UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30303

Report No. 50-338/79-13

Licensee: Virginia Electric and Power Company
Post Office Box 26666
Richmond, Virginia 23261

Facility Name: North Anna Power Station, Unit 1

Docket No. 50-338

License No. NPF-4

Inspection at North Anna Site near Mineral, Virginia, VEPCO offices, Richmond, Virginia, and Stone and Webster Engineering Corporation (S&W) offices, Boston, Massachusetts

Inspector: J. J. Lenahan, P.E. 4/5/79
J. J. Lenahan Date Signed

Accompanying Personnel: C. E. Alderson

Approved by: J. C. Bryant 4/5/79
J. C. Bryant, Section Chief, RCES Branch Date Signed

SUMMARY

Inspection on March 5, 6, 14 and 15, 1979, at North Anna site; March 7, 1979 at Richmond, Virginia; March 13, 1979 at Boston, Massachusetts

Areas Inspected

This special, unannounced inspection involved 21 inspector-hours on-site and 18 inspector-hours in the VEPCO and Stone and Webster Corporate Offices in the areas of settlement data collected on Units 1 and 2 service water pumphouse, performance of horizontal drains, collection of piezometer data and licensee action on previously identified items concerning settlement surveys. In addition, an inquiry was conducted concerning handling and review of service water pumphouse settlement data. The inquiry involved 11 hours on-site and 18 hours in the VEPCO and Stone and Webster corporate offices by an NRC investigator. The Summary of Inquiry is appended to this inspection report.

Results

Of the areas inspected, no apparent items of noncompliance or deviations were identified.

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DETAILS

1. Persons Contacted

Licensee Employees

C. M. Robinson, Supervisor, Civil Engineering Services
O. Schultz, Supervisor, Survey Services
*C. E. Sorrell, Civil Engineer
*J. W. Waddel, Manager, Power Station Engineering
P. A. Slater, Resident QA Engineer
*E. R. Smith, Jr., Supervisor, Technical Services
*J. D. Kellams, Superintendent Station Operations
*W. R. Cartwright, Station Manager
R. C. Sturgill, Assistant Engineer
T. Schreckenghast, Engineering Technician

Other Organizations

D. Barry, Resident Engineer, North Anna Site (S&W)
B. McIver, Geotechnical Engineer, Boston (S&W)

NRC Resident Inspector

*M. S. Kidd

*Attended exit interview.

2. Exit Interview

The inspection scope and findings were summarized on March 15, 1979 with those persons indicated in Paragraph 1 above.

3. Licensee Action on Previous Inspection Findings

(Open) Unresolved Item (338/78-37-04): Settlement of Class I Structures. Technical Specifications are not clear on settlement survey requirements for reset survey points and baseline dates since several of the points were not required by NRC until after the baseline dates had passed. Also, though some of the points were in existence prior to the appropriate baseline dates, survey readings were not made on the baseline date. A typical example of this is point number 117 on the service building. The Technical Specifications specify a limit on the settlement occurring after April 1, 1977. However, settlement surveys were made on March 9, 1977, and not on April 1. Therefore, it is necessary to extrapolate the post April 1 settlement for Point 117. Other examples of the need to clarify baseline dates are settlement points 206 through

209 on the Boron Recovery Tank Dike. The technical specifications specify limits on settlement after completion of construction (i.e., "as built" settlement). However, these settlement limits were not required by NRC and initial settlement readings were not made until May 1976, more than one year after this structure was built.

Six points have been reset since the technical specification baseline date. This was due either to construction activities which resulted in points being destroyed or erection of permanent facilities which have made points inaccessible to surveying. However, the licensee has a large redundancy in survey monitoring points and, therefore, was able to reconstruct the settlement history of reset points from other settlement points on the same structure or from settlement points on adjacent structures which have similar foundation and loading conditions.

A typical example of how missing data were reconstructed for reset points can be illustrated for point number 144 on Unit 1 containment structure. In addition to point number 144, the licensee had established 5 other points, numbers 126, 127, 130, 143 and 149 on the Unit 1 containment structure. These additional points were surveyed at the same frequency as point number 144. Point number 144 was destroyed between the 10/8/76 and 7/7/77 readings; however, it is possible to reconstruct the missing data for point number 144 from data collected for the other points.

The readings collected for the other 5 points on the structure indicated an average of approximately 0.016 feet of rebound during the period 10/8/76 through 7/7/77. Since all the points are on the same rigid structure, it is reasonable to conclude that point number 144 also rebounded 0.016 feet during this period. Point number 144 indicated 0.003 feet of settlement between 5/13/76 and 10/8/76 and 0.005 feet of settlement between 7/7/77 and 10/25/78. Therefore, the net apparent movement of point number 144 since May 1976 is actually .008 feet of rebound, not settlement. The Unit 1 containment structure is founded on rock. The inspector concluded, based on the data, that the structure most likely has not moved since May 1976, and the small apparent movements are a result of the limits of accuracy of surveying.

