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Licensee: GPU Nuclear Corporation

Facility Name: Oyster Creek Nuclear Generating Station

Inspection At: Forked River, New Jersey

Inspection Conducted: December 8 - 12, 1989

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Inspection Summary:

(See Executive Summary).

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EXECUTIVE SUMMARY

On December 7, 1989, at 1:55 a.m., an operator-initiated transient caused the indicated "B" condenser vacuum to drop below 23 inches of mercury ("Hg) for approximately 50 seconds. The transient was initiated by a control room operator (CRO) when he was performing a daily backwashing evolution on the "B" condenser. The "B" north condenser was isolated and drained because of high conductivity problems. Although the CRO knew that the "B" north condenser was isolated, he erroneously placed the "B" south condenser in a backwash configuration. The effect of this action was a loss of cooling water to the "B" condenser. The CRO immediately recognized his error and took action to restore cooling flow. As the CRO was attempting to restore cooling water flow, the other CROs took actions to reduce power and monitor other plant parameters. The "B" condenser vacuum returned to normal. The transient ended approximately two minutes after it was initiated.

At 4:40 a.m., December 7, 1989, the licensee made a four-hour notification to the NRC operations center which involved a main condenser vacuum transient without scram, either automatically or manually. On December 8, 1989, Region I commenced an Augmented Inspection at the site in response to operational concerns that at least one indicator in the control room indicated a scram condition and that the reactor protection systems sensors apparently did not function. The purpose of the inspection was to gather related facts, to review the causes and circumstances surrounding this event, and to assess its safety implications. (See Appendix 2 for Sequence of Events).

The two sensing systems, one for vacuum indication and one for control (reactor protection system (RPS) actuation) responded differently than expected. The designs of the two sensing systems were substantially different which affected plant response. The RPS functions for the "A" and "B" main condenser chambers were not operable consistent with the Technical Specifications in that their instrument setpoints had drifted below TS minimum limits. However, these trip functions would have actuated (at the lower setpoint) to trip the plant. Other key plant parameters/instruments responded as expected in response to the transient and operator actions.

The licensee's post-event testing (including the cold shutdown period testing) was effective in determining the proper operation of the vacuum trip system (including RPS interface) and vacuum indicating system.

The vacuum indicating system readings were unexpected and confusing to the operators, considering their knowledge of plant design. However, they suspected that one vacuum indicator was incorrect in spite of the known reduction in condenser vacuum. The information available to the operators confirmed a vacuum problem, but not a scram condition and not a failure to scram. Overall, considering the short time period of the event, the team concluded that the operator actions were adequate. The loss of condenser vacuum procedure was properly followed, i.e., restore flow and reduce power to mitigate the problem; and the operators were purportedly ready to implement the manual scram action upon second verification of the scram condition as required by administrative controls. Operators and plant operations management responded appropriately during the post-event period, which included a four-hour NRC notification.

Overall, licensee review of the event was adequate with some exceptions. The licensee's review of the event at the time of the inspection did not identify that procedures allowed the RPS low condenser vacuum trip devices to be set at the technical specification (TS) limit allowing the instrument to drift non-conservatively beyond the TS limit. Further, the licensee's review did not identify problems with the adequacy of the TS to address the correct number of instrument channels and related vacuum trip systems as reflected by the as-built design. The licensee responded appropriately to shutdown the plant when it was clear that the NRC staff was not convinced that the available data supported RPS operability. The shutdown was performed within appropriate TS action statements time limits. The licensee's decision to do a formal human performance review on the personnel error which initiated the event was sound.

Planned short term licensee corrective actions were considered adequate for startup. These actions were oriented toward demonstrating operability of the RPS condenser low vacuum trip function and alerting operators to the unique design and performance aspects of this function.

DETAILS

1. Introduction /Overview

1.1 Background

On December 7, 1989, at 4:40 a.m., the licensee made a four-hour notification to the NRC operations center in which they reported a main condenser vacuum transient without scram, either automatically or manually. During the day shift on the same day, the licensee commenced a review of the event while power operations continued and the licensee representatives periodically briefed various Region I staff personnel on the status of their findings. Region I initially dispatched to the site the resident staff and the Chief of the Reactor Projects Section No. 4B (who has responsibility for oversight of the Oyster Creek site).

During that day, Region I reviewed additional details on the event and the design of main condenser vacuum indicating and control (or protection) instrumentation systems. For the three interconnected main condenser chambers, each chamber had a pressure sensor with transmitter readout in the control room (indication only system). In addition, each chamber had a sensing line which divided to a bellows arrangement within one of two vacuum trip systems (the control or protection system). This protection system also provides alarms in the control room. Operation of the main condenser low vacuum trip system provides an anticipatory loss of heat sink signal to the reactor protection system. This function also protects the condenser from overpressurization. Additional event details are described in Section 2 and Appendix 2 of this report.

Region I was concerned that at least one indicator in the control room indicated a scram condition and that the vacuum trip system/reactor protection system apparently did not function properly. Accordingly, Region I decided to form an Augmented Inspection Team (AIT) to review the event in detail and relieve personnel who were initially dispatched to the site. Subsequent to a conference call between the licensee and NRC staff at 2:30 p.m. on December 7, 1989, the licensee completed a shutdown and cooldown of the reactor by December 8, 1989. The AIT concluded its inspection on December 12, 1989.

1.2 Purpose/Scope

The purpose of the AIT was to gather related facts and to review the cause(s) and circumstances surrounding the above noted event and to evaluate the performance of the plant, operators, and management. Based on the findings in the above noted areas, the team was also to assess safety implications. Appendix 1 to this report was the team's specific charter.

1.3 Team Composition/Methodology

The team was composed of Region I personnel from the Division of Reactor Safety and Reactor Projects (a resident inspector) and an engineer from the Office of Nuclear Reactor Regulation. The assigned personnel had expertise in plant operations, instrumentation and control engineering, and thermal hydraulic engineering. The team was led by the Chief of the BWR Section in the Division of Reactor Safety, Region I.

In addition to the above noted charter, the team used the guidance of NRC Manual Chapter 0513 Part III and NRC Inspection Manual Chapter 93800. To accomplish its mission, the team used the following techniques: personnel interviews, procedures and records review, and actual observations of as-built design and of licensee testing activities.

1.4 Summary of Major Findings/Conclusions

Plant Performance

-- The two main condenser vacuum sensing mechanisms are of a different design. The two designs exhibited different transient response and were probably affected differently by the transient flow dynamics.

-- An instrument drift problem was identified with the Vacuum Trip System (VTS).

-- The licensee's testing methodologies adequately addressed operability requirements of the affected instrumentation and attempted to address possible causes for the instrument inaccuracies

-- The operability requirements of the technical specification (TS) on the low condenser vacuum reactor trip do not adequately reflect as-built design of the three bellows arrangement per trip system considering also the standard TS definition of an instrument channel.

-- The known instrument drift on the VTS limit switches coupled with the licensee's practice of setting the limit switches at the minimum value of 23 inches of mercury resulted in as found data for the "A" and "B" condenser chambers which were apparently contrary to TS requirements.

-- The low condenser vacuum reactor trip functions for the "A" and "B" condenser chambers were not operable as defined in the TS, but sufficient evidence was developed for the team to conclude that the VTS/RPS would have functioned had cooling water not been restored to the "B" condenser. The "C" chamber function was operable but close to the TS minimum limit. Further, "A" and "B" chamber functions would have actuated at instrument settings below the TS minimum limits. Also, other independent sensors would have caused a turbine trip and consequently a reactor trip had pressure conditions in the condenser worsened. As such, the lack of VTS response to actuate RPS had a minimal impact on safety.

-- Other key plant parameters responded as expected during the transient.

Operator Performance

-- Operator error caused the loss of circulating water flow to the "B" condenser.

-- A contributing cause of the event was the non-use of information/caution measures on a component (the drained north condenser) that was out of service, but not considered for maintenance on the component.

-- Although the operator performed the backwash procedure from memory (contrary to a standard order), that action did not contribute significantly to the operator error.

-- Crew mitigating actions on the loss of circulating water were in accordance with facility procedures, proper, and timely.

-- The operators at the time of the event had conflicting information that a scram condition existed and that there was a failure to scram. As such, the operators' actions were adequate.

-- The shift operators reported the event to plant management and properly notified the NRC Operations Center.

Management Performance

-- The operations department management responded appropriately in seeking technical advice on the design of the subject system, and these actions appropriately led to a four hour notification to the NRC Operations Center.

-- The licensee conducted various reviews of the transient as though an actual plant trip occurred.

-- The licensee met the general TS action statement (TS 3.0) by placing the plant in a condition that did not require the condenser low vacuum RPS function when it was identified that the facility was potentially outside the bounds of a specific limiting condition for operation for the RPS.

-- The licensee's organization was effective in performing tests and inspections in an attempt to address possible causes for instrument inaccuracies.

-- The licensee's review of this event at the time of this inspection did not identify the apparent violation of TS requirements for the instrument setting for the condenser low vacuum function nor did it identify whether the applicable TS instrument channel operability requirements adequately reflect the as-built design.

-- The licensee's planned actions for startup were adequate to demonstrate operability of the RPS condenser low vacuum function and to alert operators as to the unique design and performance aspects of this function.

