VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

W. R. CARTWRIGHT
VICE PRESIDENT
NUCLEAR

February 21, 1989

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

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Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2
NORTH ANNA POWER STATION UNITS 1 AND 2
RESPONSE TO GENERIC LETTER 88-14
INSTRUMENT AIR SUPPLY SYSTEM PROBLEMS
AFFECTING SAFETY-RELATED EQUIPMENT

Virginia Electric and Power Company has received and reviewed Generic Letter 88-14, Instrument Air System Problems Affecting Safety-Related Equipment. As required by the letter, we are performing a design and operations verification of the Instrument Air Systems.

Provided in the attachment are the results of our Instrument Air System design and operation verification. A schedule for completion of the required testing and any identified system and program enhancements is also included. In addition, the Instrument Air System was one of the initial systems chosen for the Design Basis Reconstitution and Verification Program.

If you have any questions or require additional information, please contact us.

Very truly yours,

W. R. Cartwright

Attachment

A048
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cc: U. S. Nuclear Regulatory Commission
Region II
101 Marietta Street, N. W.
Suite 2900
Atlanta, Georgia 30323

Mr. W. E. Holland
NRC Senior Resident Inspector
Surry Power Station

Mr. J. L. Caldwell
NRC Senior Resident Inspector
North Anna Power Station

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by W. R. Cartwright who is Vice President - Nuclear, of Virginia Electric and Power Company. He is duly authorized to execute and file the foregoing document in behalf of that Company, and the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 21 day of February, 19 89.

My Commission expires: February 25, 19 90.

Vicki L. Hull
Notary Public

(SEAL)

RESPONSE TO GENERIC LETTER 88-14, INSTRUMENT AIR SYSTEMS

1. **Verification by test that actual Instrument Air quality is consistent with the manufacturers' recommendations for individual components served.**

RESPONSE

Manufacturer recommendations for air quality requirements were not specified for the air operated devices originally installed at both Surry and North Anna. We have contacted selected manufacturers of air operated devices to establish the air quality requirements but definitive requirements could not be obtained. We intend to upgrade the Instrument Air Systems to supply safety-related air operated components with air that meets the Instrument Society of America (ISA) Standard 7.3, "Quality Standards for Instrument Air," 1981 revision. This upgrade will include installation of new equipment and comprehensive surveillance and maintenance programs and will enhance the overall operation and reliability of the Instrument Air System and the devices it supplies.

Both Surry and North Anna have sampled portions of the station air system to determine existing air system quality. Details on the Instrument Air upgrade and sampling results are discussed in the subsequent sections of our response.

Sampling Program

Both Surry and North Anna have taken air samples at various locations throughout the stations' compressed air systems.

The initial sampling results taken in January 1989 for Surry indicated hydrocarbons were not present and the dewpoint was acceptable with minimal amounts of moisture present at low points in the Instrument Air System. Results of particulate sampling have not been received to date. A review was performed of recently completed maintenance work orders associated with air operated valves. No moisture attributable to the Instrument Air system was identified. These components' operability is assured by testing in accordance with Technical Specifications and the ASME, Section XI, Inservice Testing Program.

The initial sample results taken in February 1989 for North Anna indicated that minimal moisture and oil contamination were present at various locations in the Instrument Air System. However, as a result of previous operational events, the Instrument Air System lines and components have been contaminated with oil from non oil-free compressors and exposed to service water. High moisture content in the Instrument Air System has also occurred whenever

dryers were out of service or bypassed. Corrosion resulting from the service water intrusion events and dryer failures is not extensive and has not degraded component operability or reliability.

The current Instrument Air Systems provide air of a quality adequate to operate the air operated devices. Component operability is assured by the Technical Specifications and ASME Section XI Inservice Testing Program for valves. Also, functional testing of safety-related air operated valves is conducted every refueling (approximately 18 months) to verify that these valves realign to their safe position on a SI and/or CDA signal.

In addition, at North Anna air operated valves with ASCO SOVs are stroke tested on an accelerated frequency (i.e., monthly) except for cold shutdown valves. Air accumulators required to supply those valves required to achieve and maintain safe shutdown have been placed in the IST Program. Previous inspections at North Anna of ASCO SOVs did not indicate the presence of oil. Inspections of valves and air controllers previously subjected to moisture, water intrusion events, and oil contamination have not indicated degradation. Finally, the performance of air operated safety-related valves has been good.

