Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37384-2000

April 12, 2004

Mr. Paul E. Davis, Director
State of Tennessee
Department of Environment and Conservation
Division of Water Pollution Control
Enforcement & Compliance Section
6th Floor, L & C Annex
401 Church Street
Nashville, Tennessee 37243-1534

Dear Mr. Davis:

SEQUOYAH NUCLEAR PLANT – DIFFUSER LINE MANHOLE BREACH

This report follows the verbal communication between TVA and the Tennessee Department of Environment and Conservation (TDEC) on April 7-9, 2004, concerning the discovery of a breach in the diffuser line to Outfall 101 at the Sequoyah Nuclear Plant (SQN) NPDES Permit No. TN0026450. A detailed chronology of the actions following the discovery of the breach and a summary of the diffuser piping system are provided in Attachment A. Issues pertinent to the diversionary flow created by the breach are discussed in further detail below.

Description and Cause of the Diversionary Flow

The diversionary flow from the diffuser line leading to Outfall 101 was caused by an unforeseeable breach in the pipe manhole. It is estimated that approximately 4.5% of the total flow through Outfall 101 would have intermittently escaped through this breach until it was repaired. The manhole jet was centered at a location approximately 175 feet from the riverbank and estimated to be directly above the manhole of the diffuser pipe. (See Figure 1 of Attachment B)

Duration of the Breach

The diversionary flow was first discovered at approximately 8:15 a.m. EDT on April 7, 2004, when Environmental Technicians performing routine NPDES compliance sampling

A001
D030

observed this flow. After extensive investigations, the remedial work to repair the breach was completed at 5:45 p.m. EDT on April 8, 2004.

Steps taken to Reduce, Eliminate, or Prevent Future Recurrence

Divers repaired the manhole breach by placing a quarter inch thick plate over the manhole opening and then placing four pieces of angle iron over the plate and clamping the angle iron and plate to the existing angle frame. The repair work has been effective in stopping the diversionary flow. Following up on the Problem Evaluation Report (PER) initiated by TVA, a corrective action plan will be formulated to identify any long-term actions necessary to prevent recurrence.

Assessment of Non-Temperature Parameters

The breach occurred at a location downstream of facility areas which provide treatment to the wastewater stream with respect to the non-temperature parameters (pH, Total Suspended Solids (TSS), Oil and Grease (O&G), etc.). Accordingly, SQN continued to meet the non-temperature effluent limitations throughout the duration of the breach.

Assessment of Effluent Temperature

A detailed analysis of the effluent mixing from the manhole jet is provided in Attachment B. Four temporary logging stations were placed in the river to record the variation of water temperature near the manhole jet. While the manhole jet lies outside the diffuser mixing zone, it is relevant to observe that, for the duration of the breach, the mixed temperature, temperature rise, and temperature rate of change computed at the temporary logging station locations are all within the NPDES limits of 86.9°F, 5.4°F, and ±3.6°F/hr, respectively, that apply to the diffuser mixing zone. The logging station measurements were supplemented with measurements made with the use of fast-response resistance temperature detectors (RTDs). Instantaneous profiles of temperature in the surface layer were derived by suspending the RTDs from a chain at depths of 3, 5, and 7 feet and trolling from a survey boat. Analyses of these data relative to the hourly intake temperature computed from Station 13 suggest that the instantaneous temperature rise above ambient drops below 5.4°F (the limit for temperature rise in SQN's NPDES permit) within 125 to 150 feet of the manhole jet. Additionally, the instantaneous temperature ranged from a minimum of 62.1°F measured over the downstream diffuser segment while it was isolated to a maximum of 70.6°F (as compared to the maximum daily limit of 86.9°F in SQN's NPDES permit) measured at the manhole jet while the Diffuser Pond gate #1 was partially open. We believe this represents the condition of the diversionary flow which constituted a mere 4.5% of the total flow that would ordinarily be routed through the diffuser. The remaining 95.5% of the flow that continued to be routed through the diffuser and its accompanying mixing zone remained in compliance with the temperature limitations in the NPDES permit.

Regulatory Discussion

TVA investigated the cause of the breach, and its regulatory and environmental impact. The breach was closely monitored, and the information collected in the course of this monitoring indicates no adverse impact to the waters of the Tennessee River. Further, these investigations have led us to conclude that TVA continued to meet the non-temperature effluent limitations throughout the duration of the breach. As to temperature limitations, our investigations have confirmed that, at a minimum, TVA continued to meet the effluent limitations[1] for 95.5% of the wastestream that continued to flow through the diffuser ports and the accompanying mixing zone notwithstanding the breach. As you know, the cooling towers (using six cooling tower lift pumps) were activated out of an abundance of caution to facilitate compliance with the effluent limitations.

We need to emphasize that the manhole breach that resulted in the diversionary flow was beyond TVA's reasonable control. The diversionary flow, during certain periods, could also be considered an allowable bypass since the effluent limitations were not exceeded and the diversionary flow was necessary for essential maintenance to assure efficient operation. We have documented the following information regarding this breach in our logs.

