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U-601831
L30-91(05-30)-LP
1A.120

May 29, 1991

Docket No. 50-461

Document Control Desk
Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Clinton Power Station
Leak Test Results of Division I
Backup ADS Air Supply System

Dear Sir:

During the second refueling outage at Clinton Power Station (CPS), Illinois Power (IP) performed leak testing of the backup Automatic Depressurization System (ADS) air supply system. One performance requirement for this system is to provide an adequate supply of air to the ADS valves to support their "short-term" operability and provide sufficient time to connect makeup air sources to maintain ADS valve operability for at least 100 days following a design-basis accident. The original design requirement for this air supply was seven days. Testing of the Division I backup ADS air supply system during the second refueling outage failed to demonstrate a seven-day air supply without makeup. This letter and its attachment describe the basis for acceptability of this higher than expected leakage.

As stated above, the original seven-day performance requirement was based upon supporting short-term operability of the ADS following a design-basis accident. As provided in General Electric topical report NEDE-24956, "BWR ADS Pneumatic System Comparison to NUREG-0737 Requirement II.K.3.28," dated August 1981, the short-term ADS air supply must be adequate to support two ADS actuations at 70% of drywell design pressure and 100 single safety/relief valve (SRV) actuations over six hours. This six-hour period provides adequate time to depressurize the reactor to the Residual Heat Removal system shutdown cooling pressure permissive setpoint, stabilize the reactor water level, and place the reactor in the shutdown cooling mode. In addition, the backup air supply must provide adequate time to connect makeup air sources to maintain ADS operability for 100 days.

IP has determined that connecting makeup air to the ADS backup air supply system can reasonably be expected to be performed within two days following a postulated design basis accident considering the availability of an existing air compressor on site, the ability to obtain and connect a portable generator or diesel driven air compressor, if necessary, and the expected radiation levels at the makeup supply connection outside the diesel generator building. IP has also determined that a two-day air supply is adequate for the ADS/SRVs to perform their required short-term, post-accident safety functions.

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Subsequent testing of the Division I backup ADS air supply system on March 1, 1991 demonstrated that a minimum three-day air supply exists in the system without makeup. As a result, IP has concluded the observed leakage is not safety significant and that the backup ADS air supply system is still capable of performing its required post-accident safety functions. The attachment to this letter provides a more detailed assessment which supports the above conclusion.

Sincerely yours,

F. A. Spangenberg, III
Manager, Licensing and Safety

DAS/alh

Attachment

cc: NRC Clinton Licensing Project Manager
NRC Resident Office
NRC Region III, Regional Administrator
Illinois Department of Nuclear Safety

Background

NUREG-0737, "Clarification of TMI Action Plan Requirements," item II.K.3.28 addresses the requirements for the Automatic Depressurization System (ADS) air supply system. Compliance with these requirements was addressed by General Electric (GE) in topical report NEDE-24956, "BWR ADS Pneumatic System Comparison to NUREG-0737 Requirement II.K.3.28," dated August 1981. As identified in NEDE-24956, the overall ADS air supply system is provided to support "short-term" and "long-term" ADS operation. The short-term air supply must be sufficient to support use of the ADS to depressurize the reactor to the Residual Heat Removal (RHR) system shutdown cooling pressure permissive setpoint, stabilize the reactor water level, and place the reactor in the shutdown cooling mode. With respect to long-term ADS operability, the air supply system must be capable of supporting ADS operation for 100 days.

With respect to short-term ADS operability, the ADS accumulators must be able to support two ADS actuations at 70% drywell design pressure. One ADS actuation at 70% of drywell design pressure is sufficient to depressurize the reactor and allow reactor water level makeup by the low pressure emergency core cooling systems (ECCS). However, for conservatism, the ADS accumulators are sized to allow two ADS actuations at 70% of drywell design pressure. In addition, a short-term air supply must be available to provide 100 actuations of a single safety/relief valve (SRV) over six hours to allow manual reactor cooldown at 100°F per hour in the event RHR is unavailable. This short-term air supply must be available without makeup.

The basis for the 100-day "long-term" ADS operability requirement is derived from the long-term cooling acceptance criterion (Criterion 5) of 10CFR50.46. Conformance with this criterion requires either that ADS be operable in conjunction with the low pressure ECCS pumps or that RHR shutdown cooling be operable. Because of this, the primary purpose of the long-term ADS operability requirement is to keep the reactor pressure low enough that the low pressure ECCS can be used to keep the core cooled. The ADS is not required after the decay heat is low enough that the reactor vessel will not repressurize above the shutoff head of the low pressure ECCS pumps.

