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Richmond, VA 23261

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Facility Name: North Anna 1 and 2

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SUMMARY

Scope: This special, announced inspection was an Emergency Response Facility (ERF) appraisal. Areas examined included detailed reviews of selected procedures and representative records, inspection and evaluation of the adequacy of the ERFs and all equipment therein, interviews with licensee personnel, and evaluation of the effective use of emergency response facilities and equipment in support of the Emergency Response Organization (ERO) during the 1988 Annual Emergency Preparedness Exercise.

Results: No violations or deviations were identified. This inspection identified several areas requiring further action by the licensee to complete. These areas are summarized in Paragraphs 1 and 3 , below. Additional items which should be considered for program enhancement were also disclosed. These items are summarized in Paragraphs 1, 2, 3, and 4. The Emergency Response Facilities (ERF) and equipment therein, however, were determined to be adequate to support the Emergency Response Organization in the event of a radiological emergency.

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1.0 Assessment of Radiological Releases

1.1 Source Term

Emergency Procedure EPIP-4.09, Rev. 5 entitled "Source Term Assessment" was reviewed. This procedure provided the basis for source term determination during an emergency. Seven methods were identified for calculating a source term in Ci/sec. These included: effluent monitors, grab sampling of effluent pathways, sample of station inventory, containment personnel hatch monitor, containment high range monitor, containment air sample, and environmental sample data. All source terms generated were expressed in terms of Xe-133 and I-131 dose equivalent.

Effluent monitors for ventilation vents A and B, process vent, condenser air ejector, main steam lines, and the auxiliary feedwater turbine pump exhaust (AFTP) were observed. Vents A and B, and the process vent have normal range monitors, interim high-range monitors, and Kaman monitors. The condenser air ejector, main steam lines, and AFTP have only normal range monitors. Methods for converting cpm readings from the effluent monitors to uCi/ml release concentrations were reviewed and found to be acceptable. The licensee's source term methodology also allowed adjustments to be made on the Xe-133 to I-131 dose equivalent ratio based on the accident type (e.g., fuel handling accident, main steam line rupture, waste gas decay tank rupture, and steam generator tube rupture). The impact of containment shine on effluent monitor readings was being investigated by the licensee as identified in an internal memo dated May 26, 1988, entitled "ERF Appraisal Team Meeting Minutes".

Emergency Plan Procedures EPIPs 4.22 through 4.26 provide guidance for the collection and analysis of effluent samples and post-accident samples including containment atmosphere and reactor coolant samples. The licensee's core damage assessment procedure dated May 1986, was reviewed and found to contain precalculated relationships between various plant parameters including containment high range monitor readings and percent fuel damage.

Currently, the licensee can calculate a source term based on containment leakage using either the containment personnel hatch monitor or the containment high range monitor. Both rely on using precalculated relationships of monitor readings and time-since-unit-shutdown to percent fuel damage. Once percent fuel damage is estimated, the corresponding curies Xe-133 equivalent can be determined from another precalculated relationship. The licensee was in the process of eliminating use of the containment personnel hatch monitor as a source term method as discussed in an internal memo dated March 8, 1988, and entitled "Documentation of Differences between RAD/MET Model and North Anna Power Station EPIPs". Note, that according to Emergency Procedure EPIP-4.09, the licensee can also use environmental data for generating a source term. The adequacy of this method is discussed in the Section 1.2 below.

Based on the above review, the source term and the use thereof appeared to be adequate.

1.2 Dose Assessment

The licensee's dose assessment program is controlled by the following Emergency Plan Procedures: EPIP-4.08 (Initial Offsite Release Assessment); EPIP-4.09 (Source Term Assessment); EPIP-4.10 (Determination of X/Q); EPIP-4.11 (Follow-up Offsite Release Assessment); EPIP-4.13 (Offsite Release Assessment with Environmental Data); and EPIP-4.27 (Use of the Class A Meteorological and Dose Calculational Model). The licensee's primary dose assessment method is entitled RAD/MET. RAD/MET is run on the plant emergency response computer system and is available for use in the Control Room, TSC, local EOF (LEOF), and corporate EOF (CEOF). RAD/MET uses a Gaussian puff trajectory model for atmospheric transport and diffusion. Emergency Plan Procedure EPIP-4.27 describes how the model would be used in an emergency.

The licensee's backup dose assessment method is a manual method using a straight line Gaussian transport and diffusion model. The method is described in Emergency Plan Procedures EPIP-4.08, EPIP-4.10, EPIP-4.11, and EPIP-4.13. The procedural method is available in the Control Room, TSC, LEOF, and CEOF. The LEOF also has some additional dose assessment procedures for use by the Radiological Assessment Coordinator. These procedures are similar to the EPIP method but provide the capability to perform some of the calculations on the plant computer. The EPIP method could be improved by modifying it to run on a personal computer, or a computer system separate from the emergency response computer system where RAD/MET resides. This would eliminate the necessity of using multiple procedures when performing the calculations, and should reduce the time to complete the calculations as well as reduction of calculational errors.

Based on a previous NRC inspection finding (50-338/87-11, 50-339/87-11), the licensee performed a comparison between their RAD/MET model and the manual EPIP method. Results of the comparison were documented in an internal memo dated March 8, 1988, entitled "Documentation of Differences between RAD/MET Model and North Anna Power Station EPIPs". Ten items of inconsistency were noted in the memo (see Table 1.2-1). These items were discussed in detail with cognizant licensee representatives.

The licensee's approach to evaluating atmospheric transport and diffusion is appropriate for initial and continuing dose assessment within the 10-mile EPZ. However, the methodology relies heavily on procedures that are excessively detailed. This approach could ultimately lead to confusion if an actual release occurred and the effluent did not behave in a manner consistent with simple atmospheric transport and diffusion models.