1. Information pertaining to the cause of the breach.
2. Information showing that the permitted facility was being operated at the time of the breach in a prudent and workman-like manner and in compliance with proper operation and maintenance procedures.
3. Documentation of oral notification made to TDEC within 24 hours of becoming aware of the breach.
4. Monitoring data showing that the diversionary flow caused no adverse impact to the waters of the Tennessee River.

[1] The determination whether the effluent limitations for Outfall 101 are "technology-based" is a moot point since our investigation confirms that, at a minimum, the effluent limitations were not exceeded for 95.5% of the flow. Parenthetically, we note that several limitations for Outfall 101 (*e.g.*, Oil and Grease, TSS, etc.) are clearly technology-based. Even as to the limitations for temperature, TVA believes that these limitations take into account the capability of technology in setting limits necessary to ensure the protection of a balanced, indigenous population of shellfish, fish, and wildlife in the body of water into which the discharge occurs. The Section 316(a) variance process exemplifies the consideration of various factors (including the capability of technology, such as cooling towers) in setting appropriate temperature limits for a facility's discharge.

5. Documentation of the maintenance performed during the breach to assure efficient operation while the diversionary breach was being remedied.

In conclusion, TVA Sequoyah took prompt corrective measures to repair the manhole breach. In the interim, cooling tower operation was initiated to facilitate compliance with the effluent limitations and monitoring conducted to ensure no adverse impact to the environment, human health, or safety. If there are any questions or comments, please contact me at (423) 843-6700 or sahoward@tva.gov.

Sincerely,

Stephanie A. Howard

Stephanie A. Howard
Principal Environmental Engineer
Signatory Authority for
Richard T. Purcell
Site Vice President
Sequoyah Nuclear Plant

Enclosures
cc (Enclosures):
Chattanooga Environmental Assistance Center
Division of Water Pollution Control
State Office Building, Suite 550
540 McCallie Avenue
Chattanooga, Tennessee 37402-2013

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

ATTACHMENT A

CHRONOLOGY (Times are approximate EDT)

Note: TVA Sequoyah Units 1 and 2 maintained full power throughout this breach.

Wednesday 04/07/04

0815 Environmental Technicians performing routine NPDES compliance sampling notice diversionary flow in the Tennessee River and notify Environmental Engineer.

0830 Environmental Engineer confirms and notifies management and Operations department of possible diffuser line break (description follows chronology).

0845 Diversionary flow is confirmed by management and Operations. No sign of fish kill, fish distress, or abnormal bird activity is observed by plant personnel.

0930 Operations notify Operations Duty Specialist (ODS) as required per plant procedures who in turn notify Tennessee Emergency Management Agency (TEMA) at 0945.

0945 Notify TVA Police to monitor area by boat due to possible boating safety hazard.

1000 Initial information brief to Tennessee Department of Environment and Conservation Division of Water Pollution Control Chattanooga Environmental Assistance Center (TDEC) of conditions, plan to initiate three cooling tower lift pumps (CTLPs) to two cooling towers as precaution, prior week CTLP use, plan for TVA River System Operations and Environment (RSO&E) to monitor locally for thermal issues, plan for TVA Police to monitor for boat safety. TDEC requests follow up call by end of the day.

1000 Notify Sequoyah's Nuclear Regulatory Commission (NRC) Resident of conditions.

1108 Initiate Work Orders 04-774193-000 and 04-774196-000 to undertake work to correct the breach.

1145 TVA Police begin to monitor area by boat. Police monitored area until problem fixed.

1200 Place in service three CTLPs to two towers as precautionary measure.

04/07/04 (continued)

1428 Close south gate #1; diffuser jet stops. Confirm breach on 16 ft. diameter short, downstream diffuser line.

1500 RSO&E arrive to establish temporary monitoring in the river around breach location. Jet is approximately 5 ft. high and 5 ft. in diameter and located approximately 475 ft. away from mixing zone toward Sequoyah's bank.

1510 Three additional CTLPs placed in service to make total six CTLPs to two towers as precautionary measure.

1540 Open diffuser gate #1 to approximately six feet (half open) to limit level rise in Diffuser Pond and protect Station 12.

1600 Brief TDEC of updates including addition of CTLPs, initiation of monitoring, absence of any fish kill, and identification of pipe breached.

1613 though 1635 Activate temporary logging stations.

1630 Compliance model outage begins due to removal of water temperature equipment (Station 12) in preparation of potential surcharging of Diffuser Pond (while gate #1 is closed for repair) and equipment damage. Normal monitoring of Sequoyah thermal compliance is transferred to in-stream measurements at Station 8.

1631 Close diffuser gate #1 to approximately six inches open.

1800 Close L-valve (Outfall 103) to minimize flow into Diffuser Pond.

1900 Write Problem Evaluation Report (PER) 34056 to document problem.

1958 Raise diffuser gate #1 to approximately 12 inch open position.

Evening of 04/07/04 Manipulate opening and closing of diffuser gate #1 to maintain Diffuser Pond level at slightly below Station 12. This also helps determine amount of time it takes to fill the Diffuser Pond in order to determine diver stay time for pipe repair.