2. EVENT DESCRIPTION

On December 7, 1989, at 1:55 a.m., an operator-initiated transient caused the indicated "B" condenser vacuum to drop below 23 inches of mercury ("Hg) for approximately 50 seconds. Operators took action to recover vacuum in the condenser. Although the scram setpoint for low condenser vacuum was 23" Hg, no automatic reactor scram occurred, and the operators did not initiate a manual scram when the "B" condenser vacuum indicator went below 23" Hg. Below is a summary of the chronology of events as tabulated in Appendix 2.

During the 4:00 -12:00 shift on December 6, 1989, just prior to the event, the "B" north condenser was being returned to service after maintenance work was completed. The condenser had been experiencing salt water leaks for approximately two weeks. As the "B" north condenser was being filled, the high conductivity problem returned, indicating the condenser was still leaking. The condenser was again removed from service and drained.

A new plan for repair of the condenser would be decided during the day shift December 7, 1989. The status of the "B" north condenser at the time of shift relief was that it was drained with the inlet valve closed and the outlet valve and backwash valves cracked open, to provide a drain path. All valves had position indications in the control room. However, the valves were not tagged in any manner since no maintenance was planned for the 12-8 shift, December 7, 1989.

The transient was initiated by a control room operator (CRO) when he was performing a daily backwashing evolution on the "B" condenser. The configuration of the "B" condenser, however, was off normal. The "B" north condenser was isolated and drained because of high conductivity problems. Although the CRO knew that the "B" north condenser was isolated, he erroneously placed the "B" south condenser in a backwash configuration. The effect of this action was a loss of cooling water to the "B" condenser. The CRO immediately recognized his error and directed an electrician to open the breakers for the inlet and outlet valves of the "B" south condenser. That action stopped valve motion with the valves in an intermediate position. As the CRO was attempting to restore cooling water flow, the other CROs took actions to reduce power and monitor other plant parameters. The "B" condenser vacuum returned to normal. The transient ended approximately two minutes after it was initiated.

During the transient, several indications were observed by the operators. The operators observed a rapid loss of vacuum in the "B" condenser. The vacuum in the "A" and "C" condensers was minimally affected by the drop in "B" condenser vacuum. The low condenser vacuum alarm (activited by the VTS) annunciated when the "B" condenser vacuum indicator was 22.2" Hg. (The alarm setpoint is 25" Hg, and the scram setpoint was 23" Hg). The "B" condenser vacuum indicated below 23" Hg for approximately 50 seconds. A minimum of 20.7" Hg was indicated for the "B" condenser. Circulating water was fully restored to the "B" South condenser; however, "B" condenser vacuum continued to decrease for a short time before returning to normal.

The operators on shift did not manually scram the reactor when "B" condenser vacuum indicated below 23" Hg. The operators recognized that the sensing lines for indication and VTS/RPS functions and alarms were separate. Before the shift decided on a course of action, the vacuum returned to normal. Subsequent to the event, operators were concerned about what had transpired and had reported the event to licensee plant operations management which led to a four hour 10 CFR 50.72 notification at 4:40 a.m. to the NRC operations center.

3. Plant Performance

3.1 Introduction

This section addresses the design and equipment performance of the control/trip signal provided for the reactor trip from the main condenser vacuum. The discussion includes: a brief description of the system, the location of sensors and its normal performance, instrument performance during the event, post event testing, and an overall assessment of the operability of the reactor protection system.

3.2 System Description

The main condenser consists of three condenser sections which are connected by 48-inch diameter pipes in order to equalize vacuum between each condenser section. The condensers are cooled by circulating water. Circulating water to each condenser is further divided into two sections, a north section and a south section. During normal operation, each condenser has circulating water entering two separate inlet water boxes and discharges out to the discharge tunnel. During the daily backwashing evolution, the circulating water system valves are repositioned to direct circulating water discharged from one section of a condenser back through the tubes of the other section. Reversing the circulating water flow through the one section increases the circulating water temperature. This evolution is performed to heat up the condenser tubes to help remove biological growth and reduce fouling.

Each of the three low pressure turbines has a dedicated condenser chamber of approximately 21,000 cubic feet in volume. Each condenser chamber vacuum (subatmospheric pressure) is sensed through two sensing lines. One sensing line provides only an analog indication in the control room through a "Rosemont" pressure transmitter to a "General Electric" indicator. This sensing line penetrates the top portion of the condenser. The end of this tube is encased in a larger tube, closed at the end, but has numerous 1/8" diameter holes around the tube to sense an average pressure in the condenser chamber. The other sensing line is connected to a vacuum trip system (VTS) that provides input to Reactor Protection System and an alarm. This sensing line enters the condenser 150 inches below the indicator sensing line. The sensor tube is almost flush with the condenser wall.

The purpose of the condenser low vacuum trip system is to provide an anticipatory loss of heat sink signal to the reactor protection system and also to provide a protection for the turbine from the excess steam in the condenser. In a Boiling Water Reactor, the steam that exits the low pressure turbine is directed to the condenser for collection of water which is then supplied to the reactor as feedwater. Condensation of the steam is achieved through the heat exchanged between the circulating water and steam.

The vacuum trip system has two trains identified as vacuum trip system Nos. 1 and 2. Each train receives a pressure signal from the three condenser chambers. The sensing line for each condenser chamber is divided and connected to a bellows in each VTS. The pressure signal is sensed by a "bellows" type arrangement to convert pressure into mechanical movement. This mechanical movement is used to create a proportional feedback control system where a low vacuum in any condenser chamber can generate an alarm, a full reactor scram and turbine trip based on the respective setpoint. (See Appendices 5-1 and 5-2).

The above control is achieved by having three of the bellows in a train move a piston and cylinder assembly which control a master cylinder that operates a cam (See Appendix 5-2). The cylinder and piston assembly supplies fluid to the master cylinder and piston. The design of the pistons are such that a drop in pressure on the top side of the master cylinder piston (the result of a low vacuum in any condenser) will cause a movement of the master piston in the upward direction. Low vacuum sensed in any chamber can vent the fluid and transmit reduced pressure to the top of the cylinder and cause an upward movement. This operates a cam which, in turn, operates various limit switches. A mechanical feedback lever is provided for proportional motion control to assure that the rotation position of the cam corresponds to a particular value of vacuum.

The limit switches can be set independently to operate at different positions of the cam movement. With respect to the switches of interest, one is set to actuate at 25" Hg to provide an alarm in the control room to indicate condenser low vacuum. A second and third limit switch are set at 23" Hg to provide a trip to both channels of the reactor protection system (RPS) to cause a full scram. A turbine trip actuation is also generated at 22 "Hg (VTS No. 1). Other limit switches are either installed spares or perform other functions unrelated to this event. An identical arrangement of bellows, cam and switches are provided for vacuum trip No. 2.

3.3 Instrument Response, Control/Pressure Switch Performance

This section describes the condenser vacuum indicator and control response during the transient and interpretation of that response.

Key plant parameters and vacuum data for the three condenser chambers "A", "B" and "C", versus time, are shown in Appendices 5-3 and 5-4. In reference to Appendix 5-4 "B" condenser vacuum was the lowest (at about 27.5" Hg) before the transient because one of the two cooling bundles was out of service. The "A" and "C" condenser vacuum remained unexpectedly constant during the transient. The "B" condenser vacuum is shown to decrease for about 75 seconds to a minimum of 20.8" Hg and then recover within about 37 seconds.

The low condenser vacuum alarm was activated at 48 seconds into the vacuum transient which corresponds to about 22.1" Hg at the location of the indicating system. Furthermore, even at the 20.7" Hg indicated vacuum neither the low condenser vacuum reactor scram nor the low condenser vacuum turbine trip were activated at nominal settings of 23 and 22" Hg respectively. It is in this context that the inspection team attempted to determine the expected response for the reactor protection system and associated alarms during a low condenser vacuum condition and compare it to the actual plant dynamic response observed during the event.

The potential factors which may explain (in part or in total) the difference in the response of the two vacuum sensing systems utilized for indication and trip are: (1) dynamic local flow effects which reduced the local vacuum for the indication system sensing location; (2) dynamic local flow effects which raised the local vacuum at the sensing location of the vacuum trip (control or protection) system; (3) alarm, trip or scram setting differences due to drift, setting and calibration instrument uncertainty, or other causes, (4) potential time delays due to line obstruction. The team examined each of these factors in more detail.

The latter two factors are discussed in Post-Event Testing, Section 3.4.

3.3.1 Dynamic Local Flow Effects at the Vacuum Indicator System

To quantify local flow effects, a detailed study of steam flow velocities during the transient would be needed. The required modeling and calculations for such an investigation were beyond the scope of this inspection. Nonetheless, some qualitative observations can be made.

The sensing locations for both vacuum trip systems are toward the west end of condenser with the indicating vacuum sensor located close to the turbine exit above the equalizing pipes between the condenser chambers and 150 inches above the scram sensing line. The expected steam flow just before the transient (under steady state full power conditions) at the sensor is downward toward the south end of the condenser where the cooling coil is located. (The "B" north end was initially out of service). At this time, very little, if any, flow toward the "A" and "C" condenser units took place, as evidenced by the relatively normal "B" condenser vacuum due to the very cold water (at 35°F) used in the cooling coils. During the transient in the "B" condenser, there was some reduction in flow due to the decrease in turbine power and some due to the loss of vacuum, but the main change was probably the diversion of the flow to the condenser chamber equalizing connecting pipes (described in section 3.2). When this happened, the indication system could have responded to both static (bulk) and/or dynamic (local flow induced) pressure affects.