A comprehensive compressed air sampling program is being developed to monitor air system performance at both stations. This program is scheduled to be in place by August 1989.

Interim Compensatory Measures

Until the compressed air systems enhancements are completed, additional compressed air systems surveillance is being performed. For example, Instrument Air Systems and equipment (including air accumulators) are blown down periodically, and air samples and dewpoints are taken periodically.

2. **Verification that maintenance practices, emergency procedures and training are adequate to ensure that safety related equipment will function as intended on loss of Instrument Air.**

RESPONSE

Maintenance Practices

The maintenance and surveillance programs at both stations have been evaluated, and it has been determined that the programs require strengthening to improve the overall compressed air systems operability and reliability. See Section 4 for additional information.

Emergency Procedures

Both Surry and North Anna are designed to be brought to a safe shutdown condition on a complete loss of Instrument Air. Air operated components that are required to operate during accident conditions have dedicated accumulators or separate air systems to provide for their continued operation.

At both stations, complete loss of Instrument Air scenarios were run on the simulator. As a result, the Emergency Procedures were verified to adequately address the operation and/or failure of air operated components. However, enhancements were identified for the Abnormal Procedures (i.e., those procedures used for loss of air events during non-accident conditions), and have been incorporated.

Training

The training programs at both stations have been reviewed.

"Loss of Instrument Air" is included in the simulator scenarios used to conduct licensed operator initial and continuing training at both stations.

Revisions to training modules and instructional material, to include INPO SOER 88-01 and additional operator training on loss of air events have been implemented at North Anna and will be implemented by June 30, 1989 at Surry. Craft training on the maintenance and operation of the station compressed air system components is being provided at both stations. As system enhancements are made, the craft training programs will be revised to include training on the new equipments' operation and maintenance requirements.

3. **Verification that the design of the entire Instrument Air System including air or other pneumatic accumulators is in accordance with its intended function, including verification by test that air-operated safety-related components will perform as expected in accordance with all design-basis events, including a loss of the normal Instrument Air System. This design verification should include an analysis of current air operated component failure positions to verify that they are correct for assuring required safety functions.**

RESPONSE

A review has been performed to identify the design basis of the Instrument Air Systems at North Anna and Surry. The intended function of the system is to provide high quality air to a variety of air operated devices. For normal operation, redundant sources of oil-free compressed air are provided from non-oil lubricated compressors or from oil lubricated compressors with separation and filtration equipment installed for removing oil. At North Anna, oil lubricated compressors are installed and provide an additional backup. A refrigerant dryer is installed to remove moisture from the air stream before it enters the distribution system. The bulk of the air system is expected to have a dewpoint of approximately 35°F based on the design of the refrigerant dryers. Filters are also installed to remove particulates greater than 5 microns.

The Instrument Air System is not considered to be safety-related. However, the containment penetration piping and certain local accumulator tanks and associated piping are safety related. Two instrument air compressors at each station are powered from the emergency buses to provide enhanced reliability for a loss of offsite power. However, the design basis for the Instrument Air System assumes a complete loss of air in conjunction with the analyzed UFSAR accidents. Air operated components are designed to fail to a predetermined safe position upon loss of air. Components required to actively operate during accident conditions have dedicated accumulators or backup air bottles to permit operation until operator action can be taken.

A review of the UFSAR, Technical Specifications, Emergency Operating Procedures, and the Appendix R analysis was performed to identify those air operated components required to maintain the units in a safe shutdown condition. The range of design basis conditions assumed ranged from a reactor trip to a condition III or IV event coincident with a loss of air. The final list of safe shutdown components will include those components needed to assure critical safety functions are performed (i.e. containment isolation, supply of feedwater to the steam generators, decay heat removal via steam release, and ECCS system alignment). In addition, those air operated dampers required to assure control room habitability and maintenance of offsite releases to within 10 CFR 100 limits will be included on the list.

The fail safe position has been established in accordance with the UFSAR analysis and will be verified by field testing. The function of each air operated component on the safe shutdown list for each of the applicable design basis events will be evaluated with respect to

the failure position (upon loss of air) and verified during testing. A determination will be made for each safe shutdown device regarding the adequacy of its designed failure mode.

