INVESTIGATION REPORT (Attachment to IE Rpt. 50-338/79-39)

SUBJECT: VIRGINIA ELECTRIC AND POWER COMPANY (VEPCO)
North Anna Unit #1
Docket No. 50-338

Statements by VEPCO representatives to the NRC following a turbine trip/reactor trip on September 25, 1979 that a release of radioactive gases (to the Auxiliary Building atmosphere) was in part caused by a control room switch being blocked with a pencil and paper binder clamp and failure to connect/ reconnect an orifice flange in the vent line from the High Level Waste Drain Tank.

DATE OF INVESTIGATION: October 2-17, 1979

PERFORMED BY:

C. E. Alderson — 10-17-79 (Date)
Regional Investigator
Office of the Director

R. J. Marsh — 10-18-79 (Date)
Regional Investigator
Office of the Director

ACCOMPANYING PERSONNEL: K. R. Mahan, Operator Examiner
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REVIEWED BY:

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I. INTRODUCTION

On the early morning of September 25, 1979, the North Anna Unit 1 turbine tripped due to problems in the feedwater heaters. This in turn caused a reactor trip. During the recovery from the reactor/turbine trip, a safety injection was initiated automatically due to low pressurizer pressure. During subsequent recovery manuevers an inadvertent overpressurization of the Volume Control Tank occurred and radioactive gases were vented to the High Level Waste Drain Tank (HLWDT) where they subsequently escaped to the Auxiliary Building atmosphere.

During the subsequent special inspection discussed in the inspection report to which this investigation report is appended, the NRC was made aware by the licensee that the vent line to the HLWDT was found to have been disconnected at the flange for restricting orifice RO-LW-104 and was open to the Auxiliary Building atmosphere. The licensee also informed the NRC that the VCT overpressurization was caused by the control switch for the VCT level control valve, LCV-1115A being blocked in the "VCT" position with a pencil and paper binder clamp. An investigation was initiated by Region II on October 1, 1979 and was conducted under the authority provided by Section 1.64 of Title 10, Code of Federal Regulations (10 CFR) to determine:

(1) the role played by the Volume Control Tank (VCT) level control switch for valve LCV-1115A, in the overpressurization of the VCT;

(2) the presence or absence of any blocking, jumper, or bypass mechanisms affecting the proper operation of LCV-1115A and the resultant impact of the presence/absence of such a device; and

(3) the facts and circumstances behind the failure to initially install or reinstall the design required restricting orifice, RO-LW-104, in the process vent system one-inch line, LW-81-152, leaving the vent line open to the atmosphere of the Auxiliary Building.

The results of the investigation are presented herein. Technical evaluation of the reactor/turbine trip event, safety injection initiation and release of radioactivity is addressed in IE Report No. 05-338/79-39 to which this investigation report is appended.

II. SCOPE

The investigation included the following activities:

A. Discussions with North Anna's Station Manager, his supervisory staff, and plant technical personnel regarding the range and depth of VEPCO's evaluation of the event which resulted in notification to the NRC that the blocking of the control switch for valve LCV-1115A in the Unit One control room with a paper binder clamp and pencil was the causative factor behind the release of radioactive gases to the Auxiliary Building atmosphere. These discussions also sought the reasons behind VEPCO's subsequent notification stating the reversal of their position on the involvement of the control switch for valve LCV-1115A.

B. Interviews with the shift supervisor and control room operators who were on duty at the time of the event.

C. Review of pertinent technical documentation which included parts drawings, schematic, logic, and loop diagrams, and system descriptions regarding the design and function of valve LCV-1115A and its associated level control switch, the VCT, the Coolant Volume Control System (CVCS), the Gaseous and Liquid Radwaste Systems, and the Boron Recovery System (BRS).

D. Review of the documentation recording the maintenance history of LCV-1115A.

E. Review of control room records including Standing Orders, Night Orders, Jumper Logs, Alarm Computer printouts, chart recorder traces, procedures and other records and documents.

F. Review of preoperational testing records and Conditional Release (System Turnover) Packages pertinent to the installation/removal of restricting orifice, RO-LW-104.

III. CONCLUSIONS

As a result of this investigation, the NRC representatives involved concluded the following:

1. The blockage of the control switch for the VCT level control valve, LCV-1115A with a paper binder clamp and pencil has been a routine practice known and condoned by the North Anna supervisory staff for a period in excess of six weeks. However, the switch was in its normal "AUTO" position immediately prior to and during the turbine trip and subsequent release of radioactive gases and did not contribute to the incident.

2. The overpressurization of the VCT and resultant release of radioactive gases through the process vent system and open restricting orifice, RO-LW-104 flange to the Auxiliary Building atmosphere was caused by the closure of the BRS gas stripper inlet valve due to high water level in the stripper. This valve closure blocked letdown flow causing lifting of the letdown line pressure relief valve, RV-1257 diverting letdown flow directly to the VCT until its capacity was exceeded which then caused lifting of the VCT relief valve.

3. No conclusion can be reached at this time regarding installation and/or removal of the restricting orifice, RO-LW-104, and its replacement with another fitting. While it appears that the orifice was originally installed, document reviews and personnel interviews did not provide any hard evidence as to when the orifice flange was disconnected or why.

4. Based on interviews with operating personnel, it appears that they are not aware of changes made to the Nuclear Power Station Quality Assurance Manual (NPSQAM) as a result of a previous Notice of Violation (dated May 25, 1979) regarding temporary modifications or the significance of these changes.

IV. DETAILS

A. Personnel Contacted

NRC

M. Kidd, Resident Inspector

VEPCO

W. R. Cartwright, Station Manager
J. D. Kellams, Superintendent-Operations
E. W. Harrell, Superintendent-Maintenance
S. L. Harvey, Operating Supervisor
R. A. Berquist, Assistant Instrument Supervisor
Shift Supervisor
Control Room Operator
Control Room Operator
Assistant Control Room Operator Trainee

B. Background Documents

The systems description contained in North Anna Unit 1 Safety Analysis Report (Sections 9.3.4.7, 9.3.4.23 and 9.3.4.24) pertinent to the Volume Control Tank and its controls are attached as Exhibit 1. Pertinent portions of the Westinghouse system description are also included as part of Exhibit 1.

