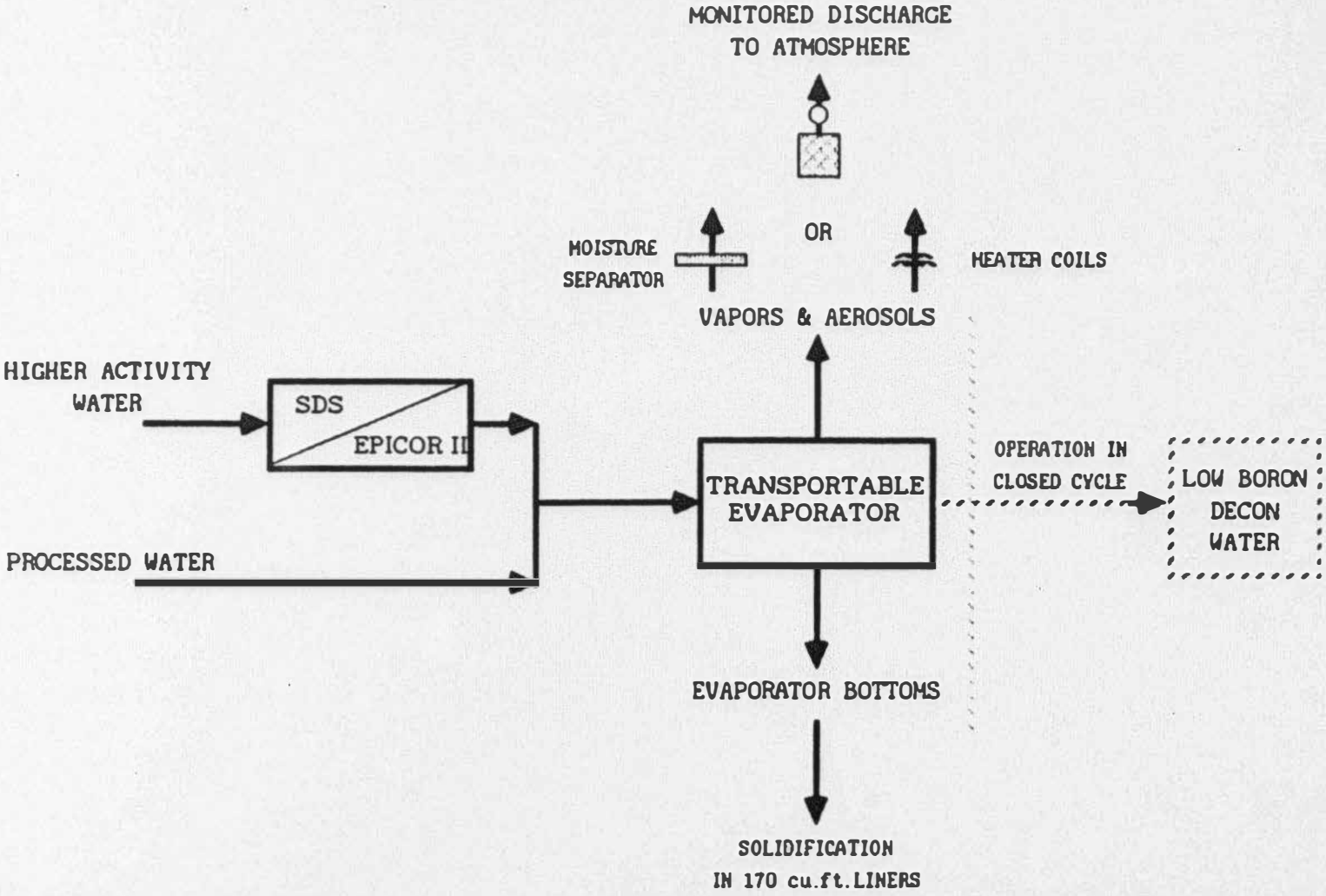
Evaporator System. A simplified flow diagram of this process is shown in Figure 4-1. Transportable evaporator systems available for use at TMI-2 range in capacity from 0.5 to 3 gpm. The characteristics, and facility and equipment requirements of these systems are unique to the design of each particular unit.

Most vendor-supplied, transportable evaporator systems are designed to operate in a closed-cycle fashion. To facilitate use of these systems for processed water disposal, modifications must be made to allow open-cycle operation. In order to control the possible spread of contamination from aerosols, some form of moisture separation will be required. This will either be accomplished by the use of an entrainment separator where the captured condensation is returned to the evaporator feed tank, or by the use of a vapor superheater that maintains a vapor exhaust temperature above the dew point. It is anticipated that the evaporator discharge will be routed to an existing atmospheric discharge point equipped with monitoring capabilities (i.e., the Chemical Cleaning Building (CCB) ventilation system).

When selecting the evaporator system, it is prudent to consider the possibility of using the evaporator for the production of low concentration borated water to support decontamination activities. This would require equipment flexibility to operate in either a closed- or open-cycle fashion. Preliminary investigations show that most transportable evaporator systems will allow this interchangable operation in a timely fashion and hence provide maximum flexibility.

The facility and equipment requirements necessary to support the use of a vendor-supplied transportable evaporator include:

FIGURE 4-1 PROCESS FLOW DIAGRAM



- o Design and construction of a concrete pad
- o Plant tie-ins, including utility services
- o Installation of a feed line from the PWSTs
- o Selection of operations staff

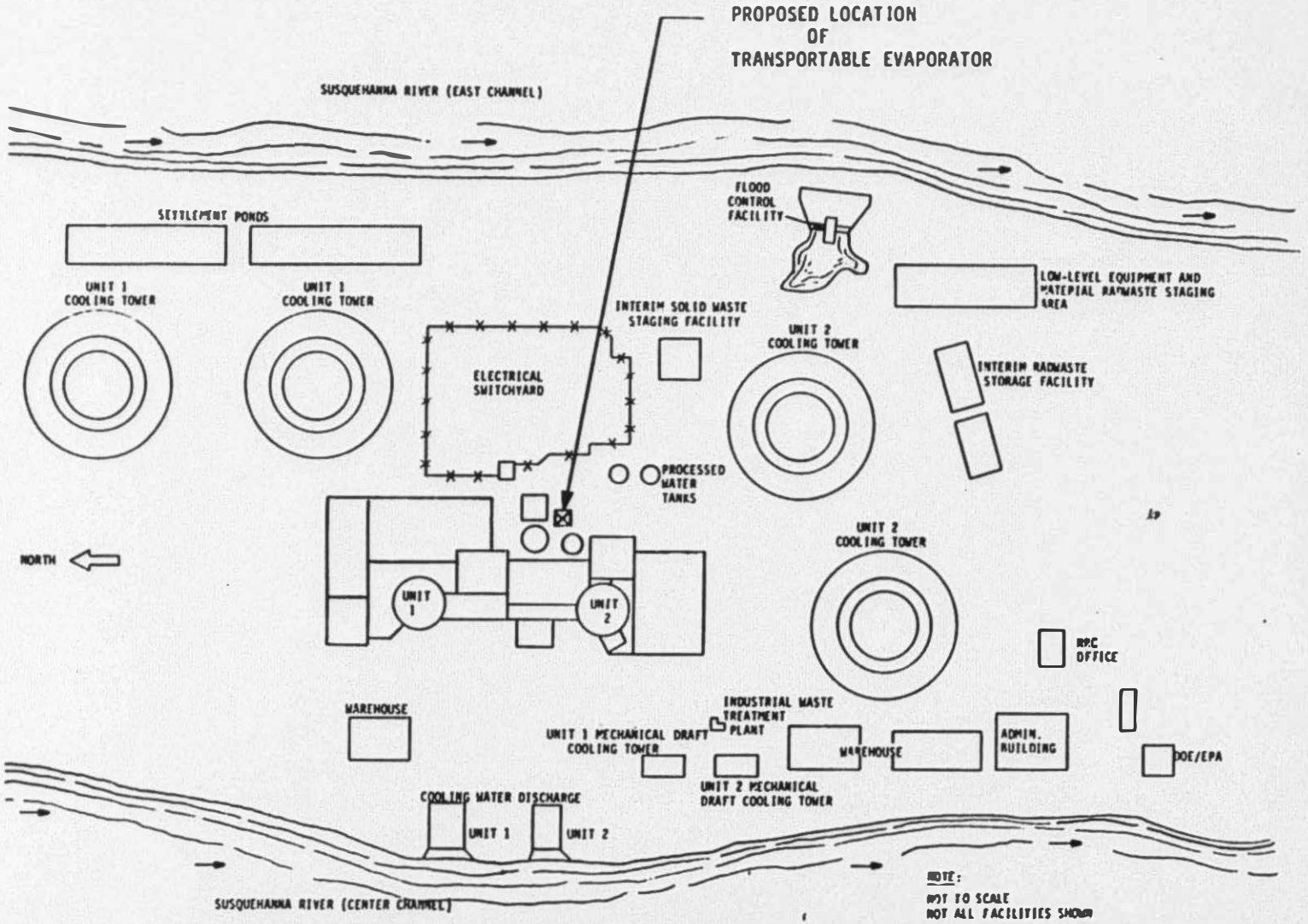
A concrete pad may be required to support the evaporator system depending on the system selected. Reg. Guide 1.143 requires that structural pads for radioactive waste processing systems be curbed to prevent the spread of contamination by spills, leaks, etc. The suggested location for the evaporator, and pad if needed, is shown in Figure 4-2. This location--the East side of the plant, between the CCB and the Unit 2 air-intake structure, will provide ideal access to the plant and the PWSTs, and minimal interference with normal traffic patterns in this area. The pad dimensions required for the systems considered for use at TMI-2 range from 12' x 46' to 12' x 80'. Additional space, as needed, will have to be designated as storage space for chemicals, tools, and spare parts.

The necessary plant tie-ins to support the operation of a transportable evaporator include the connection of station utility services. These include a supply of demineralized water, instrument air, electric power (amount dependant on system design and mode of operation), and ventilation exhaust. Telecommunications, additional shielding (as needed), and crane service are usually also required.