The inspector examined installation of two additional permanent benchmarks which had been established in the main plant area. These benchmarks had been drilled and grouted into rock. Although the surveys made to date meet the requirements for U. S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) Second Order, Class II accuracy, the survey results will be improved when these benchmarks are used since they are much closer to the plant than the benchmarks presently in use. According to NOAA standards, accuracy in leveling is a function of the square root of the distance surveyed. A reduction in the distance

surveyed will lower the acceptable errors of closure, thus increasing survey accuracy. Also, a reduction in distance surveyed will reduce the number of turning points, which will add to increased survey accuracy.

The inspector examined the licensee's revised procedure to be furnished to Moore, Hardee, and Carrouth Associates (MH&C), the engineering firm retained by the licensee to perform the settlement surveys. This procedure lists requirements for collection and reduction of survey data, transmittal of the data to the licensee, and QC requirements. The time lapse between completion of the MH&C surveys and evaluation of the data by the licensee was up to four months in the past. This revised procedure requires MH&C to transmit survey data to the licensee within seven working days after completion of the survey.

The inspector discussed with licensee management the need to protect settlement points from being disturbed by construction and other activities. The licensee is still evaluating methods to be used to accomplish this.

Based on review of the settlement data collected to date, it appears that the licensee has met the intent of Technical Specification 3.7.12.1, i.e., to monitor and evaluate settlement of Class I structures. The licensee has requested a change to the Technical Specification to clarify baseline dates and reset survey points. Unresolved item 338/78-37-04 remains open pending revision of the Technical Specification and NRC review of the licensee's corrective action and final report.

4. Unresolved Items

Unresolved items are matters about which more information is required to determine whether they are acceptable or may involve noncompliance or deviations. New unresolved items identified during this inspection are discussed in Paragraph 7.e.

5. Independent Inspection Effort

The inspector examined the service water reservoir embankment, including slope protection, slope stability, and downstream embankment toe.

No deviations or items of noncompliance were identified.

6. Scope of Special Inspection

On April 28, 1978, the licensee notified NRC Region II that survey readings taken by MH&C on March 30, 1978, indicated that the average settlement of the service water pump house (SWPH) exceeded the value

required for reporting, i.e., 75% of the maximum allowable value of 0.15 feet. The licensee submitted a special written report regarding the SWPH settlement to NRC Region II on May 31, 1978. This special inspection was performed to:

a. Make a comparison of the SWPH settlement data collected by Stone & Webster (S&W) with that collected by Moore, Hardee and Carrouth Associates (MH&C).

b. Evaluate MH&C SWPH settlement data collected since November 1978.

c. Evaluate differential settlement data between the SWPH and the north side of the service water piping expansion joints, and visually examine the expansion joints.

d. Determine the performance of the horizontal drains.

e. Review piezometer data.

In addition, an inquiry was conducted during the inspection by a Regional Investigator concerning the licensee's handling and review of SWPH settlement data. The Summary of Inquiry is appended to this inspection report.

7. Findings

a. Comparison of S&W and MH&C SWPH Settlement Data - S&W, the plant designer and constructor, monitored settlement of the SWPH during its construction in accordance with standard engineering practice to confirm their design assumptions. MH&C was retained by the licensee to perform the surveys required by the Technical Specification 3.7.12.1.

The inspector examined the S&W survey field book containing the SWPH data collected by S&W surveyors, reviewed calculations reducing the raw field data collected by S&W and MH&C to the computed SWPH settlement, made an independent check of these calculations, and compared the SWPH settlement calculated from the S&W field data to the settlement calculated from the MH&C data. A comparison of MH&C and S&W settlement measurements is shown in the following table:

MH&C DATA		S&W DATA	
Date	Average SWPH Settlement (ft.)	Date	Average SWPH Settlement (ft.)
12/01/75	0.000	12/10/75	0.000
12/17/75	0.001	12/19/75	0.000
8/23/76	0.011	8/21/76	0.020
10/01/76	0.022	--	--
10/07/76	0.029	10/06/76	0.027
11/10/76	0.033	11/13/76	0.039
--	--	12/01/76	0.038
12/06/76	0.031	12/15/76	0.064
--	--	2/24/77	0.061
3/03/77	0.061	3/28/77	0.068
--	--	5/23/77	0.066
7/11/77	0.063	--	--
--	--	8/03/77	0.114
--	--	8/29/77	0.112
--	--	10/06/77	0.114
--	--	10/31/77	0.113
12/12/77	0.103	12/08/77	0.117
--	--	1/05/78	0.116
3/15/78	0.121	3/01/78	0.112
3/30/78	0.119	3/29/78	0.123
4/25/78	0.107	4/20/78	0.118
5/10/78	0.110	5/12/78	0.132

Notes

(1) Settlement shown is in feet

(2) S&W settlement values for 8/3/77 through 1/5/78 are based on incomplete data; i.e., no readings were made on settlement point SM-8 during this period. Missing data for SM-8 was interpolated from other data.