C. Discussions with North Anna Management and Supervisory Staff

An entrance briefing covering the authority under which NRC's inquiry was being conducted, its scope, and objectives was conducted with North Anna Station Manager when the investigators arrived on site on October 2, 1979. During this initial discussion, the Station Manager advised the NRC representatives that VEPCO had additional information regarding the involvement of the Volume Control Tank level control switch (LCV-1115A) in the release of radioactive gases on September 25, 1979.

The Station Manager stated that further investigation by VEPCO had revealed that the control switch for the VCT had now been found to have not been blocked just prior to or during the event. He acknowledged this was a reversal of the position VEPCO had previously stated to the NRC Resident Inspector on September 26, 1979.

When queried as to how the initial position (e.g., that the control switch had been blocked) had been reached, the Station Manager advised that station supervisory staff had been aware that the control switch for the VCT had been routinely blocked with a paper "clip" and pencil (see Exhibit 2) by control room

operators for "quite some time" to avoid a problem of letdown flow leakage through LCV-1115A to the boron recovery system. This leakage problem was alleged by the Station Manager to be encountered when the control switch was permitted to remain in the AUTO position. The control switch for LCV-1115A was described as a three position switch, spring-loaded to return to the center (AUTO) position. The leakage was stated not to occur when the control switch was blocked to the VCT position.

The Station Manager continued that the VEPCO investigation linked the release of radioactive gases to an overpressurization of the VCT and reached a preemptive conclusion that the pencil and binder clamp blocking mechanism had been in place on the control switch (LCV-1115A) at the time of the incident. The assumed presence of the blocking mechanism accounted for the overfilling of the VCT with letdown flow and, hence, its overpressurization and the subsequent lifting of VCT relief valve, RV-1257 releasing the radioactive gases to the HLWDT and then to the Auxiliary Building via the open process vent system line LW-81-152.

Subsequent to VEPCO's announcement regarding blocking of the control switch, the control room operators (who had not previously been questioned by VEPCO's investigative team specifically concerning the blocking of the control switch) informed their supervisory staff that the control switch had been in an unblocked condition during the event. The CROs allegedly explained that nearly the entire shift (12-midnight until the trip) had been spent in the dilution mode to lower the boron concentration of the RCS. According to the Station Manager, accomplishment of this dilution routine precluded LCV-1115A being blocked in the VCT position for any substantial period of time.

At the conclusion of the entrance briefing the Station Manager and his staff were advised that NRC's investigation would proceed as planned to ascertain the facts and circumstances surrounding the release of radioactive gases on September 25, 1979. It was explained this effort would include a determination of the degree of involvement (if any) of the control switch and the significance any blocking of this control may have had in the event.

D. Personnel Interviews

1. NRC Resident Inspector

On October 2, 1979, the NRC Resident Inspector at VEPCO's North Anna nuclear plant was interviewed regarding his knowledge of the control switch blocking matter and the general sequence of events associated with the September 25, 1979 incident. The inspector provided the investigators with a chronology of the events as detailed in the inspection report. The inspector stated that he was informed that

VEPCO mentioned the blocking of LCV-1115A during a series of briefings held on the evening of September 25 which were conducted by VEPCO's Vice President-Power Supply and Production Operations. The inspector was informed that during this briefing, attended by NRC:IE headquarters staff, VEPCO made mention of the diverting of LCV-1115A to the VCT position.

During an exit briefing conducted at approximately 11:00 a.m. on September 28, 1979, the inspector was advised by the North Anna Station Manager that VEPCO had discovered the reason why the VCT level control valve did not divert. The Station Manager also relayed information received from Stone and Webster that it had been concluded that a release of activity would have occurred even if the restricting orifice had been properly installed.

The inspector stated that the Station Manager's explanation of the failure of the VCT level control valve to divert flow from the VCT included an admission that the blocking of the control switch for LCV-1115A had become a routine practice, known to the supervisory staff, as a solution to a leakage problem with LCV-1115A. It was indicated that LCV-1115A had an extensive leakage history and licensee management surmised, with no specific knowledge, that the blocking of the switch to the VCT position probably originated as a temporary "fix" for the leakage problems which complicated Primary Coolant Leak Rate Tests conducted early in 1979.

2. North Anna Station Manager

An interview was conducted with the Station Manager late on October 2nd in followup to his comments expressed during the entrance meeting. The Station Manager reiterated during the interview that the CROs had been performing a dilution of the RCS with primary grade water to lower the boron concentration for nearly the entire shift prior to the turbine/reactor trip. He stated that all of the control room staff expressed a willingness to the VEPCO investigative team to provide signed statements to that effect and to the "fact" that the LCV-1115A was not maintained in a blocked condition during their shift.

Regarding the installation of the restricting orifice, the Station Manager stated that he was sure the "turnover packages" for affected systems would reflect "walk down" inspections of the systems during approximately September 1977. He felt this would show that the orifice had been installed at that time.

3. North Anna Superintendent of Operations

The Superintendent of Operations was interviewed on October 3, 1979. When asked to provide a brief resume of his experience in the nuclear field, he stated he had approximately seven years experience in the U.S. Navy's nuclear program and had been employed with VEPCO since 1969. The Superintendent of Operations stated he had been assigned to the North Anna facility since January 1975.

He told the NRC representatives that he had arrived routinely in the Unit 1 control room at approximately 6:40 a.m. on the day of the event with no prior notification of the trip. He recalls that at that time the crew already had the RCP pumps restarted and that there was no apparent problem with the VCT. He continued that the first indication he noted of any difficulties was the sounding of radiation alarms for the Auxiliary Building at approximately 6:50 a.m.