Several areas of the procedures related to atmospheric transport and diffusion models were reviewed and discussed with licensee representatives. Areas included the following: estimation of source terms from offsite monitoring data; determination of atmospheric stability classes; and projection of plume position. These items are discussed below.

(1) Procedures EPIP-4.13 and EPIP-4.27 contain specific provisions for estimating source terms from field monitoring data. The source term estimates are then used in estimating doses at other locations. EPIP-4.09 (Source Term Assessment) states that a source term should be calculated from field monitoring data if it can not be estimated from onsite sampling and/or monitor readings. The Gaussian equation used in the dose assessment procedures can be manipulated algebraically to yield source term estimates from monitoring data.

The assumptions made in application of the Gaussian diffusion model tend to be conservative, that is, they inflate dose and dose rate estimates. For example, according to the licensee's EPIPs, releases are all treated as if they occur at ground-level. Similarly, the temperature difference is used as the primary method of determining stability class for selection of the horizontal diffusion coefficient when a more realistic and less conservative method (sigma theta) is available. When the diffusion model is inverted for use in estimating the source term, the assumptions that lead to conservative estimates of doses and dose rates will lead to nonconservative (low) assumptions of the magnitude of the release.

It is generally recognized that during the early phases of an accident sequence, the use of limited field monitoring data for back calculation of a source term will yield a number with a high degree of uncertainty. The apparent nonconservative nature of this method and its impact on determination of emergency classifications, and the protective action decision making process were discussed with licensee representatives. The discussion included precautions that should be considered if source terms derived from field monitoring data are used for the above purposes.

(2) The licensee's dose assessment procedures list vertical temperature difference (delta T) as the primary method for determining the stability class used in estimation of diffusion coefficients. This method is consistent with NRC staff guidance. If delta T is not available; however, the procedures specify use of the standard deviation of the wind direction (sigma theta) to determine stability class. Use of sigma theta

in estimating the horizontal diffusion coefficient is also consistent with NRC guidance.

Climatological data from the licensee's meteorological system show that there are frequently significant differences in the stability classes determined from delta T and sigma theta. For example, in 1987, there were 1364 hours of F and G stability based on delta T, but there were only 5 hours of F and G stability based on sigma theta. Similarly, there were 201 hours of A and B stability based on delta T, while there were 4539 hours of A and B stability based on sigma theta. Failure of the delta T system during an emergency could lead to a significant change in the dose assessment that is not related to a change in the release or the environment.

Mitigation of the effect of loss of the delta T system on dose assessment by inclusion of separate stability classes for vertical and horizontal diffusion was discussed with the cognizant licensee representatives. This separation of stability classes is accepted by the NRC and is referred to as the split-sigma procedure. In the split-sigma procedure, delta T is used as the primary method of determining the stability class for vertical diffusion, and sigma theta, which is a direct measurement of the turbulence that causes horizontal diffusion, is used to determine the stability class for horizontal diffusion. The effect of loss of either delta T or sigma theta is minimized because only one of the diffusion coefficients will change following the loss rather than both. Further, redundancy in the meteorological system makes total loss of sigma theta measurement capability less likely than loss of the delta T measurement capability. This is significant because the horizontal diffusion coefficient has a more significant role in the licensee's models than the vertical diffusion coefficient. Both delta T and sigma theta are available in the EOFs.

(3) The manual dose assessment methods included in EPIP-4.08 and EPIP-4.10 were determined to be adequate for initial dose assessment. It was noted, however, that the manual methods do not provide acceptable means for extended dose assessment during periods when the wind may shift, while the RAD/MET model (EPIP-4.27) provides the capabilities for estimating transport and diffusion under these conditions. However, the implementation of atmospheric transport and diffusion portion of the RAD/MET model is incomplete; that is, the current version of the model only tracks plume positions but does not provide estimates of future or projected plume positions and attendant dose assessment. As a result, RAD/MET is only capable of projecting doses at current and past positions of the plume.

The licensee relied on the NRC models to estimate consequences in the ingestion pathway zone. The NRC models were developed to estimate potential consequences of a release at an indeterminate time for licensing applications. They were not intended for use in evaluation of the consequences of an actual release. Models similar to RAD/MET are more appropriate for assessing consequences in the ingestion pathway zone following an actual release than are the models used by the NRC during licensing.

The Health Physics Supervisor and technicians are trained in using the EPIP dose assessment method and RAD/MET and would report to the Control Room to perform the initial dose calculations if needed prior to TSC activation. Both the licensee and an independent consultant have performed verification and validation studies on the RAD/MET model. Any software changes to RAD/MET would first be approved by a licensee planning group. If approved, the licensee program group would perform the modifications and verify that the model functions properly. Finally, an independent consultant would review and validate the software changes.

The licensee performed some limited reviews comparing RAD/MET to IRDAM and the State of Virginia's dose assessment model. It was concluded, however, that more detailed comparisons be made for a wider variety of test cases and that reasons be identified if any comparisons differed significantly. Discussions with licensee personnel indicated that the State of Virginia was in the process of changing their dose assessment model; therefore, any planned comparison would be delayed until modification of the State's model was completed and verified.

Based upon the above review, the licensee agreed to evaluate and take appropriate action on the following:

- Resolving the differences in dose calculations between the RAD/MET model and the manual method defined in the Emergency Plan implementing procedures (50-338/88-14-01, 50-339/88-14-01). See Table 1.2-1

- Evaluating the validity of the use of field monitoring data for calculating a source term and the use of the derived term in the protective action decision-making process, or in determining emergency classifications. If a source term generated from field monitoring data is used for these purposes, provide a technical basis for the procedure, identify precautions in using the procedure, and provide corresponding training for dose assessment personnel (50-338/88-14-02, 50-339/88-14-02).