Thursday 04/08/04

0830 Notify TDEC. Mentioned that the breach appears to be an upset; TVA was investigating the breach including corrective measures, and the regulatory and environmental impact. Preliminary Resistance Temperature Detector (RTD) results reveal that 200 ft. around the jet, Sequoyah's temperature rise limit of 5.4°F was not exceeded and that divers will soon be examining pipe. TDEC requests 1300 phone call for follow up to questions asked.

1130 Close gate #1 to diffuser pipe is and divers inspect south (downstream) diffuser pipe breach.

1216 Non-emergency notification made to Nuclear Regulatory Commission.

1300 Report made to Operations that breach is approximately 40 inch by 40 inch plate cover with broken latch for pipe manhole. Gate #1 reopened.

1300 Brief TDEC. Discuss the following:

- Diver update
- How much flow is escaping thru the breach? If the breach includes one of the 3-foot diameter manholes, the amount of flow escaping is about 7% of the flow through the diffuser pipe. In terms of the total flow through Outfall 101 (i.e., both diffusers), it would be approximately 3.5%.
- What is the flow through one diffuser pipe? Under normal conditions the Diffuser Pond elevation is about 6.5 feet above the river. The corresponding flow, based on the curve that compares height of Diffuser Pond water surface above river to the approximate discharge through single diffuser, is about 1240 cfs. The curve then can be used to estimate the flow through a single diffuser for other Diffuser Pond levels. Note that this curve is for an un-gated diffuser.
- What about the special releases for Sauger spawning at Watts Bar Hydro (WBH)? The special WBH release for Sauger will commence about April 15, 2004, and will continue through the end of the month. The release will include a continuous flow with a minimum of 8000 cfs.
- When will Chickamauga reach summer pool? The current target for filling Chickamauga is about April 15, 2004.
- When will temporary logging station data be available? Data will be available the following morning.
- What kind of RTD did you use in the measurements on 4/7/04? The measurements were made with platinum wire RTD's with an accuracy of ±0.25°F, resolution of 0.1°F, and a response time of 0.7 seconds.

04/08/04 (continued)

- Were temporary logging stations placed in same location of RTDs? They were placed in the same vicinity within 100 ft. of the point source (jet).
- What is the normal flow out of the Diffuser Pond? The normal flow while both units are operating is approximately 2300 cfs with three Condenser Circulating Water (CCW) pumps per operating unit.
- Discuss permit language pertaining to Upset, Overflow, and Bypass.
- TWRA has been notified per TDEC.
- TDEC also mentions that a five day written report is due five calendar days (and not five work days) and is therefore due Monday 4/12/04. An email "preliminary" report is acceptable provided that two hard copies follow along with projection of final report.
- To date, no media involvement has been reported.
- Schedule 0900 meeting 04/09/04.

1500 Close diffuser gate #1. Divers repair manhole breach.

1640 Report from TVA Aquatic Zoologist confirms, "On arrival at 1545 hrs, divers were repairing the manhole cover and the damaged diffuser was not in operation. The fish kill investigation extended approximately one mile downstream of the diffusers and there were no dead, stressed or dying fish observed. In addition, there were no abnormal sea gull or cormorant activity observed. These birds are opportunistic feeders and are a good indication of dead or dying fish during fish kills."

1745 Repair complete and diffuser gate #1 reopened.

2320 Reduce CTLPs to three in service to two cooling towers.

Friday 04/09/04

0910 Brief TDEC that temporary logging stations data reveal temperature rise 100 ft. from the point source is $\leq$4.9°F, pipe hatch has been repaired, CTLP update, fish/bird status, and further discussions of permit language (e.g. incident, bypass, upset, overflow).

1000 Divers inspect both diffuser pipes and find all nine manholes and manhole covers intact.

1315 Restore Station 12.

SEQUOYAH DIFFUSER SYSTEM PIPING

Background

A 1500 ft. diked embankment connects to the diffuser discharge system which limits the water temperature gradient in the Tennessee (TN) River and the upper temperature limit of the TN River. Two one gage (0.283 inch thick) corrugated galvanized steel pipes extend under the dike into the TN River channel. The downstream pipe which is 16 ft. in diameter, 950 ft. long diffuses the water approximately 350 ft. across the South side of the channel and the other upstream pipe which is 17 ft. in diameter, 1300 ft. long diffuses the water approximately 350 ft. across the North side of the channel. The two pipes are laid parallel to each other with the center lines approximately 25 ft. apart. The 16 ft., downstream pipe has four manholes approximately 280 ft. apart. The 17 ft., upstream pipe has five manholes approximately 280 ft. apart. Each manhole has a one gage thick cover (39 in. x 39 in.), over a (36 in. x 36 in.) angle framed opening, which is attached with two hinges and two heavy duty bolt type latches. The 350 ft. diffuser sections of each pipe have a series of two inch holes drilled in the pipe to diffuse the discharge water into the Tennessee River channel.

Problem Description

The first manhole from the shore, on the 16 ft. downstream pipe was found with the manhole cover open. The brackets, which hold the latch bolts to the angle frame, corroded allowing the manhole cover to open.

Corrective Action

A repair was made by placing a quarter inch thick plate over the opening and then placing four pieces of angle iron over the plate and clamping the angle iron and plate to the existing angle frame.

