ANALYSIS OF STATION CONDITION

SECTION VIII

Final Summary of Event or Condition and Root Cause

On May 20, 1994, while in the process of investigating a suspected water inventory loss from the Unit 1 Spent Fuel Pools, the "Sphere Foundation Sump" located on the 14 ft. elevation of the Chemical Systems Building was sampled to determine if it contained radioactivity. Previous sampling did not require analyzing for tritium.

The sample results indicated positive for tritium and an activity of $1.0E^{-5}$ μci/cc was reported for the sump liquid. It was thought that water sources to this monitored sump would likely be a good indicator of any possible leakage from the Spent Fuel Storage Pools in Unit 1.

Although prior work had been underway since the 1990 time frame to obtain more accurate information as to the suspected pool water inventory loss (See **Attachment 1** for the Unit 1 SFP Water Inventory Chronology of Events), this latest information resulted in a more aggressive and formalized approach to the problem. Immediately, a task force was established to deal with the issue and a project manager named. A project plan was formulated as the initial task. The objective of the project plan was to identify and quantify the inventory loss from the Unit 1 Spent Fuel Pools. The basic elements of the plan were designed to:

1. Isolate the East/West pools which contain reactor components and spent fuel assemblies respectively from the other four smaller pools with new gates.

2. Install more accurate level instrumentation in the West Fuel Pool.

3. Dewater/desludge the 4 smaller pools,.

4. Seal up and monitor the East/West Storage Pools for continued inventory loss monitoring.

5. Sample and monitor various plant sumps and off-site locations to determine/confirm pool effluent migration pathways.

6. Evaluate the site geology/hydrology for the purpose of assessing pool effluent migration pathways and environmental impacts,

7. Perform mass balance inventory calculations to quantify any leak and demonstrate that it is being recovered by the plant sub-surface drainage systems.

These basic elements of the plan were formulated into a detailed project schedule which is provided as **Attachment 2** to this report. This schedule constitutes the near term objectives of the overall project. Longer term project objectives are outlined in Section X of this report.

To date, two new Presray gates have been installed to isolate the East/West Pools from the other four smaller pools. New, more accurate level instrumentation has been installed in the West Pool to measure water level in the combined East/West Pools. The 4 smaller pools (Cask Load, Fuel Transfer

Canal, Disassembly and Failed Fuel Pools) have been dewatered/desludged with the sludge being transferred to the Water Storage Pool for future processing. The Water Storage Pool has been dewatered to approximately two feet off the bottom. In all, approximately 600,000 gallons of water has been processed out of all pools.

The water level in the East/West Pool has been lowered from approximately El. 63 ft. to approximately El. 49 ft. The initial attempt to stabilize water level at Elevation 52 ft. was unsuccessful because two interpool leakage cracks were discovered in the common wall between the West Pool and the Disassembly Pool during pumpdown operations. The present water level is being maintained below these cracks. Minor seepage has also been observed in two separate locations (an embedded unistrut and at the corner of the channel that forms the shelf for the bottom gate slot) on the same wall at approximately 41'-9". This seepage has been quantified at 1.5 gallons per day.

With the East/West Pools isolated and the pool openings sealed to minimize the effects of evaporation, the project has entered an extended period of monitoring pool water level and sump flowrate/activity, in order to more precisely identify and quantify the inventory loss using mass balance and inventory reduction calculations.

The following paragraphs describe the various project related assessments/analyses that have either been completed or are currently in progress. Included with each description is a summary of the results and actions taken.

On-site/Off-site Sampling and Monitoring

As a result of intensive reviews conducted by Engineering and Chemistry department personnel, a total of 45 locations, both on-site and off-site, were selected for radioactive sampling and analysis. **Attachment 3** lists the selected sample points, the dates obtained and analytical results. The primary objectives for obtaining samples at the selected locations were threefold:

1. Attempt to track the pool water migration paths from origin to the environment (i.e., either to ground water or to the Hudson River) and to adjacent building structures.

2. Assessment of the environmental impact of pool leakage external to building structures.

3. Provide input to pool leakage rate calculations.

These samples were analyzed to detect the presence of typical fuel pool isotopes (Cs-134, Cs-137, Co-60, H-3). Boron concentration was also obtained for selected locations. As can be seen in the attached tabulation, the results for off-site samples along with the various on-site storm drain and discharge canal samples showed activity levels that were LLD for those isotopes.

For those samples obtained from within building structures, there were four specific locations where analytical results indicated the presence of fuel pool leakage;

1. Sphere Foundation Drain (SFD) Sump (Boron, Tritium)
2. Sphere Annulus Sand Moat (Boron, Tritium)
3. 33 ft. Sphere Annulus Floor (All)
4. 33 ft. Foundation Curtain Drain, North side (Boron, Tritium)

The primary concern given this information was that two of the pool water effluent pathways (SFD sump and North Curtain Drain) were routed directly to the outfall structure without extensive monitoring. The Sphere Foundation Drain Sump discharge is a continually monitored effluent pathway. However, because of the high dilution factor between pool water and ground water, the installed radiation monitor is not sensitive enough to detect the gamma emitting isotopes in such low concentration. Also, tritium, which is a beta emitter passes through the rad monitor completely undetected. Additionally, it was discovered that the SFD Sump discharge to the outfall structure was via the NYPA storm drainage system. This pathway was confirmed by use of a dye tracer. (It should be noted that the discharge point is within the outfall structure and upstream of the location where grab samples are routinely taken for site radioactive effluent monitoring). Because the SFD Sump was discharging fluid containing trace quantities of radioactive contaminants to the Unit 3 property, it was decided to temporarily re-route the sump discharge back to the Con Edison side of the site. Long term action would be to make the change permanent via piping modification. Temporary Operating Instruction, TOI-197 was implemented on July 24, 1994 to re-route the SFD Sump effluent to the Unit 1 River Water system.

The north side curtain drain (NCD) at the 33 ft elevation, traverses along the top ledge of the Fuel Storage Building and containment foundation footings. The NCD line re-enters the Nuclear Service Building and converges with the south side curtain drain. From the NSB, the drain line is routed to the conventional plant side, through the Utility Tunnel and then to the Discharge Canal. Along the way, other plant drains combine flows with the footing drain water. This drainage path is not monitored for radioactive contaminants prior to the outfall. As with the SFD Sump effluent the NCD water contained trace quantities of pool contaminants that were not detectable by the time it reached the outfall. This was due to the large dilution from the other plant drains mixing with NCD effluent. Activity was detectable however, at a clean out plug located near the 33 ft. containment annulus, just prior to entering the NSB. Dilution from sources other than rain water does not occur up to this point of the effluent pathway. Although the contamination levels were considered minute, a decision was made to re-route the NCD water back to the 5 ft. elevation sphere sump, where it would then be processed by the liquid radwaste system prior to discharge. This was accomplished by a jumper and Temporary Operating Instruction, TOI-194 which was implemented on July 25, 1994.

Evaluations conducted by the Radiological Engineering section have concluded that radioactive release via these two paths is of such a small magnitude that the overall impact on past release calculations is essentially nil.

The other two locations where sample analysis indicates the presence of pool water contaminants, the annulus sand moat and annulus floor, are a lesser concern because they are currently contained within the containment structure. The water within the sphere sand moat is a stagnant leg. The origin of this water is still unknown. Within the sand layer is a perforated ring header with a drainage path to the Sphere Foundation Drain Sump. This drain line is plugged for reasons unknown. There is a plan to try and unclog this line to enable dewatering of the sand moat. Following the dewatering process, the area will be monitored to see if water is reintroduced. The presence of boron (35 ppm) and tritium (2E-4) from surface samples indicates possible intrusion by fuel pool water. The mechanism for pool water migration to this location is yet to be determined.

The annulus floor has two separate cracks adjacent and perpendicular to the fuel pools. Following roof repairs in September, 1994 which curtailed intrusion of rain water into the annulus area, standing water was still observed at these two crack locations long after other water had evaporated. The two puddles were vacuumed as dry as possible and a total leak rate of approximately 3 gpd, equally split between the two areas was obtained. Additional samples were obtained and analyzed, the exact source of the leak could not be determined. The pools adjacent to this area are the Water Storage Pool (physically closest) and the West Storage Pool. These are the only pools with water remaining. A dye tracer was placed in the Water Storage Pool, but it has not yet shown up in the Annulus area. This investigation is continuing.

Site Hydrology/Geology Assessment

An assessment of ground-water migration pathways from the Unit 1 Spent Fuel Pools was prepared by the Whitman companies (see Reference 1). Based upon an evaluation of available reports, design data, and a site reconnaissance, the assessment concluded that a site-specific combination of hydrogeologic and design features of Unit 1 is favorable for minimizing environmental impacts of any subsurface leaks. Most of the water that might leak from the spent fuel pools would be intercepted and recovered by a subsurface drainage system operated at Chemical Systems Building. This system was installed at the time Unit 1 was constructed to combat high ground water levels. An upward hydraulic gradient and upward flow resulting from location of the Station in a regional ground water discharge zone (the Hudson River Valley) will prevent any downward migration of water from the leak. If any portion of the leak were not intercepted by the subsurface drain system, it would likely follow a shallow ground water flow pathway into a small stream discharging into the Hudson River some 1,700 feet southwest of Unit 1. Ground water in the area is not used for drinking water supply.