- Revising the Emergency Plan Procedure (EPIPs) addressing dose assessment to include separate stability classes for vertical and horizontal diffusion (50-338/88-14-03, 50-339/88-14-03).

- Modifing the RAD/MET model to provide dose projection estimates at future plume positions (50-338/88-14-04, 50-339/88-14-04).

Based on the above review, licensee representatives agreed to evaluate the following:

- Modifying the manual EPIP dose calculation method to run on a personal computer or a computer system separate from RAD/MET. This computerized EPIP method could be made available in the Control Room TSC, LEOF, and CEOF.
- Conducting a more detailed comparison between RAD/MET and the Commonwealth of Virginia's dose assessment model following completion of the Commonwealth's proposed modifications to the model. Reasons should be identified if any comparisons differ by more than a factor of 3.
- Developing a version of the RAD/MET model with a domain that extends through the ingestion pathway zone.

TABLE 1.2-1

DIFFERENCES BETWEEN NORTH ANNA POWER STATION
EPIPs AND RAD/MET MODEL

1. The RAD/MET model does not perform Technical Specification calculations for liquid and gaseous releases.

2. The conversion factors for the NRC interim high range monitors are based on equivalent Kr-85 in the EPIPs and are based on equivalent Xe-133 in the RAD/MET model.

3. The RAD/MET model does not include the Kaman Science monitors for ventilation vent A (VG-179), ventilation vent B (VG-180) and process vent (GW-178).

4. The RAD/MET model currently assesses potential containment releases during a LOCA with the Containment Personnel Hatch monitors (RMS-161, RMS-261). The EPIPs include these monitors and the Containment High Range Gamma - Inner Crane Wall monitors (RMS-165, RMS-166, RMS-265, RMS-266). The Personnel Hatch monitors are being eliminated per North Anna Engineering Work Request, EWR 86-302. The EPIPs and the RAD/MET should address the Inner Crane Wall monitors only.

5. The RAD/MET model uses a R.G. 1.109 Xe-133 dose conversion factor for the normal range effluent monitors - ventilation vent A (VG-104), ventilation vent B (VG-113), and process vent (GW-102). The EPIPs use Xe-133 dose conversion factors from Kocher.

6. The RAD/MET model does not address a "primary gas release" accident. The EPIPs do handle this type accident.

7. The RAD/MET model uses R.G. 1.109 to derive whole body and thyroid dose conversion factors for each accident type. The EPIPs use Kocher to derive the whole body to thyroid dose conversion factors for each accident type.

8. The RAD/MET model accounts for the use of containment sprays which remove all elemental iodine in the containment atmosphere leaving only the organic iodines. EPIPs do not address use of containment sprays.

9. The RAD/MET model uses a LOCA scenario to model an "unknown" or "other" accident. The EPIPs use a primary gas release to model an "unknown" accident.

10. The RAD/MET model uses R.G. 1.109 in various calculations whereas the EPIPs use Kocher. An example of the differences that can be provided is the S/G tube rupture accident. The RAD/MET calculates equivalent Xe-133 using R.G. 1.109 (34,000 Ci) while North Anna's EPIPs calculate equivalent Xe-133 using Kocher (45,580 Ci); this is a 25% difference. Similar variances are seen for other accident types.

2.0 Meteorological Information

Onsite meteorological data were provided by primary and backup meteorological systems. The instruments in both systems were well exposed and generally provided data statistically representative of atmospheric conditions at the plant. Instrumentation in the primary system monitored the following meteorological parameters: wind direction and speed at heights of approximately 31 and 160 feet (ft.); temperature at 31 and 160 ft.; temperature difference between 31 and 160 ft.; standard deviation of wind direction fluctuations (sigma theta) at 31 and 160 ft.; dew point temperature at 31 ft.; solar radiation; and precipitation. Instrumentation in the backup system provided wind direction, wind, speed, and sigma theta at approximately 31 ft.

Signals from the meteorological instruments were immediately directed to instrument shelters located near the bases of the towers. Following conditioning, the signals were split for distribution. In each system, one set of signals was diverted to strip chart recorders, and another set to a data logger located in the instrument shelter. A third set of signals was sent to an additional signal conditioning unit for transmission to the Control Room where the signals were split again. In the Control Room, one set of signals was recorded on strip chart recorders, and the remaining set was sent to the HP computer.

The instrument shelters appeared to have adequate environmental control to permit the meteorological instrumentation to operate reliably. Instrument electrical power for the primary system was obtained from normal plant power, while the power for the backup system came from the vital power bus. The instruments and towers were protected from lightning. However, the lightning protection did not extend to the instrument power supplies. Note, that loss of the primary meteorological system from lightning on June 26, 1988, may have been caused by a power surge.

Plant procedures provided for daily inspections and periodic calibrations of the meteorological instrument systems. Records indicated that calibrations were performed on a regular basis, and that the availability of meteorological data was excellent.

Meteorological data were available in the control room from strip chart recorders and via the SPDS terminals. They were made available to the TSC, LEOF, and CEOF via the SPDS terminals and telephone communications. Meteorological data were available from the Safety Parameter Display System (SPDS) terminals through the RAD/MET model and through display of the signals from the individual sensors. The data obtained through the RAD/MET model were averaged and were appropriate for use in dose assessment. The displayed when signals from individual sensors were called up on the SPDS were spot values obtained at about 5 second intervals.

Based on the above review, the licensee's meteorological instrument systems appeared to be adequate for emergency response applications; however, licensee representatives agreed to evaluate the following:

- Providing support for a backup method for estimating the vertical diffusion coefficient that does not involve sigma theta. Two possible alternatives for this support are an independent, backup delta T system, and implementation of a procedure to estimate stability class from solar radiation and wind speed.
- Protecting the meteorological tower instrument power supplies from the effects of power surges caused by lightning strike.
- Replacing the spot meteorological data values available through the SPDS with time-averaged data, except where there is specific need for the spot meteorological data.