3.3.2 Dynamic Local Flow Effects at the Vacuum Trip System

This sensor consists of a half inch outer diameter tube penetration into the condenser wall. It is located below the equalizing pipe openings and across from the feedwater low pressure heater. The sensor is almost flush with the wall.

During the transient, the steam velocity toward the lower part of the condenser would be reduced and some flow would be diverted toward the equalizing connections. This change in flow patterns likely affected both pressure sensors but in a different manner. Under the maximum pressure difference between B-A and B-C condensers the equalizing tubes reached choked flow conditions, limiting steam diversion to the A and C condensers. There was very little effect on the vacuum conditions of A and C due to the excess cooling capability of all three condensers. Most likely, the extremely low cooling temperature was responsible for this excess capability i.e., the fact that no lowering of the vacuum was observed in A and C chambers.

Without more rigorous analysis of conditions inside the condenser during the transient, the team concluded the two instrumentation designs exhibited different transient response and were probably affected by the transient flow dynamics.

3.4 Post-Event Testing

On December 7, 1989, at 9:57 p.m., the reactor was shut down with the mode switch in refuel. The latter two factors addressed in Section 3.3 were addressed by the licensee during post-event testing.

The licensee addressed these concerns with a variety of tests and physical inspections to substantiate the performance of the instrumentation and to ensure the operability of the main condenser low vacuum trip system (to cause a reactor trip).

On December 7, 1989, during power operations the licensee performed a calibration check on the "B" condenser indicating instrument and reported satisfactory results.

As the plant power was brought down to a controlled shutdown, the vacuum trip systems annunciators operated in the required sequence, condenser low vacuum alarm at 25.6 and 25.8" Hg and reactor trip at 22.7 and 22.8" Hg. This demonstrated that the trip system did not have any significant binding to prevent operation. During the outage, the licensee injected air from outside the condenser into the sensing lines and into the condenser sensing points. The licensee reported no blockage based on backpressure sensors. In light of the above, the team did not have a concern about obstructed instrument sensing lines.

After the shutdown the first test that was performed was the "Condenser Low Vacuum Surveillance Calibration", Procedure 619.3.014, Revision 10, on the vacuum trip system. This procedure has been used for establishing operability for the vacuum trip systems. The "as found" values from this test established that the trip function would have been accomplished at a vacuum below the technical specification limit. (See further discussion on this subject in Section 3.5).

At the time of this inspection, neither as-built drawings to describe sensor locations in the condensers or isometric arrangements of sensor tubing were available. As a result of this, the licensee made a condenser entry to locate the instrument tubing penetration into the condenser and, also to inspect for any visual signs of blockage or corrosion. The licensee did not identify any concerns.

Another special test was conducted to verify the independence of a vacuum sensor assembly to actuate the trip system. This test was accomplished by connecting test tubing to all the sensors and subjecting it to a vacuum pressure. After simulating the normal piston position for two bellows (representing normal vacuum at the two condenser bays), the vacuum was abruptly dropped in the third bellows. This resulted in a full reactor trip signal within 30 seconds. This test demonstrates that low vacuum in one condenser can actuate the reactor trip signal. Indeed, this is a conservative test. The bellows consitutes a mechanical pressure-to-motion translator and the rapid change in pressure is a more severe test than the slower pressure rate of change experienced during the transient. This test also supports the FSAR statement in Section 10.2.2.4 that a vacuum decrease to approximately 22 inches of mercury in any of the three condenser sections will cause a turbine trip to protect against the overpressurization of the main condenser.

During the December 7 event, the indicated vacuum transient remained below 23" Hg for approximately 50 seconds. The above test shows that the trip system can respond within 30 seconds to ensure a prompt reactor trip.

Based on the above tests witnessed by the team and the facts presented during the inspection, it is the team's conclusion that the licensee's post-event testing was adequate in an attempt to address possible causes for the instrument inaccuracies.

3.5 Reactor Protection System Operability

The operation of main condenser low vacuum trip system provides an anticipatory loss of heat sink signal to the reactor protection system. This function also protects the condenser from overpressure. The technical specification Table 3.1.1 A.6 requires two condenser low vacuum trip systems with two channels to be operable in each system and the trip set to occur at more than or equal to 23" Hg. The licensee initially interpreted the two instrument channels per trip system to be the two limit switches associated with each VTS system. The team considered this to be a narrow interpretation since the limit switches are not functional when the pressure sensing bellows and cams are out of service. However, the inclusion of the three bellows arrangement in each VTS is not clearly defined in TS. The facility TS do not have the standard TS definition of an instrument channel being the combination of sensor, wires, amplifiers and output devices which are connected for the purpose of observation control and/or protection. The specific TS (Table 3.1.1, Item No. 6), does not adequately address the VTS design.

Further, the surveillance performed on December 8, 1989, had the following "as found" readings. All readings are in inches of mercury (" Hg).

Vacuum Trip System 1

	Condenser A	Condenser B	Condenser C
RSCS-11	22.80	22.90	23.35
RSCS-12	22.80	22.90	23.36

Vacuum Trip System 2

	Condenser A	Condenser B	Condenser C
RSCS-21	22.88	21.65	23.07
RSCS-22	22.88	21.65	23.07

The above readings indicate that the setpoint for the "B" condenser had drifted to a value below 23" Hg, the setpoint required by the technical specification. The team reviewed the test records from the previous outage and observed that the setpoint had also drifted below the technical specification limit for condensers A, B and C for vacuum trip system No. 2. In spite of this known drift in the setpoint, the licensee retained the technical specification limit as the desired setpoint, thus permitting a drift in a non-conservative direction. The licensee was aware of this condition, and the NRC staff addressed a similar finding in Inspection Report 50-219/88-202 issued on November 16, 1988. However, the examples addressed in this report had allowances for instrument drift without causing a technical specification limit violation. The previous inspection team questioned the adequacy of the licensee's established instrument margins with respect to TS limits. The low vacuum trip setpoint had no margin for instrument drift. The licensee had not performed a setpoint change until this outage.

The team concluded that the licensee was apparently not in compliance with the technical specification for the "A" and "B" low vacuum trip setpoints; and, thus, the low vacuum reactor scram function of the reactor protection system for these condenser chambers were not operable at the required TS setpoints. The low vacuum trip for the "C" chamber was operable but could have drifted below the TS minimum limit.

Although the "A" and "B" on condenser chamber low vacuum RPS functions were not operable (as strictly defined in TS) the team concluded that it would have functioned had circulating water not been restored. There were apparently no critical time response requirements for this anticipatory function. The team remained concerned about the licensee's practice of setting the low condenser vacuum setting for all three condenser chambers at the TS minimum limit and not accounting for known instrument drift of the actual limit switch setting.

The team further assessed the safety implications of this RPS inoperability because of the nature of the transient coupled with the sensor design features. The team assumed inoperability of the VTS for all three condenser chambers. The most likely next effect on a continued pressure rise in the main condenser would be high turbine exhaust hood temperature which is representative of a pressure build up at the entrance to the main condenser. The licensee reported that, at an exhaust hood temperature of 225°F, a turbine trip would occur. The instrumentation for this parameter also would provide an alarm at 175°F. (This alarm was not received during the subject event). A turbine trip provides a reactor trip. The licensee also reported that the safety analysis assumes the function of the turbine trip and not the other anticipatory trips such as condenser low vacuum. Therefore the low vacuum RPS trip would be backed up by high exhaust hood temperature turbine trip initiating a reactor trip.

In light of the above, the team concluded that a main condenser overpressurization would be highly unlikely and a reactor trip would have automatically occurred with the low vacuum to RPS trip functioning with some time delay backed up by a high exhaust hood temperature turbine trip that would generate a reactor trip.

3.6 <u>Summary</u>

The response of both the vacuum indicating and trip systems during the December 7, 1989 event cannot be fully explained. However, it can be concluded that the differences in the instrument tubing penetration into the condenser, and the physical distance between the tap points, had an influence on the vacuum that was sensed by the two sensing systems.

From the available recorded data, it is clear that certain areas of "B" condenser were subject to a low vacuum (control room indication), and the vacuum trip system sensed a different level of vacuum in the same condenser. The response of the vacuum trip system (VTS) during the post-shutdown tests demonstrated that the vacuum trip system (which provides a scram signal) was not operable for certain condenser chambers, since the associated instrument settings had drifted to outside the TS minimum limits. However, the VTS probably would have functioned had circulating water not been restored. There would have been minimal safety consequences on this delayed or even non-action of the VTS.

From a post-event review, the team also found that applicable specific TS for the condenser low vacuum RPS trip function do not adequately reflect as-built VTS design.

4. Operator Performance

4.1 Introduction

During the AIT inspection, an extensive review of operator performance was conducted. This review included a detailed review of operating and administrative procedures governing the event, as well as interviews with all of the operators involved. A total of eight individuals were interviewed, which included the normal shift complement and the shift electrician. Also present for each interview was a member of plant management and a member of the licensing department staff. Each interview lasted approximately one hour. The plant systems computer and the security keycard computer were used to substantiate in conjunction with the information received during the interviews to construct the chronology of events. The following sections of the report detail the operations and human factors that contributed to this event. Members of the team also maintained contact with and attended meetings of the licensee's review group formed to reconstruct the human factors performance evaluation.