Sphere Foundation Drain Sump and North Curtain Drain Leak Analysis

Project actions undertaken in the summer 1994 time frame have curtailed leakage addition to the Sphere Foundation Drain Sump (SFDS) and the North Curtain Drain (NCD). Current data suggests arrested, but possibly not fully interrupted, leakage as well as a reservoir effect which appears to explain the deceasing levels of activity in the SFDS and NCD. The following summarizes the results of associated data analyses:

1. North Curtain Drain (NCD) Data and Analysis

The introduction of activity to the NCD, via one or possibly several pool wall leaks, is well-documented. To estimate the effective pool leakage, one needs to know those contaminants whose presence in pools, proximity, and behavior make them manifest the pool leakage in some confident manner. In the case of the NCD, the tritium pool concentration and stability, the transportability in aqueous systems and ready detectability make it a good signature contaminant. Boron appears to be another fair choice for many of the same reasons; however, boron seems (as will be shown later) to exhibit a stronger reservoir effect than tritium does, implying that its concentration is somewhat more immune to changes in rainfall which causes essentially all the NCD flow. Co-60 and Cs-137 are also found consistently in NCD samples. They do not change concentration in response to rainfall as tritium does, but they reflect rainfall additions more strongly than boron does (see next several pages of charts). It is preferred to use tritium to gauge leakage rather than any other contaminant because the somewhat reciprocal relationship between tritium concentration and flow rate is timely.

Because pool corrective actions and tests have been frequent in June, estimate of the pool leakage should be based as much as possible on data taken under near-static conditions. Therefore, the NCD leakage for periods prior to these actions and tests must be evaluated separately from leakage estimates made long after actions and tests have been stopped. The pool leakage estimate is derived from the following:

1. Determination of average tritium concentration from flow-dependent sample concentrations.

2. Estimate of pool contribution to average tritium concentration with consideration given to average flow rate, pool concentration and background concentration.

The first of these is calculated by:

$$[H\text{-}3]\ ave = \frac{\text{summation}\ [\ flow_i \times [H\text{-}3]_i\ ]}{\text{total flow}}$$

The second is calculated by:

pool leakage to NCD = A[1 - (B-C)/(B-D0]

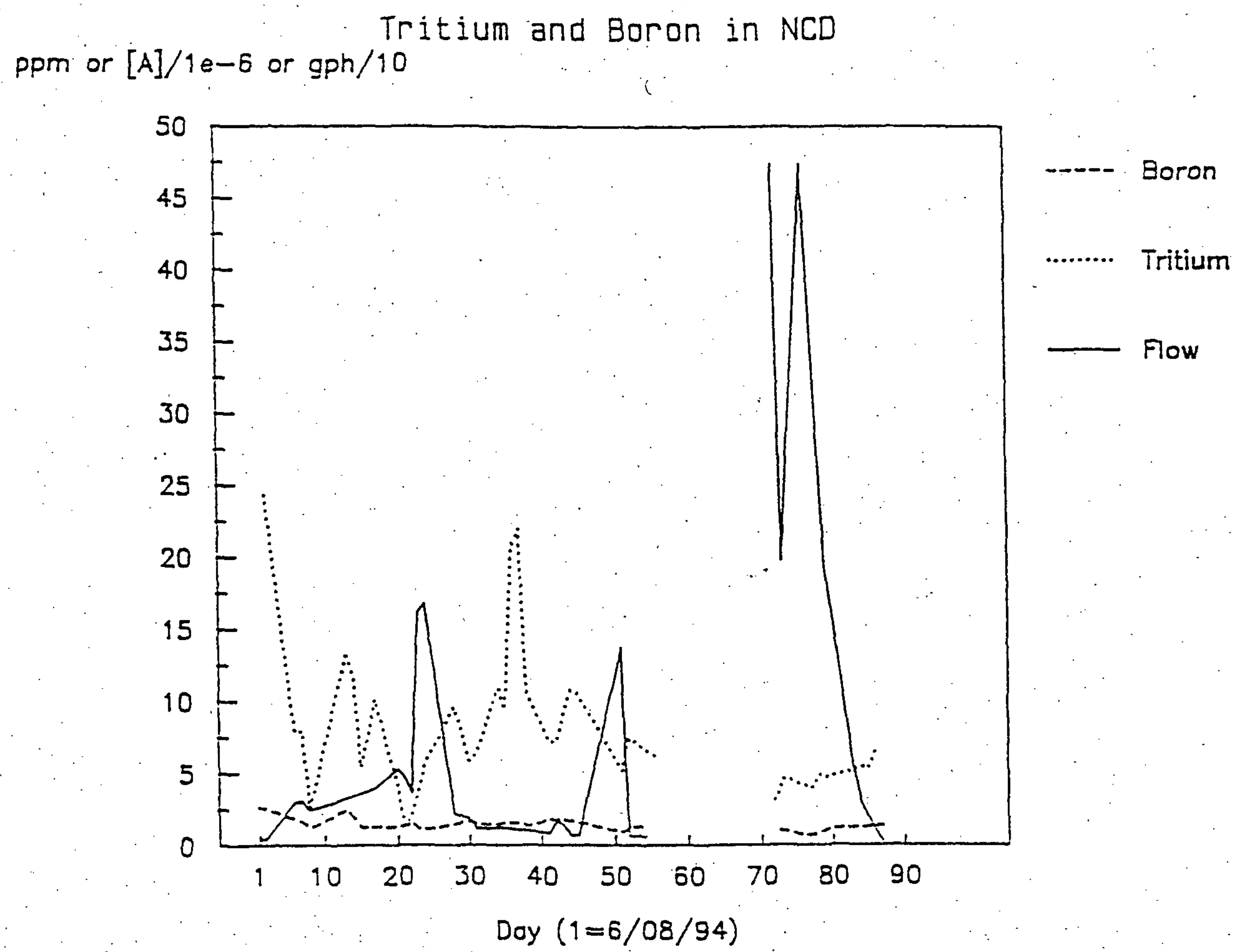
where: A = average NCD flow rate
B = pool concentration
C = NCD concentration
D = background concentration

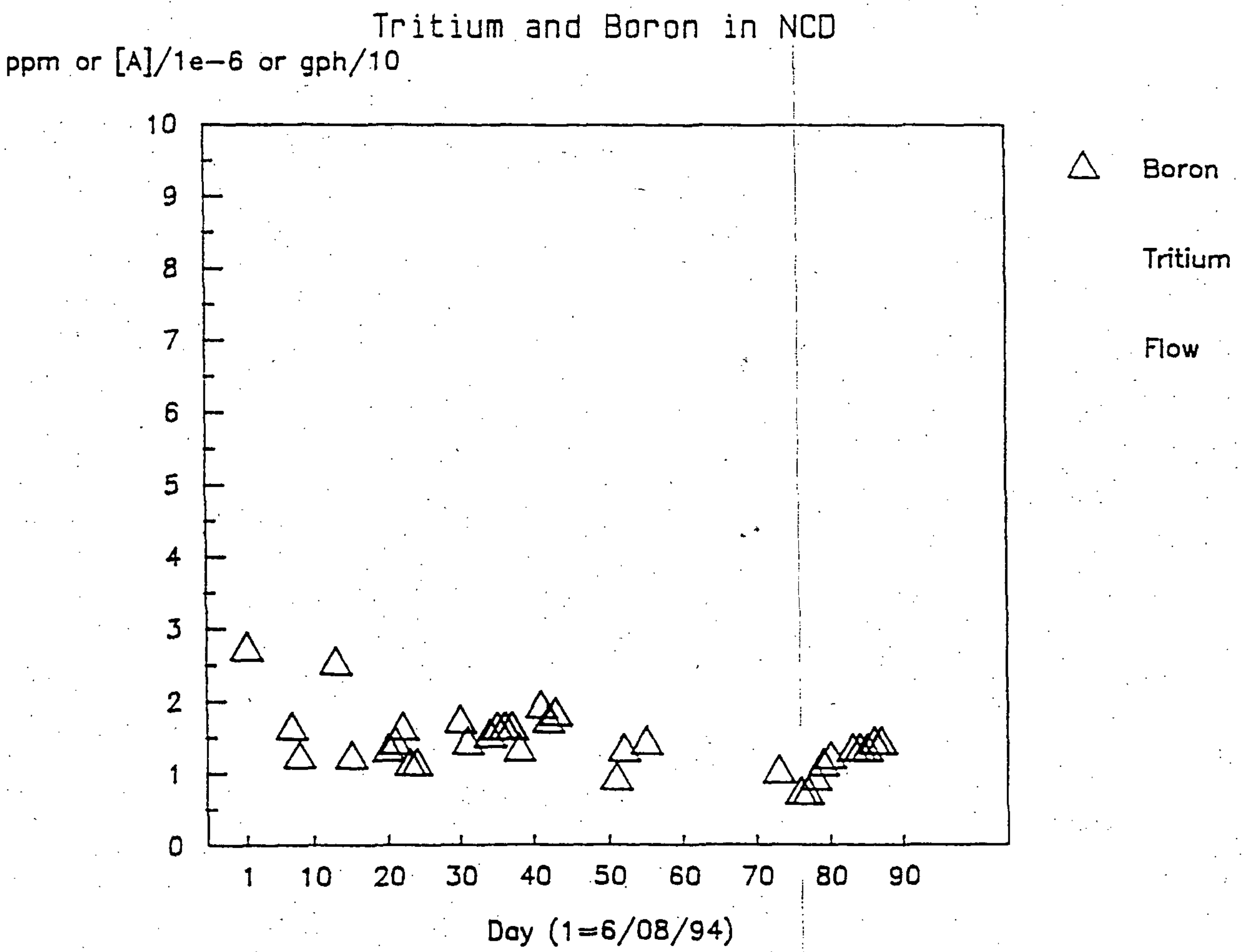
For the early to mid-June time frame, recognizing the minimal amount of data, the pool leakage to the NCD is calculated at 1.15 gpd. For the time period of July 1 to July 29 (a period post-tests/actions, for the most part), the leakage from pools is 0.81 gpd. These two estimates, ostensibly for different conditions, may or may not be statistically different. It could well be that the future to approach the true actual leakage depends upon the reservoir "depth" for the contaminant of concern. i.e. the change in leakage after sufficient time has passed and leakage estimates appear depleted and the new detection of leakage is a scalar with regard to the actual leakage. The reduction of some leakage may be explained by:

1. Loss of static head driving force

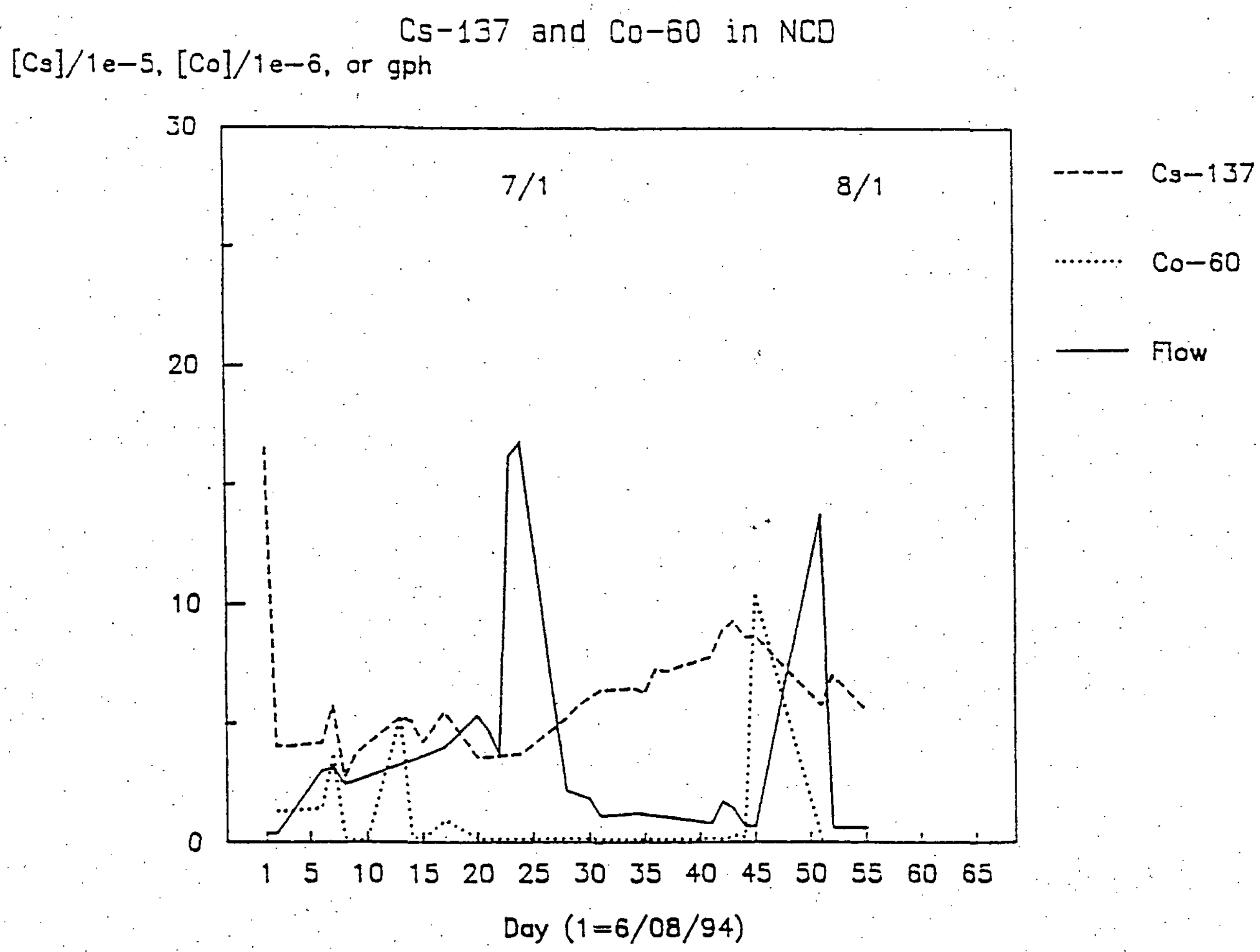
2. Leak has more than one locus, and each is affected in different degree by corrective actions.

The detection of a leakage reduction is dependent on measurements of concentration and flow rate and how long-term indicators in reservoir-like systems behave. Thus, changes in the pool leakage are conceptually related to reactor coolant leakage changes where containment reservoir and alternate depletion effects, which may not be valid or discernable for all times of concern, and the size of the source term production rate affect leakage change detectability.

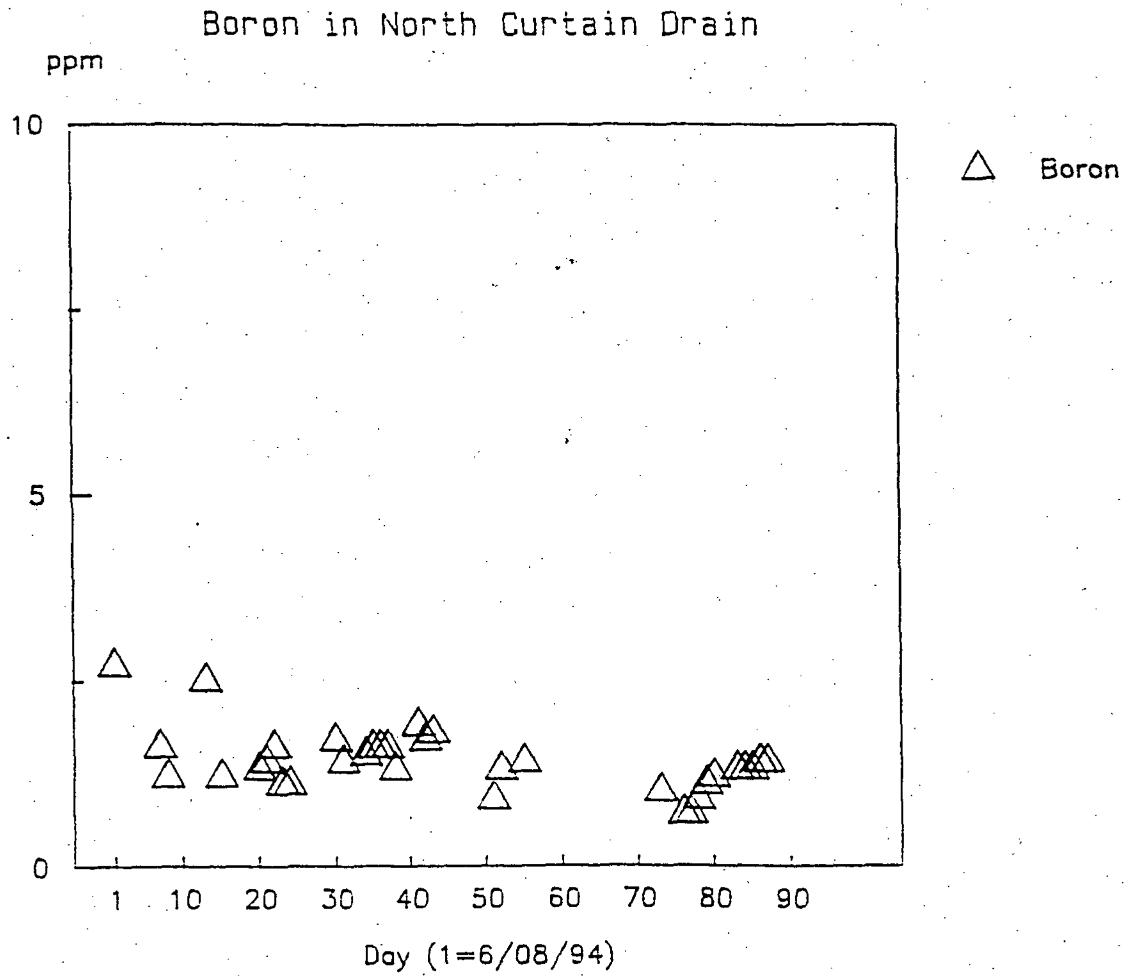

Tritium and Boron in NCD
ppm or [A]/1e-6 or gph/10
50
45
40
35
30
25
20
15
10
5
0
1
10
20
30
40
50
60
70
80
90
Day (1=6/08/94)
Boron
Tritium
Flow


Tritium and Boron in NCD
ppm or [A]/1e-6 or gph/10
10
9
8
7
6
5
4
3
2
1
0
1
10
20
30
40
50
60
70
80
90
Day (1=6/08/94)
Boron
Tritium
Flow

ncd4



Cs-137 and Co-60 in NCD
[Cs]/1e-5, [Co]/1e-6, or gph
30
20
10
0
7/1
8/1
Cs-137
Co-60
Flow
1 5 10 15 20 25 30 35 40 45 50 55 60 65
Day (1=6/08/94)



Boron in North Curtain Drain
ppm
10
5
0
1
10
20
30
40
50
60
70
80
90
Day (1=6/08/94)
Boron

2. Sphere Foundation Drain (SFD)Sump Data and Analysis

The dynamics of activity and flow in the SFDS have common elements with the NCD. One noteworthy effect is the relative significance of pool leakage both before and after corrective actions in June-on the total daily load in the sump. The sump does respond to rainfall additions, but more slowly and recovery is not to a nearly zero flow rate, but one approaching 8 gpm. The reservoir, as will be seen, for the SFDS may be ascertained reliably only if a significant dry period is in effect following a good short-term rainfall. It was fortunate that such a dry period lasting three weeks occurred in the latter part of August and extended into September. It strongly appears that the sump has an 8 gpm baseline flow rate, and additions by rainfall decay off to the 8 gpm baseline level with a 4.4 day half-life. This is shown on one of the following charts.