For each air operated component on the safe shutdown list, a test will be performed to verify that the device fails to its safe position upon a loss of air by locally bleeding off pressure to the instrument loop. Where existing test procedures can be used to simulate loss of air to the device, credit will be taken for this testing versus writing a new test procedure. For those components with local accumulators, normal Instrument Air supply will be isolated from the accumulator and system pressure slowly bled off. This will allow verification of the seating of the check valve. In addition, the components supplied from the accumulators will be tested to verify proper operation by cycling the valve a specified number of times. Results from cycling the components this number of times will be extrapolated to demonstrate that the capacity meets its design basis.

Design verification testing will be completed at Surry before each unit starts up from its current outage. For North Anna, the testing will be completed during the 1989 refueling outage on each unit (Unit 2 started outage on February 19, 1989, and Unit 1 is scheduled for April 1989). Required operability testing of these components is completed in accordance with the Technical Specifications and/or the ASME Section XI Inservice Testing Program. Accumulator testing will be performed on a periodic basis.

4. **Provide a discussion of the program for maintaining proper instrument air quality.**

RESPONSE

A. Existing Program

A preventive maintenance program is in place that provides proper operation of compressors and their dryers and the components/devices they supply. The current program includes the following requirements which are performed on the applicable equipment at different frequencies depending on service requirements and run time:

- overall general equipment inspection
- clean and/or replace associated screens, filters, traps, strainers and separators
- lubricate couplings and bearings
- megger motors and control circuits
- inspect cooling system i.e., fans, fins, or heat exchangers
- verify operation of loading/unloading

In addition to the preventive maintenance performed, selected instrument air equipment is checked routinely by operations. The following items, at a minimum, are completed for the appropriate equipment:

- check cooling system and sealing system
- check oil-levels
- check air filter indication (delta pressure)
- blow down inservice dryers, receivers, inter and after coolers
- check discharge pressure

B. Program Enhancements

A comprehensive review of the requirements for maintenance and surveillance programs has been completed. Until the program enhancements can be completed (i.e., procedures developed and implemented for additional maintenance and testing), periodic dewpoint measurements are being taken on operating systems. Air sampling for oil contamination and moisture will be periodically performed at critical points in the distribution system. Performance testing (to include sampling) will be required after maintenance and at a frequency consistent with equipment usage and/or runtime. The enhanced maintenance and surveillance programs will be fully implemented at both stations by December 1989.

The following is a summary of the enhanced maintenance and surveillance programs:

1. Compressors

Performance tests will be developed that verify the compressors are operating as designed. This test will be used post-maintenance to determine operability and will consider the following parameters as applicable:

- Compressor discharge pressure
- Ambient air temperature
- Compressor and drive motor vibration
- Pressure drop across the pre-filter and after-filter
- Phase to phase voltage
- Line voltage
- Running current

In addition, whenever a compressor is in service, operators will periodically check discharge pressure and temperature, filter differential pressures, verify lubrication level and perform a general inspection.

2. Dryers, Receivers, and Filters

A surveillance performance test will be developed and implemented to verify operability, after maintenance, and periodically during routine operation. The following parameters will be considered to determine operability as applicable:

- Air pressure
- Dewpoint of air discharge from the dryer
- Particle size of the discharge air stream
- Discharge air temperature
- Inlet air temperature of the dryer
- Refrigerant pressures
- Filter-separator differential pressure
- Checks will be made for oil leaks

In addition, during normal operation with the dryer or receiver in service, the following parameters, as applicable, will be routinely checked:

- Discharge and inlet air pressure
- Dewpoint of the discharge air
- Proper operation of the dryer and filter water trap drains

3. Instrument Air Check Valves and Relief Valves

At North Anna, accumulator check valves and relief valves have been incorporated into the IST program and tested for operability (i.e., movement and leakage). At Surry, accumulator check valves and relief valves will be incorporated into a surveillance program and tested for operability.