4.2 Initiating Event - Loss of Circulating Water

The Control Room Operator commenced the backwash evolution on the "A" north condenser. The procedure states that condenser backwashing should be accomplished in a staggered sequence starting with the "A" south or north condenser. Following the procedural sequence from memory he then backwashed the "C" north condenser, realized he could not backwash the "B" north condenser and started on the "A" south condenser. The "C" south condenser was completed next and then the CRO, not remembering the "B" north was isolated, placed the "B" south in backwash mode. Having immediately realized his mistake he radioed an electrician, standing by the valve breakers to open and then close the breakers for both the inlet and outlet valves. This action stopped the valves from closing, reset the valve logic and allowed the control room switches to operate the valves in an open direction.

The team concluded that the lack of any caution or information measures on the control switches for the "B" north condenser, contributed to the operator not remembering that the condenser was out of service. A review of the administrative procedures identified no requirement to tag control switches for equipment out of service with no maintenance being performed. Licensee representatives indicated that they plan to re-review this practice.

The interviews with the control room personnel indicated that the CRO performing the backwash procedure, did not have the procedure opened in the control room at the time the backwash was being conducted. He was, however, performing the backwash in accordance with the procedure and in the proper sequence. Not having the backwash procedure "in hand" was contrary to the Standing Order No. 41, "Procedure In Hand." This standing order listed procedures that do not require the operator to have the procedure "in hand." The "Main Condenser Circulating Water System" Procedure Number 323 was not on that list. However, considering the circumstances leading to the error, the team concluded that having the procedure in front of the operator would not have prevented this event from occurring.

The CRO's immediate action, to contact the electrician standing by the valve breakers, was proper, timely and led to a rapid mitigation of the event.

4.3 Vacuum Transient Operator Action

The reduction of circulating water in the "B" condenser resulted in a rapid decrease in indicated vacuum for that condenser. A second CRO in the control room observed the vacuum decrease and immediately reduced recirculation flow to reduce reactor power. This action was in accordance with the "Loss of Condenser Vacuum" Procedure, 2000-ABN-3200.14, and also led to a rapid mitigation of the event.

As the "B" condenser indicated decreased vacuum, a third CRO observed that the indications for "A" and "C" condensers were remaining close to normal (about 29 - 30" Hg). At 26-27" Hg on the "B" condenser, the Group Shift Supervisor (GSS) stated that a manual scram may be necessary. The second CRO stood by ready to insert the manual scram. The third CRO monitored the plant response and anticipated the low condenser vacuum alarm at 25" Hg. Shortly after the indicated vacuum decreased to 23" Hg (scram setpoint), the low condenser alarm annunciated. This apparent lag in the alarm/RPS function coupled with the indication on "A" and "C" condenser remaining normal, caused the third CRO to state that the "B" vacuum indication may not be accurate. This inconsistency in the indications caused the crew to hesitate inserting a manual scram, even though the scram setpoint had apparently been reached on the "B" condenser indicator. Approximately 30 seconds later the "B" indicated vacuum began to increase rapidly to above the 23" Hg scram setpoint and return to normal due to the restoration of circulating water flow to the south condenser.

Station Procedure 106, "Conduct of Operations," states that when an operator notes a symptom, he shall verify the symptom by checking related instrumentation. Station Procedure 106 also states that indications are to be believed, unless they are verified by some other means to be false. In this event, the operators appropriately verified that a degrading vacuum condition existed in the "B" condenser. The recognition of the initiating event, the lowering "B" condenser vacuum indication, and the receipt of the low vacuum alarm qualitatively verified the symptom of degrading vacuum. The operators, however, observed that the low vacuum alarm annunciated below the scram setpoint (23" Hg). To their knowledge, the alarm was set to annunciate at approximately 25" Hg. Although the alarm did not provide continuous (readout) verification of the "B" condenser vacuum indication, it did provide a quantitative comparison at a single point. To the operators at the time of the event, the information from the alarm (VTS) and the indicator conflicted.

Given the plant configuration, there was no practical way for the operators to verify which one of the two indications was false. The fact that vacuum stayed relatively the same on the "A" and "C" condenser did not indicate which indication was false, because both the alarm and the "B" indicator indicated a vacuum condition which was significantly lower than both "A" and "C" condenser vacuums. The use of other alarms, i.e., receipt of turbine trip alarm, as a quantitative verification, was not practical, because the point at which the corresponding alarms would be received would be at or below the scram setpoint. From an operating point of view, this would defeat the purpose of manual scram initiation as required by Procedure 106 noted above.

An entry condition of Oyster Creek's Emergency Operating Procedures (EOPs) is "a condition which requires a reactor scram and power above 2% or cannot be verified." If an automatic scram has not been initiated, the operator was directed by the EOPs to manually insert a scram. During this event, the "B" vacuum indicator was below a scram setpoint. Again, the operators were confronted with two indications which differ quantitatively upon which there was no practical way for the operators to determine which one was false. Given this information an appropriate action would have been to manually scram the reactor. However, the period of time between the point at which the low vacuum alarm was received and the point at which vacuum began to rise sharply was less than 30 seconds. The team concluded that 30 seconds was not adequate time for the operators to assess and resolve the conflicting indications and to determine that, because no practical method existed for showing which indication was false, a scram was required. The uniqueness of the event and the lack of redundancy of the "B" condenser vacuum indication compounded the situation for the control room operators. As such, the operators' actions were adequate.

It was not possible to determine if the operators would have inserted a scram if low vacuum prevailed for a longer duration. However, through operator interviews, the operators demonstrated that an understanding of scramming the reactor when a parameter approaches a scram setpoint so as not to challenge the automatic features.

In summary, the team considered several factors that influenced operator actions: short time period for the operators to make a decision, the uniqueness of the event, the lack of redundancy in indication, and the low safety significance of the event. The team had no concerns with the operators' actions. After the initial error, the operators performed well to promptly restore cooling water and reduce reactor power. The operators were observant in noting that there was a quantitative discrepancy between the alarm and indication. The operators interviewed exhibited a clear understanding of inserting a manual scram when a verifiable symptom indicates a scram condition.

4.4 Post-Transient Operator Actions

When the event had concluded it was apparent to the group shift supervisor (GSS) that there was the possibility that a failure to scram had not occurred. This conclusion led him to believe conditions may not have satisfied any entry condition to the Emergency Operating Procedure or a TS Limiting Conditions for Operation. However, the GSS knew that the NRC would have to be notified of the event but could not decide the type of notification, due to the nature of the event. After 30 minutes the GSS called the Manager of Plant Operations to inform him of the plant transient and to gain additional guidance for the notification. A conference call was then established with the GSS, STA, Manager of Plant Operations and the Director of Plant Operations. Later in the conversation a corporate engineer was added to the call. Pending further review, the group tentatively concluded that a failure to scram had not occurred; however, the group further noted that the pending review might determined that the event alone could have prevented the fulfillment of the RPS safety function (10 CFR 50.72 b (2) (iii) (A)). Accordingly, a four-hour notification was made to the NRC operations center.

The notification was made well within the four hour time frame and was considered by the team to be an appropriate response.

4.5 Summary

The initiating event was clearly an operator error brought about by the routine and repetitive nature of the evolution. The use of caution/information measure may have alerted the operator as to the condition of the out of service water box, preventing his mistake. The failure to properly implement a standing order did not significantly contribute to the cause of the event.

It has been the licensee's policy and longstanding philosophy that, if a verified operating parameter is approaching a scram setpoint, a manual scram shall be entered before that setpoint is reached. In the case of the loss of circulating water event, there was conflicting information to the operating crew that a scram condition would have been reached or existed. Considering the time period that the indicated parameter was less than the scram setpoint and the contradictatory indications available during that time, the operators' action for this situation was adequate. The crew responded rapidly to the event and properly implemented the "Loss of Condenser Vacuum" procedure.

After the plant was returned to normal, the crew made a concerted effort to inform plant management and the proper NRC notification was made.

5.0 Management Performance

5.1 Introduction

This section summarizes and assesses the performance of licensee management related to the findings and conclusions within the sections on plant and operator perfo.mance.

5.2 Assessment

During the mid-shift of December 7, 1989, the operations department management responded appropriately in the discussion of the facts with the shift operators and in seeking appropriate technical advice on the design of the subject system. These actions appropriately led to a four hour notification to the NRC Operations Center and to briefings with cognizant Region I personnel in the early morning hours of that day.

On the day shift of December 7, 1989, the licensee started a review of the transient as though an actual plant trip had occurred. A review group was led by the plant operations manager supported by plant and corporate engineers. Other independent reviews were simultaneously conducted at the corporate office.

Licensee representatives stated that they were about four hours away from a decision at the time of the December 7th 2:30 p.m. conference call with NRC staff on whether the plant should be shut down in order to fully address the RPS operability issue. However, the licensee reported that they shut down and cooled down the reactor when it was clear to them that the NRC staff was not convinced that the RPS condenser low vacuum function was operable.

The team concluded that the licensee met the TS action statement (TS 3.0) by placing the plant in a condition that did not require the condenser low vacuum RPS function when it was identified that the facility was potentially outside the bounds of a specific limiting condition for operation for the RPS system (TS 3.1 and Table 3.1.1, Item 6). During the December 7th power operations time period, there was no clear evidence that the RPS was inoperable. Being conservative, the team assumed that the TS 3.0 action statement started at or near the time of the event, and then concluded that the licensee would have met the 30 hour requirement had the shutdown not started until four hours after the conference call, which ended at about 3:30 p.m.