References:
TVA Drawing 31N306-1
Contract 71C53-54170

Attachment B

In-stream Assessment

The manhole jet was centered at a location approximately 175 feet from the riverbank and estimated to be directly above the manhole of the diffuser pipe. Locations and distances specified herein refer to a local coordinate system centered on the manhole jet. The transverse axis is aligned with the main diffuser pipes and the longitudinal axis is perpendicular to the diffuser pipes. The downstream direction refers to the prevailing direction of the flow in the river (for example, the 24-hour average flow) along the longitudinal axis. Hydro peaking operations at Watts Bar and Chickamauga Dams can produce transient river flows in the upstream direction.

Four temporary logging stations were placed in the river to record the variation of water temperature near the manhole jet. The station locations were selected in the field with the aim of capturing data that would yield the best insight into the mixing of heated water from the manhole jet. Table 1 lists the locations and times of activation for the stations and the manhole jet. Three of the four stations were placed downstream of the manhole jet because most of the mixing was expected to occur in the direction of the prevailing river flow. River flows during much of time the manhole jet was active were transient and low in magnitude, such that their influence on the shape of the jet mixing region was minimal to moderate. Water depth in the vicinity of the manhole jet varied from 7 feet near the shore at Station DSR to 11 feet at Stations DSL and USC.

Rationale for Placement of Temporary Logging Stations

All of the stations were placed outside of the region in which the initial momentum of the jet is dissipated. TVA RSO&E Hydrothermal Engineers estimated this region to be circular with a radius of 100 to 150 feet. The placements are advantageous for two reasons: (1) they enabled the stations to rest in areas of relatively calm water, thus avoiding excessive fluctuations of sensor depths due to wave action and (2) most of the cooling and mixing of the heated water, including cooling from aeration as the jet boils and breaks above the water surface, occurs within this region. Outside of this region, the decrease of the mixed temperature is assumed to be gradual and limited to that caused by mixing from ambient turbulence of the river and, speculatively, some buoyant spreading during periods of extremely low flow in the river.

Temperature Measurement Equipment

The sensor used for all of the temporary stations is the Hobo® Water Temp Pro, a thermistor device with specified accuracy of ± 0.33°F at 70°F and a resolution of 0.04°F. The sensors are programmed to log temperature at one minute intervals. Each sensor is fixed to a Kevlar ribbon at the scheduled depth by plastic wing-nut clamp that prevents slippage. The sensor array is suspended from a floating tire, which is anchored to 50-pound concrete cylinder placed on the river bottom. A 7.5-pound weight is attached to the bottom end of the Kevlar ribbon, below the deepest sensor, to minimize the deflection of sensor array from vertical, thus ensuring that each sensor hangs close to its scheduled depth in mild to moderate river flows. Logged temperature data must be extracted from each sensor to a laptop computer via an infrared link.

Instantaneous profiles of temperature in the surface layer were collected with platinum resistance temperature detectors (RTDs) suspended from a chain at depths of 3, 5, and 7 feet and trolled from a survey boat. A 15-pound weight was fixed to the bottom of the chain to minimize the deflection of the chain from vertical. The advantage of the RTDs for mapping thermal outfalls is their exponential time constant of approximately 300 milliseconds, which enables them to respond almost fully (99%) to a step change in temperature within 1.4 seconds. This fast-response behavior is essential to resolving the temperature gradients in the vicinity of thermal outfalls.

Measurements and Results

Surface temperature data collected with the trolled RTD array are shown in Figure 1. These data were collected from 1714 to 1832 CDT on April 7, 2004. These instantaneous temperature data ranged from a minimum of 62.1°F measured over the downstream diffuser discharge segment, while it was isolated, to a maximum of 70.6°F measured at the manhole jet while the Diffuser Pond gate #1 was partially open. Preliminary analyses of these data relative to the hourly intake temperature computed from Station 13 suggest that the instantaneous temperature rise above ambient drops below 5.4°F within 125 to 150 feet of the manhole jet for the period from 1714 to 1832 CDT on April 7, 2004.

Time series data for April 7-8, 2004 from the permanent compliance monitoring systems and the temporary logging stations are shown in Figures 2, 3, and 4. The following comments are applicable to these figures:

- It is emphasized that the temperatures for the compliance model and Station 8 are for the end of the diffuser mixing zone, whereas those for the temporary logging stations are for the manhole jet.

- Although the NPDES thermal criteria call for 24-hour averaging for the downstream temperature and temperature rise, the manhole jet breach was not long enough to enable computation of meaningful 24-hour averages for the temporary logging stations. In lieu of 24-hour averages, the temporary logging station data are plotted as 1-hour averages, with the assumption that if 1-hour average data fall within NPDES criteria, the 24-hour averages may be assumed to fall within the criteria also.
- The compliance model 24-hour average temperature is no longer available after 1530 CDT on April 7, 2004, when the effluent temperature monitoring station was removed from service.
- Station 8, located at the downstream corner of the diffuser mixing zone, is shown as the alternate source of data for demonstrating compliance with the downstream temperature, temperature rise, and rate of change limitations.