3.0 Technical Support Center

The Technical Support Center (TSC) was located within the plant site protected area, adjacent to Unit 1 Control Room. The total size of the TSC was approximately 4900 square feet. The facility provided approximately 1800 square feet for emergency operations, 900 square feet for computers and their support, 250 square feet for personnel support facilities, and slightly less than 75 square feet per person.

3.1 Regulatory Guide 1.97 Variable Availability

Regulatory Guide 1.97 variables were provided in the TSC, Local Emergency Operations Facility (LEOF), and Corporate EOF (CEOF) via the Emergency Response Computer System (ERCS). The Safety Parameter Display System (SPDS) is a component of the ERCS and provided the TSC managers with information required for performance of their emergency response functions.

The inspector reviewed documentation for Regulatory Guide 1.97 criteria. Through a series of correspondence, the licensee provided the NRC a detailed description of their conformance to RG 1.97 as applied to the ERF. In a Safety Evaluation Report (SER) dated March 31, 1988, the NRC informed the licensee that their instrumentation met the recommendations of the Guide, with the exception of the containment water sump temperature instrumentation which was not environmentally qualified. It was further stated that the NRC staff would conduct a generic review to determine whether instrumentation for measurement of the subject variable required environmental qualification (Category 2 instrumentation). This matter was under NRR review at the time of the inspection.

The primary means for accessing RG 1.97 variables was the SPDS, a component of the ERCS. In addition to the required parameters, the SPDS expanded NUREG 0737, Supplement 1 requirement to display reactor core cooling and heat removal from the primary system into two level displays entitled "Core Heat Removal". This modification provided the operator a more practical approach to evaluation of plant conditions and the applicable parameters.

In addition to electronic availability of RG 1.97 variables via the ERCS, dedicated communicators were assigned specific status boards within the TSC. These personnel were in communications with the Control Room and other locations, and recorded key plant status and radiological parameters on assigned status boards. A clerk also recorded the information on plant status sheets. A sufficient number of telephones with redundant power supplies were available to ensure continuous and effective manual transmission of essential data. Data provided to the TSC was adequate to support determination of required protective action recommendations. Note, that Table 3.1-1 lists RG 1.97 variables that were not available to the ERFs via the ERCS. The table lists the specific variable and type, its respective range, and method of determining the magnitude of the release.

TABLE 3.1-1

REGULATORY GUIDE 1.97 VARIABLES UNAVAILABLE TO ERFs

RG 1.97 Variable	Range	Input
Airborne Radiohalogens & Particulates (Type E)	10^{-9} to 10^{-3} uCi/cc	Portable Equip
Plant & Environment Radiation (Type E)	10^{-3} to 10^{4} R/hr, photons 10^{-3} to 10^{4} rad/hr, beta radiations & low-energy photons	Portable Equip
Plant & Environment Radioactivity (Type E)	Isotopic Analysis	Portable Equip

TABLE 3.1-1

REGULATORY GUIDE 1.97 VARIABLES UNAVAILABLE TO ERFs

RG 1.97 Variable (cont'd)	Range	Input
RCS Soluble Boron Concentration (Type B)	0 - 6000 ppm	Manual
Analysis of Primary Coolant (Type C)	10umCi/gm - 10 Ci/gm	Manual
Primary Coolant & Sump Sample (Type E)		
- Gross Activity	1 µCi/ml to Ci/ml	Manual
- Gamma Spectrum	(Isotopic Analysis)	
- Boron Content	0 to 6000 ppm	
- Chloride Content	0 to 20 ppm	
- Dissolved Hydrogen or Total Gas[22]	0 to 2000 cc (STP)/kg	
- Dissolved Oxgen	0 to 20 ppm	
- pH	1 to 13	
Containment Air Sample (Type E)		Manual
- Hydrogen Content	0 to 10 vol-%	
- Oxgen Content	0 to 30 vol-% for ice condensers 0 to 30 vol-%	
- Gamma Spectrum	(Isotopic Analysis)	

Based on the above review and respective written procedures, the availability of RG 1.97 variables was determined to be adequate.

3.2 TSC Functional Capabilities

Specific areas of power continuity were considered in evaluating the capability of the TSC to function without interruption during a station blackout; namely, data acquisition systems, communication systems and equipment, emergency lighting, and the ventilation system (HVAC).

The TSC vital and semi-vital loads provided satisfactory multiple power sources. The vital loads were on an uninterrupable power supply (UPS) buss which was normally fed from the 2G2 buss via a 80V/120-208V transformer. These vital loads were the computers, emergency lighting, radiation/meteorological monitoring equipment, fire protection system, and telemetering equipment. Emergency backup power to the UPS bus was available from batteries via an inverter and a static throw-over switch. The batteries were kept charged from the 1G3 bus. Prior to the appraisal, the licensee recognized that no procedure was provided to test the throw-over feature of this system. Accordingly, the licensee was actively engaged in investigating methods and development of procedures to implement required testing. Telephones in the TSC were adequately protected with backup power supplies.

Although the SPDS was determined adequate for the support of TSC functions, it was noted that the SPDS top level display color-coded alarm conditions did not correspond to the Emergency Action Level (EAL) trip points for the applicable parameters. This observation was discussed with cognizant licensee representatives and the apparent need to coordinate the SPDS display color code with applicable EAL parameter escalation values was identified. TSC data systems are discussed in Section 3.4.

Based on the above review, this portion of the licensee's program was adequate; however, the licensee agreed to evaluate the following:

- Developing a procedure to test the throw-over feature of the UPS buss.
- Developing algorithms to coordinate the SPDS top level display color code with the applicable EAL parameter escalation values.