The team also concluded that a shutdown was inevitable and the team found it reasonable that the licensee's review would have led to that conclusion. The questions on the operability of the VTS bellows arrangement could not be fully addressed until shutdown surveillance testing was performed. Also as-built drawings did not reflect specifics of the design of the sensors and instrument tubing. This information was obtained by entry into the condenser and other areas not easily accessible during operations.

With respect to the outage period, the licensee's organization was effective in performing tests and inspections in an attempt to address possible causes for instrumentation inaccuracies. The licensee's actions for startup were adequate to demonstrate operability of the RPS condenser low vacuum function and to alert operators as to the unique design and performance aspects of this function. These actions included: reset the low condenser vacuum trip to 24" Hg; re-emphasize established administrative controls on manual scram; train operators on the event lessons learned; revise related abnormal procedure for this event to reflect the one of three condenser low vacuum trip design; and review the information/caution measures when major component are out of service but not considered for maintenance on the component.

However, as of the close of the inspection, the licensee's review of the event did not identify the following items:

-- The apparent violation of TS by setting VTS instrument channels at the TS minimum limit for condenser low vacuum trip and not accounting for the instrument actually drifting in the non-conservative direction which affected RPS operability. (The instrument drift issue related to TS instrument settings was similar to that identified in a previous NRC inspection report 50-219/88-202 issued on November 16, 1988).

-- The apparent inadequacy of TS to address operability of the VTS three bellows arrangement per trip system as a complete instrument channel assembly.

Proposed Licensee longer term actions (beyond restart) included:

- -- Evaluate the event and the findings on the as found data for the VTS vacuum trip settings for licensee event reportability in accordance with 10 CFR 50.73.

- -- Upgrade as-built drawings to reflect additional details of the indicating and trip system sensor locations and instrument tubing isometrics.

- -- Complete the human performance review on the operator error which caused the event.

- -- Evaluate the adequacy of the applicable TS operability requirements for the RPS condenser low vacuum function.

These long term actions are subject to further assessment in a future inspection.

6. Management Meeting

During the course of the inspection, the team conducted several meetings with licensee management to discuss the status of licensee event review efforts and to discuss the status of the inspection team findings and the needs of the inspection team. In addition to an introductory meeting on December 8, 1989, there were daily morning meetings, a special meeting on the licensee's human performance evaluation, and a final exit meeting on December 12, 1989, to summarize the major findings and conclusions of the team. Those in attendance at these meetings other than the daily mornings meetings are tabulated in Appendix 3 to this report.

APPENDIX 1

AIT CHARTER - See Next Page

07 DEC 1989

MEMORANDUM FOR: Marvin W. Hodges, Director
Division of Reactor Safety

FROM: William T. Russell
Regional Administrator

SUBJECT: AUGMENTED INSPECTION TEAM (AIT) - LOW CONDENSER VACUUM ALARM AND POSSIBLE FAILURE TO SCRAM AT OYSTER CREEK

You are directed to perform an Augmented Inspection Team (AIT) review of the causes, safety implications, and associated licensee actions which led to and followed, both immediately and subsequently, the low condenser vacuum alarm that occurred at Oyster Creek on December 7, 1989. The inspection shall be conducted in accordance with NRC Manual Chapter 0513, Part III, and additional instructions in this memorandum.

DRS is assigned responsibility for the overall conduct of this inspection. Robert Gallo is designated as the Regional Team Manager and Richard Conte as the onsite Team Leader. The team will include participants from the Division of Reactor Safety, the Division of Reactor Projects and from NRR.

OBJECTIVES

The general objectives of this AIT are to:

a. Conduct a timely, thorough, and systematic review of the circumstances surrounding the December 7, 1989 event;

b. Collect, analyze, and document all relevant data and factual information to determine the causes, conditions, and circumstances pertaining to the event, including the response to the event by the operations and technical support staffs and by licensee management;

c. Assess the safety significance of the event and communicate to Regional management the facts and safety concerns related to the problems identified; and to

d. Evaluate the adequacy of the licensee's internal review of the event.

SCOPE OF THE INSPECTION

The AIT response should identify and document the relevant facts and determine the probable causes of the event. It should also critically examine the licensee's response to the event. The team leader will develop and implement a specific, detailed inspection plan addressing this event upon his arrival onsite.

As a minimum, the AIT should:

a. Develop a detailed chronology of the event;

b. Determine the root cause(s) of the event;

c. Determine the expected response of the reactor protection system and associated alarms during a low condenser vacuum condition and compare it to the actual plant dynamic response observed during the event;

d. Assess the adequacy of the responses of operators to the event, including the adequacy of their procedures and training;

e. Assess the scope and quality of the licensee's internal review of the event, including its initial (preliminary) and followup (detailed) review; and,

f. Assess the scope and quality of short-term actions and gather information related to the long-term actions intended to prevent recurrence of the event, including licensee-identified concerns and corrective actions.

SCHEDULE

The AIT shall be dispatched to Oyster Creek so as to arrive and commence the inspection no later than 8:00 a.m., December 8, 1989. A written report on this inspection will be provided to me within three weeks of completion of on-site inspection effort.

W. T. Russell

William T. Russell
Regional Administrator

APPENDIX 2

Chronology of Events

On December 6, 1989, at 4:00 a.m., the plant was operating at 82 percent power. The main turbine was on its 73rd day of continuous operation. When the condenser vacuum transient occurred, no technical specification action statements were in effect, and no significant maintenance activity was taking place.

Date/Time	Source	Description
December 6		
4:15 a.m.	CRO logs GSS logs	A helium test to identify condenser tube leaks was completed. No leaks were identified.
9:35 p.m.	CRO logs GSS logs STA logs	As "B" North condenser was being returned to service, conductivity was observed to be increasing.
9:50 p.m.	CRO logs STA logs	With "B" North condenser approximately half filled, conductivity was indicating 2.0 micromhos/cm and increasing. The GSS ordered "B" North condenser isolated and drained.
10:20 p.m.	CRO logs GSS logs	Operators began increasing reactor power. Reactor power was initially at 1585 MW thermal, and main generator output was at 519 MW electric.
December 7		
12:00 Midnight	STA logs	Power ascension was continuing. Reactor power was at 1845 MW thermal.
*1:35 a.m.	Personnel Interview	CRO 1 commenced condenser backwash in accordance with the following sequence: "A" North, "C" North, "A" South, "C" South.
1:55 a.m.	Personnel Interview SCR	The GSS, three CROs and a CRO trainee were in the control room. An electrician was stationed by the "B" South inlet and outlet circulating water valve breakers. The GOS and STA had just left the control room.
1:55 a.m.	Personnel Interview CRO Logs	CRO 1 placed the "B" South condenser in the backwash with the "B" North condenser isolated. Ten seconds after placing "B" switch in backwash, CRO 1 realized his error and had the electrician open and close the valves' breakers. (Stroke times for valves are 30-60 seconds.) Ten seconds later, the breakers were opened and the valve stroke stopped. When the breakers were reclosed the valves were in an intermediate position.

1:55:05 a.m.	Plant System Computer	Indicated "B" condenser vacuum started to decrease. The initial vacuum indicated 27.6 inches Hg. Initial "A" and "C" condenser vacuum were 28.3 inches Hg.
1:55 a.m.	Personnel Interview CRO logs	CRO 2 reduced recirculation flow to lower reactor power. Recirculation flow was reduced to 10.9 E+4 gpm.
1:55 a.m.	Personnel Interview	GSS stated, "We may have to punch it out [scram]." (Vacuum in "B" indicated 26-27 inches Hg.)
1:55 a.m.	Personnel Interview	CRO 3 noted "B" condenser indicated vacuum at 25 inches Hg, but no low vacuum alarm was received.
1:55:45 a.m.	PSC SAR	Indicated "B" condenser vacuum was 23 inches Hg and decreasing. Indicated "A" condenser vacuum had decreased to 28.1 inches Hg. Indicated "C" condenser vacuum had decreased to 28.2 inches Hg.
1:55 a.m.	Personnel Interview	CRO 2 was standing by to insert a manual scram. CRO 3 announced, "low vacuum alarm; this gauge can't be right." CRO 2 backed off from the scram buttons. (Vacuum in "B" condenser indicated 22-23 inches Hg.)
1:55:55 a.m.	SAR	Condenser low vacuum alarm received. "B" Condenser vacuum indicates 22.2 inches Hg.
1:56 a.m.	Personnel Interview	CRO 3 noted that circulating water was fully restored (valves were wide open); however, "B" condenser vacuum continued to decrease.
1:56:19 a.m.	PSC	Indicated "B" condenser vacuum reached a minimum 20.7 inches Hg. Indicated "A" condenser vacuum was 28.0 inches Hg and the "B" 28.2 inches Hg.
1:56 a.m.	Personnel Interview	GSS announced vacuum was 21 inches Hg and recovering.
1:56:34 a.m.	PSC	Indicated "B" condenser vacuum was 23 inches and increasing.
*1:57 a.m.	Personnel Interview	Reactor power reduced to 80-85%.
1:58 a.m.	SCR	STA returned to control room.