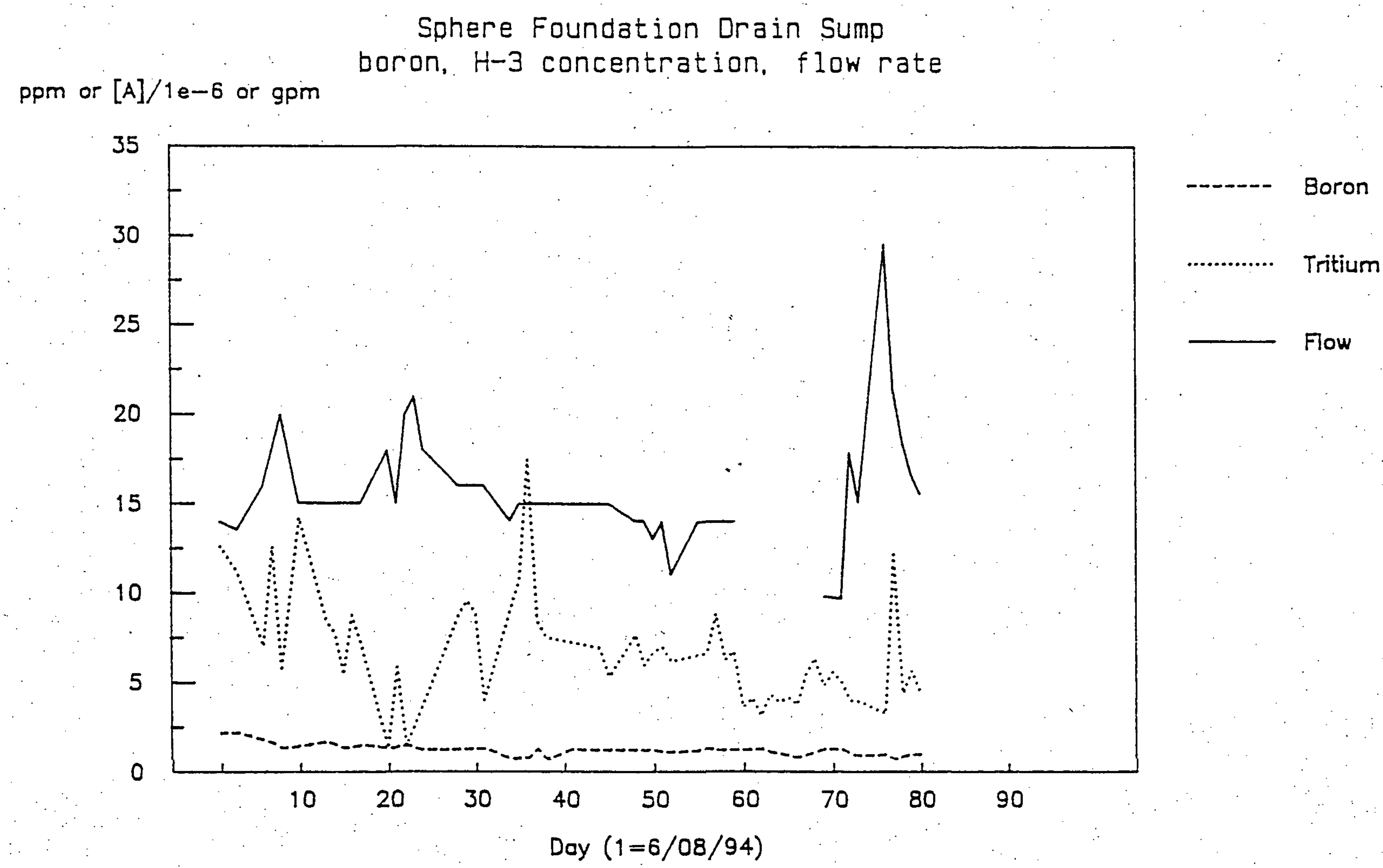
As was the case for the NCD, the tritium concentration in the sump acts somewhat reciprocally with respect to sump duty whereas boron does not. Remarkably, Co-60 is never detected in sump water and Cs-137 has only qualitatively been detected at very low frequency. Therefore, essentially complete scavenging of these two species occurs at some point between the pool leak point(s) and the sump. Perhaps an ultrafiltration/ion exchange/gravitational settling combination of factors may be in effect.

If one calculates, using tritium indicator, the pool contribution to the total SFDS duty for periods before and after corrective actions are completed, one would notice a larger contribution prior to corrective actions and lower, in progressive fashion, afterwards. Before June corrections, the rate is calculated, in similar fashion as shown for NCD, at 73 gpd. From 7/1-7/29 the rate is calculated at 56 gpd; for late August/early September the rate is 34 gpd and, eliminating a reservoir-effect data flier, the rate for this period is calculated at 24 gpd. The rate is not decreasing as fast as one would expect if there were no reservoir nor as fast as one would expect in the absence of a secondary, or grand, reservoir. It is proposed that two reservoirs are in effect and that the "upper", or marginal one is affected by prompt rainfall additions while the "lower", or grand, reservoir has a feed from distant groundwater sources. These two reservoirs communicate in different degree for different contaminants. Note on a chart provided that the boron is trending only very slowly and that it's projected that natural boron level (0.3-0.4 ppm) won't be measured until at least the middle of 1995.

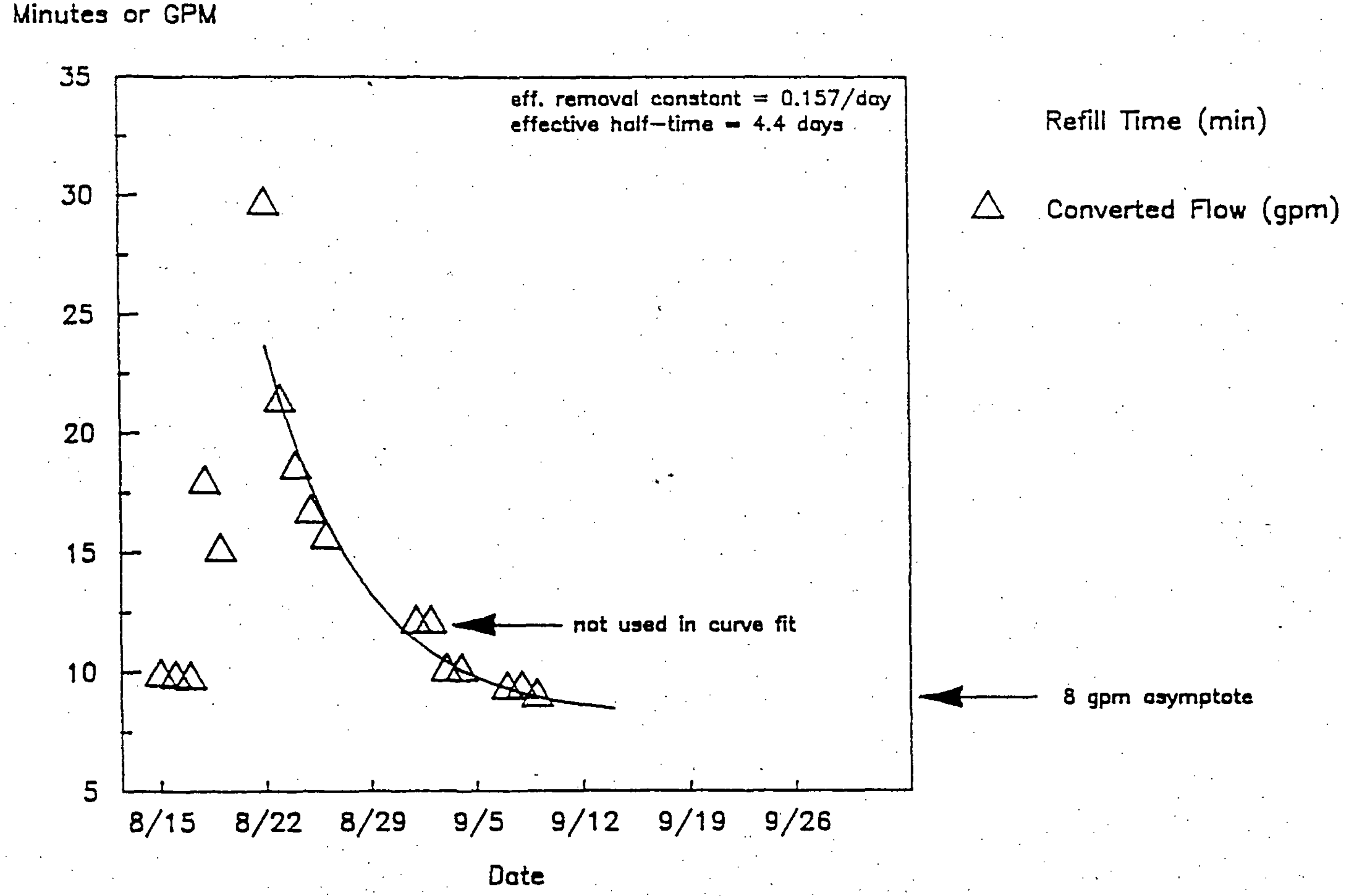
If one calculates the leakage based on boron indicator, the period prior to corrective actions is 76 gpd; for July it's 35 gpd, but for late August/early September the rate has flattened out somewhat to 33 gpd. Clearly, by looking at the graphed behavior and the calculation, the boron reservoir seems deeper than the tritium reservoir. Tritium is the better early predictor of effective corrective action and estimator of long-term leakage rate. Based on the apparent boron behavior, it's doubtful that adding boron conclusive of an arrested leak. Increasing boron, at this point in the trend, may eventually show only that leakage still exists.