3.3 TSC Habitability

The TSC was provided with adequate shielding to ensure that personnel working in the facility under accident conditions, including a LOCA, would not receive an integrated radiation dose in excess of 5 rem to the whole body or 30 rem to the thyroid or to the skin, as specified in GDC 19 and SRP-6.4. Calculations performed by the licensee resulted in integrated doses of 4 rem to the whole body, 27.22 rem to the thyroid and 6.43 rem to the skin, that is, less than the guideline values defined in the above cited references. The calculations included exposure contributions from containment and ECCS leakage. Inhalation dose from airborne activity assumed to pass through the emergency filtration system was included in the dose estimates. An activated charcoal filter was provided in the air intake to meet the filter efficiency of 99%, consistent with Regulatory Guide 1.52. The TSC provided for continuous monitoring of radiation dose rates and airborne radiation levels of three locations within the facility during an emergency.

The TSC ventilation system operated satisfactorily to pressurize the facility via a filter consisting of series components in the following order: prefilter-charcoal-HEPA. This arrangement for the emergency ventilation system was consistent with the recommendations of RG 1.52. Inspection of the emergency ventilation system consisted of a review of operational procedures, as well as test procedures and results. A walk-through of operational procedure 1-OP 21-10 was conducted and disclosed that the procedure, as written, would not ensure proper system operation. Prior to the appraisal, the licensee recognized the need for the operator to check and record the positive pressure in the contained spaces. Required changes to the procedure were in progress. However, the licensee did not identify the need for the operator to verify the actual position of key dampers in the normal ventilation system to verify proper operation of the system. Further, the licensee did not recognize that certain interlock features within the system were being tested neither by the operational procedure nor the system test procedure (1-PT 77.9). It was also determined that no preventive maintenance program was scheduled for key system components such as the dampers. A walk-through of the system disclosed that indicator lights were inoperable on the system control panel; a local fan controller and a fan belt protector were mislabled; and the damper open and closed positions need to be labeled for the operator to be able to verify damper positions.

Based on the above review, the licensee agreed to evaluate and take appropriate actions on the following:

- Revising TSC emergency ventilation operational procedure (1-OP 21-10) to include operator verification of normal system damper positions to ensure proper system operation (50-338/88-14-05, 50-339/88-14-05).

- Revising TSC emergency ventilation test procedure (1 PT 77.9) to test emergency ventilation system components including system interlocks (50-338/88-14-06, 50-339/88-14-06).

Based on the above review, the licensee also agreed to evaluate the following:

- Providing a preventive maintenance program for key emergency ventilation system components.

3.4 Data Collection, Storage, Analysis and Display

Licensee system hardware and corresponding documentation was reviewed to determine whether Emergency Response Facility (ERF) functions would be adequately supported.

a. Methods of Data Collection

Real-time data acquisition, display, and storage to support ERF functions were performed by a distributed computer system. The distributed system included a Validyne data gathering front end, a Data Communications Processor (DCP) based on a MODCOMP Classic II 75 system, a Local Emergency Operations Facility (LEOF) unit based on a MODCOMP Classic II 75 system, a Corporate Emergency Operations Facility (CEOF) unit based on a MODCOMP Classic II 75 system, and an Emergency Response Facility Input/Output (ERFIO) unit also based on a MODCOMP Classic II 75 system.

All of the units based on the MODCOMP classic II 75 system have the following features:

1 - Megabytes (MB) Random Access Memory (RAM)
1 - 67 MB hard desk unit
1 - 13 MB hard desk unit
1 - 13 MB hard desk unit
1 - nine - track tape drive

The DCP, ERFIO, and CEOF systems had redundant processors for continuous backup. Switch-over to backup computers could be achieved in three different ways: (1) a "watchdog" process running on the backup system monitors the primary system, that is, if the primary system fails to respond to requests within a fixed time period, the backup system automatically assumes primary system functions; (2) the primary and backup systems could be switched using software commands; and (3) computer panel switches could be manually switched to swap the primary and backup systems.

The following were the configurations and primary functions of the computers supporting ERF (Emergency Response Facility) functions:

- Validyne Front Ends

  Licensee contacts were not able to furnish the microprocessor type or amount of memory used; however, detailed drawings were reviewed that showed redundant sensor monitoring as well as redundant multiplexer units used. It was observed that neither disk nor tape drives were required.

  Function: Collect data from plant sensors, perform signal conditioning, multiplex data, and transmit sensor data in binary format to the DCP system.

  - DCP (Redundant System)

  Function: As the hub of the distributed computer system, the DCP computers collected data from the Validyne front end, converted binary values to values with engineering units, performed alarm checking, stored data, and transmitted data to the ERFIO, LEOF, and CEOF computer systems for further processing.

  - ERFIO (Redundant System)

  Function: This system received data from the DCP, performed required computations to drive display devices in the Control Room (CR) and the TSC, did 10 minute radiological and meteorological data averaging, and performed status functions.

- LEOF (Non-redundant System)

  Function: Performed the same computing and display functions as the ERFIO for the LEOF.

- CEOF (Redundant System)

  Function: Performed the same computing and display functions as the ERFIO for the LEOF.

The bulk of the ERF software was written in FORTRAN 77 with some routines written in assembly language. Supporting documentation (e.g., user's guide, programmer's reference manual, and test acceptance documentation) was found to be comprehensive and professionally done.