The Superintendent of Operations acknowledged that the blocking of the control switch had been routine practice for a "couple of months". He stated this had to be done to preclude leakage through LCV-1115A. He claimed it was he who discussed the presence of the pencil and paper clamp with the Station Manager on September 25th just after the trip. He stated to the NRC representatives, "I thought I remembered seeing the clip (on entering the control room)". However, he also stated that he had no discussion with the operators concerning the blocking of the control switch at that time. He stated he did discuss the blocking of the LCV-1115A with the Operating Supervisor prior to the Operating Supervisor's interviewing the CROs later in that week (September 26, 27, 28).

The Superintendent of Operations indicated he subsequently found out the CROs had been "blending at 60 gpm" and that he knows a dilution sequence can not take place with the control switch blocked in the VCT position.

He had no recollection or knowledge of entries in the Standing Order or Night Order book in the control room, or any other existing memoranda regarding the blocking of the control switch.

He also stated he could add nothing to what little was known concerning the restricting orifice.

4. North Anna Operating Supervisor

The Operating Supervisor was interviewed on October 3, 1979. In a brief summary of his work experience in the nuclear

field, the Operating Supervisor stated he had been in the U.S. Navy's nuclear program from 1961 until 1969. He stated he joined VEPCO in 1969 and worked at the Surry 1 and 2 facility until 1974 at which time he was assigned to North Anna.

The Operating Supervisor indicated he was notified of the turbine/reactor trip at his residence by telephone at 6:13 a.m. on the day of the event by the Shift Supervisor. Arriving in the control room of Unit One at approximately 7:00 a.m., he remembers that the Station Manager and Superintendent of Operations were already present.

Following a short briefing by the Shift Supervisor of the events and actions that had occurred up to that time, he recalls that he observed that both VCT level and pressure were high. He stated he began to manually work with the control switch for LCV-1115A to reduce the pressure and re-establish a "bubble" in the VCT. He specifically recalls noting the absence of a pencil and "clip" (paper clamp) on the control switch at that time. He also recalls making the assumption that the blocking mechanism "must have" been in place before the turbine/reactor trip.

He told the NRC representatives that there have been "quite a lot of problems" with LCV-1115A and numerous maintenance requests (MR's) have been submitted over the past months. He also stated similar problems have (and are) being encountered on the equivalent valve installed in North Anna Unit 2 (LCV-2115A).

Regarding the missing restricting orifice, RO-LW-104 in the process vent system line LW-81-152, the Operating Supervisor stated he had no knowledge of how or why the restricting orifice had been removed/replaced with an elbow. He did state, however, that he recalls observing a hose connected to the subject fitting at some time in the past. When pressed for details, the Operating Supervisor could only recall it was "way back", possibly months ago and he recalled observing the connected hose during a walking tour. He does not remember making any check of where the connected hose terminated or what its purpose was.

5. North Anna Control Room Staff

On October 3 and 4, 1979, members of the "B" shift crew who were on duty on September 25, 1979 during the turbine trip/reactor trip sequence and subsequent recovery efforts were interviewed by NRC representatives. At the conclusion of these interviews on October 4, 1979, the Shift Supervisor and two control room operators were requested to provide

written statements regarding their knowledge of the event and blocking of the LCV-1115A control switch. Copies of these statements are attached as Exhibit 3A, 3B and 3C.

The statements of each of the control staff were in agreement with facts and circumstances of the event as known. The Shift Supervisor was unsure of the exact time the dilution process was initiated and approximated it at 1:00 a.m. whereas statements of the CRO who alleges he began the sequence places the time closer to 12:20 a.m.

None of the operating staff interviewed expressed any knowledge of the restricting orifice being removed or the history of its installation.

All were in agreement concerning the routine blocking of the control switch for LCV-1115A due to a continuing leakage problem. None had a firm recollection of just how long this practice had been in effect, but all were in general agreement it was in excess of six weeks. One individual stated that the procedure of blocking the control valve may have been in effect "six to eight months ago".

Each of these individuals were asked if they were aware of the noncompliance identified by NRC inspectors early in 1979 regarding control of temporary modifications (jumpers and lifted leads) or of the changes made to Section 14 of the NPSQAM as a result of the noncompliance. Each was also asked to explain his understanding of Section 14 of the NPSQAM. Their responses indicated that, while some were aware that the NPSQAM had been revised, they were not familiar with the revision or its significance. Each also stated that they had not received any training regarding the revision.

E. Review of Strip Chart Records

The statements of VEPCO operating personnel that they had initiated RCS dilution shortly after assuming duty at midnight, September 24th (0001 hours, September 25th) are corroborated by the strip chart recorder tracing for that date which records utilization of primary grade water and a second strip chart record (multifunction) which reflects Boron Recovery System gas stripper water level. Copies of these tracings are provided as Exhibit 4.

The primary grade water record reflects the initiation of dilution (e.g., increased utilization of primary grade water) at approximately 12:15 a.m. The addition of primary grade water to the CVCS continues at a indicated rate of approximately 55 gallon per minute until approximately 6:15 a.m. A brief interruption at approximately 5:30 a.m. was explained by a CRO as having occurred

when he shutdown the dilution process for a short period to check other parameters in the control room to assure himself "everything was OK" prior to resuming the dilution.

The BRS gas stripper water level is reflected on the strip chart as having increased just after B shift assumed duty at midnight and continued at an elevated level until approximately 7:05 a.m. to 7:10 a.m. (indicated) when it spiked rapidly upward, sustained an apparent trip of the stripper inlet valve (TV-BR-111A) and rapidly dropped to lower levels. A second spike (and apparent inlet valve closure) follows approximately 30 minutes later.

This is in agreement with statements made by the CRO that at one point during the problem with the VCT level and pressure increase, he noted that valve, TV-BR-111A had tripped closed. The Assistant CRO Trainee stated when interviewed that he had noticed that TV-BR-111A had tripped closed and that he reset (opened) it, but he could not state the time at which he accomplished this.