1:58:09 a.m.	SAR	Condenser low vacuum cleared. Indicated "B" condenser vacuum was 27.1 inches Hg.
2:03 a.m.	CRO logs GSS logs	Condenser low vacuum alarm cleared. "B" south condenser returned to service.
*2:05 a.m.	Personnel Interview	CRO started raising reactor power to 100%.
2:25 a.m.	STA logs	Manager of Plant Operations was informed of the operator error and plant transient.
3:12 a.m.	STA logs	Conference call held with GSS, STA, Manager of Plant Operations, Director of Plant Operations and a Corporate Engineer. Concerns with continuing plant operations were discussed. It was decided that the PTRG should be convened to determine why no low vacuum scram occurred when "B" condenser indicated 20.7 inches Hg.
3:16 a.m.	SCR	GOS returned to control room.
*3:30 a.m.	Personnel Interview	Corporate Engineer stated in a conference call that the bellows are independent of each other. The observed conditions may be explained by flow dynamics in the "B" condenser. Plant management, the GSS and STA concluded that there was no failure to scram.
*4:15 a.m.	Personnel Interview	Personnel were contacted to convene the PTRG.
4:40 a.m.	CRO logs GSS logs STA logs	Category III notification was made based on possible failure of RPS to actuate from low condenser vacuum at 23 inches Hg. (10 CFR 50.72 four hour notification)
*6:30 a.m.	Personnel Interview	Calibration of the "B" condenser vacuum indication was completed. The instrument was found within calibration. The electrical section of the low condenser vacuum scram portion of RPS was surveyed and found operable.
7:45 a.m.	GSS logs	Control room operators for the 12 a.m. to 8 a.m. shift were instructed to insert a manual scram if any vacuum gauge on "A", "B", or "C" condensers indicated less than or equal to 23 inches Hg.
*8:00 a.m.	CRO logs	Personnel at the morning turnover meeting were instructed to insert a manual scram if any vacuum gauge reads less than or equal to 23 inches Hg.

9:52 a.m.	CRO logs	GSS instructed control room operators to insert a manual scram if any vacuum gauge on A, B or C condensers indicated less than or equal to 23 inches Hg. This instruction was an interim measure until the status of the low vacuum trip was verified.
2:30 p.m. - 3:45 p.m.	NRC Records	Plant management and NRC management conference call to discuss the status of licensee's review of the event and RPS operability.
4:15 p.m.	CRO logs GSS logs	Reactor shutdown commenced per Operations management direction in order to be in cold shutdown within 30 hours of 1:55 a.m. 12/7/89. Initial reactor power was 1921.3 MW thermal.
7:05 p.m.	CRO logs GSS logs	Main generator was off line.
9:57 p.m.	CRO logs GSS logs	All control rods were fully inserted. Mode switch was in refuel.
December 8 4:50 a.m.	CRO logs GSS logs	Reactor temperature was less than 212 degrees F.

*Indicates Estimated Times

GSS - Group Shift Supervisor
CRO - Control Room Operator
STA - Shift Technical Advisor
SCR - Security Card Reader
PSC - Plant Computer System
SAR - Sequence of Alarm Recorder
GOS - Group Operations Supervisor

APPENDIX 3

Persons Contacted

The following licensee personnel attended the below listed meetings to support the Oyster Creek AIT.

1. AIT Entrance Meeting - December 8, 1989

GPU Nuclear Corporation

M. Heller, Oyster Creek Licensing Engineer
J. Barton, Deputy Director Oyster Creek Nuclear Generating Station
P. Scallon, Manager Plant Operations, Oyster Creek
R. Feuti, Manager - Site Quality Assurance
V. Foglia, Manager Technical Functions Osyter Creek Site
A. Rone, Plant Engineering Director
R. Barrett, Plant Operations
D. Ranft, Manager Plant Engineering
W. Popow, SS Special Project Director
J. DeBlasio, Manager, Project Engineering
E. Roessler, Manager Nuclear Safety
D. MacFarlane, Site Audit Manager
E. Fitzpatrick, VP/Director Oyster Creek
J. Sullivan, Licensing/Parsippany
G. Busch, Licensing/Oyster Creek

U.S. Nuclear Regulatory Commission

E. Collins, Senior Resident Inspector
T. Easlick, Operations Engineer
R. Conte, Chief, Boiling Water Reactor Section
D. Lew, Resident Inspector
T. Koshy, Senior Reactor Engineer

State of New Jersey

N. DiNucci, New Jersey DEP/BNE

2. Human Performance Evalaution System Debrief for AIT - December 8, 1989

GPU Nuclear Corporation

M. Heller, Oyster Creek Licensing Engineer
G. Busch, Oyster Creek Licensing Manager
B. Barrett, Director Oyster Creek Operations
R. Gepmawn, Nuclear Safety Assessment Director
E. Roessler, Manager Nuclear Safety
E. Griffin, HPES Coordinator

U.S. Nuclear Regulatory Commission

T. Easlick, Operations Engineer
R. Conte, Chief, Boiling Water Reactor Section

3. Plant Transient Review Group for AIT - December 8, 1989

GPU Nuclear Corporation

Paul J. Crosby, Supervisor Operations Engineering
R. Newberry, Non-PTRG member (assistant)
J. E. Frank, STA - Plant Analysis
Phil Scallon, Manager Plant Operations

U.S. Nuclear Regulatory Commission

R. Conte, Chief, Boiling Water Reactor Section
D. Lew, Resident Inspector
T. Easlick, Operations Engineer

4. AIT Exit Meeting - December 12, 1989

GPU Nuclear Corporation

M. Heller, Oyster Creek Licensing Engineer
E. Fitzpatrick, VP/Director Oyster Creek
J. Barton, Deputy Director Oyster Creek
V. Foglia, Manager T.F. Oyster Creek Site
D. Robillard, Quality Assurance Audits
R. Sullivan, Emergency Preparedness Manager
E. Scheyder, Site Services
S. Polon, GPUN Communications
R. Feuti, Manager - Site Quality Assurance
D. Ranft, Manager Plant Engineering
E. Roessler, Manager, Nuclear Safety
P. Scallon, Manager, Plant Operations
A. Rone, Plant Engineering Director
P. Crosby, Supervisor Operations Engineer
R. Barrett, Plant Operations Director
G. Busch, Licensing Manager
J. Roegens, Licensing Engineer
W. Popow, Site Service

U.S. Nuclear Regulatory Commission

T. Easlick, Operations Engineer
R. Gallo, Chief, Operations Branch
R. Conte, Chief, Boiling Water Reactor Section
T. Koshy, Senior Reactor Engineer
L. Lois, Senior Reactor Engineer, NRR
D. Lew, Resdient Inspector
E. Collins, Senior Resident Inspector
M. Banerjee, Resident Inspector

State of Jew Jersey

N. DiNucci, State of New Jersey DEP
R. Ebright, NJ/DEP

5. Licensee Personnel Interviewed

F. Ciganik, GSS
J. Rumbin, GOS
J. Frank, STA
S. Hoy, R.O. Trainee
D. Brittner, CRO
D. Brac, CRO
J. Vermeylon, LCRO
B. Porsteer, Electrician
R. Scallon, Manager Plant Operations
R. Barrett, Plant Operations Director
E. Fitzpatrick, Director Oyster Creek

APPENDIX 4

Documents/Records Reviewed

1. GEK-5522, Steam Turbine - Generator Technical Manual Revision 5
2. Group Shift Supervisor Logs
3. Control Room Logs
4. Shift Technical Advisors Log
5. Station Procedure 619.3.014, "Condenser Low Vacuum Surveillance Calibration", Revision No. 7
6. Condenser Low Vacuum Switches and Associated Circuits Surveillance Test, Revision No. 7
7. Station Procedure 106, "Conduct of Operations", Revision 55
8. Emergency Operating Procedure EMG-3200,01, Revision 3 "RPV Control"
9. Technical Specifications
10. Emergency Plan Implementing Procedure 9473-IMP-1300.1, "Classification of Emergency Conditions", Revision 5
11. Station Procedure 619.3.014 data sheets performed 02/25/89, 11/22/86, 06/26/81, 12/08/89.
12. 2000-ANW-3200.01 "Reactor Scram"
13. Computer printout for condenser vacuum indicated
14. SAR printout
15. Station Procedure 323 "Main Condenser Circulating Water System", Revision No. 30
16. Operator/Personnel Statements
17. Station Procedure 2000-RAP-3024.03, "BOP Annunciator Response Procedure", Revision No. 24
18. Station Procedure 2000-ABN-3200.15 "Condensate High Conductivity", Revision No. 3
19. Station Procedure 198, "Equipment Control", Revision No. 45
20. Turbine Controls Lesson Plan Number 828.51
21. Post Trip Review Report Number PTRG 89-132, dated December 7, 1989
22. Licensee Interal Memorandum, dated December 10, 1989 A. Rone to File on "Analysis of December 7, 1989 Vacuum Transient"
23. Standing Order Number 41 "Procedure In Hand" requirement
24. GPU Nuclear Job Order - Gen Work - Main Condenser