The following is a list of analog (continuously variable) and digital (2 state) plant sensors routinely sampled and used to assess plant safety status:

	Analog Sensors	Digital Sensors	Computed Points	Total Sensors
Unit #1	400	550	200	1150
Unit #2	400	550	200	1150
Totals:	800	1100	400	2300

Based on the above findings, this portion of the licensee's program appeared adequate.

b. Data Displays

Data display cathode ray tubes (CRTs) supporting ERF functions were as follows:

- Control Room (CR)

  2 - CRTs for CR operators
  2 - CRTs for shift supervisors

  TSC

  2 - 25 inch CRTs (no touch screens)
  7 - 19 " CRTs (with touch screens)
  5 - 13 " CRTs (" " ")
  1 - Tektronix hard copy unit

LEOF

4 - 13 inch CRTs (with touch screens)
3 - 18 " CRTs (" " ")
1 - Tektronix hard copy unit

CEOF

3 - 19 inch CRTs (with touch screens)
1 - 13 " CRT (with touch screen)
2 - 25 " CRTs (without touch screens)

The above display CRTs were controlled by Aydin model 5215 RGB (red/green/blue) display generators with 4 kilobytes of memory.

Display generation was well implemented for North Anna's ERFs. Users were given the option of selecting displays by: (1) pressing function keys; or (2) touching the screen in marked locations. Displays were generated on the CRTs in 1 to 5 seconds with no significant delays in response to display requests. In addition to being able to select from a variety of pre-formatted displays showing plant status, users could also select up to 4 sensors for trend plotting.

The touch screen feature for this site was reported to be no longer supported by the original vendor. The feature did not consistently operate as designed; for example, frequent attempts to select features of the display system did not elicit the intended response. Although this finding identified a weakness in the system, it was not viewed as a problem, since the function key feature worked well and consistently supported all required display functions.

Based upon the above review, this portion of the licensee's program appeared to be adequate.

c. Time Resolution

ERF supporting computers read, analyzed, and stored to hard disk data from 1900 analog and digital sensors for Units #1 and #2. The sampling rate for data varied between 1 second for the complete digital sensor set, to 5 seconds for the analog sensor set. The data sampling rate was considered low to moderate speed.

If required, higher resolution transient data could be obtained from the General Electric Transient Analysis Recording System (GETARS). This system was currently configured to record data from 150 plant sensors in 2 milliseconds. This data was not displayed in real time, but could be valuable for post event analysis.

Based upon the above findings, this portion of the licensee's program appeared to be adequate.

d. Signal Isolation

In a letter dated November 5, 1984, from the licensee to the NRC Office of Nuclear Reactor Regulation (addressing: "Virginia Electric and Power Company North Anna Unit Nos. 1 and 2 ... Safety Parameter Display System"), the licensee stated that the data acquisition system implemented provided isolation by multiplexer units that were qualified 1E. Further, the letter stated that fiber optic links were used from the multiplexer to downstream units. Inspection, including discussions with cognizant licensee representatives, and review and evaluation of system schematics, confirmed that the Validyne front end component-links used fiber optics.

Based upon the above review, this portion of the licensee's program appeared to be adequate.

e. Data Communications

Data communications capabilities were reviewed for the Validyne front end, the DCP, ERFIO, LEOF, and CEOF. Transmission rates between the Validyne, DCP, ERFIO, and LEOF were reported to be 2 megabits per second. The transmission rate between the DCP and the CEOF via a microwave link was reported at 56 kilobits per second. A dedicated telephone link was also available for telecommunications between the DCP and the CEOF as a backup in the event of possible microwave system failure. Modem firmware and operating system software for ERF telecommunications support was reported to use error detection and correction, or request for retransmission on error detection.

Based upon the above review, this portion of the licensee's program appeared to be adequate.

f. Processing Capacities

The Validyne, MODCOMP Classic II 75 and peripheral computer systems were configured to support plant safety monitoring and reporting needs. As previously described, the distributed computing system implemented was functionally partitioned to avoid overloading any processor. The data acquisition tasks were performed by the Validyne front end and the DCP. Processing was based on multitasking to allow several software functions to be processed concurrently while executing the highest priority tasks first. Data acquisition and storage tasks were high priority tasks and execute before supporting tasks.

Interviews of cognizant licensee representatives and review of pertinent documents disclosed the following loading for the distributed system processors for routine operation:

Processor	Estimated Loading
Validyne	could not estimate - no indication of overloading
DCP	60 %
ERFIO	25 %
LEOF	25 %
CEOF	25 %

Based on the above review, this portion of the licensee's program appeared to be adequate.

g. Data Storage Capacity

Historical data was stored to disk such that, at any time, 15 minutes of pre-event and 2.5 hours of post-event data would be saved. Routinely, 15 minutes of historical data were available for trending. Utility personnel interviewed reported that once an event has been indicated, that any 2.5 hour time slice could be saved to magnetic tape. This process could then continue indefinitely, depending on magnetic tape availability.

Based upon the above review, this portion of the licensee's program appeared to be adequate.

h. Model and System Reliability and Validity

Documentation for model algorithms was reviewed in detail and determined to be valid and acceptable. Report SAIC-86/1901& 264&0 ("Verification and Validation Final Report for Virginia Power Company (VEPCO) 0696 Computer Project", Revision 0, dated December 19, 1986, by Science Applications International Corporation) was also reviewed. The goal of the V&V (Verification/Validation) report was to independently determine that requirements of NUREG-0696/0737 were satisfied. This effort included reviewing requirements for correctness, completeness, consistency, clarity, feasibility, testability, and traceability.

Based upon the above review, this portion of the licensee's program appeared to be adequate.

i. Reliability of Computer Systems

Computer system availability was documented by the utility in a letter dated December 2, 1985, to the Vice President-Power

Station Engineering/VEPCO. The subject was "Completion of Availability Testing".

A problem with plant sensor data acquisition was identified. Specifically, a licensee data base to track maintenance requests showed that from November 10, 1987 to June 14, 1988, at least 18 sensor errors were found and corrective action was taken. Of these 18 errors, 7 sensor problems were found to be caused by either incorrect wiring, calibration, or incorrect requirements. Sensor drift and occasional malfunctions had a high probability of occurrence, but were not of concern in this instance. The concern was, however, that sensor problems may be traceable to weaknesses in requirements, verification, testing, or maintenance verification.