4. Accumulators and Backup Air Bottles for Those Valves Required to Operate for Safe Shutdown and Accident Mitigation

A preventive maintenance procedure will be developed and implemented for accumulators that are normally pressurized by the compressed air systems to verify that there is no physical damage, leakage from pressure retaining components (other than design leakage), abnormal corrosion products, erosion, corrosion or loss of integrity at bolted or welded connections. Additionally, NDE will be performed on the bottom of each accumulators to verify that the wall has not been degraded below the minimum acceptable thickness in accordance with ASME Boiler & Pressure Vessel Code, and state and local jurisdictional requirements. For air bottles used to supply backup air, inspection and testing is implemented in accordance with the Department of Transportation regulations.

A surveillance procedure will be developed and used to verify that each accumulator is capable of performing its design function. The capability of supplying a specific component will be verified after maintenance and during each refueling outage. During normal operation the following will be routinely performed.

- Accessible accumulators and backup air bottle pressure will be monitored and recorded.
- Each accumulator will be periodically blown down.

5. Instrument Air Distribution Network

A Maintenance Program will be developed to perform preventive maintenance on Instrument Air network components.

6. Instrumentation

The accuracy, range and calibration requirements of the Instrument Air System instrumentation will be modified to be consistent with established practices for plant instrumentation. Frequency of instrumentation checks for the Instrument Air System will be consistent with established station procedures. Instrumentation will include the instruments and controls associated with the compressors, dryers, receivers, accumulators, and filters. Additional instrumentation will be added as necessary to implement the enhanced maintenance surveillance program.

7. End Use Components and Regulators

A preventive maintenance procedure will be developed for maintaining end use components and pressure regulators that regulate the air pressure to components supplied by the Instrument Air System.

5. System Enhancements

RESPONSE

System enhancements have been identified and are being implemented as described below to ensure compressed air meets the quality requirements of ISA Standard 7.3. Further review and evaluation during the Design Basis Reconstitution and Verification Program may identify the need for further modifications and enhancements.

Surry

The Instrument and Service Air Systems were originally provided with a total of four identical Ingersol Rand positive displacement, reciprocating type air compressors. Two air compressors were dedicated for each unit's Instrument Air System while the other two air compressors were used to provide Service Air for both units. Each air compressor was designed to deliver 373 SCFM of oil free air at a discharge pressure of 110 psig, which resulted in a total station Instrument and Service Air System capacity of approximately 1490 SCFM. A 76 cubic feet receiver tank was provided with each air compressor to provide additional air storage for peak demands and to minimize compressor cycling.

Periodic increases in compressed air demand (primarily during outages) had required longer compressor running times. This increased compressor running time had accelerated component wear and increased compressor maintenance significantly above the normal routine maintenance resulting in reduced reliability.

To increase the reliability of the compressed air system and to reduce the demand on the Instrument Air and Service Air compressors during outages, an outage service air compressor and associated receiver tank was installed during the Steam Generator Replacement Outage in 1979 as an additional source of compressed air. This compressor was originally dedicated as the source of outage service air inside containment but can now be utilized to supply compressed air to the Instrument and Service Air subsystems. The outage service air compressor delivers about 440 SCFM of oil free air at a discharge pressure of 110 psig. A second identical outage compressor was installed in September 1986.

In addition to the outage service air compressors, the instrument air compressors for the condensate polisher were tied into the Instrument Air System for additional instrument air backup. The condensate polisher instrument air compressors are of the centrifugal type and have been reliable compressors.

Until recently, the Instrument and Service Air Systems were supplied by the outage service air compressor and the condensate polisher instrument air compressors with the original instrument and service air compressors used to provide backup air.

To further increase the capacity and reliability of the compressed air system, the original service air compressors were replaced on a

one for one basis with two new Atlas Copco ZT3A oil free, rotary screw air cooled air compressors in September 1986. Each new service air compressor is double the capacity (rated at 757 SCFM) of an original service air compressor and is now the normal source of service and instrument air for the station. The total air capacity of the new service air compressors equals the total capacity of the original compressors.

Although the new service air compressors provide both service and instrument air during normal unit operation, the original instrument air compressors remain installed and are dedicated for emergency service. The original instrument air compressors operate during a loss of power event as originally designed and provide backup air during normal operation. The original instrument air compressors do not operate during normal station operation since the combined capacity of the new service air compressors equal the total instrument and service air capacity originally provided. Additional compressed air capacity is available from the outage service air compressors and the condensate polisher air compressors. Each outage service air compressor can provide 440 SCFM of compressed air. However, only one can operate at a time while the condensate polisher air compressors can be made available to deliver 200 SCFM with periodic supplies of 500 SCFM.