Combining the knowledge obtained from both tritium and boron analyses, the leak rate in the early-June time frame is about 75 gpd. If chemistry's mass balance calculation of the long-term pool boron concentration changes indicated a total pool water loss of 90 gpd, then unknown loss pathways and evaporation constituted a 1 gpd amount.

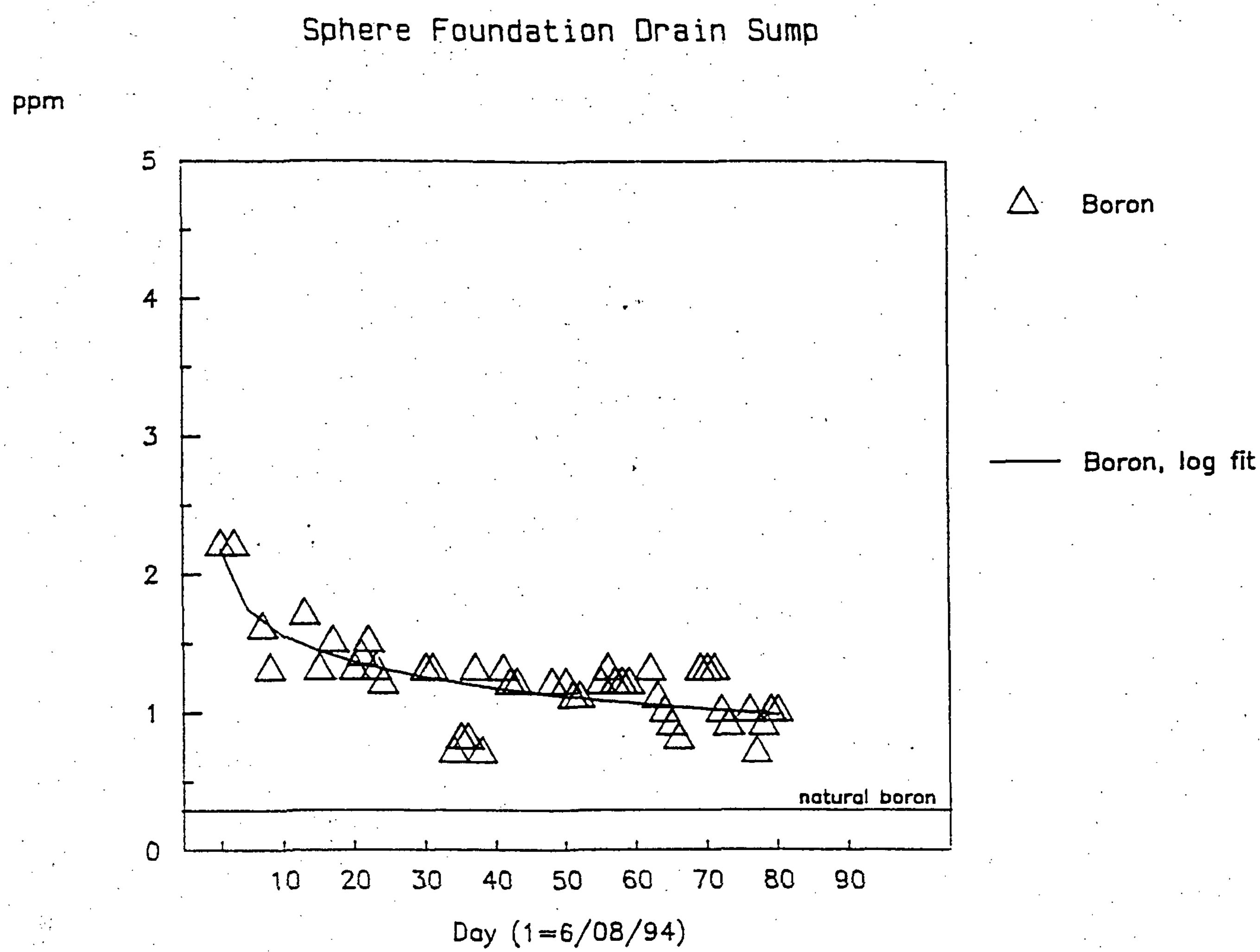
If the current stance of preventing or severely curtailing losses by evaporation continues, one would expect to see water losses approaching zero if the leakage has been arrested. It's too soon to tell if the leakage has stopped, but certainly a flattening of indicator concentrations in the SFDS to


Sphere Foundation Drain Sump
boron, H-3 concentration, flow rate
ppm or [A]/1e-6 or gpm
35
30
25
20
15
10
5
0
10
20
30
40
50
60
70
80
90
Day (1=6/08/94)
Boron
Tritium
Flow

SPDS Trends for 3rd Quarter 1994
Daily Timed Minutes On & Converted Flow Rate



sfp4


Sphere Foundation Drain Sump
ppm
5
4
3
2
1
0
10
20
30
40
50
60
70
80
90
Day (1=6/08/94)
natural boron
Boron
Boron, log fit

sfp5

background level would be proof that the water leakage to the largest pathway is terminated. The boron indicator will not show this in the next half-year; perhaps the tritium will continue its overall downward trend and come to a zero real leakage rate or to a very low positive leakage rate.

Assess Pool Inventory Loss By Evaporation Tests

In order to establish whether any significant amount of water is leaking from the IP 1 pools, measurements have been made in the IP1 spent fuel pools; and these have been used, in conjunction with a simple essentially first principles model, to predict the evaporation rate. This model includes the effect of temperature variation and local water vapor content on density difference, and thus natural circulation. In addition, spent fuel pool water level measurements over time are also made and these measurements allow direct calculation of water lost (by evaporation and leakage, if present). The comparison of the water lost, to the predicted evaporation, provides an estimate of leakage. Additional details on the methodology and the evaporation model are provided in Reference 2.

During periods when pool maintenance activities are not in progress it is possible to compare the water loss, as obtained from the observed pool's water level drop, to evaporation predictions. This was done over several time periods during June, 1994 and are summarized in Table 1 of Reference 2.

In addition an offer was made to reconcile uncertainty in the analysis. The major sources of uncertainty in the analysis are: use of level data to calculate water loss, the assumption of free convection under conditions of very low predicted evaporation (i.e.,$\Delta T^*<0$), temperature bias in the differential temperature (ΔT) obtained from water and air temperature measurement, and the use of a limited number of predicted evaporation rates. An assessment of these uncertainties are reflected in Reference 2, Table 2 as well as their relative impact in the analysis result. It was thus concluded that, although the evaporation prediction uncertainties are relatively large, they do not effect the conclusion that the pool leakage is not large. This is because the underprediction of evaporation (- error) is considerable less than the possible overprediction error (+ error). Arithmetically applying the uncertainties in the worst directions and similarly taking the uncertainties in the most favorable direction (i.e., favorable meaning that direction that minimizes the calculated leakage) indicated no large leakage is occurring. The results are suggestive of leakage of on the order of 0 to 25 gal/day.

Assess Pool Inventory Loss By Water Level Monitoring

In order to accurately assess inventory loss from the pools independent from evaporative effects, it becomes crucial to ensure a tight vapor seal of all pool openings. Referring to **Attachment** 4 , it can be seen how difficult that task actually is.

Once the lower water level channel was installed on August 2, 1994, a long term phase of water level monitoring ensued. The first problem was encountered on August 5, 1994 when all pool decking and vent openings were sealed. The pool sweep air system dampers had previously been checked closed. Almost immediately, and over the next several days, the water level changes indicated an inventory reduction of approximately 95 gallons/day. This prompted an investigation as to the cause of such an unanticipated change. Through air flow measurements, it was discovered that a large chimney effect updraft was occurring at the sweep air ventilation plenum through the Fuel Transfer Tube (previously water sealed). This air circulation path had become much greater once the other pool openings had become sealed. The updraft condition was stopped by sealing up the transfer tube and ventilation plenum. Water level monitoring continued throughout.

The weeks between August 10, 1994 and September 7, 1994 showed a relatively steady decline in water level that was being computed to be approximately 48 gallons/day. Toward the end of this particular monitoring period, it became evident that there was a significant amount of moisture carryover into the adjacent empty pools. By this time, small amounts of decay heat from spent fuel had warmed the water to 91^{0}F. The moisture laden air was then transporting pool water vapor into the empty pool air space where condensation took place on walls and deck covers. Significant amounts of condensation were noted on the exposed surfaces of all empty pools. In addition, a discernable increased water level in the previously emptied pools existed.

To remedy the moisture carryover effects, the original gates were installed between the West Fuel Storage Pool and the adjacent pools as vapor barriers. Remaining air gaps were sealed as best as possible with plastic. Top deck plates were also sealed with saran to minimize the escape of moisture laden air from within the pool vapor space. These actions were completed between the dates of September 7 through September 9, 1994.