The licensee's calibration procedure ICP-TSC-2-MUX-10, VEPCO "Instrument Calibration Procedure Validyne Remote Multiplexer - 2MUX" was reviewed and appeared to be adequate as a tool to perform instrument calibration. Cognizant licensee representatives reported that calibration was an ongoing process that required 24 months to complete, and that an automated calibration scheduling process was used.

Based upon the above review, the licensee agreed to evaluate and take appropriate action on the following:

Establishing a mechanism to track all sensor data errors to help correct and prevent abnormal sensor data errors. (50-338/88-14-07, 50-339/88-14-07). The tracking should include:

- time, sensor identification, and problem description using a consistent set of problem declarations;
- report the frequency of problem types;
- track corrective and preventative action items, namely: responsible organization, corrective and preventative action, and due dates

j. Manual Systems

Review and inspection disclosed that no manual data entry processes were employed in the ERFs.

k. Specifications of Environmental Control Systems

Design Criteria Documents Cover Sheets were made available for review. Air conditioning units installed were required to support proper functioning of ERF computers. The design criteria reviewed specified air conditioning equipment capable of handling 0% to 70% relative humidity and 0°F to 90°F temperatures.

Based upon the above review, this portion of the licensee's program appeared to be adequate.

4.0 Local Emergency Operations Facility

4.1 Location and Habitability

The LEOF was located adjacent to the Training Center approximately 0.25 miles from the plant; therefore, it must meet Option 1 requirements in Table 1 of NUREG-0737, Supplement 1. LEOF walls consisted of 8 inch concrete block and 4 inches of brick. The roof consisted of 12 inches of concrete block. Shielding calculations performed by the licensee indicated a protection factor of 12.6 from 0.7 MeV gamma exposure which meets the requirements in NUREG-0737, Supplement 1.

The LEOF ventilation system operated satisfactorily to pressurize the facility via a filter train consisting of a pre-filter and HEPA filter. Facility radiation monitors were located downstream of the filter train. Documentation for the LEOF emergency ventilation system was reviewed. The licensee was in the process of revising the operational and test procedures (ES-88-16 and 1-PT 77.10, respectively) to ensure that facility positive pressure could be maintained. The licensee was also evaluating the feasibility of installing differential pressure gages within the ventilation system similar to those installed in the TSC.

Within the LEOF, 19 battery operated dual emergency lights were strategically located. Inspection of facility emergency lighting included: lights to show a detailed review of preventative maintenance procedure E-11-LP/SA-1 and attached equipment guide list; testing of lighting system; review of documentation of LEOF emergency lighting system tests; and preventative maintenance records.

Evaluation of LEOF emergency lighting disclosed the following: (1) test of the emergency lights showed that three of the 19 light units failed to actuate, two of which were located in the computer room; (2) absence of non-safety preventive maintenance program to assure periodic maintenance and documentation of systems testing and results.

Based on the above review, LEOF habitability was determined to be adequate. Licensee representatives, however, agreed to review and evaluate the following:

- Revising non-safety preventive maintenance program to ensure periodic maintenance of non-safety systems and documentation thereof.

- Documenting periodic testing of non-safety systems and the results thereof.

4.2 LEOF Functional Capabilities

a. Data Analysis Adequacy

The LEOF and CEOF received the same Emergency Response Computer system (ERCS) data as the TSC. As described for the TSC, the data is well formatted for LEOF accident analysis and supporting protective action recommendations.

b. Backup EOF (CEOF)

The backup EOF, located in Richmond, Virginia, was not evaluated. The Corporate EOF (CEOF) was being moved to a new permanent location during the appraisal. The new location places the facility 10 miles closer to the North Anna plant site.

c. LEOF Reliability

The Local EOF (LEOF) was provided with only one source of power from the Rappahannock Cooperative Power Grid. However, the grid itself had multiple power sources including the North Anna plant via Gordonsville. The Corporate EOF (CEOF) located over 30 miles away received its power from the 12th Street Sub-Station in Richmond which also had multiple power sources. The emergency response computer systems and the telemetering system for the EOFs were powered from the UPS Bus described in Section 3.4. EOF telephone systems were provided with sufficient back-up power supplies to keep the EOFs functional in case of loss of power.

Based on the above review, this portion of the licensee's program was determined to be adequate.

4.3 Regulatory Guide 1.97 Variable Availability

a. Regulatory Guide 1.97 Variable Availability and Sufficiency

Since the LEOF used the same ERCS data and displays as the TSC, refer to discussion of RG 1.97 variables in Section 3.1 above. Computer systems and related display, data storage and analysis are discussed in Section 3.4.

b. Manual Data

The back-up system for transmitting plant variables to the EOFs was by facsimile transmission of the plant status sheets from the TSC. At the EOFs, the status received by FAX was displayed on status boards. There were sufficient redundant telephones to ensure transmission paths for facsimile transmission.

During evaluation of the LEOF, it was observed that status boards were not used when the ERCS was functional. Even if plant variables were not of general interest, the plant emergency status, and chronology of events, would be most informative to emergency response personnel entering the facility. The above observation was discussed with cognizant licensee representatives.

Based on the review, the provisions for backup manual data to the EOFs appeared to be adequate to support protective action decisions and recommendations.

4.4. Data Collection, Storage, Analysis and Display

The same computers supporting the Technical Support Center and Emergency Response activities supports the CEOF and the LEOF. These systems and details of their functions have been described in Section 3.4, above. The data provided to the LEOF appeared adequate to support protective action decisions and recommendations.

Based upon the review, EOF data systems appeared to be adequate.