Since the record of BRS stripper level appeared not to correlate with other events time-wise, a reenactment of how the CRO annotated the time reference marks on the chart was accomplished at the request of the NRC investigators. This revealed an inherent lag of approximately ½ inch (30 minutes) between the time hack mark drawn by the CRO and the actual point of the recorder pen (within the interior of the mechanism) at the time the hack mark was made. Correcting the "indicated" time reflected above, to "true" time places the initial BRS stripper water level spike (and trip valve closure) at approximately 6:40 a.m. This appears to support the conclusion that the closing of the BRS gas stripper inlet valve blocked letdown flow causing the letdown line pressure relief valve to lift, diverting letdown flow directly into the VCT. The VCT then overfilled and overpressurized, thus opening the VCT relief valve (RV-1257) and venting the compressed gases in the VCT to the HLWDT.

F. Review of Drawings and Maintenance History of LCV-1115A

A review of maintenance records (MR's) provided by VEPCO regarding the VCT level control valve, LCV-1115A revealed six (6) closed maintenance reports addressing the operation of this valve. Five identify leakage as the problem and the sixth stated the valve was stuck in mid-position. Also provided was one open MR.

A summary of their status is provided below:

Date	Problem	Corrective Action Taken
Completed		
07-22-78	Leaking	Realigned limit arm
10-05-78	Stuck Mid-Position	Realigned limit arm
05-01-79	Leaking	Adjusted-Parts Awaited (Jan. 28 MR)
05-06-79	Leaking	Voided-Deferred to January 28 MR
05-23-79	Leaking	Voided-Deferred to January 28 MR
07-09-79	Leaking	Cancelled
Pending		
01-28-79	Leaking	Parts ordered

The Station Manager indicated that repair/replacement of the valve was held in abeyence after receipt of the January 28, 1979 Maintenance Request due to the location of LCV-1115A in a high radiation area. It was stated that the necessary repair is programmed for accomplishment during the current refueling outage. He also stated that an engineering evaluation of the valve was to be conducted.

Based on a review of the drawings concerning the control of LCV-1115A, the investigator determined that blocking the switch in the VCT position caused instrument air supply of 20 psig to be placed on the valve diaphragm operator as opposed to a maximum of 15 psig which would normally be applied to the valve operator when the switch is in the AUTO position. This would provide additional force to seat the valve and reduce leakage through the valve.

G. Review of the Preoperational Testing Packages

Review of the Unit 1 Preoperational Testing and Conditional Release (System Turnover) packages was accomplished by the NRC representatives in an attempt to confirm the installation of the restricting orifice RO-LW-104 or to determine what test procedures, if any, required its removal/replacement with an elbow. A review of the packages for the liquid and gaseous waste systems failed to identify any confirmation of its installation, acknowledgement of its presence/absence during an inspection, or require its removal/replacement with another fitting during any reviewed testing procedure.

The NRC representatives were provided a copy of a Stone and Webster Advisory Engineering Daily Log report for December 2, 1976 containing an entry listing the installation of the orifice on that date (Exhibit 5).

No other specific information was identified regarding the installation of the restricting orifice, RO-LW-104, or its (subsequent) removal/ replacement with other fittings. VEPCO stated they were continuing their search for documentary information on the history of this part.

H. Exit Briefings and Licensee Comments

An exit briefing was conducted with the Station Manager and the Superintendent of Operations on the afternoon of October 4, 1979. At that time the Station Manager was advised of the actions taken by the investigation team as well as their results and conclusions. It was stated that two apparent items of noncompliance with NRC rules and regulations (10 CFR 50.59) had been identified and would be further researched prior to their inclusion in the inspection report.

The Station Manager stated he and his staff accepted full responsibility for the failure to analyze and document the use of the blocking mechanism utilized on the control switch for LCV-1115A and, further, that this practice had been abolished and written directives to this end had been issued.

The investigators asked if any other switches had been similarly blocked and both the Station Manager and the Superintendent of Operations indicated that to their knowledge the control switch for LCV-1115A was the only one which had ever been blocked.

Regarding the missing restricting orifice in the process vent system, the Station Manager stated it was reinstalled and the vent piping was reconnected immediately after the event and a detailed analysis of its removal and other considerations brought about by the event was underway.

I. Review of Emergency Plan Implementation

Subsequent to the completion of the on-site portion of the investigation into the matters addressed in Paragraphs A-H above, the scope of the investigation was expanded to include a review of the implementation of the North Anna Emergency Plan with regard to the unplanned release of radioactive material on September 25, 1979. The additional investigative activity was to determine whether or not the licensee should have declared an "Emergency Alert" in response to the release.

On October 16, 1979, the investigator reviewed Section 4 of the North Anna Emergency Plan, Alarm Procedure 1-AP-5.14, and Emergency Plan Implementing Procedures EPIP-1 (dated 11-03-76), EPIP-2 (dated 08-15-77) and EPIP-11 (dated 11-13-78) which deal with uncontrolled or unplanned releases and which were available in the Region II office. The investigator also contacted a Region II Radiation Specialist who was then at the North Anna site and requested that he determine whether or not EPIP-1, EPIP-2 and EPIP-11 had been initiated following the release of radioactive material. The Radiation Specialist was also asked to reconfirm radiation monitoring data and other information provided to the NRC representatives during the special inspection conducted following the event.

On October 17, 1979 the Radiation Specialist and Resident Inspector provided the following information to the investigator by telephone. The Radiation Specialist stated that he had been informed by licensee personnel that the Emergency Plan Implementing Procedures had not been implemented following the release of radioactive material on September 25, 1979. Licensee personnel stated that following the receipt of radiation monitor alarms, the North Anna Health Physics group was notified at 7:10 a.m. and a grab sample was obtained from the process vent at 7:30 a.m. Analysis of this sample indicated radioactivity levels near background level. The licensee stated that grab samples were then obtained from Ventilation Vents A and B at 7:55 and 8:03 a.m., respectively. The analytical results of these samples are presented in the inspection report to which this report is appended. Based on these sample results, the licensee determined that the release had not exceeded any regulatory limits and no off-site radiological hazard existed.