A temporary feed line to transfer the processed water from the PWSTs to the evaporator feed tank will have to be installed. A heat traced, reinforced flexible hose is anticipated. New procedures will be required for the transfer of the processed water from the PWSTs to a transportable evaporator feed tank.

Most vendor-supplied, transportable evaporator systems allow the client the choice of supplying his own operations staff, or to rely on the vendor's services. GPU will supply operations, health physics, chemistry, security personnel, and off-site environmental monitoring to support the vendor's operations activities.

FIGURE 4-2 SITE PLAN



The following tasks will be required to support the operation of a vendor-supplied, transportable evaporator:

- o Development of operating procedures and a start-up and test sequence, and the modification of existing procedures
- o Engineering software, including engineering change authorizations and unit work instructions
- o Operator training
- o Radiation and environmental monitoring
- o Chemistry and health physics support

Evaporator Bottoms Processing. The concentrated solids withdrawn from an evaporator, commonly known as evaporator bottoms, generally range from 16 to 25 weight percent (w/o) solids. At an average evaporator feed rate of 3 gpm, and operation for 20 hours per day, the quantity of bottoms produced per day will be approximately 2,670 lb/day and 1,670 lb/day for a 16 w/o and 25 w/o concentrate, respectively. Table 4-1 presents the major characteristics, relating to the waste disposal concerns, of the evaporator bottoms.

As previously mentioned, the evaporator bottoms will be immobilized by solidification and disposed of by shallow land burial at the U.S. Ecology LLW burial site at Hanford, WA as this is currently the only burial site available to TMI-2. Vendor solidification is anticipated since the use of a vendor solidification system will allow the use of any size solidification container. This could prove beneficial since it is well established that several economic advantages are gained by using larger liners for solidification of low activity wastes such as the evaporator bottoms. The use of vendor services also allows for the selection of several approved binders that are compatible with concentrated boric acid wastes.

The solidification equipment is expected to be located on the 280'-6" elevation of the auxiliary building, just beneath the equipment hatch. This location is compatible with the evaporator system, however, special procedures for transferring the evaporator bottoms from the concentrates receiving tank to the solidification system will be required. Additionally, some piping modifications are anticipated for the transfer of the evaporator bottoms to the solidification system.

TABLE 4-1
CHARACTERISTICS OF EVAPORATOR BOTTOMS

SOLIDS CONCENTRATION OF BOTTOMS	MRF	TOTAL QUANTITY OF BOTTOMS (lbs)	BINDER/WASTE VOLUME RATIO	QUANTITY OF BOTTOMS PER LINER(lbs)	[cu. ft.]	NUMBER OF LINERS	10 CFR 61 WASTE CLASS	RAM TYPE	TOTAL ACTIVITY PER LINER (Ci)	TOTAL BURIAL VOLUME (cu. ft.)
16 w/o	10	2,012,500	.35	7434	[103]	271	A	A / LSA	4.507E-3	46,022
16 w/o	10	2,012,500	.66	3889	[54]	517	A	A / LSA	2.358E-3	87,972
25 w/o	10	1,288,000	.35	8011	[103]	161	A	A / LSA	7.587E-3	27,332
25 w/o	10	1,288,000	.66	4190	[54]	307	A	A / LSA	3.940E-3	52,258

NOTES :

1) TOTAL VOLUME OF A.G.W. TO BE EVAPORATED — 2.10E+6 GALLONS

2) SOLIDIFICATION LINER SIZE — 170 cu. ft.

3) CEMENT BINDER

Previous analyses have shown cement solidification of this waste type in large liners (i.e., 170 cubic feet) to be more cost effective than the use of such containers as 55-gallon drums or 50 cubic feet liners. For the purposes of this evaluation it was assumed that 100% of the total dissolved solids in the processed water are retained in the evaporator bottoms, and 100% of the mixed fission products are concentrated in these bottoms. If cement solidification in 170 cubic feet liners is employed, approximately 161 to 271 liners would be generated in this campaign for a 25 w/o and 16 w/o solids concentration, respectively. The waste classification of these packages would be Class A as per 10 CFR 61.55. The Radioactive Material (RAM) shipment category would be Type A, LSA.

The estimated number of solidified liners presented above is based on a cement binder-to-waste volume ratio of 0.35; that is, approximately 117 cubic feet of evaporator bottoms are mixed with approximately 41 cubic feet of cement in a 170 cubic feet liner. This mixture is obtainable based on past solidification work of similar waste types at TMI-1. If this binder-to-waste volume ratio is not obtainable for the evaporator bottoms, the number of liners could be increased to as many as 307 to 517 for a 25 w/o and 16 w/o solid concentration, respectively.

The resultant total volume of solidified evaporator bottoms for disposal is between 27,000 cubic feet and 46,000 cubic feet for solidification at an anticipated binder-to-waste volume ratio of 0.35 for a 25 w/o and 16 w/o bottoms concentration, respectively. It is noted that this total volume may be as much as 52,000 cubic feet for a solids concentration of 25 w/o or 88,000 cubic feet for a solids concentration of 16 w/o if a lean solidification mixture (i.e., a binder-to-waste ratio of approximately 0.66) is required. For comparative purposes, the burial volume allocated to TMI-2 under the 1985 Amendment to the Low-Level Waste Policy Act of 1980, is 66,468 ft^3 between 1986-1992. When considering the volume of radioactive waste anticipated from the remainder of the cleanup activities along with the volume anticipated from the disposal of the processed water, it will be necessary to provide for either interim on-site storage or an increased burial volume allocation.

Additional low-level radioactive wastes will be generated from such activities as system modifications and tie-ins, evaporator operation

and maintenance and solidification of the evaporator bottoms. These wastes include normal DAW, HVAC/HEPA filters, and some non-compactable wastes. The volume of these wastes is expected to be small, and when compared to the volume of the evaporator bottoms, it should be relatively insignificant.

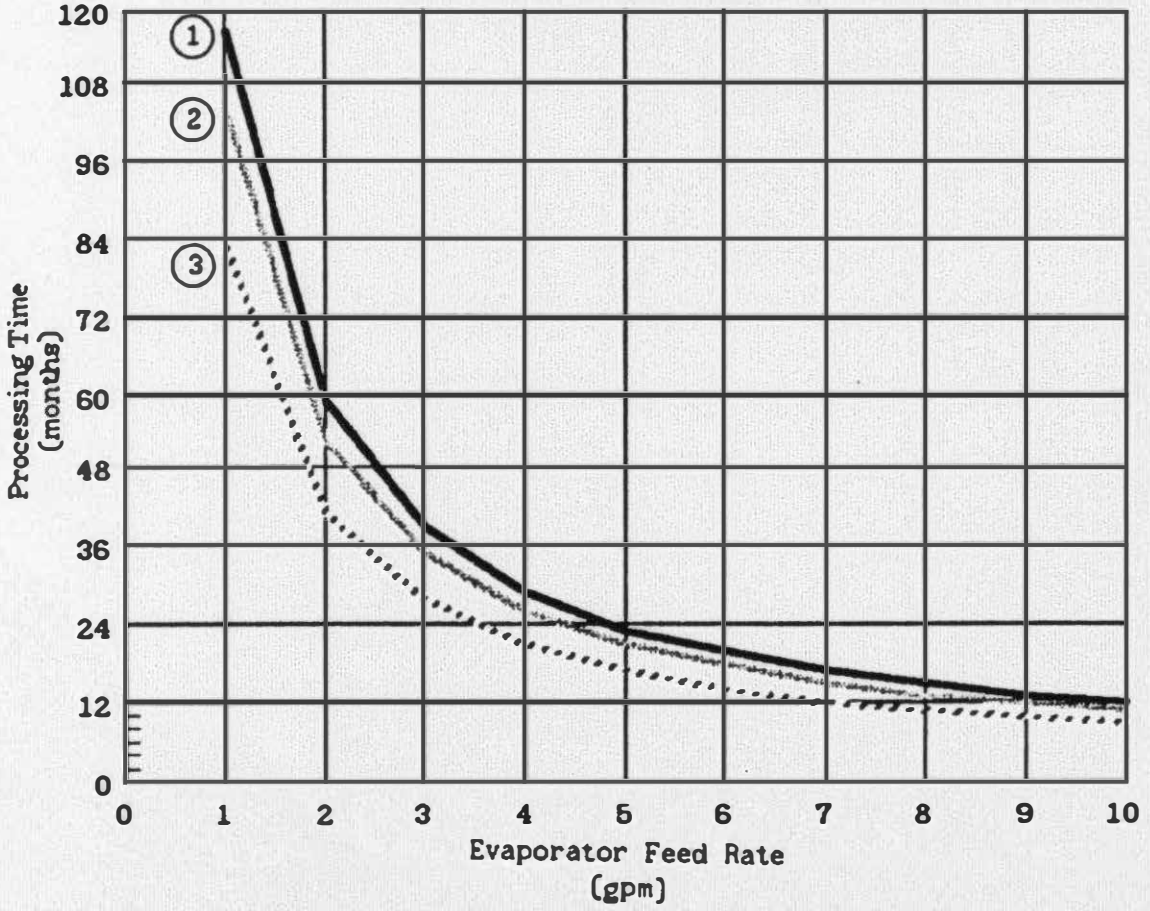
4.1.2 Schedule

The total time to evaporate the processed water is dependent on the feed capacity of the system, the chemical concentrations in the water, and the allowable atmospheric discharges as discussed in Section 4.2.1. Figure 4-3 shows the time required to processs 2.1 million gallons as a function of evaporator feed rate based on various conditions of operation. An overall system availability of 75% was assumed. Most vendors claim that some transportable systems can achieve as much as a 95% overall availability, however the assumed 75% availability will provide conservative results for this evaluation.

The activities required to implement this system for the processed water disposal by forced evaporation are listed sequentially in Figure 4-4. A comparison of the program scheduling and development of these activities is also presented in this figure. In addition to the major activities listed in Figure 4-4, there will be preliminary overhead activities such as safety review, licensing, etc. that are assumed to be equally incorporated into each applicable program activity. The scheduling impact of the major activities for this option is discussed below.