The Technical Specifications require that the licensee perform an engineering evaluation to determine the consequences of additional settlement when the average settlement of the SWPH exceeds 75% of 0.15 feet (0.1125 feet). The licensee is required to notify the Commission and submit a special report within 60 days of when this limit is detected. S&W data indicate that 76% of the allowable SWPH settlement of 0.15 feet occurred by August 3, 1977. However, the MH&C data indicates only 42% of the allowable settlement had occurred by July 11, 1977, and that 69% had occurred by December 12, 1977. S&W data of December 8, 1977 indicates, for all practical purposes, no change from the August 3 data. The difference, 69%

of 0.15 and 76% of 0.15, is less than 0.01 foot. MH&C data did not indicate that the allowable settlement (75% of 0.15 ft.) was exceeded until March 15, 1978.

The S&W data generally indicated approximately 0.01 foot more settlement than MH&C data. Examination of the data in the S&W survey field book disclosed that survey loop closures were not documented for the period between March 28, 1977 and March 27, 1978. Since these loop closures are not documented, the accuracy of the S&W surveys for this period is questionable. In addition, S&W did not make settlement survey readings on settlement point SM-8 (S&W point number 3) from August 3, 1977 through January 5, 1978. The settlement data for point SM-8 was interpolated from the data obtained for point numbers SM-7, SM-9 and SM-10. Therefore, some of the S&W average settlements shown in the above table are based on suspect and/or incomplete survey data and in any case would not have the same degree of accuracy as the MH&C data.

The MH&C average SWPH settlement shown in the above table is based on complete data obtained from well controlled surveys which were made to Second Order, Class II accuracy. The MH&C survey loops were closed with acceptable accuracy in all cases. In cases of conflict between the MH&C data and the S&W data, the inspector concluded that MH&C data would be accepted as correct since it was complete and was obtained from a more accurate and better controlled survey than the S&W surveys. A more detailed discussion concerning MH&C and S&W survey procedures is contained in Region II inspection report number 50-338/78-44.

No deviations or items of noncompliance were identified.

b. Evaluation of MH&C SWPH Data Collected Since November 1977 - The inspector reviewed MH&C SWPH data collected since November 1978. Selected MH&C data is given below to show trends:

Date	Average SWPH Settlement (Feet)	Percent of Allowable Settlement (.15 Feet)
12/01/75	0.000	0
7/11/77	0.063	42
12/12/77	0.103	69
3/15/78	0.121	81
3/30/78	0.119	79
4/25/78	0.106	71
5/10/78	0.110	73
8/03/78	0.117	78

Date	Average SWPH Settlement (Feet)	Percent of Allowable Settlement (.15 Feet)
11/06/78	0.126	84
11/20/78	0.124	83
1/03/79	0.128	85
2/06/79	0.127	84
3/07/79	0.126	84

Notes

December 1, 1975 is the baseline date for SWPH settlement in the Technical Specifications.

The data for Spring and early Summer 1978 indicate that average SWPH settlement was approximately 0.115 feet. Readings made in November 1978 through March 1979 indicate that average SWPH settlement was approximately 0.125 feet. This means that the SWPH settled an additional 0.01 foot between early Summer and early Winter 1978. The licensee indicated that monitoring of SWPH settlement will continue on a monthly basis until further evaluation indicates the frequency can be reduced.

No deviations or items of noncompliance were identified.

c. Differential Settlement between SWPH and North Side of Service Water Piping Expansion Joints and Inspection of the Expansion Joints - The inspector reviewed the results of surveys performed by MH&C since November 1978 to measure settlement of the service water lines north of the expansion joints. Settlement of the service water lines is compared to the settlement of SWPH settlement point SM-7, which is located on the northeast corner of the SWPH where the service water lines enter the pumphouse. The settlement of point SM-7 versus settlement of point numbers SM-15 and SM-18 on the two outboard service water lines north of the expansion joints is tabulated below. Data are selected to show trends.

Settlement in Feet

Date	Point SM-7	Point SM-15	Differential Between SM-7 and SM-15	Point SM-18	Differential Between SM-7 and SM-18
7/11/77	.000	.000	--	.000	--
12/12/77	.039	.051	.012	.058	.019
3/15/78	.059	.071	.012	.081	.022

Date	Point SM-7	Point SM-15	Differential Between SM-7 and SM-15	Point SM-18	Differential Between SM-7 and SM-18
3/30/78	.057	.072	.015	.077	.020
4/25/78	.045	.060	.015	.066	.021
5/10/78	.043	.063	.020	.071	.028
8/03/78	.051	.066	.015	.069	.018
11/06/78	.058	.081	.023	.082	.024
11/20/78	.057	.083	.026	.083	.026
1/03/79	.063	.095	.032	.090	.027
2/06/79	.061	.101	.040	.090	.029
3/06/79	.061	.097	.036	.088	.027

Notes:

(1) July 11, 1977 is date when initial survey was performed on service water lines.