Mixed temperature, temperature rise, and temperature rate of change measured at Station 8 are well below the NPDES limits of 86.9°F, 5.4°F, and ±3.6°F/hr, respectively for the diffuser mixing zone. While the manhole jet does lie outside the diffuser mixing zone, it is relevant to observe that the mixed temperature, temperature rise, and temperature rate of change computed at the temporary logging station locations are also within the NPDES limits that apply to the diffuser mixing zone.

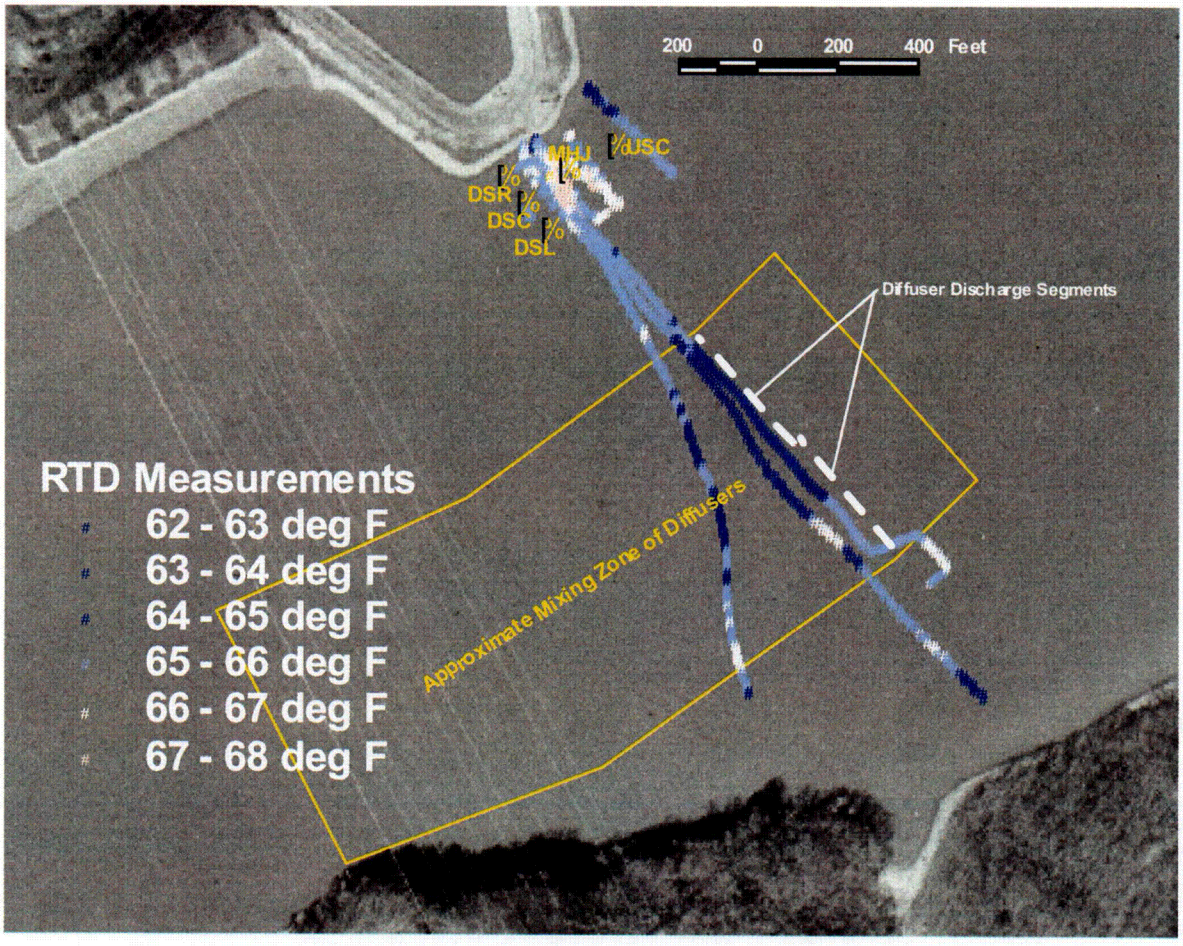

Figure 1. Location of manhole jet (MHJ) temperature assessment activities for April 7-9, 2004.

Table 1. Specification of Temporary Logging Stations

Station ID	Description	Location	Activation Time
DSC	150 feet downstream	W85° 05' 22.17'' N35° 12' 56.81''	07-Apr-2004 16:13 EDT
DSL	150 feet downstream, 90 feet left-of-center (away from plant)	W85° 05' 21.39'' N35° 12' 56.14''	07-Apr-2004 16:20 EDT
DSR	150 feet downstream, 85 feet right-of-center (toward plant)	W85° 05' 22.73'' N35° 12' 57.44''	07-Apr-2004 16:35 EDT
USC	125 feet upstream, 60 feet left-of-center	W85° 05' 19.16'' N35° 12' 58.04''	07-Apr-2004 16:25 EDT
MHJ	Manhole jet	W85° 05' 20.61'' N35° 12' 57.50''	-