With regard to implementation of the Alarm Procedures and Emergency Plan Implementing Procedures, the Resident Inspector and Radiation Specialist determined that the CRO had taken the steps required by Alarm Procedure 1-AP-5.14 which included turning off the ventilation supply and exhaust blowers for the affected areas and switching the discharge flow path to utilize the HEPA filters.

Licensee representatives stated that the Emergency Plan implementing procedures were not initiated, per se because the grab sample analytical results indicated that no significant radiological hazard existed.

The investigator performed the calculations required by EPIP-11 using strip chart recorder data which would have been available to control room personnel at the time of the release and determined that at the time of maximum release rate, EPIP-11 would have indicated a release rate of approximately 1600 Ci/hr which would have required an "Emergency Alert" per EPIP-1 criteria. However, the investigator also noted that the activity levels indicated by the strip charts decreased fairly rapidly and determined that if activity levels indicated on the strip chart four to five minutes later were used in performing the EPIP-11 calculations, the calculated release rate would not have warranted an "Emergency Alert" under EPIP-1 criteria. Further, the investigator determined that declaration of an "Emergency Alert" condition does not require any specific notifications of the condition in that neither off-site nor general on-site hazards exist. Individuals in the affected areas within the plant were notified and evacuated the area. Declaration of this condition requires the licensee to obtain grab samples, analyze them, determine the problem, and proceed with corrective actions; which the licensee did.

Based on the review of procedures EPIP-1, EPIP-2 and 1-AP-5.14, and the actions taken by the licensee during the release, it appears that these procedures could be enhanced by clarification regarding the use of supervisory judgment or calculated data based on control room radiation monitoring indications for initial assessment and classification of incidents versus later assessments based on analytical results of grab samples. This will be reviewed in more detail during future inspections.

discharged to the primary drain transfer tank in the Waste Disposal System.

An alternate letdown path from the Reactor Coolant System is provided in the event that the normal letdown path is inoperable and for draining an isolated reactor coolant loop. Reactor coolant can be discharged from a cold leg and flows through the tube side of the excess letdown heat exchanger. Downstream of the heat exchanger, a remote-manual control valve controls the excess letdown flow. The flow normally joins the number 1 seal discharge manifold and passes through the seal water return filter and heat exchanger to the suction of the charging pumps. The excess letdown flow can also be directed to the primary drain transfer tank. When the normal letdown line is not available, the normal purification path is also not in operation. Therefore, this alternate condition would allow continued power operation for limited periods of time dependent on Reactor Coolant System chemistry and activity. The excess letdown flow path is also used to provide additional letdown capability during the final stages of plant heatup. This path removes some of the excess reactor coolant due to expansion of the system as a result of the Reactor Coolant System temperature increase. In this case, the excess letdown is diverted to the primary drain transfer tank.

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Surges in Reactor Coolant System inventory due to load changes are accommodated for the most part in the pressurizer. The volume control tank provides surge capacity for reactor coolant expansion not accommodated by the pressurizer. If the water level in the volume control tank exceeds the normal

operating range, a proportional controller modulates a three way valve downstream of the reactor coolant filter to divert a portion of the letdown to the Boron Recovery System. If the high-level limit in the volume control tank is reached, an alarm is actuated in the Main Control Room and the letdown is completely diverted to the Boron Recovery System.

The Boron Recovery System (Section 9.3.5) receives and processes reactor coolant effluent for reuse of the boric acid and purified water. The system decontaminates the effluent by means of demineralization and gas stripping, and uses evaporation to separate and recover the boric acid and primary grade water.

Low level in the volume control tank initiates makeup from the reactor makeup control system. If the reactor makeup control system does not supply sufficient makeup to keep the volume control tank level from falling to a lower level, an emergency low level signal causes the suction of the charging pumps to be transferred to the refueling water storage tank.

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9.3.4.2.2 Chemical Control, Purification and Makeup System

pH Control

The pH control chemical employed is lithium hydroxide. This chemical is chosen for its compatibility with the materials and water chemistry of borated water/stainless steel/zirconium/inconel systems. In addition, lithium-7 is produced in the core region due to irradiation of the dissolved boron in the coolant.

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Volume Control Tank

The volume control tank provides surge capacity for part of the reactor coolant expansion volume not accomodated by the pressurizer. When the level in the tank reaches the high level setpoint, the remainder of the expansion volume is accommodated by diversion of the letdown stream to the Boron Recovery System. It also provides a means for introducing hydrogen into the coolant to maintain the required equilibrium concentration of 25-35 cc hydrogen (at STP) per kilogram of water and is used for degassing the reactor coolant, and serves as a head tank for the charging pumps.

A spray nozzle located inside the tank on the letdown line nozzle provides liquid to gas contact between the incoming fluid and the hydrogen atmosphere in the tank.

For degassing, the tank is provided with a remote operated solenoid valve backed up by a pressure control valve which ensures that the tank pressure does not fall below minimum operating pressure during degassing to the Waste Disposal System. Relief protection, gas space sampling, and nitrogen purge connections are also provided. Relief discharges from the letdown line and the seal water return line go to this tank.

Volume control tank pressure and temperature are monitored with indication given in the Main Control Room. Alarm is given in the Main Control Room for high and low pressure conditions and for high temperature.

Two level channels govern the water inventory in the volume control tank. These channels provide local and remote level indication, level alarms, level control makeup control, and emergency makeup control.