APPENDIX 5

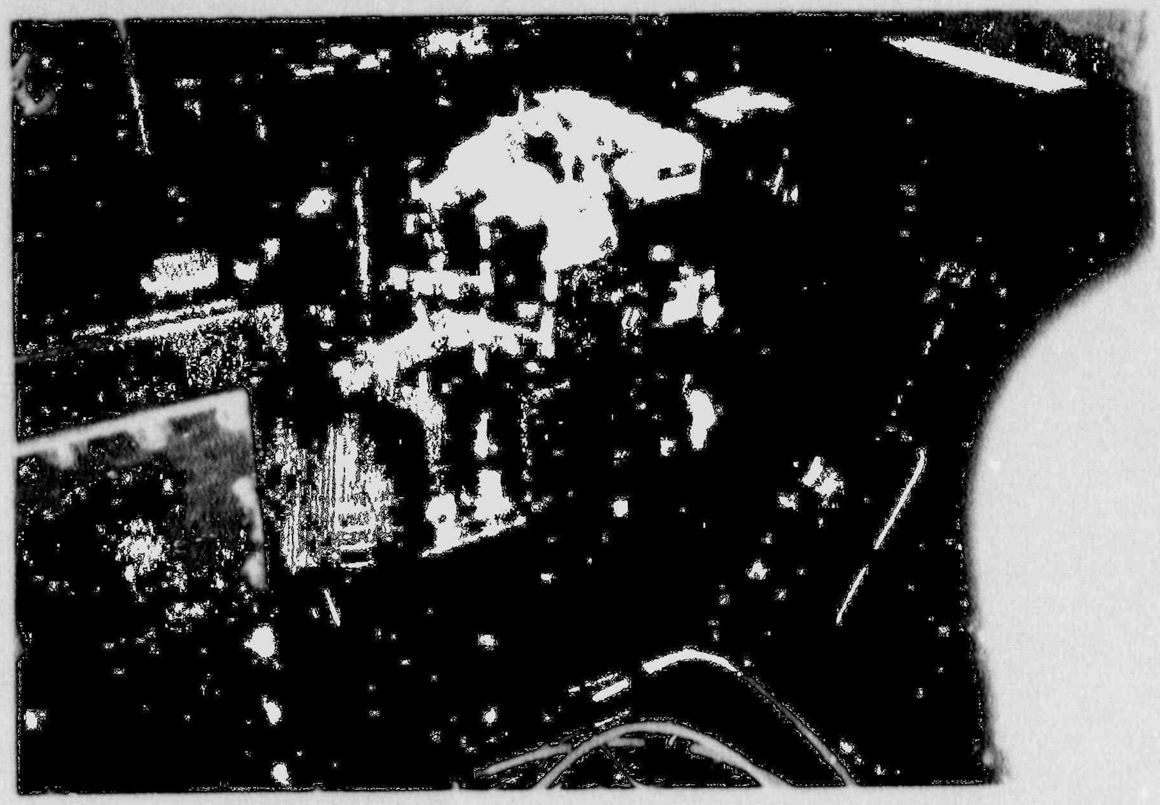
Charts/Figures

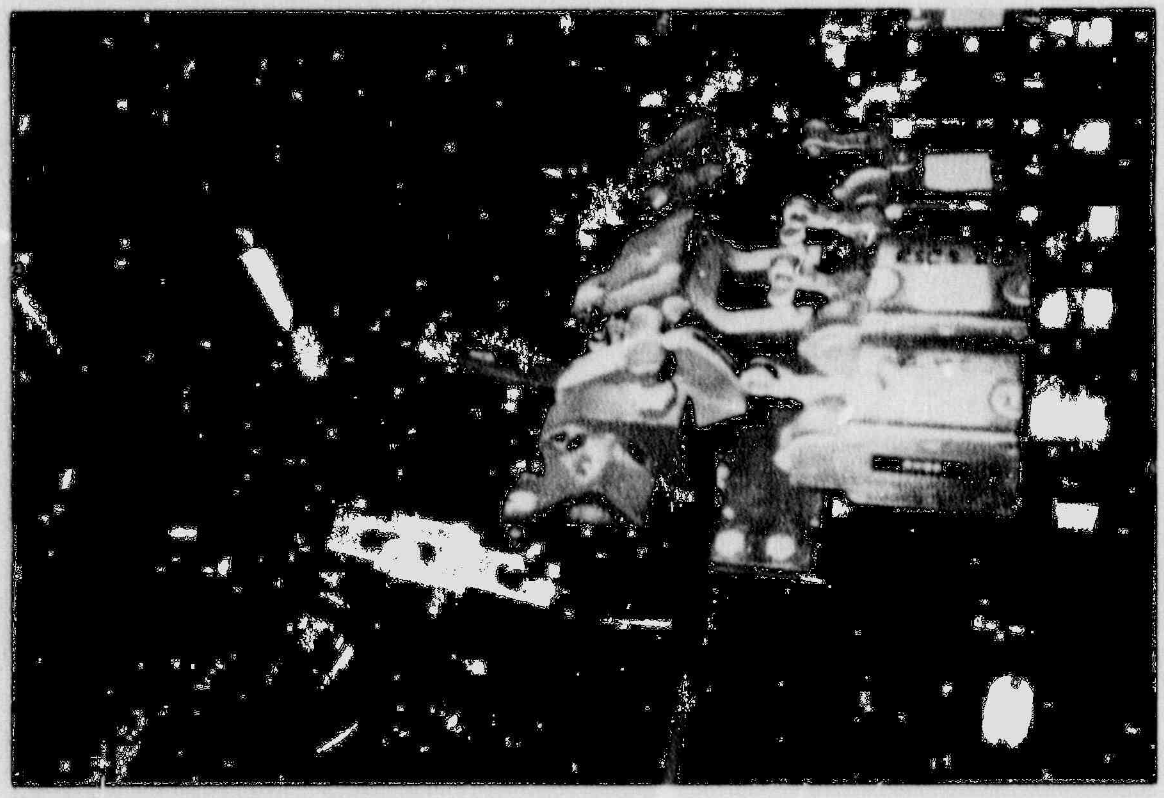
Attached are the following charts and figures to which the AIT report refers.

5-1 Vacuum Trip System Arrangement (Three Pictures on Two Pages)
5-2 Attachment 1 to Surveillance Procedure 619.3.014
5-3 Video Trend Display - of Key Plant Parameter During the Transient
5-4 Condenser Vacuum Computer Point Range 1 Display (2 Pages)