5.0 Site Personnel Contacted

*G. Kane, Station Manager
*M. Bowling, Assistant Station Manager
*F. Cox, Supervisor, Emergency Preparedness
*S. Harrison, Coordinator, Emergency Planning
D. VandeWalle, Supervisor, Licensing
C. Tarintino, Corporate, Staff Health Physicist
W. Austin, Supervisor, Telecommunications Operations
*D. Ross, Senior Staff Health Physicist
*W. Madison, Senior Instructor
*R. Driscoll, Manager, Quality Assurance
*W. Beck, Senior Staff Engineer
*P. Knause, Information Resource Specialist
*B. Dunlap, Project Engineer
*M. Blankenship, Electrical Engineer
*P. Perrine, ERCS Coordinator
R. Krich, Nuclear Licensing Engineer
R. Carroll, Jr., Project Engineer (Surry Station)
*R. Cross, Nuclear Specialist
L. Thomasc Corporate Health Physicist
D. Dunkerle, Nuclear Instrumentation Engineer
R. Boehling, Performance Engineer, Telecon Operations
B. Sawyer, Station Maintenance
*B. McBride, Emergency Planning Coordinator
D. Roth, Nuclear Specialist

*Attended Exit Interview

NRC Resident Inspector

*J. Caldwell, SRI

6.0 Action on Previous Inspection Findings (92701)

a. (Closed) Inspector Followup Item (IFI) 338,339/86-16-02, Press Releases not Annotated: "This Is A Drill".

Review of all press releases disseminated to the public during the 1988 annual emergency exercise indicated that they were correctly annotated.

b. (Closed) IFI 338,339/86-16-03, Required Updating of Recovery Manager.

Enhanced training and procedural revision were implemented to assure prompt and complete updating of Recovery Manager by Radiological Assessment Coordinator and respective staff.

c. (Closed) Unresolved Item 338,339/87-05-01, Provision for Evacuation of Nonessential Site Personnel Upon Site Area Emergency and General Emergency.

Review of EPIPs 1.04 and 1.05 (12/11/87) confirmed that required evacuation of nonessential site personnel attending declaration of site area and general emergency classifications, respectively, were adequately clarified to ensure implementation of subject procedural requirement.

d. (Closed) IFI 338,339/87-05-03. Formalized Tracking of Annual Emergency Preparedness (EP) Training.

Inspection disclosed that a computer program was in place to provide a detailed tracking format and retrievable record of all Emergency Preparedness (EP) personnel annual and projected requalification training.

e. (Closed) IFI 338,339/87-11-01, Availability of Augmentation Personnel.

Inspection confirmed that interim procedure 1-EP-MISC-1 was issued to implement an off-hours availability check of station emergency response personnel to assure their arrival at the station in a timely manner consistent with Table 5.1 of the REP.

f. (Closed) IFI 338,339/87-11-02, Comparative Study Between EPIP and RAD/MET Models.

Inspection confirmed that a comparison of the EPIP manual dose calculation method and the RAD/MET Model A dose assessment was completed as committed, and documented in a licensee internal memorandum. The differences compiled were being reviewed and factored into a planned corrective program.

7.0 Exit Interview

The inspection scope and findings were summarized on June 30, 1988, with those persons indicated in Paragraph 5 above. The inspector described the areas evaluated and discussed in detail the items listed below. These specific items are characterized as Open and are ones for which action is not complete but the need for completion has been recognized and agreed upon by the licensee. The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspectors during this inspection. No dissenting comments were expressed by the licensee.

Item Number	Type	Description
338,339/88-14-01	Open	Resolve differences in dose calculations between the RAD/MET Model and manual method defined in the Emergency Plan Implementing Procedures (Paragraph 1.2.1)
338,339/88-14-02	Open	Evaluate validity of use of field monitoring data for calculating a source term and use of same in the protective action decisions process, or in determining emergency classifications (Paragraph 1.2.2).
338,339/88-14-03	Open	Revise the EPIPs addressing dose assessment to include separate stability classes for vertical and horizontal diffusion (Paragraph 1.2.3).
338,339/88-14-04	Open	Modify the RAD/MET Model to provide dose projection estimates at future plume positions (Paragraph 1.2.3).
338,339/88-14-05	Open	Revise TSC ventilation operational procedure (1-OP-21-10) to include operator verification of normal system damper positions to ensure proper system operation (Paragraph 3.3).
338,339/88-14-06	Open	Revise TSC ventilation test procedure (1-PT-77.9) to test components including system interlocks (Paragraph 3.3).

Item Number (cont'd)	Type	Description
338,339/88-14-07	Open	Establish a mechanism to track all sensor data errors to help correct and prevent abnormal sensor data errors (Paragraph 3.4.i).

8.0 Glossary of Acronyms and Initialisms

AFTP	Auxilary Feedwater Turbine Pump
CEOF	Corporate Emergency Operations Facility
Ci	Curie
CR	Control Room
CRT	Cathode Ray Tube
DCP	Data Communications Processor
EAL	Emergency Action Level
EOF	Emergecny Operations Facility
ERCS	Emergency Response Computer System
ERF	Emergency Response Facility
ERFIO	Emergency Response Facility Input/Output
ERO	Emergecny Response Organization
EPIP	Emergency Plan Implementing Procedure
GETARS	General Electric Transient Analysis Recording System
HEPA	High Efficiency Particulate Air (Filter)
HVAC	Heating, Ventilation, Air Conditioning
IRDAM	Interactive Rapid Dose Assessment Model
LEOF	Local Emergency Operaions Facility
MB	Megabyte
RAD/MET	Primary Dose Assessment Method
RAM	Random Access Memory
RG	Regulatory Guide
RGB	Red Green Blue
SER	Safety Evaluation Report
SG	Steam Generator
SPDS	Safety Parameter Disp' System
TSC	Technical Support Cent
UPS	Uninterruptable Power Supply
V&V	Validation and Verification