If the volume control tank level rises above the normal operating range, one channel provides an analog signal to a proportional controller which modulates the three-way valve downstream of the reactor coolant filter to maintain the volume control tank level within the normal operating band. The three-way valve can split letdown flow so that a portion goes to the Boron Recovery System and a portion to the volume control tank. The controller would operate in this fashion during a dilution operation when primary water is being fed to the volume control tank from the reactor makeup control system.

If the modulating function of the channel fails and the volume control tank level continues to rise then the high level alarm will alert the operator to the malfunction and the letdown low can be manually diverted to the Boron Recovery System. If no action is taken by the operator and the tank level continues to rise, the full letdown flow will be automatically diverted.

During normal power operation, a low level in the volume control tank initiates auto makeup which injects a pre-selected blend of boron and water into the charging pump suction header. When the volume control tank is restored to normal, auto makeup stops.

3.3.4 Level Controls

a. LT-112, LT-115, LCV-115A,B,C,D & E

These volume control tank level transmitters provide the following:

LT-115 - (1) High and Low level alarms
(2) Initiation of automatic makeup on low level
(3) Indication of level on the vertical control board
(4) Actuation of valves LCV-115B,C,D,E in combination with LT-112 in transfer of suction of charging pumps to RWST from VCT on low-low level
(5) Actuation of LCV-115A to divert entire letdown stream to the boron recycle system on high level

LT-112 - (1) Provides a proportional control signal for the modulating function on the three-way diversion valve LCV-115A leading to VCT and BRS
(2) Provides a signal for actuation of valves LCV-115B, C,D,E in combination with LT-115 in transfer of suction of charging pumps to RWST from VCT on low-low level

Normally the water level in the tank will vary between a pre-set proportional band of level in a region above the makeup point, by modulating the three-way valve LCV-115A. A level controller diverts as necessary the letdown to either the Volume Control Tank, Boron Recycle System or both, to accommodate 1) Normal variations in inventory of the reactor coolant system because of the dead-band in the Reactor Control and protection system temperature instrumentation, 2) Variations due to changes in power level wherein makeup has been added to adjust the chemical concentration, and 3) Makeup added to account for normal plant leakage.

A remote manual control station is provided in the main control room for manual positioning of the modulating valve.

Filling of the tank to and beyond the upper limit of the level control band will divert the entire letdown to the BRS. Failure

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to divert the letdown to the BRS at this point will, on continued filling of the tank to a preset high level, cause diversion from the separate control channel to prevent overpressurization of the VCT.

The high and low level alarms are set to actuate when approaching the high level diversion point, and the low level alarm is set to actuate when the tank level drops below the point required for automatic makeup but before low-low level transfer of suction to the RWST.

b. LT-161, LT-106, LT-163, LT-108, LT-165, LT-102

These level transmitters on the boric acid tanks each provide an input to level indicators in the main control room and provide for intiation of high, low, and low-low level alarms.

The level in a tank between high and low level alarm is the normal operating region, and the included volume is equivalent to that required for a refueling shutdown.

High level alarm indicates the approach to the maximum design level before overflowing of the tank would occur.

Low level alarm indicates the approach to the minimum volume necessary for an emergency cold shutdown with a stuck control rod.

Low-low level alarm actuation indicates the level where the remaining volume in the tank is the cold shutdown margin.

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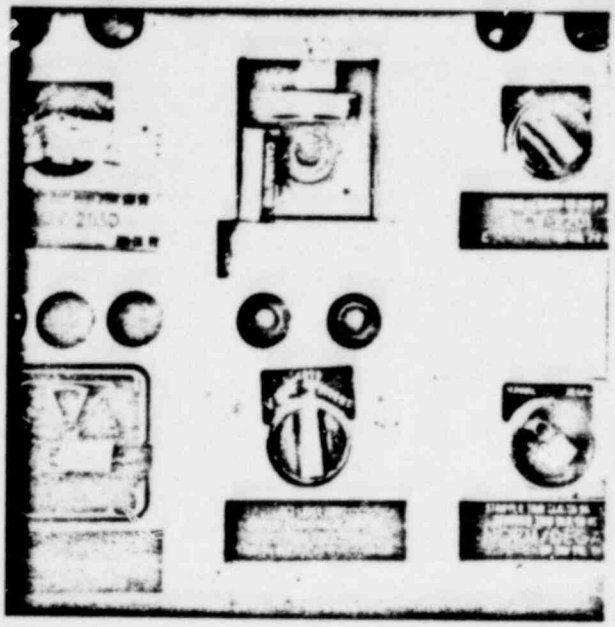

FY 12-02

The above depicts the Unit 2 equivalent (LCV 2115A) VCT Level Control Switch and the components of the blocking device utilized. The manner of installing the blocking mechanism is illustrated below.

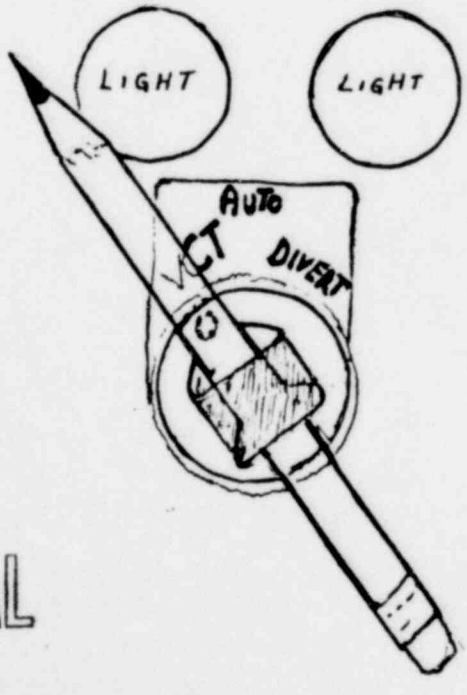

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Exhibit 2
Page 1 of 1

Shift Supervisor October 4, 1979

I , make the following statement freely and voluntarily to Robert J. Marsh who has identified himself to me as as investigator with the U.S. Nuclear Regulatory Commission. Mr. Marsh has informed me of the authority under which this investigation is being conducted, its scope, and of the fact that I do not have to make a statement if I do not want to. I recognize that my statement is part of an official investigation and, as such, may later be used in a judicial proceeding.