A vendor-supplied, evaporator system can be delivered, installed, and made fully operational in as little as four months. This ability greatly reduces the lead time of this option. If a typical processing rate of 3 gpm is assumed, and the operating basis is seven days a week, with two, twelve-hour shifts per day, and ten hours of actual processing per shift with an overall availability of 75%, approximately 28 months would be required to process the 2.1 million gallons of processed water. Operation at 3 gpm for the above operating scenario, will generate between 1,673 pounds (at 25 w/o) of concentrated evaporator bottoms per day of operation and 2,674 pounds (at 16 w/o) of concentrated evaporator bottoms

FIGURE 4-3 PROCESSING TIME AS A FUNCTION OF EVAPORATOR FEED RATE



LEGEND :

BASIS :

- 2-12 hr shifts/day
- 10 hrs work/shift
- 5 work days/week
- 75% availability

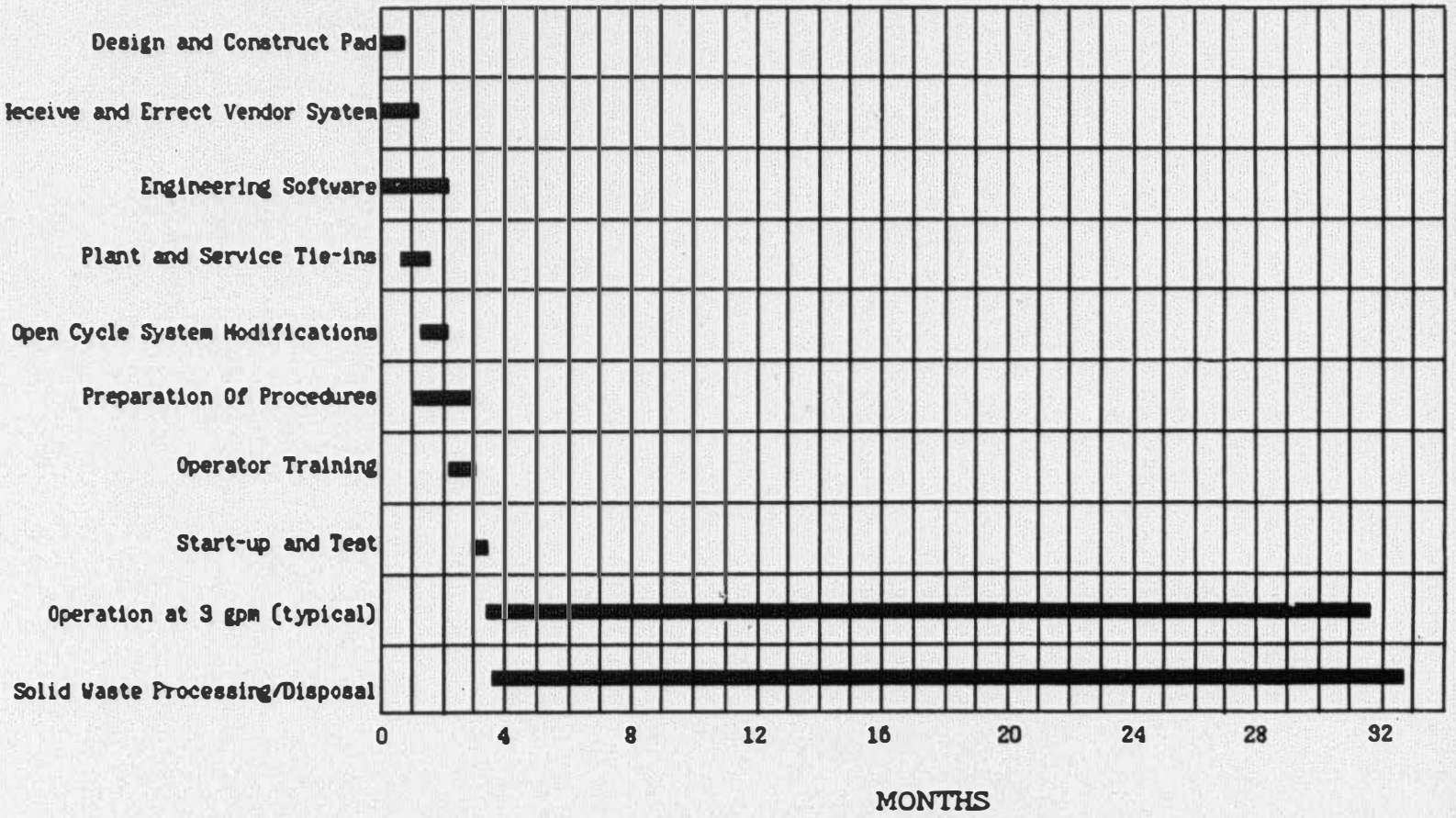
BASIS :

- 2-10 hr shifts/day
- 8 hrs work/shift
- 7 work days/week
- 75% availability

BASIS :

- 2-12 hr shifts/day
- 10 hrs work/shift
- 7 work days/week
- 75% availability

FIGURE 4-4 COMPARISON OF PROGRAM SCHEDULING AND DEVELOPMENT



per day of operation. A typical vendor-supplied solidification system employing the use of large liners will be able to accommodate this production rate. It is concluded that solidification of the evaporator bottoms in large liners (by a vendor) will not interfere with the operation of the transportable evaporator. It is anticipated that the processing and disposal of the evaporator bottoms will occur concurrent to the evaporation activities with a one-month carry-over to allow for system decommissioning.

The total time to dispose of the processed water, using a vender-supplied, transportable evaporator with vendor services for the solidification of the evaporator bottoms, is estimated to be 33 months.

4.1.3 Costs

Cost estimates have been conducted for the disposition option for the processed water using forced evaporation. A range of costs is presented based on various solidification binder-to-waste volume ratios for the two solids concentrations of the evaporator bottoms. The total cost of each estimate is composed of the costs for the evaporation activities (including any necessary system modifications) and the costs for the processing and disposal of the evaporator bottoms. In this disposal option, the costs associated with the processing and disposal of the evaporator bottoms far exceeds the costs of the actual evaporation activities. Table 4-2 summarizes the results of the cost estimates; the major assumptions are highlighted below.

The cost for processed water disposal by forced evaporation using a vendor-supplied transportable system with vendor solidification of the evaporator bottoms, ranges from 6.25 to 8.02 million dollars for a 25 w/o and 16 w/o bottoms concentration, respectively. This cost estimate is based on the expected binder-to-waste volume ratio of 0.35, if however this is not achievable, the total cost of this campaign could be as much as 8.60 to 11.96 million dollars as highlighted in Table 4-2. The total campaign cost may increase by $2.3M if 100% of the water volume is processed.

The following major assumptions were made in the economic evaluation:

- Vendor-supplied, transportable evaporator will be operated by vendor personnel

TABLE 4-2
SUMMARY OF ECONOMICS EVALUATION FOR PROCESSED WATER DISPOSAL BY FORCED EVAPORATION

SOLIDS CONCENTRATION OF BOTTOMS	SOLIDIFICATION BINDER/WASTE VOLUME RATIO	TOTAL COST FOR EVAPORATION OF 2.1 E+6 GALLONS OF WATER (1) (2)	TOTAL COST FOR PROCESSING OF EVAPORATOR BOTTOMS (1) (3)	TOTAL COST FOR TRANSPORTATION & BURIAL OF SOLIDIFIED BOTTOMS (1) (4)	** TOTAL PROJECT COST ** (1) (5)
16 w/o	.35	3.61	1.50	2.90	$ 8.02
16 w/o	.66	3.61	2.82	5.53	$ 11.96
25 w/o	.35	3.61	.91	1.73	$ 6.25
25 w/o	.66	3.61	1.70	3.29	$ 8.60

NOTES :

(1) $1,000,000'S in 1986

(2) Includes system modifications, all operations, and vendor fees

(3) Includes system modifications, all operations, consumables, and vendor fees

(4) Includes all activities necessary to ship waste, burial fees, and surcharges

(5) Additional water processing (i.e. > 40% of volume) would increase the total costs by an additional $2.3 M

- o Transportable evaporator placed on a pad
- o Evaporation unit operation costs are per day of operation
- o Vendor solidification of evaporator bottoms in 6' x 6' liner with cement binder approved for commercial LLW disposal
- o Vendor services at $80/ft^3, including cost of liner

4.2 Radiological Considerations

4.2.1 Radioactive Effluents

The evaporation of the processed water will be controlled such that the resultant release of radioisotopes to the atmosphere will comply to the limitations on gaseous effluents given in Section 3.1.1. For tritium the continuous release rate is limited to 570 uCi/sec. Assuming the average tritium concentration in the processed water of 0.131 uCi/cc (from Table 2-8), the expected feed rate to the evaporator of 3 gpm (approximately 190 cc/sec), and a 100% release fraction, the expected release rate of tritium is approximately 25 uCi/sec or less than 5% of the allowable continuous tritium release rate limit. For particulates the continuous release rate is limited to 0.024 uCi/sec. The particulate release rate is dependent on the particulate concentration in the processed water being evaporated, the feed rate to the evaporator, and the "carry-over" fraction for the evaporator, (i.e., the percentage of particulates in the influent to the evaporator that is released with the vapor as aerosols). From Table 2-8, assuming 40% of the water is processed prior to evaporation, the average particulate concentration in the processed water is approximately 1.6×10^{-4} uCi/cc. It is assumed that 1% of the particulates in the influent is released to the atmosphere. This assumption is based on a decontamination factor of 100 for open cycle operation. Vendor literature states that under closed cycle operation approximately 0.1% of the particulates would be released to the atmosphere. For operation in an open cycle, the release would be slightly greater. The assumption of 1% is conservative since no credit has been taken for particulate plate-out which would be expected via moisture separation and along the discharge duct. At a 3 gpm feed rate, therefore, the continuous particulate release rate is expected to be 0.0003 uCi/sec or less than 1.5% of the allowable continuous particulate release rate.