C01

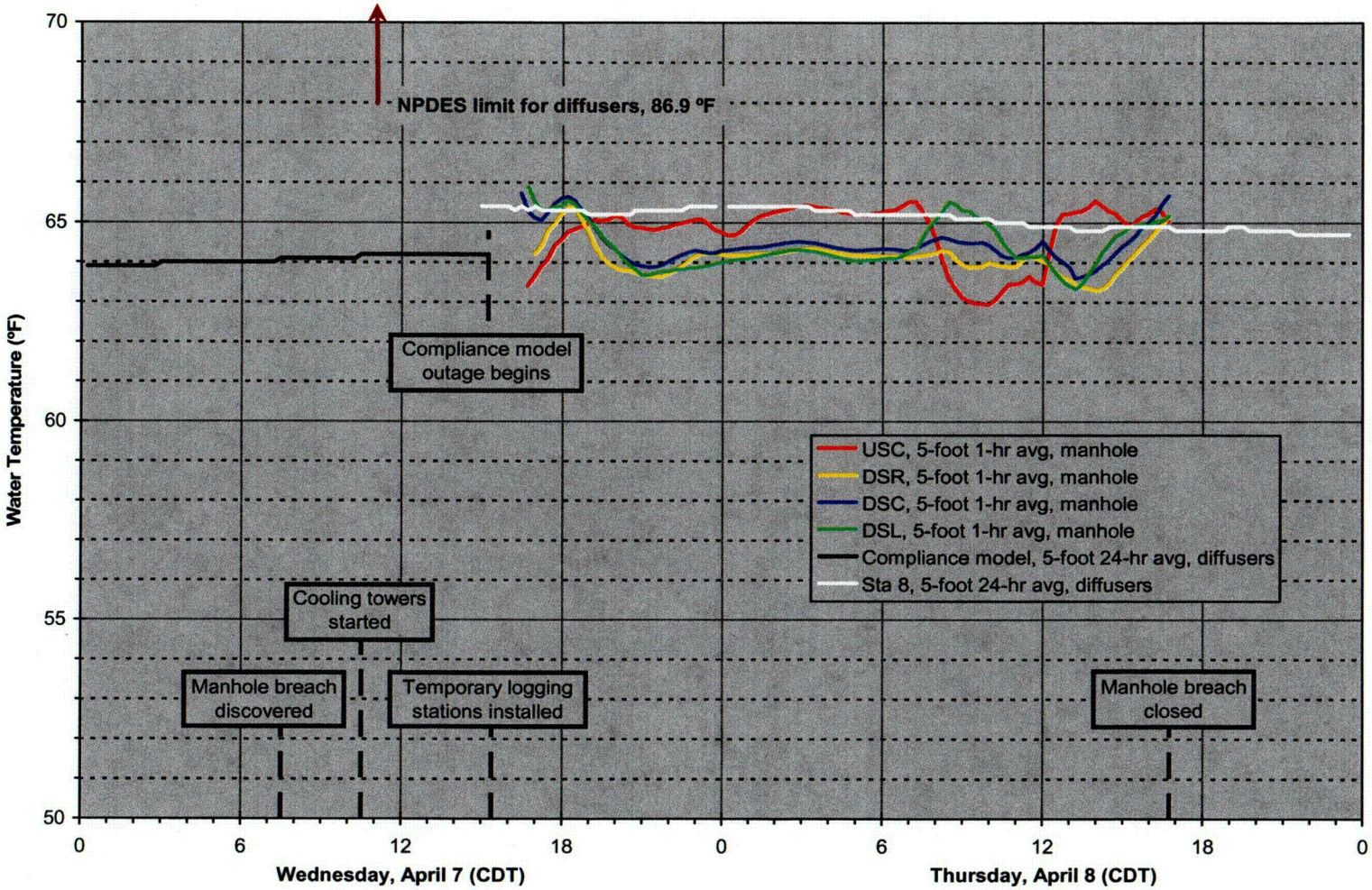

Figure 2. Variation of Downstream Temperatures

C02

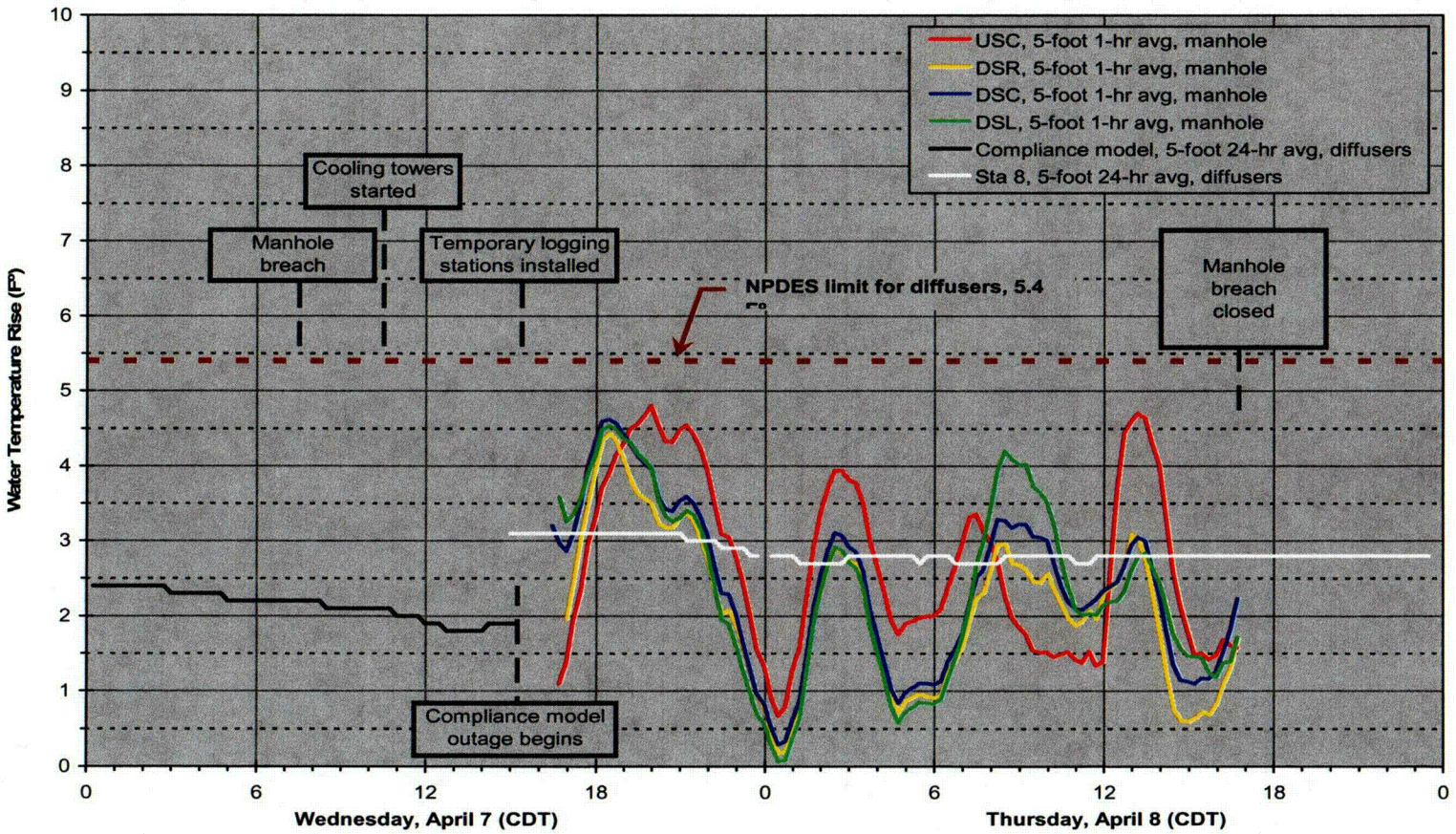