Due to the increased size of the new service air compressors over the original service air compressors, total station air capacity and system reliability has increased over the original compressed air system. Each reciprocating type air compressor was sized originally to provide 100 percent of the estimated design instrument and service air requirements for one unit. As a result, each of the new rotary screw air compressors is capable of providing the instrument and service air required for the station during normal operation. Additional system reliability and capacity are provided by the outage service air compressors, the original instrument air compressors and the condensate polisher instrument air compressors.

The service air compressors supply compressed air to two service air receiver tanks. The outage service air receiver tank is also supplied by the new service air compressors to provide additional compressed air storage and to minimize compressor load/unload cycling. The service air receivers are supplied by new 4 inch piping, sized to pass the entire air flow from both service air compressors (1500 SCFM). The new supply piping is constructed of stainless steel to prevent contamination of the Instrument or Service Air Systems from corrosion products.

Each unit's control room annunciator display for service air compressor trouble is used for the new service air compressors. The annunciator activates on a compressor motor overload, high oil temperature, low oil pressure, high outlet air temperature and loss of power. The service air annunciator also activates if the backup service air compressor starts. The noted inputs to the service air annunciators are similar to the trouble inputs used for the original service air compressors. In addition, pressure switches are installed in each units instrument air header downstream of the instrument air dryers. The pressure switches are at 80 psig and

activate the common instrument air compressor annunciator display when instrument air header pressure drops below 80 psig.

The existing refrigerant air dryers are being replaced with two heatless desiccant-type air dryers. These dryers will provide improved filtration and dewpoint capabilities that meet the requirements of ISA Standard 7.3.

North Anna

The Instrument Air and Service Air Systems were originally provided with four (4) identical Ingersol Rand positive displacement, reciprocating type air compressors. Two air compressors (with dryers and filters) were dedicated for each unit's instrument air and the other two air compressors were used to provide service air (for instrument air backup) for both units. Each compressor was designed to deliver 373 SCFM of oil free air at a discharge pressure of 110 psig which results in a total station Instrument and Service Air System capacity of approximately 1490 SCFM.

Due to increase system demands and to increase system reliability, two Sullair compressors were installed with an associated 1005 cubic feet receiver and a dryer capable of 800 SCFM at 100 psig with a dewpoint of approximately 35°F to provide instrument air to both units. A coalescing filter is used to remove oil. However, because of piping layouts and inadequate sizing of compressor drive motors, the air system pressure could not always be maintained at the required system pressure.

In 1985, the Service Air System was modified to allow Service air to backup instrument air, utilizing the construction air compressors. There are four construction air compressors used to augment the original instrument air compressors to meet system demands. These Ingersol Rand and Joy compressors are oil lubricated, air cooled. These compressors are the major source of oil contamination in the compressed air system. In 1988, new motors were installed on the Sullair compressor to increase discharge pressure, and therefore, reduce dependence on the non oil-free construction compressors. Also, an oil-free diesel driven air compressor has been installed to enhance the Instrument Air System reliability. Recently, an extensive maintenance effort was made to restore the original Instrument Air compressors (which are supplied from the emergency buses and cooled from the ultimate heat sink). These compressors are now available in auto standby and are considered reliable. Finally, a desiccant dryer capable of -40 degrees F dewpoint is scheduled to be installed on the discharge of the Sullair Compressors and in parallel with the existing 35 degrees F dewpoint refrigerant dryer by the end of February 1989. Systematic inspections of Instrument Air components is planned for the 1989 refueling outages. Components will be replaced or cleaned as required, and selected ASCO SOVs will be inspected and analyzed.

To eliminate the problems noted above and improve system reliability, the original instrument air compressors will be replaced with oil free rotary screw compressors. Each new compressor will have a capacity in excess of the original installed

compressors. These compressors will be powered from the emergency bus. The Sullair compressor will be redesiginated for service air supply. In addition to the new compressors, the refrigerant dryers associated with the original air compressors will be replaced with desiccant-type dryer. These dryers which include filters will improve filtration and will provide dewpoint capabilities that meet ISA Standard 7.3. The dryers will also be powered from the emergency bus. Completion of these system modifications is scheduled for July 1990.