In the ensuing weeks, water level changes have indicated a relatively steady decline with a calculated inventory reduction of approximately 25 gallons/day average.

Because the pool water temperature is still elevated (currently 87^{0}F) coupled with the fact that a perfect seal of all pool openings is near impossible, an attempt is being made to cool the pool water to near ambient temperature. It is felt that by doing so, the effects of evaporative losses can be minimized and an accurate assessment of actual pool leakage will be realized. This is to be accomplished by Temporary Operating Instruction, TOI-199, which is a procedure for cooling the pool water using a temporary cooling system.

<u>References:</u>

1. Assessment of Ground-Water Migration Pathways from Unit 1 Spent Fuel Pools, by The Whitman Companies, Inc., July, 1994

2. Analysis of Evaporation from Indian Point Unit 1 Spent Fuel Pools, by Daniel M. Speyer, August 1994 as Revised 9/21/94

ANALYSIS OF STATION CONDITION

SECTION IX

Root Cause Category

Component BD (Aging) Human Performance ____________

Based upon up close inspections of the pool wall coatings, it has been determined that aging related failures of the epoxy resulted in transmissibility of pool water to the external wall surfaces in cracks/fissures.

SECTION X

Corrective Actions Suggested

Corrective Action	Responsible Section Head	Due Date
1. Complete Unit 1 roof repair efforts, namely the dome slab caulked joints, which are still leaking.	Hinrichs	8/95
2. Continue efforts to identify the source of pool leakage on the 33 ft annulus floor.	Homyk	(Upon completion of WSP de- watering, Action 16.)
3. Clear path from Annulus sand moat to Sphere Fdn Drain Sump to allow for its dewatering.	McCann	2/95
4. Attempt to identify source of water intrusion into the Annulus sand moat.	Hinrichs	8/95
5. Implement TOI-199 for Spent Fuel Pool cooling.	McAvoy	12/94
6. Develop program for long term pool water level monitoring.	Hinrichs	2/95
7. Permanently re-route SFD sump discharge.	Lomm	6/95
8. Permanently re-route NCD drain path.	Entenberg	6/95

Corrective Action	Responsible Section Head	Due Date
9. Perform structural integrity evaluation of spent fuel pool walls.	Villani	
Phase 1 - Identify high stress areas using finite element analyses.	Villani	6/95
Phase 2 - Perform physical exam and evaluate results.	Villani	10/95
Phase 3 - Implement Phase 2 recommendations	Villani	12/95
10. Complete studies for in-situ dry fuel storage.	Hinrichs	9/95
11. Formalize program and continue monitoring the SFD and NCD flowrates and activities.	Homyk	2/95
12. Install permanent plug in Annulus drain to sphere spray sump line.	Entenberg	Complete
13. Evaluate methods for permanent isolation of the Fuel Transfer Canal and Failed Fuel Pool from the other pools.	Hinrichs	9/95
14. Develop PM/test requirements for the Presray gate seals and instrument air system.	Vasely	Complete
15. Decontaminate areas in Annulus and CSB that were impacted by pool leakage.	Homyk	Pending completion of actions 1 and 2
16. Complete the dewatering and de-sludging of the Water Storage Pool.	Homyk	6/95
17. Initiate cleanup of the East/West Storage Pools.	Homyk	7/95
18. Include periodic sampling of stream situated south of site and site storm drains into Environmental Monitoring Program.	Homyk	Complete

ANALYSIS OF STATION CONDITION

SECTION XI

Written by: Michael J. Vasely Michael J. Vasely 12/7/94
Name Date

Reviewed by: Thomas Schmerer
Plant Manager

N/A
Concurrence by additional Department Managers (as appropriate)

SNSC Review Required: Yes ✓ No____

SECTION XII

SNSC Review: Meeting No.:____

Secretary Signature:____

SNSC Open Items:

ATTACHMENT 1

Indian Point 1 Spent Fuel Pool Water Inventory Chronology of Events

Indian Point 1 Spent Fuel Pool Water Inventory Chronology of Events

April, 1990	Astrab to Schmeiser memo regarding NFSC concerns on responsibility of tracking Spent Fuel Pool Water Loss/Evaporation Loss. o No formal tracking system, estimates can be derived from log entries. o Evaporation loss is not known.
June, 1990	Tobler to Schmeiser memo regarding Unit 1 Spent Fuel Pool. Confirmed responses to NFSC questions, see above.
July, 1990	Recognized need for better level monitoring instrumentation.
August, 1990	Received instrumentation to monitor level and make-up water from Central Engineering. Sonar level instrument and rotometer. Modification package for use of device being prepared. Had instrument installed as temporary test. Instrument did not function well - no repeatability. Removed instrument.
December, 1990	Designed a float type level instrument. Maintenance manufactured instrument.
March, 1991	Reviewed Operation logs to determine pattern of water make-up.
August, 1991	Evaporation tests initiated after installation of float level device. Evaporation pan manufactured, load cell and temperature instrumentation obtained.
Sept. 91 to Mar 92	Testing in progress.
March, 1992	Evaporation tests completed. Environmental sample data reviewed, no abnormalities reported.
May, 1992	Indian Point 1 Spent Fuel Pool inventory loss report completed. 90 gallons per day total loss (51 gallons per day evaporation, 14 gallons per day known leakage, 25 gallons per day unaccounted for). Initial action plan included isolating east and west pools from the others, lowering water level and installing level instrumentation.

July, 1992	Attempted to install old gates to isolate pools gates did not hold (seals no good).
	Radiological surveys, using TLDs, ion chambers and GM tubes were completed in each of the six pools to determine the radiological impact of lowering pool water levels.
August, 1992	Memo recommending actions to determine integrity of fuel pool walls. (English to Homyk)
September, 1992	Existing fuel pool gates removed and Presray contacted to determine cost and time to return gates to operable condition.
November, 1992	10CFR50.59 Safety Evaluation request initiated to allow lowering the water level in the pools to 52' elevation. Also, in November of 1992 we received a response from Pressray informing us the fabric the existing seals were made from were no longer available, and based on the condition of the gates they recommended we buy replacement gates. (Letter Cooper to Vasely)
January, 1993	Proposed Technical Specification change submitted to NRC to allow lowering water level in the unit one fuel pool.
March, 1993	Processed Spent Fuel Water to reduce activity.
August, 1993	Appropriations for level monitoring and gates approved.
October, 1993	Cost estimate from Pressray revised to show cost for two gates with double seals. (Letter Cooper to Vasely)
November, 1993	Purchase Requisition initiated for the purchase of new gates.
December, 1993	Level monitoring device modification approved and issued. Purchase Order issued to Presray for new gates.
January, 1994	Shop drawing for new gates submitted to Con Ed by Presray for review and approval prior to proceeding with manufacturer. (Letter Cooper to English)
February, 1994	Level instrument on-site and modification package issued.
March, 1994	Installation of level instrumentation in progress.
	Revised shop drawings approved.
April, 1994	NRC Bulletin 94-01 issued.
May, 1994	Inventory loss recalculated using boron depletion methodology.
	Estimate of 150 gallons per day using this method.
	Installation of new level instrument complete.

May, 1994 | Con Edison response to NRC Bulletin 94-01.

Additional site sampling initiated.

Task force was established to deal with fuel pool activities.

Pool water being lowered.