4.2.2 Off-Site Radiological Consequences

Radiological consequences from the controlled atmospheric release of the evaporated processed water have been determined by estimating the dose to both the maximally exposed hypothetical off-site individual and to the total exposed population. The dose to the maximally exposed hypothetical off-site individual is a conservative (over estimated) assessment of the exposure to a member of the public, as required by 10 CFR 50, Appendix I using Regulatory Guide 1.109 dose methodology. The estimated dose to the total exposed population is a more representative assessment of the radiological consequences resulting from the evaporation of the processed water.

4.2.2.1 Maximally Exposed Hypothetical Individual

Dose Model

Doses were calculated using the Meteorological Information and Dose Assessment System (MIDAS) which is used by TMI Environmental Controls for quarterly and semi-annual dose assessments which are submitted to the NRC with TMI-1 and TMI-2 effluent reports. MIDAS uses hourly averages of on-site meteorological data to calculate an integrated dispersion for the period of interest. It integrates the dispersion over each hour into each of sixteen sectors at ten distances. The location of the five nearest vegetable gardens larger than 500 square feet, and the location of the nearest milk cow, milk goat, meat animal, and residence in each of the sixteen sectors, is used to evaluate seven airborne pathways: plume exposure, direct dose from ground deposition, inhalation, and the consumption of meat, cow milk, goat milk, and vegetables. The maximally exposed hypothetical individual is conservatively taken to be that person in the maximum inhalation location and is assumed to consume meat, vegetables, and milk from each of the other maximum locations. These calculations are performed in accordance with Regulatory Guide 1.109 and are identical to those used for semi-annual and quarterly effluent/dose reports. The meteorological data from 1985 was used to calculate annual dispersion into the atmosphere. There is good confidence that the dispersion resulting from the 1985 data is similar to annual dispersion in recent years.

Estimated Doses

Using the release fractions given in Section 4.2.1 and the dose methodology given above, Table 4-3 presents the estimated doses to the maximally exposed hypothetical off-site individual for the duration of the evaporation process taking into account the extent of processing/reprocessing of the processed water. The evaporation of all of the processed water is expected to take at least two years. Therefore, the average annual doses to the maximally exposed hypothetical off-site individual from evaporation of the processed water would be one-half of the values reported in Table 4-3. The highest average annual doses to the maximally exposed hypothetical off-site individual (i.e., 1.8 mrem to the bone and 1 mrem total body) are only 12% of the annual limit of 15 mrem and 20% of the annual limit of 5 mrem, respectively, given in 10 CFR 50, Appendix I for internal exposure from airborne releases.

4.2.2.2 Population Dose

To estimate the population dose MIDAS was again utilized. The affected population is considered to be the population surrounding TMI-2 out to a distance of 50 miles. The population affected by the atmospheric release associated with the evaporation of the processed water is estimated to be 1.2 million people. The dose pathways include inhalation; milk, meat, and vegetable consumption; plume exposure; and direct dose from ground deposition. Table 4-3 presents the population dose estimated for the duration of the evaporation process taking into account the extent of water processing/reprocessing. Since the evaporation of all the processed water is expected to take at least two years, the annual population doses (for two years) are one-half of the values reported in Table 4-3.

4.3 Environmental Consequences

The environmental consequences associated with the evaporation of the processed water and the solidification of the evaporator bottoms include the expected dose to the workers and to the public. The occupational

TABLE 4-3

RADIOLOGICAL CONSEQUENCES FROM THE EVAPORATION OF THE PROCESSED WATER

	Water Processed Prior to Evaporation	
	40%	100%
Radioisotopic Inventory	Table 2-8	Table 2-6
Dose to Maximally Exposed Hypothetical Off-site Individual (mRem)		
Bone	3.6	0.36
Total Body	2.0	1.3
Population Exposure (person-rem)		
Bone	24	2.4
Total Body	17	12
Average Exposure to a Member of the Population (mRem)		
Bone	0.02	0.002
Total Body	0.014	0.01

dose attributed to evaporation of the processed water and the solidification of the evaporator bottoms has been conservatively estimated to be 53 person-rem. This maximum dose is based on approximately 36,000 man-hours for the evaporation process in a radiation field of 0.6 mrem/hr (background radiation level on TMI-2), approximately 10,000 man-hours for the solidification of the evaporator bottoms in a radiation field of 2.5 mrem/hr, and the processing of about 40% of the volume of water. An additional 5 person-rem has been estimated if the entire volume of water is processed. This dose is a very small percentage of the total exposure to the work force estimated in Supplement No. 1 of Reference 1 (i.e., 13,000 to 46,000 person-rem). Table 4-3 presents the average dose an individual in the exposed population would receive from the evaporation of all the processed water. This average dose is obtained by dividing the population dose by the affected population of 1.2 million people. The annual average doses (for two years) a member of the affected population would receive are one-half of the values reported in Table 4-3. These annual doses (for two years) are insignificant compared to the background radiation dose a member of the public receives per year (i.e., approximately 100 mrem). Thus, the evaporation of the processed water and subsequent solidification of the evaporator bottoms have insignificant environmental consequences.

5.0 EVALUATION OF SOLIDIFICATION AND ON-SITE DISPOSAL

The objective of this option is to solidify the processed water as a grout mixture for ultimate disposal in an excavated pit within the confines of TMI. The resulting grout mixture would have very low concentrations of radioisotopes and thus would have environmental consequences which would support a 10 CFR 20.302 submittal to the NRC. NRC approval per 10 CFR 20.302 would require that the on-site disposal of the solidified processed water be "below regulatory concern" (see Section 3.4). Upon NRC approval an application would then be submitted to the PaDER Bureau of Solid Waste Management for a permit to construct an industrial landfill. This landfill would consist of a large pit (approximately 260' x 190' x 15' deep) backfilled with a homogeneous slab of cement and the processed water.

5.1 Process Description

5.1.1 Equipment and Operations

Processed water would be transferred to a grouting system feed tank located within the system trailer located near the Interim Solid Waste Staging Facility (ISWSF). Cement will be fed from storage silos to be mixed with water within a screw mixer and transferred into the excavated pit using a grout feed pump at approximately 10 gpm.

Prior to the solidification process, test mixtures will be made to determine the best formulation that will result in the least volume of solidified product. The formulations being considered include the use of Type 1 Portland Cement or masonry cement with water-to-cement ratios (W/C) between 0.5 and 0.75. The total volume of the solidified mass would range from 390,000 cubic feet to 460,000 cubic feet, dependent upon the cement used and the W/C ratio utilized.

The projected inventory of radioisotopes, in the processed water in October 1988 following 100% processing/reprocessing are shown in Table 2-6. Due to the heat of hydration during the mixing and curing of the

immobilization/solidification process, it is estimated that 50% of the tritium inventory will be directly released to the atmosphere as tritiated water vapor. The remaining tritium and all the other radioisotopes, will be dispersed throughout the matrix produced by the solidification process. Table 5-1 lists the expected range of radioisotopic concentrations in the solidified mass.

The grout-in-place solidification system would consist of a trailer mounted system, with associated cement storage silos located within the TMI dike in the area North and East of the ISWSF. The trailer mounted grouting system would contain all of the equipment and instrumentation necessary to receive the processed water from the PWST and cement from adjacent storage silos, mix these two materials (together with appropriate stabilizing additives), and pump the grout mixture into an engineered excavation pit for final setting. A conceptual schematic of the proposed grouting system is provided in Figure 5-1, which includes major components and connections to interfacing systems.

The excavated pit for the grout mixture is, for all practical purposes, a landfill subject to approval and licensing by the PaDER Department of Solid Waste Management. As such, this pit will be required to be an engineered landfill with groundwater protection (impermeable liners and leachate collection) and groundwater monitoring (monitoring and observation wells). The pit is planned to be located North-Northeast of the existing ISWSF.

A cross section of a conceptual landfill is depicted in Figure 5-2. The overall dimensions of the excavated pit are 260' x 190' x 15' deep. A 2-foot-thick layer of compacted clay and a 36-mil Hypalon liner (or equivalent) will be installed to provide groundwater protection. The compacted clay layer provides a cushioned base for the synthetic liner in addition to preventing the instrusion of groundwater.

Leachate collection laterals will be placed in the pit, directly on the synthetic liner. A gravel/soil backfill will be added to cover the laterals and protect the liner. The collected leachate will be held in a sump located at the landfill site. Radiation monitoring of this sump will

TABLE 5-1

RADIOISOTOPIC CONCENTRATIONS IN THE SOLIDIFIED MASS
(After 28 days of cure)

Isotope	Curies/Ft^3	Pico Curies/gram
H-3	1.3E-3 to 1.1E-3	2.8E+4 to 2.2E+4
Sr-90	2.1E-7 to 1.8E-7	4.4 to 3.4
Cs-137	7.8E-8 to 6.6E-8	1.7 to 1.3