I am a Shift Supervisor on Unit 1 of the North Anna Power Station. My shift, Shift B was on duty during the morning of September 25, 1979, when a turbine trip occurred. My previous experience in the nuclear field includes experience in the U.S. Navy from 1968 to 1972. Since October 1972 I have been employed by VEPCO in various operating positions (Ass't CRO, CRO,SRO, etc.) up to and including the present.

My shift assumed duty in the control room at 12-midnight on September 24, 1979, relieving Shift D which had been on the swing shift. At approximately 1:00 a.m. on September 25, 1979, I instructed to reestablish deboration of the reactor coolant by dilution with primary grade water. I am quite sure, but not positive, that the pencil and binder clip were in place on the control switch for LCV-1115A at the beginning of the shift. This jumper was removed by as part of the preparations for dilution. The dilution continued for most of the shift until the turbine trip occurred just after 6:00 a.m. I am not aware of the binder

clip and pencil being replaced on the control switch during the remainder of my shift at approximately 12-noon on September 25, 1979.

I have read the above statement consisting of two (2) pages and have initialled all corrections. This statement is true and correct to the best of my knowledge and belief.

Signed _____ 10/4/79 Date

WITNESSED: Robert J. Mauk

_____

Exhibit 3A
Page 2 of 2

Control Room Operator

October 4, 1979

I, make the following statement freely and voluntarily to Mr. Robert J. Marsh who has identified himself to me as an investigator with the U.S. Nuclear Regulatory Commission. Mr. Marsh has informed me of the authority under which this investigation is being conducted, its scope, and of the fact that I do not have to make a statement if I do not want to. I recognize that my statement is part of an official investigation and, as such, may later be used in a judicial proceeding.

I am currently employed as a Control Room Operator on Unit 1 of the North Anna Power Station. I have approximately eleven years nuclear experience at VEPCO's Surry and North Anna Power Stations and in the U.S. Navy.

At approximately 12-midnight on September 24, 1979, when I started my shift duties I found the binder clip and pencil in place on the control switch for LCV-1115A holding it in the "VCT" position. Approximately twenty minutes later at 12:20 a.m. on September 25, 1979, I removed the clip to allow the switch to return to the "AUTO" position because I was starting a continuous dilution of the reactor coolant. The clip remained off for the remainder of the shift. At the completion of my shift at approximately 12-noon on September 25, 1979, the clip was still off.

I have read the above statement and initialled any corrections. This

statement is true and correct to the best of my knowledge and belief.

Signed

10-4-79
Date

WITNESSED: Robert J Waugh

Control Room Operator October 4, 1979

I, make the following statement freely and voluntarily to Robert J. Marsh who has identified himself to me as an investigator with the U.S. Nuclear Regulatory Commission. Mr. Marsh has informed me of the authority under which this investigation is being conducted, its scope, and of the fact that I do not have to make a statement if I do not want to. Irecognize that my statement is part of an official investigation and, as such, may later be used in a judicial proceeding.

I am a Control Room Operator on Unit 2 of the North Anna Power Station. I was on duty in the Unit 2 control room on the morning of September 25, 1979, when a turbine trip occurred on Unit 1. My nuclear experience includes six years in the U.S. Navy and since July 1975 I have been assigned to the North Anna Power Station.

I was on the Unit 1 side of the common control room at the time the turbine trip occurred on Unit 1 which was approximately 6:10 a.m. on September 25, 1979. Shortly thereafter, a Safety Injection (SI) occurred. At some point during the event I noted that pressurizer level and pressure were decreasing rapidly and I placed the makeup system control in automatic. Later in the event, during recover from SI, I noted that the Volume Control Tank (VCT) was full or almost full and I placed and held the control switch for LCV-1115A in the "DIVERT" position to prevent additional water from entering the VCT. I do not believe that the pencil and binder clip were on the switch at that time. I soon realized that water was not being diverted even though I had the switch in the "DIVERT"

position. I looked at the back panel where the controls for the Gas Stripper are located and observed that the inlet valve to the gas stripper was closed, thus preventing letdown flow from being diverted. The inlet valve to the gas stripper was subsequently opened; however, the VCT was already solid at that time.