ATTACHMENT 2

Indian Point 1 Fuel Pool Project Schedule

ATTACHMENT 3

Chemistry Sampling and Analytical Results

SAMPLE POINT	DATE	BORON (ppm)	Cs-134(uCi/cc)	Cs-137(uCi/cc)	Co-60(uCi/cc)	H-3(uCi/cc)
EAST FUEL POOL	11/21/94	590.0	3.75E-5 +/-8.84E-6	3.15E-2 +/-1.10E-4	7.97E-5 +/-6.61E-6	3.18E-3
WEST FUEL POOL	11/21/94	595.0	4.32E-5 +/-9.30E-6	3.13E-2 +/-1.10E-4	8.61E-5 +/-7.47E-6	3.18E-3
WATER STORAGE POOL	10/12/94	345.0	<1.89E-5	6.47E-3 +/-3.29E-4	4.40E-4 +/-3.08E-5	4.76E-3
TRANSFER CANAL - SURFACE SAMPLE	06/17/94	485.0	2.35E-5 +/-3.51E-6	1.42E-2 +/-7.60E-4	1.20E-4 +/-8.10E-6	3.13E-3
TRANSFER CANAL - 2/3 DEPTH	06/23/94		2.75E-5 +/-5.09E-6	1.48E-2 +/-1.06E-3	1.59E-4 +/-1.48E-5	2.42E-3 +/- 4.84E-5
TRANSFER CANAL - BOTTOM WATER/SEDIMENT	05/24/94		1.46E-4 +/-2.02E-5	8.96E-2 +/- 2.1E-4	1.03E-2 +/- 6.50E-6	—
TRANSFER CANAL - BOTTOM SEDIMENT	05/24/94		<6.7E-3	2.15E+0 +/- 1.67E-2	5.45E-1 +/- 9.65E-3	—
CASK DISASSEMBLY POOL	05/24/94		2.14E-5 +/- 7.80E-6	1.65E-2 +/- 9.85E-5	1.83E-4 +/- 9.60E-6	1.95E-3 +/- 5.90E-5
CASK LOAD POOL	05/24/94		3.35E-5 +/- 7.30E-6	1.60E-2 +/- 9.65E-5	1.02E-4 +/- 7.30E-6	2.30E-3 +/- 4.60E-5
FAILED FUEL POOL	05/24/94		2.59E-5 +/- 7.05E-6	1.52E-2 +/- 9.25E-5	7.89E-5 +/- 6.75E-6	2.32E-3 +/- 4.90E-5
TEL-TALE	06/17/94	460.0	<5.11E-6	2.43E-3 +/-1.32E-4	9.91E-6 +/-1.68E-6	3.11E-3
SPHERE FOUNDATION DRAIN(SFD) SUMP	12/06/94	0.8	<8.57E-8	<1.33E-7	<1.05E-7	2.74E-6
ANNULUS SAND MOAT	06/17/94	35.0	<2.95E-7	2.86E-7 +/-1.06E-7	6.06E-8 +/- 1.37E-8	2.00E-4
33' ANNULUS FLOOR	10/06/94	105.0	2.66E-6 +/-4.24E-6	2.10E-3 +/-1.14E-4	1.84E-5 +/-1.11E-6	3.02E-4
U1 SPHERE BORE HOLE	05/18/94		<5.0E-7	2.27E-4 +/- 2.30E-5	1.61E-5 +/-1.60E-6	2.10E-3 +/- 3.00E-4
SFD SUMP RIGHT SIDE PIPE	05/20/94		<4.7E-8	<5.1E-8	<5.6E-8	9.88E-6 +/- 3.10E-7
SFD SUMP REAR (SAND MOAT) PIPE	05/20/94		<7.3E-6	<7.6E-6	<1.1E-5	2.58E-4 +/- 7.80E-6
CSB SEWAGE SUMP	06/27/94		<5.64E-8	8.20E-8 +/-5.55E-8	<6.57E-8	9.94E-6 +/-2.00E-7
UNIT 1 SPHERE CURTAIN DRAIN(Utility Tunnel)	06/10/94		<5.9E-8	1.71E-6 +/- 1.1E-7	<7.3E-8	1.10E-5
UNIT 1 SPHERE CURTAIN DRAIN(North Side)	12/06/94	1.0	<1.62E-7	4.21E-5 +/-7.22E-7	<2.18E-7	4.99E-6
UNIT 1 SPHERE CURTAIN DRAIN(South Side)	NO FLOW		NO FLOW			
UNIT 1 VC SUMP	06/14/94					
UNIT 1 CONTAINMENT SPRAY SUMP	05/19/94		1.72E-8 +/-3.02E-9	6.19E-7 +/- 1.79E-8	1.10E-7 +/- 9.45E-7	3.06E-5 +/- 1.00E-6
UNIT 2 5' FLOOR WATER	05/24/94		<2.0E-8	<2.3E-8	<2.6E-8	2.96E-5 +/- 1.00E-6
NSG WATER	05/23/94		<5.24E-8	<6.67E-8	<5.87E-8	—
UNIT 2 STORM DRAIN #2	05/24/94		<1.02E-7	<1.26E-7	<1.48E-7	<5.60E-6
UNIT 2 STORM DRAIN #3	05/24/94		<4.36E-8	<4.65E-8	<4.80E-8	<5.60E-6
UNIT 2 STORM DRAIN #4	05/24/94					8.50E-6 +/- 3.70E-7
GLAND STEAM COND. VAPOR EXT. VENT	05/27/94		<6.82E-8	<1.14E-7	<1.36E-7	4.59E-5 +/- 1.90E-6
DISCHARGE CANAL	06/22/94		<3.97E-8	<4.79E-8	<3.65E-8	<5.6E-6
RIVER WATER	05/26/94		<8.17E-8	<1.13E-7	<1.48E-7	<5.6E-6
OUTFALL #1	05/24/94	5.0	<7.45E-9	<3.06E-9	<3.28E-9	<2.45E-7
OUTFALL #2	05/24/94	0.6	<5.65E-9	<2.60E-9	<2.76E-9	<2.45E-7
OUTFALL #3	05/24/94	0.4	<2.15E-9	<1.99E-9	<2.12E-9	<2.45E-7
UNIT 3 EAST STORM DRAIN	05/23/94		—	—	—	<5.6E-6
UNIT 3 WEST STORM DRAIN	05/23/94		—	—	—	<5.6E-6
STORM DRAIN #1 - UNIT 3 ACCESS ROAD	06/13/94	0.3	<7.84E-8	<1.24E-7	<1.32E-7	<1.09E-5
STORM DRAIN #2 - UNIT 3 ACCESS ROAD	06/13/94	0.1	<5.37E-8	<7.43E-8	<6.31E-8	<1.09E-5
STORM DRAIN #3 - UNIT 3 NEAR RWST	06/14/94	1.6	<1.44E-8	<5.06E-8	<3.67E-8	3.60E-6
STORM DRAIN #3 - UNIT 3 ON ACCESS ROAD	06/17/94		<1.01E-7	<1.11E-7	<8.44E-8	2.69E-6
* 5th STREET WELL	05/19/94		<4.00E-9	<4.00E-9	<4.00E-9	<1.00E-7
* TRAP ROCK QUARRY	05/19/94	0.3	<3.00E-9	<4.00E-9	<3.00E-9	<1.00E-7
* INDIAN POINT LAKE	05/19/94		<4.00E-9	<4.00E-9	<3.00E-9	1.60E-7 +/-1.00E-7
UNIT 2 CST GROUND WATER	05/24/94		—	—	—	<5.6E-6
SAB SPRING WATER	05/20/94	0.1	<4.9E-8	<5.4E-8	<6.2E-8	<5.6E-6