Figure 3. Variation of Temperature Rise Above Ambient

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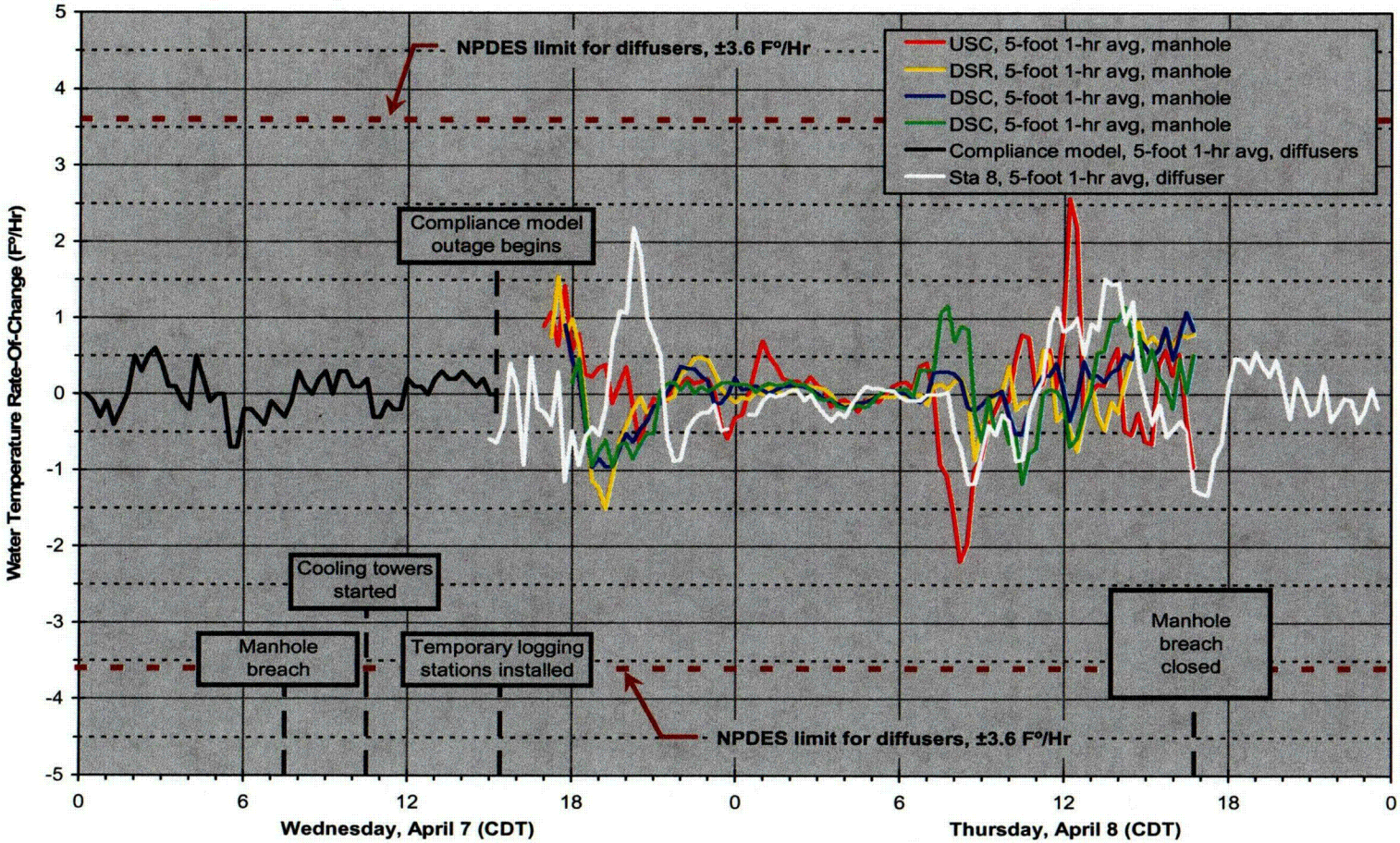