FIGURE 5-1

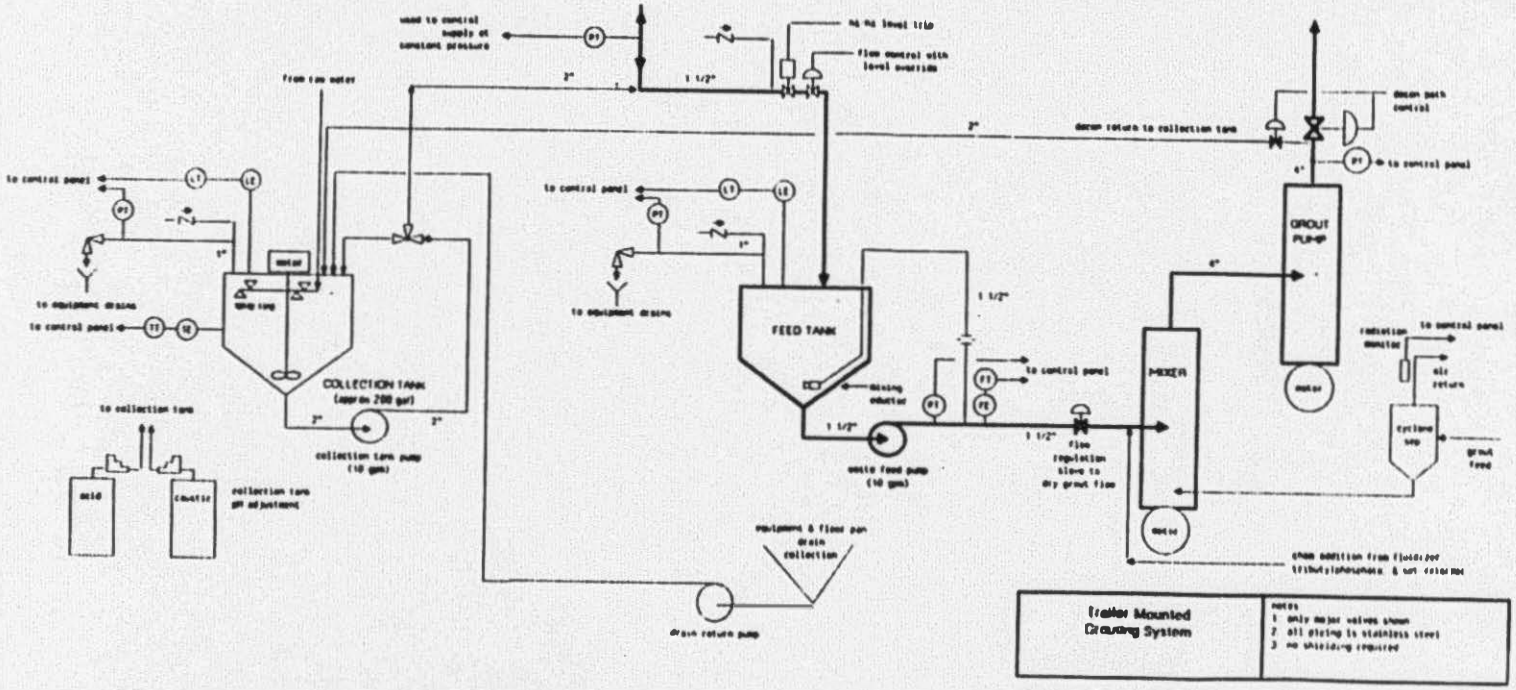
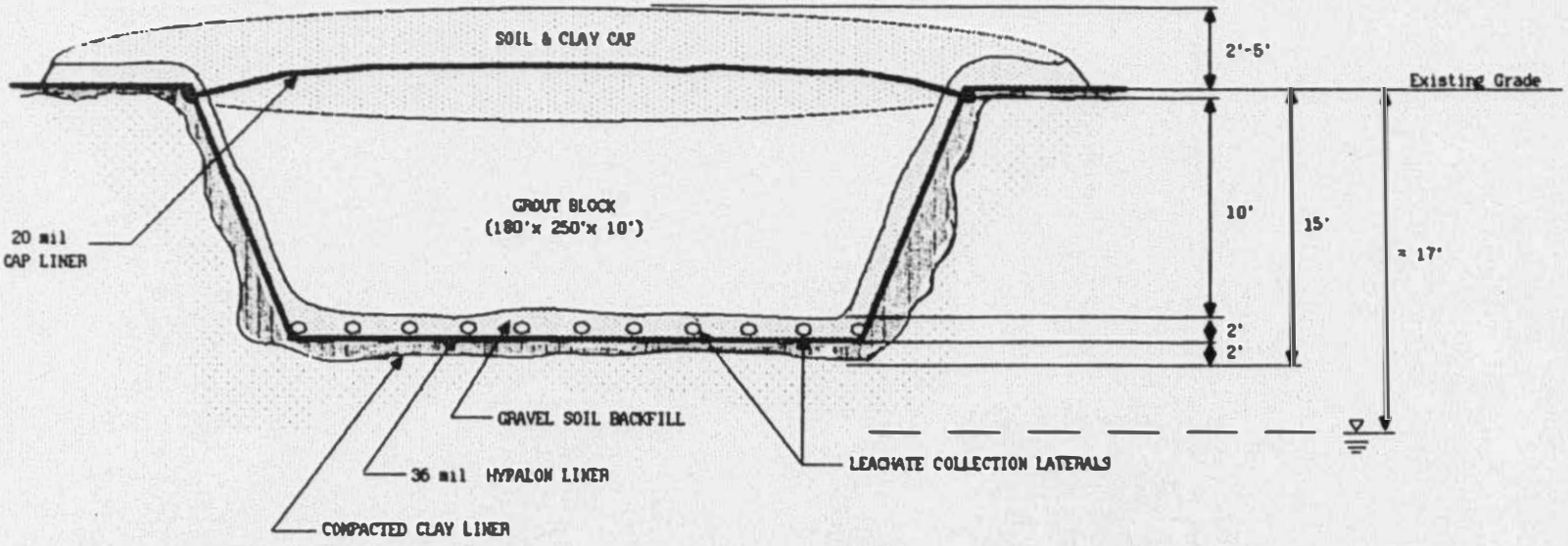

COLLECTION TANK
FEED TANK
GROUT PUMP
MIXER
Trailer Mounted
Grouting System

FIGURE 5-2 CONCEPTUAL LANDFILL CROSS SECTION



NOTES:

- Not drawn to scale
- All dimensions are approximate
- Bedrock is 35' below grade

be provided. No radioactivity is expected after landfill closure. The leachate will be monitored and is expected to be pumped to the industrial waste treatment system (IWTS) for treatment and discharge.

It is noted that the only source of leachate will be precipitation that accumulates in the pit before the final cover and 20 mil cap liner are installed. Leachate could also result from infiltrated groundwater, but this is not likely as it would mean that the impervious liner would have had to fail (a very unlikely situation). Not enough data is available at this time to predict the total daily quantity of leachate production. The cap liner is used to provide an impermeable seal over the grout block, and thus prevent the continued percolation of precipitation down through the landfill. This is prudent as it will ensure that the surveillance and leachate treatment commitments will not prevail indefinitely.

The final cover will be 2 feet thick at a minimum. The final grade of the cover will be approximately 2% to ensure proper storm water runoff and drainage without errosion of the cover material.

Monitoring wells will be installed for groundwater observation. The position of these wells will be such that one is up-gradient of the groundwater flow paths, and the rest are down-gradient.

5.1.2 Schedule

It is anticipated that the grout system would be in operation 5 days per week, with a total of 11 shifts per week in actual grout mixing operations. For the assumed operation scenario, and an estimated 10 gpm processing rate, with an average availability of 45%, 39 weeks will be required to complete all grouting operations, including time to erect the grouting system, excavate the disposal pit, and complete backfill operations.

5.1.3 Costs

Based upon the conceptual grouting system described above, the grouting system hardware is estimated to cost $1,512,000, Table 5-2 itemizes this estimated cost.

The engineered pit to be filled with a grout mixture of processed water and cement has been estimated to be approximately 260' x 190' x 15' in size. Preliminary estimates to develop this pit are presented below:

Initial Excavation	$110,000
Leachate Collection System	80,000
Ground Water Wells (4)	10,000
Base & Side Liner (36 mil Hypalon)	75,000
Clay Base	16,000
20 mil Cap Liner	22,000
Backfill & Cap Seal	73,000
	$386,000

The cement and hardening additives to be used with the grouting system are estimated to cost approximately $75 per ton of cement. It is estimated that, approximately 14,500 tons of cement will be required, for a total cost of $1.1 million. Operation costs (including cement) are estimated at $1.4 million, resulting in a total solidification cost of $3.3 million. An additional reprocessing charge of $2.3 million will also be attributed to this option (see Section 2.2), for an overall cost of $5.6 million.

5.2 Radiological Considerations

5.2.1 Radioactive Effluents

The solidification and on-site disposal of the processed water will cause the release of radioactive material to the environment. The solidification process is expected to release tritium to the atmosphere in

TABLE 5-2 GROUTING SYSTEM COST ESTIMATE

COMPONENT	RATING	COST k $$	SUBTOTALS
process equipment			
grout mixer w/motor		120	
grout pump w/motor		25	
feed pump	10 gpm	10	
liquid collection tank pump	10 gpm	10	
drains pump	10 gpm	10	
liquid collection tank mixer		10	
acid injection pump	1 gpm	1	
caustic injection pump	1 gpm	1	
drain tank w/accourtenances	200gal	20	
feed tank w/appurtenances	200 gal	20	
cement pneumatic feed		20	
air return cyclone sep		5	
cement silos		20	
			272
trailer			
bed	1	50	
collection pan	SS	20	
walls and ceiling	1	20	
misc structural	1	10	
jacks	4	5	
			105
ventilation			
exhaust fan		5	
exhaust sampler (CAM)		20	
roughing filter		5	
hepa filter		10	
			40
instrument loops			
feed tank level		25	
collection tank level		25	
mixer feed flow control		25	
grout feed flow control		25	
auto line flush on trip		25	
fire protection		10	
			135
miscellaneous			
power distribution center		5	
contol panel		10	
piping		10	
electrical cable/conduit		10	
valves		25	
			60
		total equipment	612
		allow for design and fabrication	500
		allow for erection	200
		allow for field test	200
		total	1,512

the form of water vapor due to the heat of hydration during the mixing and curing of the solidification process. Prior to closure of the landfill the release of small quantities of radioactive material to the river may occur due to the release of leachate.

Release to the Atmosphere

A conservative estimate of the continuous tritium release rate to the atmosphere has been determined based on the assumptions given below.

- The average tritium concentration in the processed water is 0.131 uCi/cc (Table 2-6).
- A release fraction of 50% for tritium
- A solidification process rate of 10 gpm (631 cc/sec)

The above assumptions yield a tritium release rate of 41.3 uCi/sec. This is approximately 7% of the allowable continuous tritium release rate limit given in Section 3.1.1.