(2) SM-15 is settlement point on east pipe.

(3) SM-18 settlement point on west pipe.

The above data indicate that differential settlements between the service water lines north of the expansion joints and the northeast corner of the SWPH has been approximately 1/2-inch since July, 1977. The data indicate that the service water lines have settled more than the SWPH. The expansion joints in the service water lines are located where the height of fill in the dike is the greatest.

Monitoring of pipe settlement was not initiated until July 1977 while the expansion joints in the service water lines were installed in August and October 1976. However, conservative estimates of the total differential settlement which has occurred between the SWPH and the north side of the expansion joint can be made by comparison of SWPH settlement data with available service water line settlement data. Settlement point SM-7 on the SWPH settled 0.046 feet between December, 1975 and July, 1977. The maximum differential settlement between SM-7 and the service lines for this magnitude of settlement of SM-7 was 0.028 feet, occuring in May, 1978. Therefore it would be reasonable to conclude that the amount of differential settlement between SM-7 and the service water lines in the time period August 1976 to July, 1977 was approximately 3/8-inch (0.03 feet). This amount, added to ½-inch which has occurred since July 1977 would mean that approximately 7/8-inch of differential settlement has occurred between the SWPH

(point SM-7) and the service water lines since the expansion joints were installed in August and October 1976. The expansion joints are designed to tolerate up to three inches of differential settlement between the SWPH and the service water lines. The inspector examined the expansion joints during the inspection and detected no problem.

No deviations or items of noncompliance were identified.

d. Performance of the Horizontal Drains - The licensee committed in an amendment to the FSAR to control the ground water level in the vicinity of the SWPH. The licensee had considered the use of deep wells, but this method was ruled out after the results of pumping tests indicated that, due to the low permeability of the insitu soils, large drawdowns and close well spacing would be required. The licensee then elected to use drilled horizontal drains.

Drilled horizontal drains to control groundwater have been in use since the 1940's on numerous projects, including dams, highways, railroads, buildings, and other structures.

The initial drain, drain 0 was installed in August, 1976. During installation of this drain the impermeable liner of the reservoir was punctured. The licensee reported this to NRC Region II as a 50.55(e) item. After repairs to the liner were completed and installation procedures were revised, horizontal drain number 1 was installed at North Anna in October, 1976 as a test drain. The data gathered from this drain was used to determine drain pipe size, drain spacing, and drain flow characteristics. Based on the data gathered from drain 1, the licensee determined that five additional drains were needed to control the groundwater level in the vicinity of the SWPH. The additional drains, drains 2 through 6, were installed in July and August of 1977. The drains were installed near the groundwater table elevation existing at time of installation.

The inspector examined field books containing records of the horizontal drain installation and discussed installation techniques with the responsible engineers. Examination of the records disclosed that after the problems with drain 0 had been resolved, installation of the remaining drains was carefully controlled. The location of the drains, both horizontal and vertical, was determined during installation using various types of instrumentation. Drain 4 was installed at elevation 272.5. The remaining drains were installed between elevation 274 and elevation 276.

The inspector examined records of periodic tests performed by the licensee to measure the volume of flow from the horizontal drains and to measure the turbidity and suspended solids in the effluent from the horizontal drains. Records examined were those of tests

performed on April 7, 1978, July 7, 1978, and January 4, 1979. Acceptance criteria for measurement and analysis of flow from the horizontal drain are contained in PT-75.6, "Service Water Pump House Drain System - Turbidity - Suspended Solids", and Technical Specification 3/4.7.7.1., "Service Water System". The required frequency of testing is at least once every six months.

No deviations or items of noncompliance were identified.

e. Review of Piezometer Data - The inspector examined records of piezometers located in the vicinity of the SWPH to determine the effect of horizontal drain installation on groundwater levels. Prior to installation of the drains, piezometer number P-14 indicated ground water was at elevation 274. Piezometer P-14 is angled to a point under the center of the SWPH. Piezometer P-13 indicated groundwater was at elevation 276 prior to drain installation. Piezometer number P-13 is a vertical piezometer which was installed on top of the dike approximately 40 feet west of the SWPH. After installation of the drains, piezometer P-13 indicated a drop in groundwater from elevation 276 to elevation 274 while piezometer P-14 indicated a drop in groundwater from elevation 274 to elevation 270.5. Since this is below the level of the horizontal drains, the only explanation that S&W engineers could offer for the behavior of piezometer P-14 after drain installation was that the transducer for this piezometer was installed approximately 4 feet higher than previously believed.