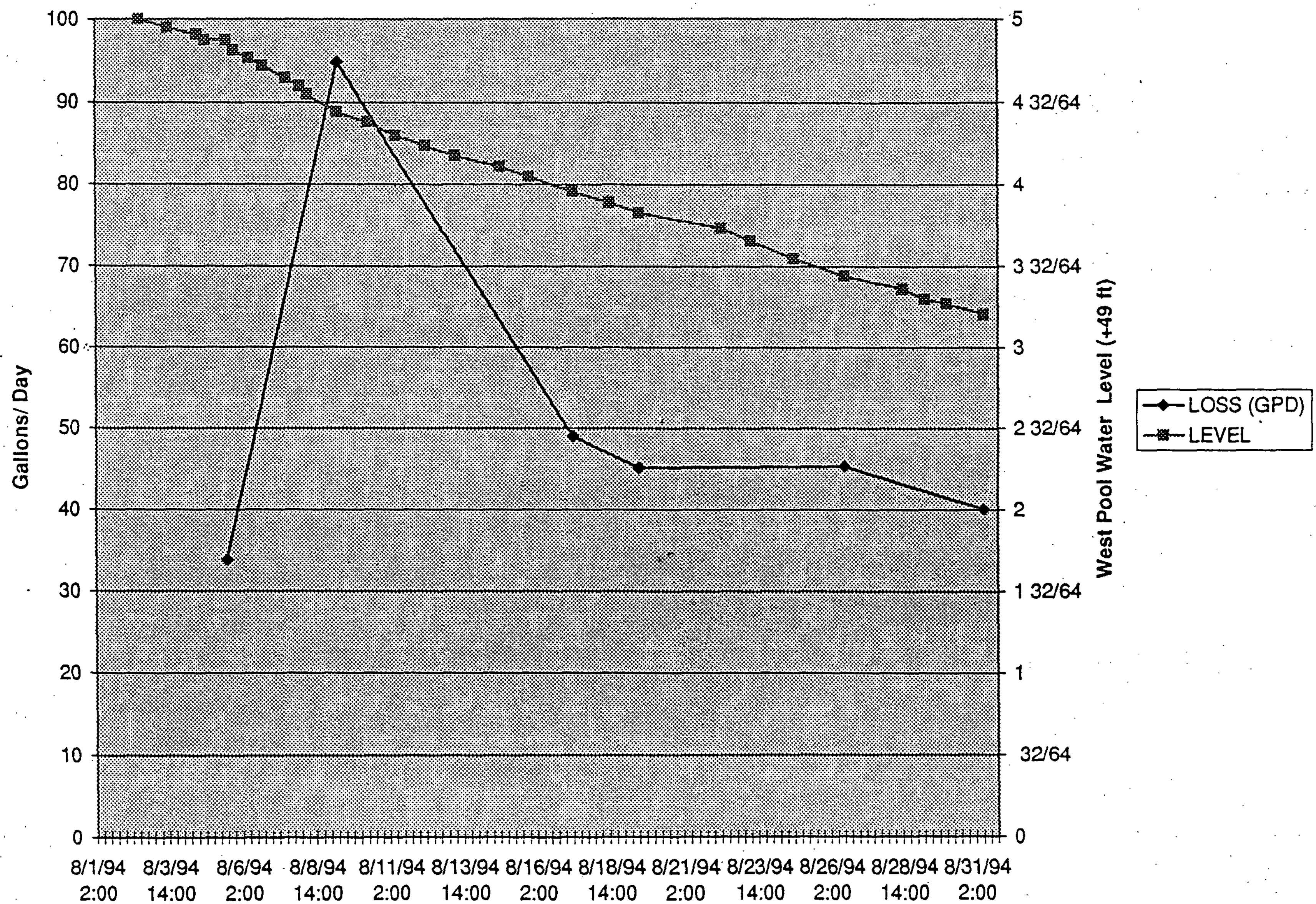
* TELEDYNE ANALYSIS

Data as of December 6, 1994

ATTACHMENT 4

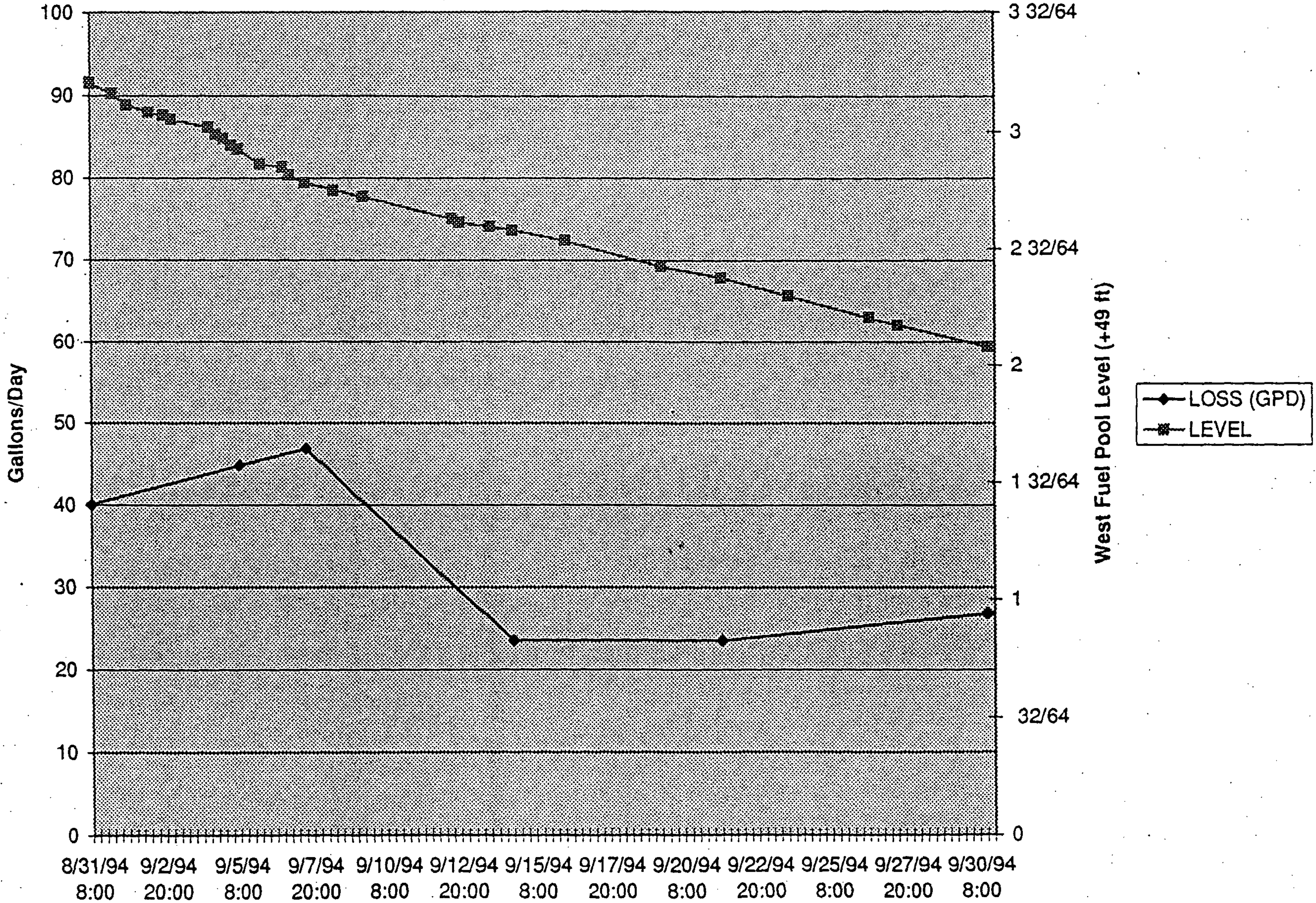
Unit 1 Fuel Pool Water Level Monitoring

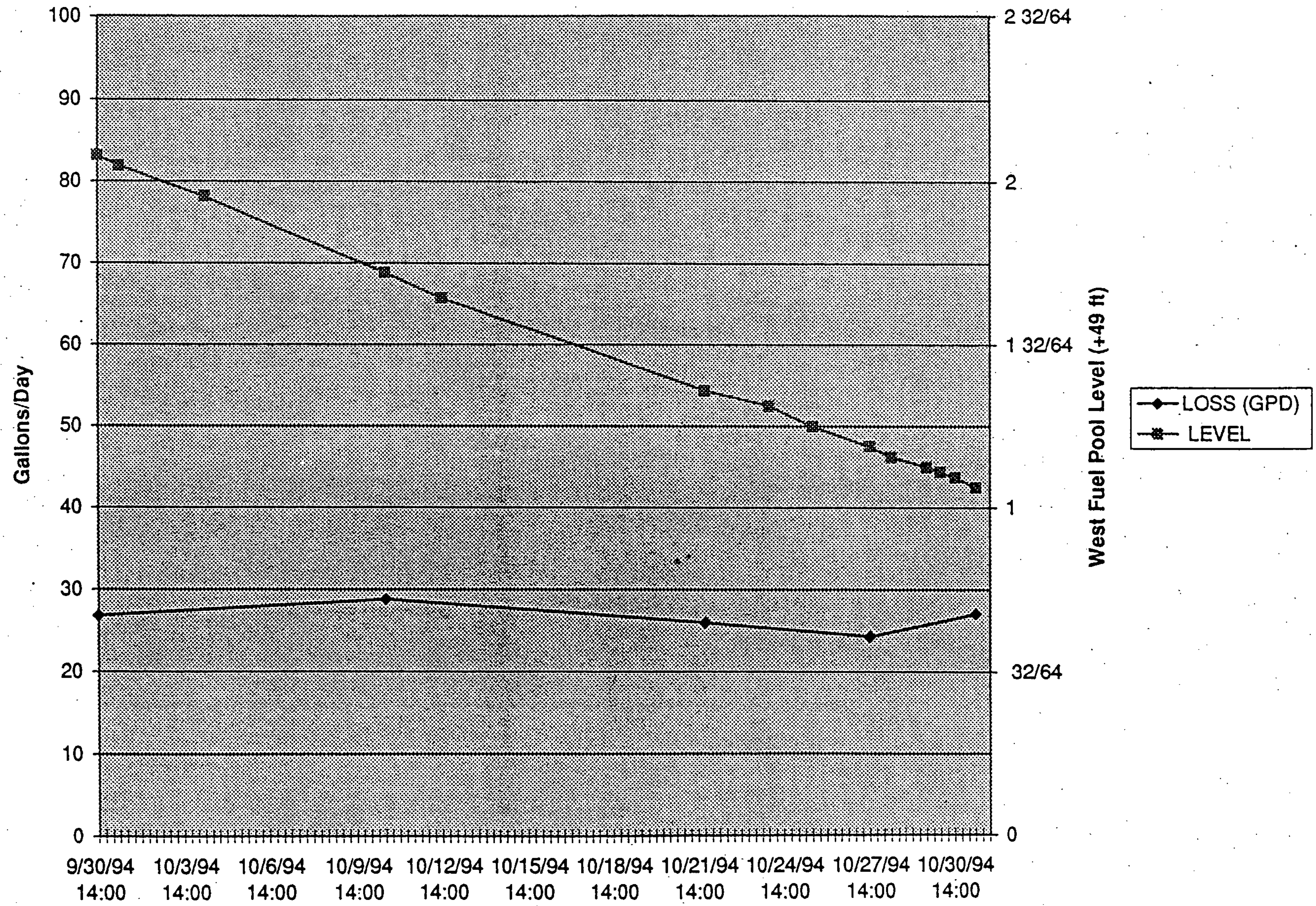
Chart8



Gallons/ Day
100
90
80
70
60
50
40
30
20
10
0
5
4 32/64
4
3 32/64
3
2 32/64
2
1 32/64
1
32/64
0
West Pool Water Level (+49 ft)
LOSS (GPD)
LEVEL
8/1/94 2:00
8/3/94 14:00
8/6/94 2:00
8/8/94 14:00
8/11/94 2:00
8/13/94 14:00
8/16/94 2:00
8/18/94 14:00
8/21/94 2:00
8/23/94 14:00
8/26/94 2:00
8/28/94 14:00
8/31/94 2:00

Chart9


100
90
80
70
60
50
40
30
20
10
0
Gallons/Day
3 32/64
3
2 32/64
2
1 32/64
1
32/64
0
West Fuel Pool Level (+49 ft)
8/31/94 8:00
9/2/94 20:00
9/5/94 8:00
9/7/94 20:00
9/10/94 8:00
9/12/94 20:00
9/15/94 8:00
9/17/94 20:00
9/20/94 8:00
9/22/94 20:00
9/25/94 8:00
9/27/94 20:00
9/30/94 8:00
LOSS (GPD)
LEVEL



Gallons/Day
100
90
80
70
60
50
40
30
20
10
0
2 32/64
2
1 32/64
1
32/64
0
West Fuel Pool Level (+49 ft)
LOSS (GPD)
LEVEL
9/30/94 14:00
10/3/94 14:00
10/6/94 14:00
10/9/94 14:00
10/12/94 14:00
10/15/94 14:00
10/18/94 14:00
10/21/94 14:00
10/24/94 14:00
10/27/94 14:00
10/30/94 14:00

UNIT 1 SPENT FUEL POOL - NORTH CURTAIN DRAIN LEAK RATE