Release to the River

Prior to closure of the landfill, the accumulated leachate would be directed to the normal plant discharge for release to the river. As this is a new source of water to be discharged, PaDER approval may be required. Since the volume of leachate and the radioisotopic concentration in the leachate cannot be quantified, a bounding evaluation has been made to determine a conservative estimate of the radioactive effluents to the river. It is conservatively assumed that 1% of the total radioisotopic inventory in the solidified mass is released in the leachate. This assumption is based on the total surface area of the solidified monolith, assuming leaching of 100% of the activity in the first two inches. From Table 2-6 (after taking into account the 50% release of tritium during solidification) this release would consist of 5.1 curies of tritium, 0.0008 curies of Sr-90, and 0.0003 curies of Cs-137.

5.2.2 Off-site Radiological Consequences

Radiological consequences from the solidification and on-site disposal of the processed water have been determined by estimating the dose to

both the maximally exposed hypothetical off-site individual and to the total exposed population. The dose to the maximially exposed hypothetical off-site individual is a conservative (over estimated) assessment of the dose to a member of the public as required by 10 CFR 50, Appendix I using Regulatory Guide 1.109 dose methodology. The estimated dose to the total exposed population is a more representative assessment of the radiological consequences. The release of tritium to the atmosphere is only expected during the solidification process, thus the radiological consequences from the release of tritium to the atmosphere is a one-year dose commitment. The release of tritium, Sr-90, and Cs-137 in the leachate to the river from the on-site disposal of the solidified mass is only expected prior to closure of the landfill and thus is also expected to be a one-year dose commitment.

5.2.2.1 Maximally Exposed Hypothetical Individual

Release to the Atmosphere

Using the methodology presented in Section 4.2.2.1 and the assumed release of 510 curies of tritium (50% of the tritium inventory in the processed water), the maximally exposed hypothetical individual is estimated to receive a dose of 0.59 mrem to the total body. This dose is less than 12% of the 10 CFR 50, Appendix I annual limit of 5 mrem.

Release to the River

The dose model utilized to estimate the dose to the maximally exposed hypothetical individual from liquid effluents is described in Section 6.2.2.1. For the release of 5.1 curies of tritium, 0.0006 curies of Sr-90, and 0.0003 curies of Cs-137 to the river, the maximally exposed hypothetical individual is estimated to receive a dose of 0.02 mrem to the bone and 0.008 mrem to the total body. These doses are approximately 0.2% and 0.3% of the 10 CFR 50, Appendix I annual limits of 10 mrem to any organ and 3 mrem to the total body, respectively.

5.2.2.2 Population Dose

Release to the Atmosphere

Using the dose methodology presented in Section 4.2.2.2 with the release of 510 curies of tritium, the population dose is approximately 5.5 person-rem to the total body during the solidification process. This compares to 228,000 person-rem to that same population attributable to the dose from natural background and medical radiation in a single year.

Release to the River

The dose model utilized to estimate the population dose from the release of tritium, Sr-90, and Cs-137 in the leachate to the river is described in Section 6.2.2.2. For the release of 5.1 curies of tritium, 0.0008 curies of Sr-90, and 0.0003 curies of Cs-137, the population dose is estimated to be less than 0.4 person-rem to the bone and less than 0.2 person-rem to the total body.

5.3 Environmental Consequences

The environmental consequences associated with the solidification and on-site disposal of the processed water include doses to the workers and the public. The occupational dose is obtained from the processing of the processed water and the solidification process. Additional occupational dose from the on-site disposal of the solidified mass is insignificant because of the layer of soil cover over the solidified mass following closure of the landfill. The occupational dose from the solidification process has been conservatively estimated to be approximately 18 person-rem. This dose is based on approximately 16,000 man-hours for the solidification and transfer of the grout, in a radiation field of 0.6 mrem/hr and 8 person-rem from the processing of the water. This dose is a very small percentage of the total exposure to the work force estimated in Supplement No. 1 of Reference 1 (i.e., 13,000 to 46,000 person-rem). The solidification process has been estimated to cause a population (public) dose of 5.5 person-rem to the total body. This estimated population dose can be interpreted as an average dose of approximately 0.005 mrem to the

total body for an individual in the exposed population of 1.2 million people. This dose is insignificant compared to the background radiation dose a member of the public receives per year (i.e., approximately 100 mrem). Prior to closure of the landfill, the assumed quantity of radioactive material released to the river, from the leachate, has been estimated to cause a population dose of less than 0.4 person-rem to the bone and less than 0.2 person-rem to the total body. The population affected by the introduction of radioactive effluents into the river has been estimated to be five million people. Thus, the population dose from the assumed leachate can be interpreted as an average dose of less than 0.0001 mrem for an individual in the exposed population, which is insignificant compared to the background radiation dose a member of the public receives per year.

Since no accumulation of leachate is expected following closure of the landfill, and since there is no appreciable direct dose from the landfill because of the soil cover, no doses to the public are expected following the closure of the landfill.

Therefore, the solidification of the processed water and the on-site disposal of the solidified mass have insignificant environmental consequences.

6.0 EVALUATION OF DISCHARGE TO RIVER OPTION

Discharge to the river of the processed water can be accomplished within regulatory requirements for acceptable environmental impact and dose impact. The total inventory of the processed water can be discharged in about one year's time. PaDER notification is required prior to the discharge of the processed water into the Susquehanna River.

6.1 Process Description

6.1.1 Equipment and Operations

Discharge of the processed water to the Susquehanna River is via the existing discharge path. Water is pumped from storage tanks, where it is held after processing, to one of two Evaporator Condensate Test Tanks (WDL-T-9 A or B). Water to be released is pumped from these tanks to the Mechanical Draft Cooling Tower (CW-C-2) from where it is discharged to the river via cooling tower letdown. The discharge flow path is shown in Figure 6-1. The cooling tower provides a diluent flow of about 22,000 gpm prior to discharge.

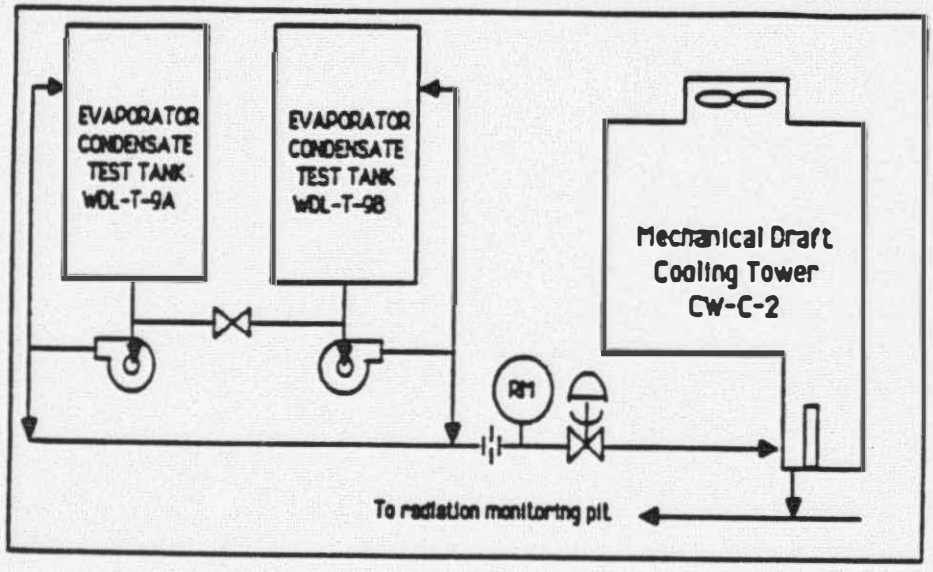


FIGURE 6-1 DISCHARGE FLOW PATH

Each Evaporator Condensate Test Tanks holds 11,000 gallons. At 50 gpm, the fill time is about four hours. When filled, a tank is recirculated for a time equivalent to at least three tank volumes after which it is sampled. At a nominal pumping rate of 50 gpm, about eleven hours of recirculation is required. Sampling and sampling analysis requires about one shift if a tritium analysis is to be performed; somewhat less if gross gamma and gross beta can be used to verify the discharge batch is the same as the source batch.

Very little additional equipment is required to discharge the processed water. New equipment would include an automatic flow controller loop. This would require replacement of flow transmitter WDL-FT-1636, addition of a manual control station, trip modules and trip solenoids for valves WDL-V-93A and B. An upgraded radiation monitor system may also be required at the existing location (WDL-R-1311). This is based on the different mix of radioisotopes of concern (tritium and strontium) than the mix of radioisotopes expected for release during normal plant operations which was the design basis for the existing monitoring system.

6.1.2 Schedule

The time to discharge is dependent on the allowable flow rate based on isotopic and chemical concentrations in the water. Table 6-1 derives the total time to discharge about 2.1 million gallons based on a range of discharge flow rates. This derivation considers the turnaround time per tank.

Table 6-1 shows that discharge flow rates of less than 5 gpm will severly restrict the ability to discharge in a productive manner. At discharge flows greater than about 10 gpm, the recirculation and sample analysis time is controlling. Therefore, a 10 gpm discharge rate is recommended.

6.1.3 Costs

Activities for the Entire Campaign

Certain activities apply to the entire discharge campaign and are not considered to be unit operations costs. These include:

TABLE 6-1

TIME IN HOURS TO DISCHARGE 2,100,000 GALLONS
AS A FUNCTION OF DISCHARGE FLOW RATE

	- discharge gpm -			
	50	10	5	1
Fill	4	4	4	4
Recirculate	11	11	11	11
Sample	1	1	1	1
Analysis	4 to 8	4 to 8	4 to 8	4 to 8
Discharge	4	18	36	183
Time per tank (hours)	24 to 28	38 to 42	56 to 60	203 to 207
Tanks per day	2	-	-	-
Tanks per 5 day week	10	4	2	-
Tanks per month	42	18	9	4
Gallons per year	5,540,000	2,376,000	1,188,000	528,000
Years to discharge	1	1	about 2	3 to 4

1. Inspection, refurbishment, and operational test of WDL-T-9 A & B, WDL-P-11 A & B, and connected piping, valves, interlocks, and instruments to the cooling towers. An operational leak test should be conducted after re-installation of the flow element. Flushing may be prudent if there is any reason to suspect that fouling has occured.