The inspector examined monthly records of piezometer readings taken from June 1978 through February, 1979 to determine the ground water level of the service water reservoir. Acceptance criteria for measurement of the groundwater level are contained in PT-75.7, "Service Water Reservoir - Groundwater Level", and Technical Specification 3/4.7.13, "Groundwater Level - Service Water Reservoir-Limiting Condition for Operaton."

Piezometer numbers P-13 and P-14 have indicated drops in groundwater level of approximately 1.5 feet since late November, 1978. The inspector questioned North Anna site personnel concerning the apparent drop in groundwater level. These discussions disclosed that site personnel compare the piezometer readings to Technical Specification (TS) requirements and if the data is within the TS limits, no further action is required. Results are then filed in the Document Control Unit (DCU) after distribution of copies of the data to various personnel in the Richmond VEPCO and Boston S&W offices. Site personnel do not perform and procedures do not require a trend analysis which would disclose variations in data

from average monthly readings. Site personnel had no comment concerning the piezometer data, except to state that the data were within TS limits.

Discussions in the Richmond VEPCO offices with the VEPCO Supervisor of Civil Engineering Services and in Boston with the S&W Geotechnical Engineer disclosed that the apparent drops in groundwater levels in these piezometers are suspected to be either a result of errors by the individual making the readings or malfunction of the pore pressure indicator (instrument used to read the piezometers). The VEPCO Supervisor of Civil Engineering Services notified the site of the potential problem with the piezometer data in late February, 1979.

Further discussions at the site on March 14 and 15, 1979, with licensee management disclosed that the manufacturer of the pore pressure indicator will be contacted in the near future to send a representative to the site to service and calibrate the instrument, if required, review the procedure being used to read the instrument, and verify that the individual reading the piezometers is doing it correctly.

The inspector expressed concern over the delay in discovery of the potentially incorrect piezometer readings and questioned whether or not a trend analysis should have been performed to detect potential errors in readings. The apparent lack of adequate procedures to specify corrective action, e.g., perform a trend analysis, was identified to the licensee as Unresolved Item 338/79-13-01. This item is being evaluated by NRC to determine if adequate procedures have been established. NRC will also review the report of the pore pressure indicator manufacturer in evaluation of this item.

The most current SWPH settlement survey data at the site on March 6, 1979, were the November 20, 1978, readings. The inspector verified that these data were the most current available on site on this date by review of DCU files and discussions with the engineer responsible for review and analysis of SWPH settlement data. During discussions with the VEPCO Supervisor of Civil Engineering Services and his staff on March 7, 1979, the inspector questioned if any additional SWPH settlement surveys had been made since November 20, 1978. The inspector was informed that surveys were made in January and February but that this data had not yet been received from MH&C. During a discussion of the effect of the apparent drop of groundwater table elevation on SWPH settlement, the licensee's representative indicated that they were not concerned

that additional SWPH settlement had resulted from a drop in the groundwater table since they assumed the piezometer data was incorrect. At the request of the inspector, the licensee obtained copies of the January 3, 1979, and February 6, 1979, survey data. The inspector and the licensee reviewed the data and verified that additional SWPH settlement had not occurred since November 20.

No deviations or items of noncompliance were identified.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W.
ATLANTA, GEORGIA 30303

SUMMARY OF INQUIRY

Subject: Virginia Electric & Power Company (VEPCO)
North Anna Unit 1
Docket No. 50-338

Allegations that VEPCO had knowledge of significant safety information regarding foundation conditions (Service Water Pump House settlement) at the North Anna site in August 1977 and withheld the information from the NRC for seven months until April 28, 1978.

Dates of Inquiry: March 5-13, 1979

Performed by: C. E. Alderson — 3-27-79 Date
Regional Investigator
Office of the Director

Reviewed by: F. J. Long — 3-27-79 Date
Acting Deputy Director
Office of the Director

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I. INTRODUCTION

In a letter to the Commissioners dated November 1, 1978, the North Anna Environmental Coalition (NAEC) stated that from information available to the NAEC it appeared that significant safety information regarding foundation conditions at the North Anna site had been withheld from the NRC for a period of seven months and was never reported to the Atomic Safety and Licensing Board (ASLB). The letter alleged that VEPCO had been aware of abnormal and differential settlement in August 1977 and had not reported it to the NRC until April 1978. The letter further alleged that the matter was reportable under the Unit 1 Technical Specifications and had been reportable under the requirements of 10 CFR 50.55(e) prior to issuance of the Unit 1 operating license.

In a letter to the Advisory Committee on Reactor Safeguards (ACRS) dated November 3, 1978, the NAEC stated that it would appear that VEPCO undertook no evaluation for months after becoming aware of the excessive settlement. This letter to the ACRS included a copy of NAEC's November 1st letter to the Commissioners.