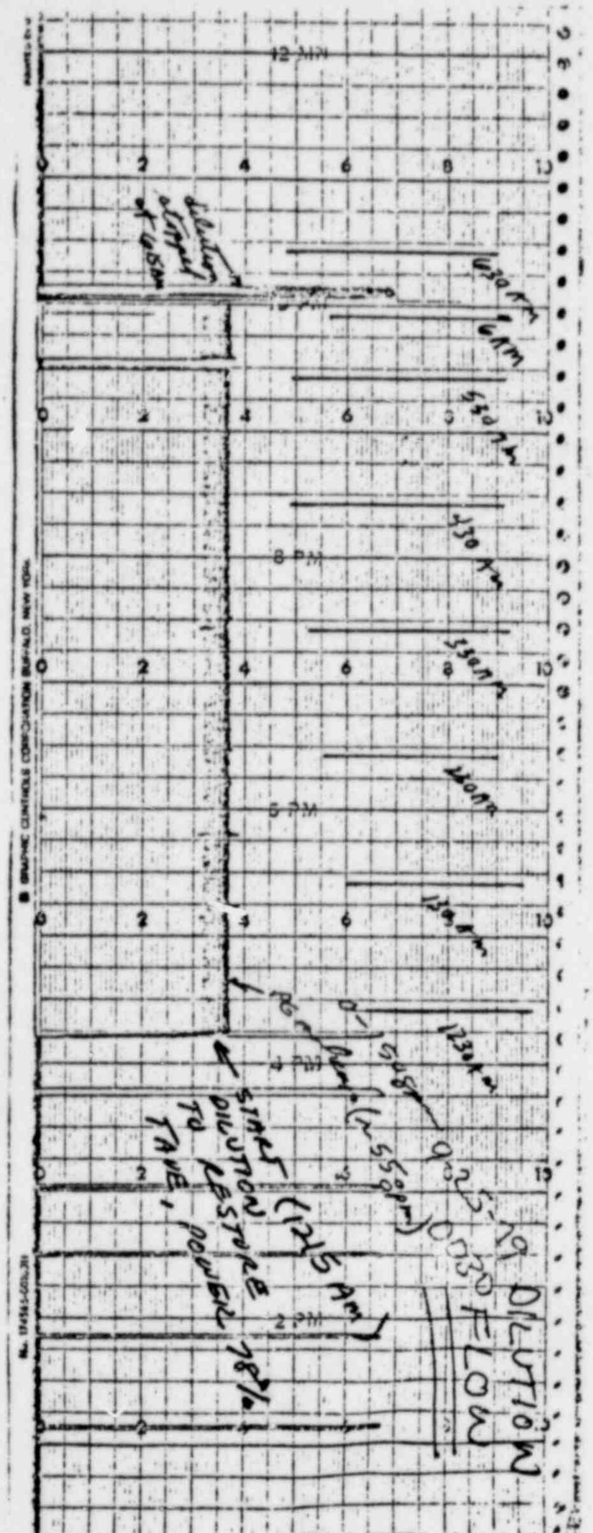
I have read the above statement consisting of two (2) pages and have initialled all corrections. This statement is true and correct to the best of my knowledge and belief.

Signed _____ Date Oct 4 1979

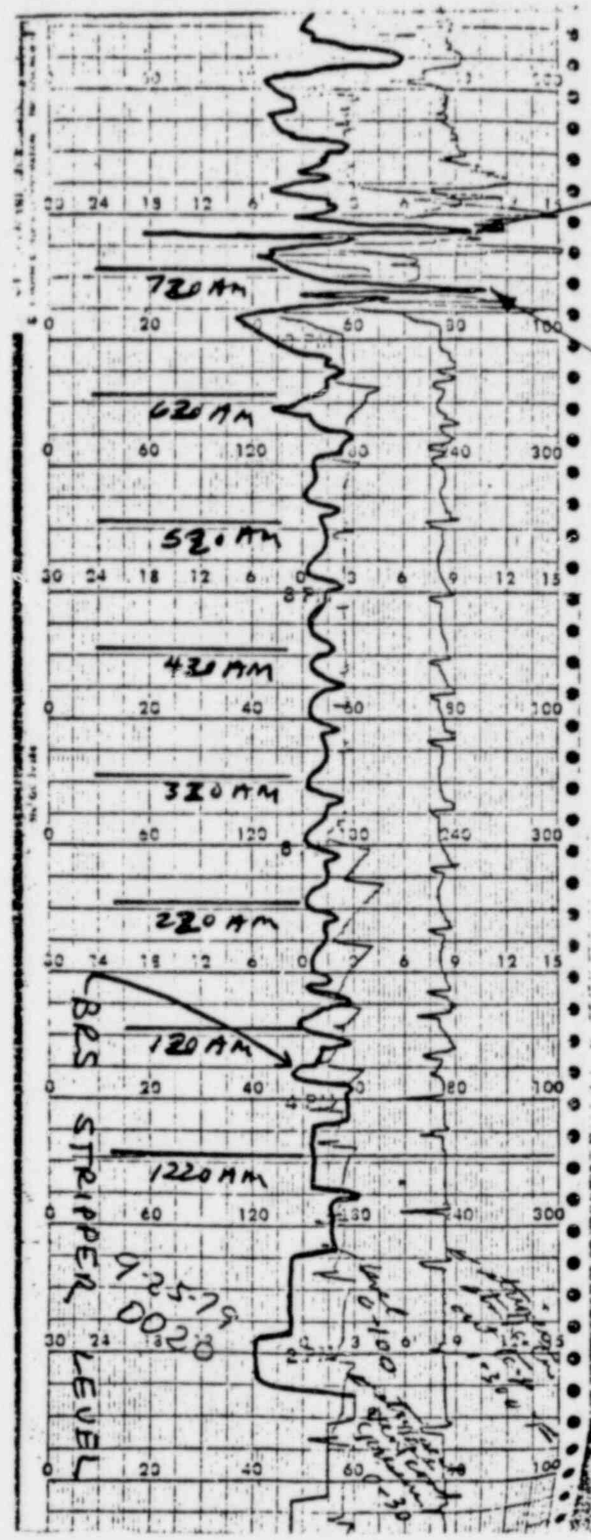
WITNESSED: Robert J Grant

C F Cielen

Times corrected for error in time "hack" placement



PRIMARY GRADE WATER FLOW



Approx. 7:15 a.m

Approx. 6:45 a.m

BRS GAS STRIPPER
(Flow darkened)

POOR ORIGINAL

Exhibit 4
Page 1 of 1

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DAILY REPORT - December 2, 1976

Waste System

Vepco continues to work on the calibration for LCV-LW-104.

Painters continue to paint on 1LW-CL-1A

Insulators completed putting temporary insulation on LW-E-1 & 6.

Installed RO-LW-104.

Operators working on lining up the process vent system.

Installed RO-BR-103 which comes from Boric Acid Tanks and goes to the process vent system.

Have new values for LT-LW-107, 108 and 109 which Vepco has to recalibrate.

Modifying the sensing line to PCV-LW-147 by adding root valve and test conenction.

Checking into E&D 12547-1 which affects 14 different Bartons which are PDI's. Each has internal wiring which has to be changed but there are no existing CDR's against any of them.

Continue running LW-EV-1 to check diffferent parameters.

T A Bennett

T. Bennett

Exhibit 5
Page 1 of 1

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Stone & Webster Log.
Rfm
10-04-79