Figure 4. Variation of Rate of Temperature Change.

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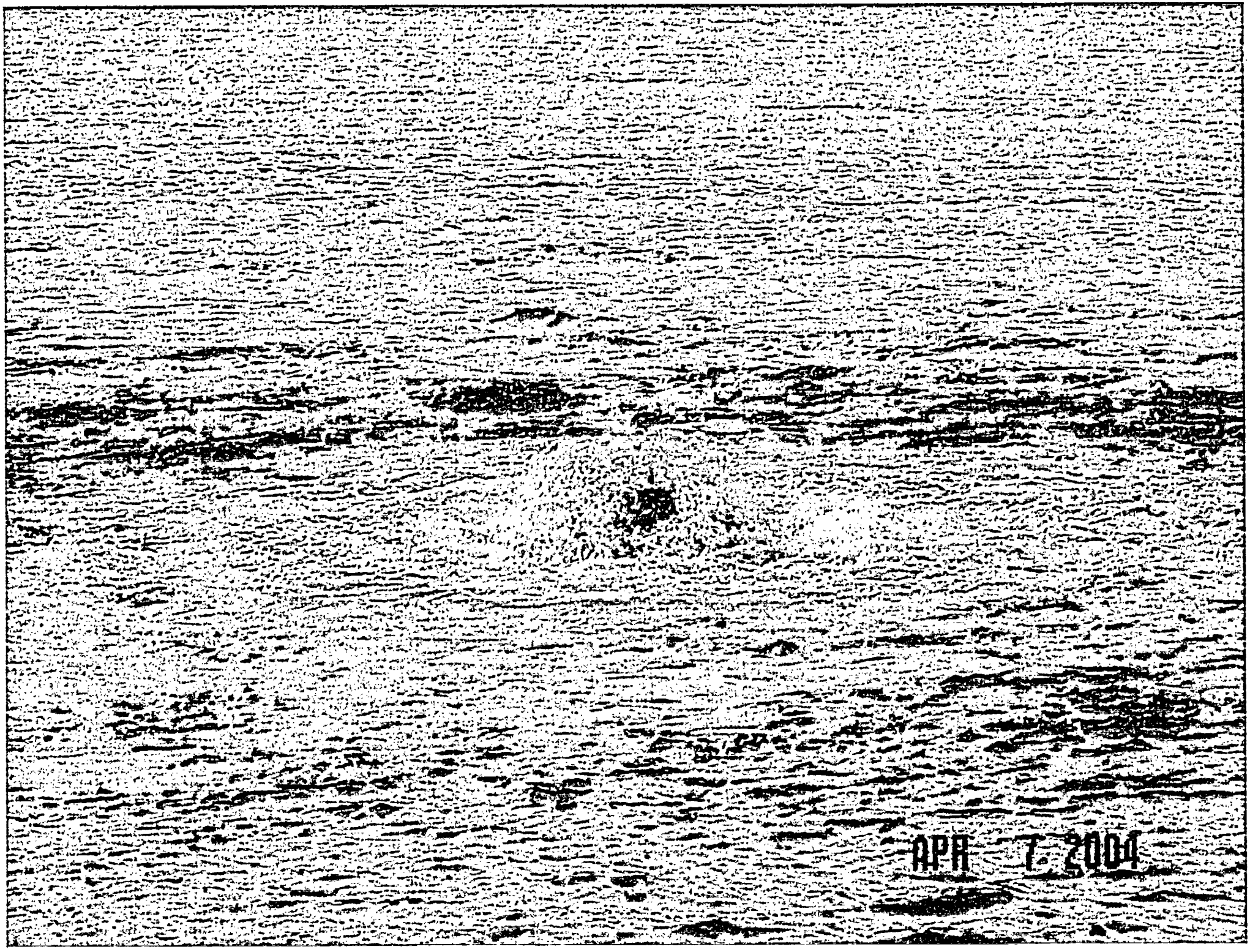
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