This inquiry and a special inspection were initiated under the authority provided by Section 1.64 of Title 10, Code of Regulations and were conducted jointly to: (1) determine the specific reporting requirements pertaining to the Unit 1 and 2 Service Water Pump House settlement which were in effect at the various times in question; (2) review Stone and Webster (S&W) and VEPCO procedures for the accumulation, evaluation and reporting of settlement data; (3) determine the specific handling of the data resulting from the survey performed by Stone and Webster in August 1977; and (4) determine if an investigation into the matter was warranted.

The results of the inquiry are presented below. Technical evaluation of the North Anna settlement monitoring program, including S&W surveys and Moore, Hardee and Carrouth Associates (MH&C) surveys is addressed in the report of the special inspection (IE Report No. 50-338/79-13) to which this Summary of Inquiry is appended.

II. SCOPE

This inquiry included the following activities:

a. Review of 10 CFR 50.55(e) reporting requirements.

b. Review of North Anna Unit 1 Technical Specification reporting requirements.

c. Review of: (1) Correspondence between VEPCO and the NRC; (2) the transcript of the ASLB hearings for the Unit 1 operating license;

(3) the North Anna Unit 1 and 2 Safety Analysis Report; and (4) the North Anna Units 1 and 2 Safety Evaluation Report including supplements, to determine whether VEPCO had made any commitments beyond the settlement monitoring and reporting requirements of the Unit 1 Technical Specifications.

d. Review of files related to settlement in the possession of the S&W Construction Group at the North Anna site and discussions with the S&W Site Construction Project Engineer on March 5, 1979.

e. Review of files related to settlement in the North Anna Station Records (VEPCO) and discussions on March 6, 1979, with the engineer on the North Anna operating staff assigned responsibility to evaluate settlement data.

f. Review of files in the possession of and interwiews with VEPCO's Supervisor of Civil Engineering Services and the Chief Surveyor at the Corporate Offices in Richmond, Virginia on March 7, 1979.

g. Review of files in the possession of and interviews with S&W's Lead Geotechnical Engineer for the North Anna project and a previous Engineering Project Engineer for North Anna Unit 1 at S&W's Corporate Offices in Boston, Massachusetts on March 13, 1979.

h. Discussions with the current and prior Licensing Project Managers and the Leader of the Geotechnical Engineering Section in the Office of Nuclear Reactor Regulation.

i. A telephone discussion with the official of the NAEC who had written the letters to the Commissioners and the ACRS.

III. DETAILS

a. Review of Monitoring and Reporting Requirements and Effective Dates

Paragraph 50.55(e) of 10 CFR 50 was reviewed for applicability to the situation. Based on this review, it would appear that VEPCO's telephone notification to Region II on April 16, 1975 and their subsequent written report to the NRC dated May 15, 1975 concerning settlement of the Unit 1 and 2 Service Water Pump House satisfied the reporting requirements of 50.55(e). The purpose of 50.55(e) is to ensure that the NRC is made aware of any significant problems identified during construction of a facility so that the problems can be evaluated and monitored to assure appropriate resolution. Periodic status reports are not required by 50.55(e) after initial notification is made.

The monitoring and reporting requirements of the North Anna Unit 1 Technical Specifications became operative on November 26, 1977 when the operating license was issued, and therefore, no report could have been required thereunder, before that date. The question as to whether a sixty-day report on the S&W survey results of August 1977 would have been due on: (1) the day the license was issued (since more than sixty days had elapsed since the surveys had been made), (2) sixty days following issuance of the license, or (3) sixty days from the time VEPCO became aware of the results, requires a legal interpretation of the Technical Specification. However, based on the information obtained during this inquiry, the answer to this question does not appear to have any bearing in this matter.

The investigator reviewed VEPCO/NRC correspondence on this issue and discussed it with both the current and prior NRR Licensing Project Managers, and the Geotechnical Engineer who had been involved to determine if any special reporting requirements had been imposed on VEPCO regarding settlement survey results. The review and discussions did not disclose any special requirements; however, a letter from VEPCO to the NRC dated July 11, 1975 was found to contain the following statement:

> " Monitoring of the settlement will be continued on a monthly basis throughout the construction and initial operation of Units 1 and 2. These observations will be reviewed at that time to determine if a less frequent monitoring sequence can be justified. The staff will be consulted prior to any change in the monitoring schedule."

This statement was contained in VEPCO's response to a question from NRR which requested a discussion of proposed Technical Specification limitations. The investigator was unable to locate any subsequent NRC/VEPCO correspondence regarding monitoring frequency until the proposed Technical Specification with a six-month surveillance frequency, was submitted in October 1977. This response was also discussed with the three individuals from NRR and none could recall the letter or a discussion of a one-month frequency. They further stated that there was never a requirement that surveys be accomplished monthly.