VIEW OF VACUUM TRIP SYSTEM NO. 1

OYSTER CREEK AIT 12/8 - 12/89



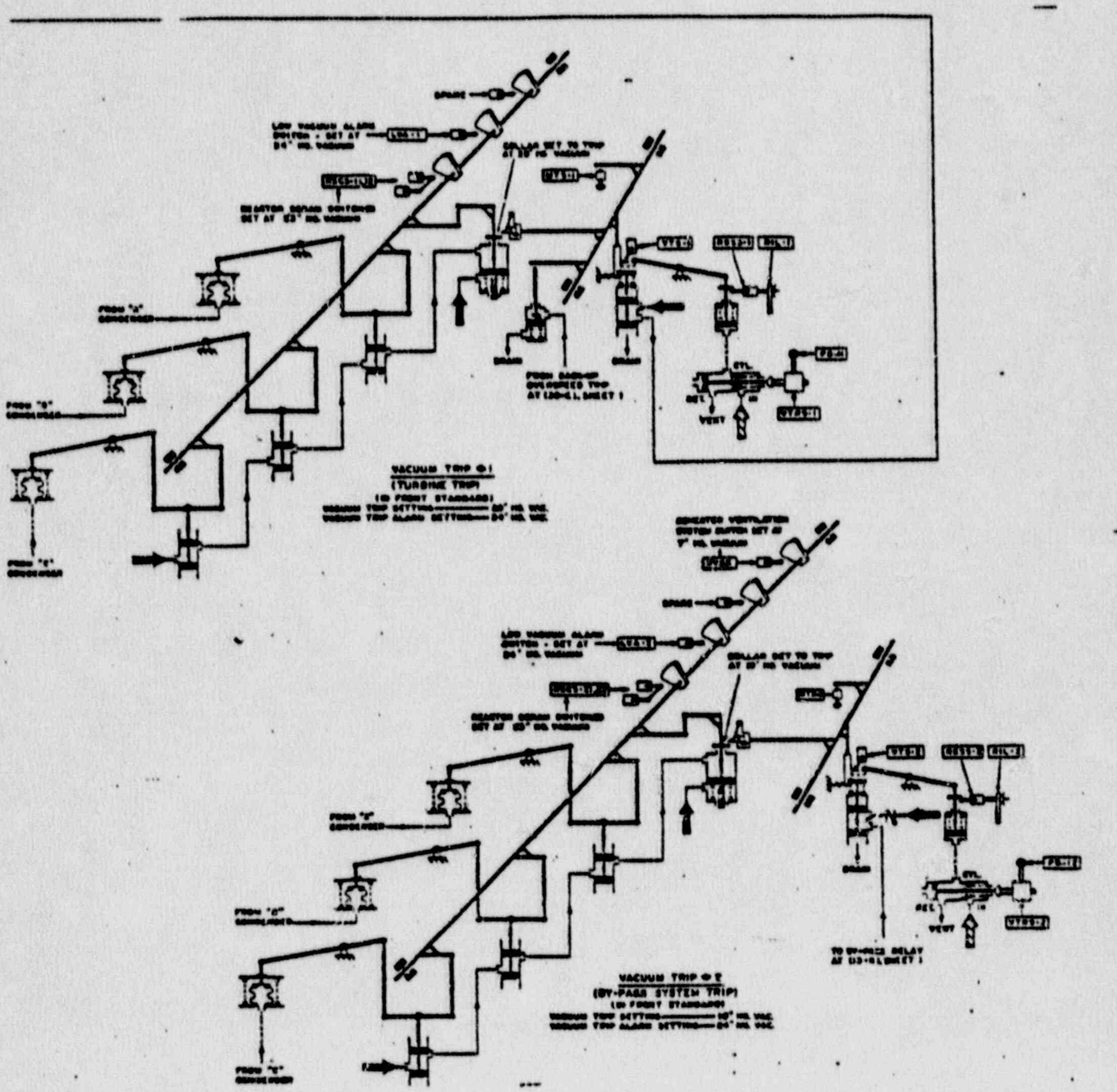


DIFFERENT VIEWS OF VACUUM TRIP SYSTEM

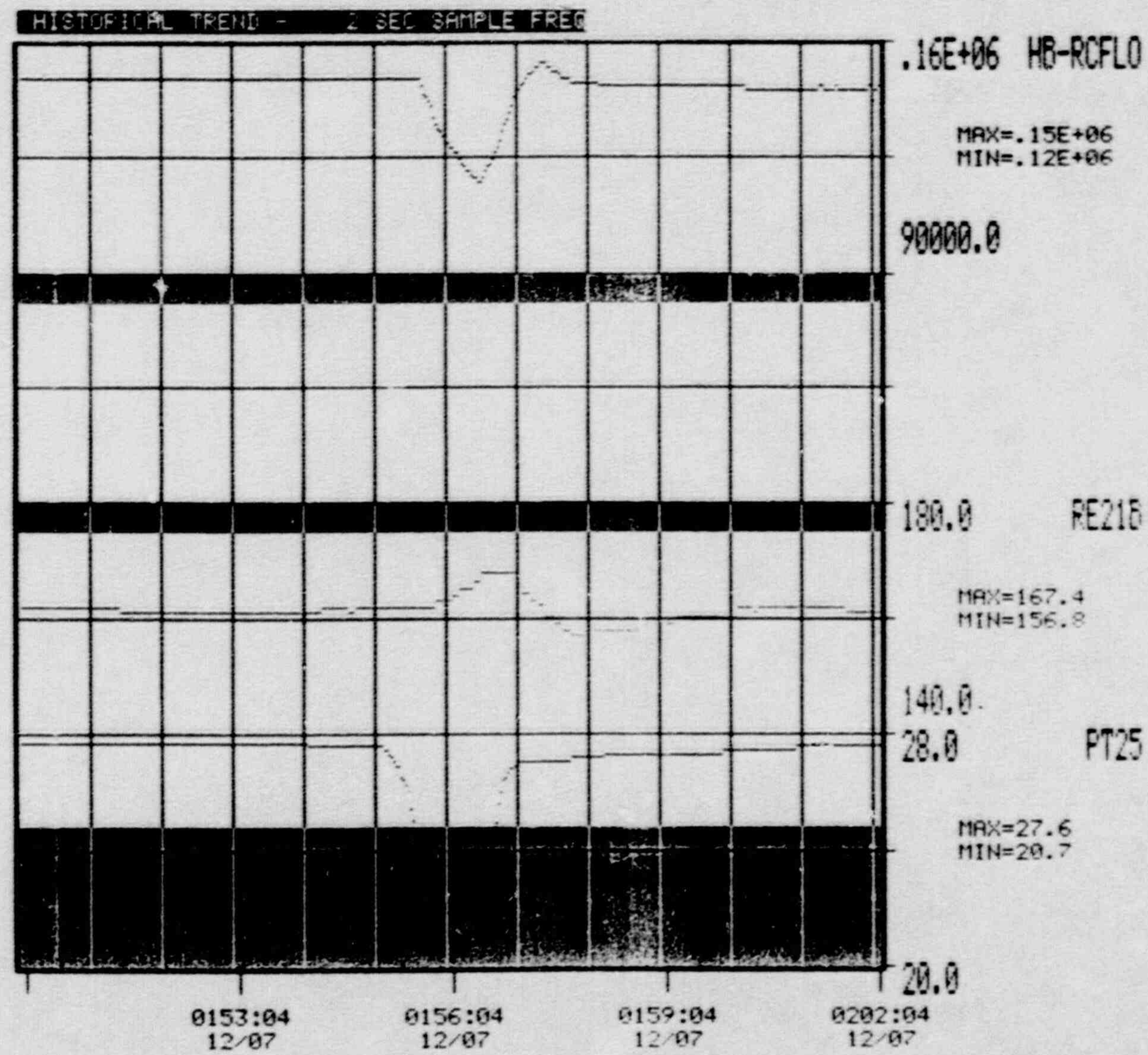
NO. 1 (TOP) NO. 2 (BOTTOM)

OYSTER CREEK AIT 12/8 - 12/89

ATTACHMENT 1



12/08/89 17:48:19 VIDEO TREND DISPLAY PAGE 1 OF 1



END TIME OFFSET +/-MINUTES

PAGE LT/RT

ØYSTER CREEK

CØNDENSER VACUUM

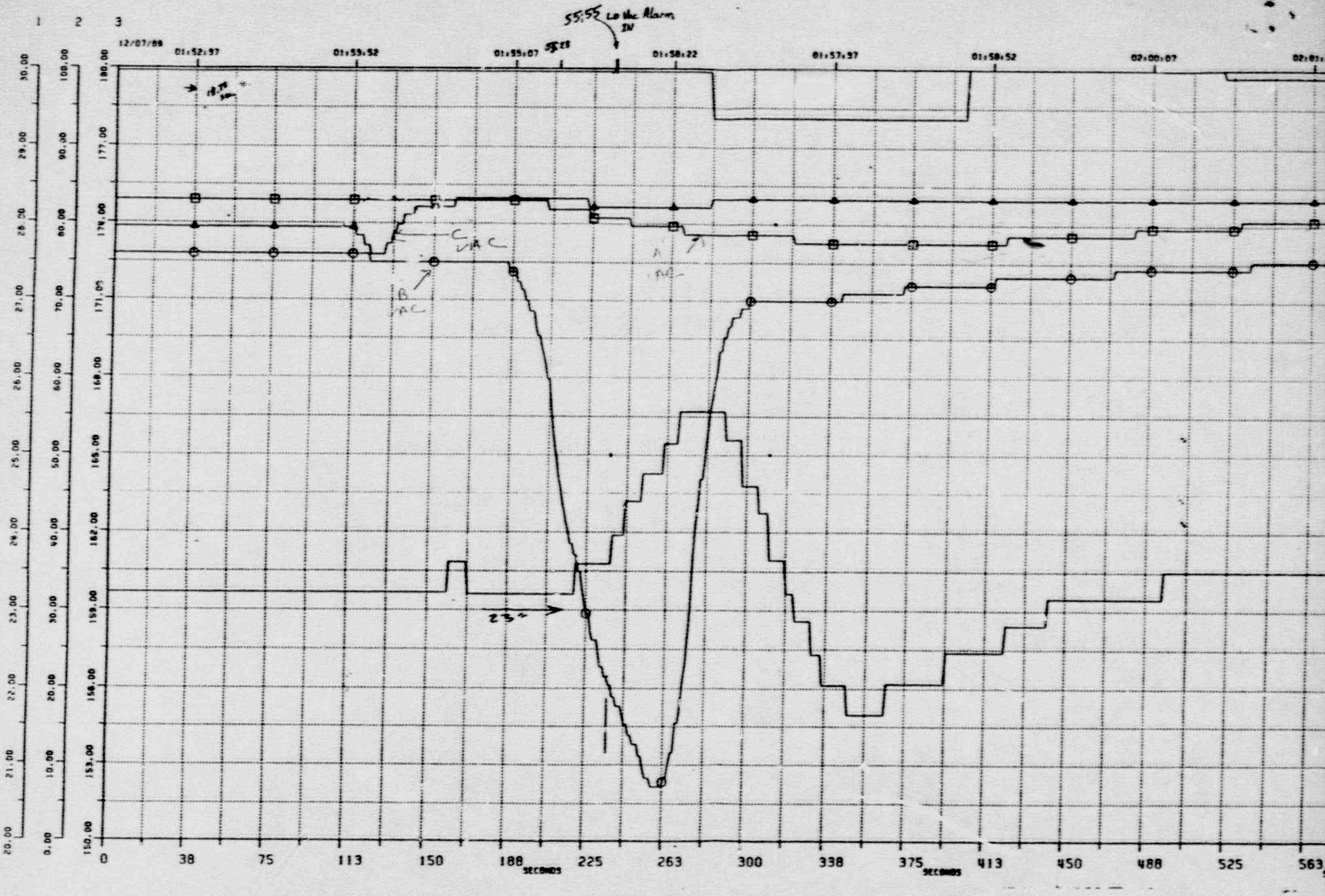
DATA FROM FILE: CP1

POINT ID	RANGE MINIMUM	MAXIMUM	ENG. UNITS	SCALE	SYM
PT24	20.00	30.00	INCHES HG	1	□
PT25	20.00	30.00	INCHES HG	1	○
PT26	20.00	30.00	INCHES HG	1	△
HB-CTP	0.00	100.00	PERCENT	2	
LTID13A	150.00	180.00	INCHES TAF	3	

SAMPLE RATE 1 SECONDS PER SAMPLE

START TIME 12/07/89 01:52:00

STØP TIME 12/07/89 02:07:00



1 2 3
12/07/89
01:52:37
01:53:52
01:55:07
01:56:22
01:57:37
01:58:52
02:00:07
55:55 Lo Vac Alarm IN
C VAC
B VAC
A VAC
23"
30.00 29.00 28.00 27.00 26.00 25.00 24.00 23.00 22.00 21.00 20.00
100.00 90.00 80.00 70.00 60.00 50.00 40.00 30.00 20.00 10.00 0.00
180.00 177.00 174.00 171.00 168.00 165.00 162.00 159.00 156.00 153.00 150.00
0 38 75 113 150 188 225 263 300 338 375 413 450 488 525 563
SECONDS