2. Revised operating procedure (2104-4.2 - Section 4.10) for discharge.

3. New chemistry procedures to calculate the allowable discharge flow rate based on batch sample analysis.

4. Revised health physics procedure (HPP-1621) to authorize release of water to the environment.

Unit Processing Operations

Unit operations include:

1. Sample and analysis of process tank to be transferred to the WDL-T-9 A & B
2. Transfer of water from process tanks to WDL-T-9 A & B
3. Placing WDL-T-9 A & B in recirculation and drawing sample. The tank is then sampled.
4. Pumping water from WDL-T-9 A & B to the cooling tower.

Two cost estimates have been conducted for discharge to the river; Case 1 is for a 10 gpm discharge rate and Case 2 is for 5 gpm. The only difference in costs is that the processing campaign costs are higher for Case 2 because the total calendar time is greater. The costs are shown in Table 6-2. An additional reprocessing charge of $2.3 million will also be attributed to this option (see Section 2.2), for an overall cost of about $2.6 million.

TABLE 6-2

COST ESTIMATE SUMMARY FOR DISCHARGE OF
2,100,000 GALLONS OF PROCESSED WATER
(All values are in dollars)

Cost Element	Case 1: 10 gpm Discharge Rate	Case 2: 5 gpm Discharge Rate
System Mods	38,600	38,600
Campaign Ops	74,300	98,200
Unit Ops	145,000	145,000
Totals	257,900	281,800
Cost/Gallon	.13	.14

6.2 Radiological Considerations

6.2.1 Radioactive Effluents

The discharge of the processed water to the Susquehanna River will be controlled to comply with the limitations of radioactive liquid effluents given in Section 3.2.1. The planned discharge flow rate is 10 gpm. Using the expected MDCT plant discharge flow rate of 22,000 gpm the plant dilution factor is 2,200 for the 10 gpm flow rate. A plant dilution factor of 120.2 is required to ensure compliance to 10 CFR 20 radioisotopic concentrations in the plant effluent (see Section 3.1.2). With a plant dilution of 2,200 the radioisotopic concentrations in the plant effluent would be less than 6% of the MPC given in 10 CFR 20. Using the low river flow rate of 5,000 cfs (Section 3.1.2) and the planned discharge flow rate of 10 gpm (0.022 cfs) the river dilution factor is greater than 220,000. With a river dilution factor of 220,000 the radioisotopic concentrations in the river at the nearest downstream user is less than 6% of the 40 CFR 141 limit.

6.2.2 Off-site Radiological Consequences

Radiological consequences from the controlled discharge of the processed water to the Susquehanna River have been determined by estimating the dose to both the maximally exposed hypothetical off-site individual and to the total exposed population. The dose to the maximally exposed hypothetical off-site individual is a conservative (over estimated) assessment of the exposure to a member of the public as required by 10 CFR 50, Appendix I using Regulatory Guide 1.109 dose methodology. The estimated dose to the total exposed population is a more representative assessment of the radiological consequences resulting from the controlled discharge to the river.

6.2.2.1 Maximally Exposed Hypothetical Individual

Dose Model

River discharge was evaluated by calculating the dose to the maximally exposed hypothetical individual using the 1985 mean monthly river flows and

the mechanical draft cooling tower flows, of 36,000 cfs and 22,000 gpm, respectively. The average monthly river flow actually varies from 5,000 cfs to about 100,000 cfs over the course of a year. To calculate the doses from liquid releases, the liquid dose routines in MIDAS were used. These are the identical routines used by TMI Environmental Controls for the quarterly and semi-annual dose assessments which are submitted to the NRC with the Unit 1 and Unit 2 effluent reports. The model accounts for dilution in the MDCT flow, near field dilution, and far field dilution in the total river flow. The model uses three pathways: freshwater sport fish ingestion, shoreline direct radiation exposure, and ingestion of river water as a drinking water source. The shoreline and fish ingestion doses are evaluated using the near field dilution above the York Haven dam; therefore, the river flow rate does not affect the dilution. The drinking water pathway applies to all persons using Susquehanna River water as a drinking water source withdrawn from the river downstream of the plant discharge. The maximally exposed hypothetical individual is that person who eats fish from the river at the plant discharge, stands along the shoreline, and drinks Susquehanna River water.

Estimated Doses

Using the total activities given in Table 2-6, the 1985 mean monthly river flow of 36,000 cfs, and a MDCT flow of 22,000 gpm, the maximally exposed hypothetical individual will receive a dose of approximately 2.2 mrem to the bone and 0.84 mrem to the total body. 10 CFR 50, Appendix I limits the dose to the bone to 10 mrem year and the dose to the total body to 3 mrem per year. Thus, the estimated doses to the maximally exposed hypothetical off-site individual are less than 15% and 30% of the 10 CFR 50, Appendix I limits to the bone and total body, respectively.

6.2.2.2 Population Dose

To estimate the population dose the liquid dose routines of MIDAS were again utilized. The mean monthly river flow rate of 36,000 cfs and the MDCT discharge flow rate of 22,000 gpm were also used in this analysis. The exposed population is considered to be the affected population

surrounding TMI-2 and downstream of the plant discharge. The population affected by the discharge of the processed water is estimated to be five million people. The dose pathways are fish consumption, shoreline exposure, and drinking water. The majority of the population dose is from the drinking water pathway. The estimated population doses have been determined to be 37 person-rem to the bone and 16 person-rem to the total body.

6.3 Environmental Consequences

The environmental consequences associated with the controlled discharge of the processed water to the river include the doses to the workers and to the public and the release of boric acid and sodium hydroxide to the river. The occupational dose attributed to the controlled discharge of the processed water to the Susquehanna River has been conservatively estimated to be approximately 11 person-rem. This dose is based on approximately 4,000 man-hours in a radiaton field of 0.6 mrem/hr and includes an estimated 8 person-rem associated with the processing of the processed water. This maximum dose is a very small percentage of the total dose to the work force estimated in Supplement No. 1 of Reference 1 (i.e., 13,000 to 46,000 person-rem). The estimated population doses have been determined to be 37 person-rem to the bone and 16 person-rem to the total body for the affected population of approximately five million people. These population doses can be interpreted as an average dose of less than 0.008 mrem to the bone and approximately 0.003 mrem to the total body for an individual in the exposed population. These doses are insignificant compared to the background radiation dose a member of the public receives on an annual basis (i.e., approximately 100 mrem). The release of boric acid and sodium hydroxide and the pH of the effluent into the Susquehanna River are limited by the NPDES permit issued to TMI from the PaDER. The continuous boron release limit of 25 ppm in the NPDES permit is the controlling chemical limit for discharge of the processed water into the Susquehanna River. Section 3.5 shows that a plant dilution factor of 240 is required to meet this boron limit of 25 ppm. As shown in Section 6.2.1, a plant dilution of 2,200 is expected. Thus, even for an assumed boron concentration of 6,000 ppm in the processed water, the boron concentration at the plant discharge

is approximately 10% of the NPDES limit. The NPDES permit also limits the pH of the effluent to a range of 6 to 9. For the few processed water sources which are currently not within this range, the requirements on pH can be readily achieved by blending water sources prior to discharge.

Therefore, the discharge of the processed water into the Susquehanna River would have insignificant radiological and non-radiological environmental consequences.

7.0 10 CFR 50.59 EVALUATION

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.

7.1 Unreviewed Safety Question Determination

10 CFR 50, Paragraph 50.59, states a proposed change involves an unreviewed safety question if:

a. The probability of occurrence or the consequence 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.

Although some of the disposal options outlined in this report are different from the disposal options for liquid wastes outlined in the FSAR, the consequences of these activities are bounded by analyses provided in the FSAR.

The disposal options considered would not increase the probability of an accident or malfunction of equipment important to safety. The implementation of the selected option would be governed by procedures approved pursuant to Section 6.8.2 of the TMI-2 Technical Specification and would be designed to minimize the potential for an inadvertent release and, therefore, reduce the probability of an accident. Additionally, the

consequences of any accident associated with the selected disposal option would be bounded by the evaluations given in the TMI-2 FSAR for a postulated failure of the Borated Water Storage Tank (BWST).

Supplement 2 of the TMI-2 FSAR evaluated the postulated failure of the BWST. This evaluation assumed that the BWST contained "design basis" radioisotopic concentrations. The mix of radioisotopes, in the FSAR evaluation, is vastly different from the mix of radioisotopes in the processed water. However, the resulting doses from the release of the BWST contents into the Susquehanna River can be compared to the expected doses resulting from a hypothetical release to the river of all of the processed water. The doses calculated below are for illustrative purposes only and show that the hypothetical release of all the processed water is bounded by a previously reviewed accident evaluation. Table 1 in Supplement 2 (page S2-13C) of the FSAR, presents the resulting concentrations in the river from the postulated failure of the BWST. For this mix of radioisotopes, the radiologically significant radioisotopes are Cs-134, Cs-136, and Cs-137. Using the concentrations given in Table 1 of Supplement 2 for the east side of the island and the dose methodology given in Regulatory Guide 1.109, an adult is estimated to receive a dose of 7.8 rem to the liver from the consumption of one kilogram of fish residing in the east side of the island. The liver is the limiting organ for exposure for cesium.

For comparative purposes, this same adult is estimated to receive a dose of 0.56 rem to the bone (the limiting organ for the mix of radioisotopes in the processed water), and 0.015 rem to the liver, from the total release of processed water to the river. These dose consequences are based on the following assumptions:

- Catastrophic failure of all tankage and water sources containing processed water (NOTE: Considered to be an incredible event)

- Instantaneous release of all processed water to the river

- Radioisotopic inventory in the processed water to the river presented in Table 2-8

- River dilution access at the east side of the island (i.e., same as the FSAR evaluation)

- Dose methodology is as described in Regulatory Guide 1.109

Therefore, the dose consequence from a hypothetical release of all the processed water is significantly less and bounded by the dose consequence for the postulated failure of BWST presented in the FSAR.