It should be noted that between June 11, 1975 and the submittal of the proposed Technical Specification, additional structures had been identified as requiring monitoring for settlement. The Technical Specification which was eventually issued required a much more extensive program than was being considered when the earlier letter was written.

b. Responsibilities for Performing Surveys

The investigator interviewed several individuals to determine the relationship between S&W surveys and those performed by MH&C. The Supervisor of Civil Engineering Services (VEPCO) stated that monthly settlement measurements were initiated in December 1972 due to the appearance of cracks in the SWPH wing-wall. At that time S&W was instructed by VEPCO to perform the necessary surveys for what was believed to be a temporary program. However, the Supervisor said that in 1975 it became apparent to VEPCO that the NRC would require a long-term monitoring program, possibly lasting the life of the plant. The Supervisor explained that since S&W would eventually leave the site when construction was completed, VEPCO decided that it would be better to hire a local company to perform the surveys. MH&C had been performing survey work for VEPCO in other areas since 1967 and VEPCO decided that they should perform the surveys required by the Settlement Monitoring Program being developed at that time.

The investigator reviewed the "open-ended" service contract between VEPCO and MH&C and determined that it had been entered into on September 1, 1967. The investigator also reviewed a letter from VEPCO to MH&C dated September 23, 1975 which authorized MH&C to initiate a survey program to monitor the North Anna Service Water Reservoir dam and pump house under the service contract. The letter specified that upon completion of the original surveys, the alignment-settlement markers were to be monitored when the water-level in the reservoir reached certain specified levels and once each year after the reservoir was filled.

The investigator found several S&W and VEPCO letters in the various files reviewed which clearly establish that S&W was assisting VEPCO in the development of the Settlement Monitoring Program and the proposed Technical Specification, including the identification of structures and components to be monitored, the frequency of monitoring and the limits on differential settlement. The letters and various internal memoranda also indicate that it was VEPCO's intent to have a single monitoring program which satisfied the informational needs of VEPCO, S&W and the NRC, and that the surveys would be performed by MH&C.

The individuals interviewed were unable to state why the S&W pump house settlement surveys continued after MH&C was contracted to perform the settlement surveys; however, it was pointed out to the investigator that S&W surveys did not include but five of the many points required by the Technical Specifications and were never intended to satisfy those requirements.

c. Procedures for Accumulating, Evaluating and Reporting Settlement Data

The S&W Project Engineers for Construction (site) and Engineering (Boston), and the Lead Geotechnical Engineer were interviewed to determine the normal procedure for handling the settlement survey data within the S&W organization. At VEPCO's Corporate Office the Supervisor of Civil Engineering Services and the Chief Surveyor were interviewed to determine the normal procedure for handling the settlement survey data within the VEPCO organization. Discussions were also held with the engineer on the North Anna operating staff responsible for evaluating the survey data and discussions had been held previously with the S&W survey party chief who had been involved in the August 1977 surveys. These interviews and records reviews disclosed that prior to October 11, 1977 there were no formal written procedures within S&W or VEPCO covering this area, but the descriptions provided by these individuals as to how the data was handled were all in general agreement.

With regard to S&W surveys, the S&W surveyors would make the surveys and enter the raw data in a field book. At some later time the survey party chief would transfer the raw data to a form which was then forwarded to S&W-Boston. The records indicate that from initation of the survey program in late-1972 until late-1975 this form with the raw data was sent only to one individual at S&W-Boston by telecopier. In late-1975 (around August) a standard transmittal form was introduced and the distribution of the raw data was expanded to include several individuals, including VEPCO employees. From this point in time on, the data was mailed to the recipients, except for special requests which were sometimes telecopied. The transmittal sheet was revised at least once and the distribution was changed. The transmittal sheets contained no data themselves and merely served as "routing" forms. For this reason, the transmittal sheets were not retained with the data sheets, if at all, and the investigator was unable to identify from the records those individuals who received any particular set of raw data or when they received it.

The records available did indicate that between February 1973 and mid-1975 the S&W survey data was being received by S&W-Boston within one to two weeks from the time the survey was made. After mid-1975, the records indicated a continuing trend of increase in the time between the survey and receipt of the data in Boston. Beginning in late-1976 it appears that the S&W survey data was forwarded to S&W-Boston and other persons on distribution only after a data sheet was full; the time required being dependent on the frequency of surveys. Generally, it appeared that S&W-Boston received the data within one to two months after the first survey on the data sheet was made.

Regarding MH&C data, normal flow of the raw survey data was from MH&C to VEPCO's Chief Surveyor, who passed it on to VEPCO's Supervisor of Civil Engineering Services. The Supervisor of Civil Engineering Services then forwarded copies of the data to S&W-Boston, and following issuance of the operating license, to the operating staff at North Anna.

The various individuals interviewed indicated that prior to licensing of Unit 1, S&W's Lead Geotechnical Engineer was responsible for reducing and evaluating the survey data from both S&W and MH&C. Within VEPCO, the responsibility for the Settlement Monitoring Program was assigned to the Supervisor of Civil Engineering Services. Upon issuance of the operating license, responsibility for evaluating the data for compliance to the Technical Specifications was assigned to an engineer on the North Anna operating staff. This engineer only received and evaluated the MH&C data. He did not normally receive S&W data.

The Lead Geotechnical Engineer stated that raw S&W data would sometimes be received regularly, but that at other times, no data would be received for quite a while and then several sets of the raw data would be received at one time. He explained that it depended on the workload of the Survey Party Chief and when he could find time to transfer the raw data from the field book to the data sheets. At times, the Lead Geotechnical Engineer would call the S&W Survey Party Chief and request the data be forwarded. The Lead Geotechnical Engineer further stated that there was no specific schedule established for him to reduce the raw data and determine settlement and that he did it at irregular intervals.

The Supervisor of Civil Engineering Services (VEPCO) stated that he normally received copies of the S&W data, but that he only glanced at it, as S&W was responsible for reducing the data and informing VEPCO if any problems were encountered.

d. Handling of S&W Survey Data for August 1977

The Lead Geotechnical Engineer (S&W) stated that he did not believe that he received any S&W survey data from the field between May 1977 and January or February 1978. He explained that he had requested the data from the S&W Survey Party Chief several times, but that the Survey Party Chief was busy and had not gotten around to sending the data. He stated that he was out of the office for three weeks in January 1978 and when he came back he started reviewing MH&C data and bringing his settlement plots up to date. He further stated that around the end of February 1978 he was reviewing and plotting the data for the MH&C pump house survey of December 12, 1977 and noticed a significant change, but did not know if it was

an actual settlement or a bad survey. He then notified VEPCO's Chief Surveyor of the possible problem and requested that the Survey Party Chief send all S&W survey data not previously received by S&W-Boston from the field. An internal memorandum from the S&W Survey Party Chief to the Lead Geotechnical Engineer indicated that S&W survey data was forwarded to S&W-Boston on February 28, 1978.

A memo from the Lead Geotechnical Engineer back to the Survey Party Chief indicated that S&W surveyors performed an additional survey on March 1, 1978 and that the field books were reviewed to determine the validity of the bench marks. The memo also indicates that the Lead Geotechnical Engineer had reached the conclusion that the MH&C data for December 12, 1977 survey was valid.

The Lead Geotechnical Engineer stated that he prepared a letter to VEPCO and on March 6, 1978 he notified VEPCO's Supervisor of Civil Engineering Services that the MH&C data for December 12, 1977 indicated that the pump house had attained 65 percent of the average allowable total settlement and that S&W survey data confirmed the validity of the measurement.

VEPCO subsequently requested MH&C to perform additional surveys. An MH&C survey performed on March 15, 1978 indicated that the pump house settlement had exceeded the 75 percent limit and a special report to the NRC was required within 60 days. This required report was provided on May 31, 1978; however, the NRC had been notified of the settlement and members of NRR had visited the site as early as April 13, 1978 to review the matter. A Licensee Event Report was submitted on April 28, 1978.

e. Discussion With NAEC Official

In reviewing the draft of this summary, it was noted that the phrase "from information available to the NAEC" which appeared in the NAEC's letter to the Commissioners dated November 1, 1978, could imply that they had information beyond that which they addressed in the letter and which might not be known to the NRC staff. The NAEC representative who had signed the letter was contacted by telephone on March 28, 1978, and was asked if the NAEC had any information that had not been made available to the NRC. The individual stated that she did not believe they had any information beyond that available in the documents in the Public Document Room.

With regard to the allegation that VEPCO was aware of the settlement on August 3, 1977, the individual stated that this was based on the information contained in VEPCO's special report dated May 31, 1978. Regarding reportability of the settlement, she stated that

the NAEC had contacted the consultant to the ACRS after reading his report to the ACRS dated July 19,1978 and that he had said he felt the settlement should have been reported in August 1977.

IV. CONCLUSIONS

a. The records available clearly indicate that VEPCO intended that there be one monitoring program and that VEPCO expanded an existing contract with MH&C to accomplish the necessary surveys.

b. Prior to issuance of an operating license, VEPCO relied on S&W to evaluate the survey data and forwarded the results of MH&C surveys to S&W.

c. Subsequent to issuance of the Unit 1 operating license, responsibility for evaluating survey data to determine compliance with Technical Specifications rested with the plant operating staff and only MH&C data was forwarded for their evaluation. However, VEPCO continues to forward the MH&C results to S&W for further evaluation.

d. When reduced and evaluated, the results of the surveys performed by S&W on and after August 3, 1977 indicated that the service water pump house settlement had exceeded 75-percent of the limit; however the investigator could not conclusively establish the date that S&W-Boston or VEPCO became aware of the August 3, 1977, and subsequent S&W survey results, but there was no indication that either received the raw data for these surveys until near the end of February 1978.

e. There did not appear to be any significant differences in the handling and processing of S&W data of August 3, 1977 and later, when compared to the handling and processing of earlier S&W data.

f. The allegations are not substantiated and no further investigative effort is warranted with regard to this matter.

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