The disposal options being considered would not create an accident or malfunction of a different type. Postulated accidents associated with processed water disposal would consist of line breaks or tank ruptures for which the bounding accident has been evaluated above.

The disposal of the processed water does not reduce any margin of safety as defined in the basis for any technical specification. The disposal options have been evaluated to determine the controls necessary to ensure, by compliance with governing procedures, that the implementation of the selected option will comply with applicable technical specifications. Compliance with the applicable technical specifications ensures that public exposure from the planned gaseous or liquid discharges is well within the objectives of 10 CFR 50, Appendix I.

In conclusion, the disposal of the processed water does not involve an unreviewed safety question.

7.2 Changes to Technical Specifications

Disposal of processed water does not require a Technical Specification change. NRC approval of the disposal option selected by GPU Nuclear is required by Technical Specification 3.9.13; accordingly, this evaluation is submitted to obtain that approval. Further, the effluent release analyses performed in support of this evaluation demonstrate that the effluents from each of the disposal options presented are well within the limits imposed by Appendix B to the TMI-2 Technical Specifications. Therefore, no changes to the TMI-2 Technical Specifications are required.

8.0 SUMMARY

For purposes of conducting the evaluation of ultimate disposition options for processed water, several assumptions have been defined. The assumptions considered are the following:

- The TMI-2 cleanup endpoint is defined as September 30, 1988
- A total of approximately 2,100,000 gallons of processed water is estimated to require disposition under this evaluation.
- Any new water generated after the recovery endpoint will not be considered processed water, and therefore its disposal will not be within the scope of this report.
- All processed water must be effectively and completely dispositioned within six (6) months after the recovery endpoint (i.e., by March 31, 1989).
- NRC review and approval of the final disposition option is expected by the end of 1986.
- Radioactive waste disposal allocations provided by the 1985 Amendment to the Low-Level Waste Policy Act of 1980 are the only commercial disposal allocations available to TMI-2 until 1993. Additional (or special) allocations and non-commercial radioactive waste disposal may be required to supplement the disposal options.

8.1 Processed Water Description

By the end of the TMI-2 cleanup program, it is estimated that approximately 2.1 million gallons of processed water will require disposition. Prior to final disposal, and depending on the option chosen, from 40% to 100% of the 2.1 million gallons of the processed water will undergo processing through the Submerged Demineralizer System (SDS) and/or EPICOR II water purification systems. The processing will reduce the average radionuclide concentrations and minimize the environmental effects.

The processed water will then have the average characteristics presented in Table 8-1.

These radionuclide characteristics are representative of the influent feed for the evaporator, and are based on processing 40% of the water prior to evaporation. For the options in which 100% of the water would be processed--solidification or discharge to the river--the remaining total activity of strontium-90 and cesium-137 would be lower: 0.08 curies and 0.03 curies, respectively. All other radionuclides are expected to be below lower limits of detection. While tritium (1,020 curies) is the dominant radionuclide in the processed water with respect to

TABLE 8-1

PRE-DISPOSITION PROCESSED WATER CHARACTERISTICS
(Based on processing 40% of the total volume)

Volume		Approximately 2.1 Million Gallons	
Tritium:	Concentration	1.3E-1	uCi/ml
	Total	1020	Ci
Cs-137:	Concentration	3.7E-5	uCi/ml
	Total	0.29	Ci
Sr-90:	Concentration	1.15E-4	uCi/ml
	Total	0.9	Ci
Boron:	Concentration	3000	ppm
	Total	150	Tons H_3BO_4
Sodium:	Concentration	700	ppm
	Total	11	Tons NaOH

quantity, the most radiologically significant radionuclide is strontium-90. That is because strontium concentrates in bone marrow and gives a relatively larger, though in this context insignificant, dose than the whole body dose from tritium. In addition, the water will contain approximately 150 tons of boric acid and 11 tons of sodium hydroxide.

8.2 Disposal Options

A large number of potential disposal options for processed water were evaluated. Only three options were determined to be practical for application to TMI-2 water, and are:

A. Direct solidification, with on-site disposal of the solidified waste

B. Forced evaporation, with off-site disposal of the solidified concentrates in a licensed commercial low-level radioactive waste disposal site

C. Controlled discharge to the river

Continued storage of the processed water on-site was considered, but was rejected since it did not result in a final resolution to the ultimate water disposal objective.

8.3 Disposal Evaluations

The disposal options have been evaluated by the TMI-2 staff on the basis of relative technical feasibility, environmental effects, direct costs, and time necessary to complete the task. Table 8-2 summarizes the results of the environmental assessments performed for the three potential disposition options. From this table, it is apparent that the off-site environmental consequences for each option are comparable, and well below regulatory limits even for the extremely conservative assessments performed in accordance with Reg. Guide 1.109. Using a more representative assessment of potential dose to any average member of the population, the environmental consequences are insignificant.

TABLE 8-2

ENVIRONMENTAL SUMMARY

DISPOSAL OPTION	MAXIMALLY EXPOSED[1][5] HYPOTHETICAL INDIVIDUAL (mRem)	AVERAGE DOSE[4][5] (mRem)	OCCUPATIONAL DOSE[5] (Person-Rem)
Evaporation with off-site waste disposal	4.0 to 0.4 (bone)[3] 2.0 to 1.0 (total body)[3]	0.02 to 0.002 (bone)[3] 0.01 (total body)[3]	53 to 58
Solidification with on-site disposal	0.6 (total body)[2]	0.005 (total body)[2]	18
River Release	2.0 (bone) 0.8 (total body)	.008 (bone) .003 (total body)	11

(1) Conservative assessment per Reg. Guide 1.109

(2) Dose reported is for the solidification process

(3) Annual dose for evaporation is one-half the value reported, all others are annual doses

(4) Assessment of dose to an average member of the exposed population

(5) The range in doses is due to the amount of processing through SDS/EPICOR II prior to disposal

TABLE 8-3

OPERATIONAL SUMMARY

DISPOSAL OPTION	COST[1]	COST UNCERTAINITY	TIME REQUIRED	TIME UNCERTAINITY	REGULATORY CONSTRAINTS
Evaporation with off-site waste disposal	$6.0-14.0[2]	Medium	2.5 Years	Medium	Requires additional commercial disposal allocation
Solidification with on-site disposal	$5.6	Medium	1 Year	Medium	Requires NRC Approval per 10 CFR 20.302 and PaDER landfill permit
River Release	$2.6	Low	1 Year	Low	PaDER notification and possible approval

(1) $1,000,000's in 1986 dollars

(2) The range in cost is due to different mixes of waste solidification media resulting in different final waste volumes

In addition, the environmental consequences to the public (population doses) are bounded by the estimates developed in the PEIS (i.e., 30-900 person-rem for discharge to the river, and 26-440 person-rem from releases to the atmosphere). Table 8-3 summarizes the economic and schedular effects of each option evaluated, as well as any major regulatory constraint affecting each option.

The incremental cost to implement the various disposition options vary by a factor of 2-4, while the time required could vary from less than a year to over 2 years. Only the river discharge option presents no apparent regulatory constraints beyond disposition approval, while the other two options would require additional effort to address other regulatory issues.

The GPU Nuclear technical evaluation has resulted in the following summary of advantages and disadvantages for each potential disposal option.

A. Forced Evaporation - Vendor System

ADVANTAGES:

- o Concentrates waste requiring LLW disposal
- o Insignificant off-site radiological consequences
- o Minimal SDS/EPICOR reprocessing required

DISADVANTAGES:

- o Inadequate, current, LLW disposal allocation
- o Interim on-site storage may be required

- o Complicated logistics
- o Highest cost

B. Direct Solidification - On-site Landfill Disposal

ADVANTAGES:

- o Relatively simple to implement
- o Short time to complete
- o Second lowest cost
- o Decoupled from LLW disposal
- o Insignificant off-site radiological consequences

DISADVANTAGES:

- o Requires separate submittal for NRC approval per 10 CFR 20.302
- o Requires industrial landfill
- o PaDER approval for leachate discharge
- o Retains on-site legacy

C. Controlled Discharge to the River

ADVANTAGES:

- o Technically simple

- o Lowest direct cost
- o Shortest time to complete
- o No on-site legacy
- o Minimal manpower required
- o Simple logistics
- o Insignificant off-site radiological consequences

DISADVANTAGES:

- o PaDER notification

8.4 Disposal Recommendation

On the basis of overall technical merit, analysis indicates that the controlled discharge of the processed, diluted water to the Susquehanna River is the simplest, least costly option and involves insignificant environmental impact, as do the competing options. However, GPU Nuclear has opted not to recommend discharge to the river in recognition of an existing public perception that unique health risks are associated with this disposal option.

After considering the technical merits of each option, as well as public, institutional and political concerns, GPU Nuclear has selected evaporation as the preferred option for disposal of TMI-2 water. Evaporation, including solidification and shipment of evaporator residue to a low-level waste burial ground, will remove the small amount of remaining radioactivity from TMI. Successful implementation of this recommendation requires approval of an additional waste disposal allocation.

There is a common objective-safe disposal of the processed water. Our recommended disposal method is technically feasible and environmentally safe. It should be found acceptable by the NRC, the public and other government agencies.

This report is submitted to provide the NRC with the GPU Nuclear recommendation concerning disposal of the TMI-2 water in accordance with Technical Specification 3.9.13 and to seek NRC approval by the end of 1986. Timely initiation of water disposal is in the common interest.

9.0 REFERENCES

1. "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," NUREG-0683, USNRC, March 1981.

2. "Radioactive Materials Released from Nuclear Power Plants," NUREG/CR-2907, Vol. 1, Brookhaven National Laboratory, 1980 Annual Report

3. "Off-site Dose Calculation Manual for Three Mile Island Nuclear Station Unit 1," Revision 6.