The long-term duration for which the ADS must be available is dependent on factors such as the power of the reactor at the time of the postulated loss-of-coolant accident (LOCA), break size and location, available injection systems, and availability of RHR shutdown cooling. For the BWR/6 model plant, GE states that the long-term ADS design requirement is 100 days. This is based on their judgement of the time required to make any necessary repairs to the RHR shutdown cooling system,

thus ensuring the core would be kept cool. Makeup to the backup ADS air supply system is required to support this 100-day long-term air supply requirement.

CPS Design

The ADS air supply at Clinton Power Station (CPS) is shown on Figure 9.3-2, sheet 5, of the Updated Safety Analysis Report (USAR). As noted previously, the ADS accumulators have sufficient capacity to provide two ADS actuations at 70% of drywell design pressure. The normal air supply to the accumulators for both the ADS and non-ADS SRVs is from the station instrument air (IA) system. Compressed air is supplied at 120 psig from one of the three 100% capacity service air (SA) system compressors and is processed through one of the three 100% capacity IA system filter/dryer packages. Instrument air to the ADS and non-ADS SRV accumulators is processed through twelve 20% capacity air amplifiers which double the regulated supply pressure of 80 psig to 160 psig. The higher pressure air is then delivered to the accumulators for the associated SRVs.

If the normal air supply is not available, the safety-grade backup air supply system will preserve ADS valve accumulator pressure. This backup system has two independent air storage facilities located in separate corners of the basement of the auxiliary building. Each facility consists of eight 1.75 ft^3 bottles, pressurized to 2300 psig, and equipped with appropriate pressure regulating valves and interconnecting piping to supply one division of ADS valves and one non-ADS valve. Division I supplies four ADS SRVs and one non-ADS SRV, and Division II supplies three ADS SRVs and one non-ADS SRV. The capacity of the backup air supply system is sufficient to recharge the accumulators following two ADS actuations, support 100 actuations of a single SRV, and provide makeup for system leakage until long-term makeup air sources can be connected. Both facilities have remote makeup capability from a connection located outside the diesel generator building which is accessible following a LOCA. This remote makeup capability provides assurance of a minimum 100-day, post-accident ADS air supply.

In the event of a loss of the normal air supply system, control room alarms would alert the operator. The operator would verify that automatic actions to maintain the normal air supply had occurred and manually perform any which had not. If the normal air supply system could not be maintained and the system pressure decreased from 120 psig to below 70 psig (i.e., 140 psig to the ADS accumulators), then the control rod drive system scram valves would fail open, causing the associated control rods to insert and thus shut down the reactor. The control room operator remotely places the backup air supply into service by closing the two normal air system

supply valves and opening the two backup air system supply valves from the main control room.

In the event of an accident or transient which results in an automatic containment isolation, the normal air supply system would automatically isolate and the backup air supply system would automatically be placed into service.

The design of the ADS air accumulators and backup air supply was specifically discussed in Section 6.3.2.2 of Supplemental Safety Evaluation Report (SSER) 5 for CPS. This SSER 5 section identifies that the backup ADS air supply was designed to supply the required volume of air for seven days without makeup, with the capability for remote makeup (i.e., recharging) to ensure a 100-day, post-accident ADS air supply.

Testing Requirements

In addition to continual surveillance of control room alarms by the control room operator and daily monitoring of backup air storage pressure by the auxiliary equipment operator, the ADS accumulators are tested to ensure their capability to maintain the required air supply to the ADS valves without makeup. This testing, performed at each refueling outage, consists of two separate tests. For the first test, the isolation boundaries are the ADS accumulator inlet check valve and the deenergized SRV actuation solenoids. For the second test, the SRV actuation solenoid is energized so that the SRV pneumatic operator and the solenoid valve vent port become part of the test boundary. By performing these two tests, leakage contributions from the accumulator check valve and the SRV pneumatic operator can be determined both when the SRV is closed and when the SRV is open. For each of these tests, the leakage acceptance criteria is 0.425 scfh, which is 85% of the expected leakage. The expected leakage is obtained by subtracting a margin of 0.5 scfh from the 1.0 scfh maximum design leakage for the valves. These tests ensure that the tested subsystems are adequately leak-tight while accounting for degradation which may occur during a plant operating cycle.

In addition to these tests, the ASME Code requires that a system inservice/pressure test be performed during each inspection period. This test can be performed using a variety of methods. The method chosen during the second refueling outage consisted of pressurizing the divisional piping with the air amplifiers isolated and using the backup air bottles to maintain system pressure. The acceptance criteria for this test were based on the allowable system leakage as determined by calculation. Specifically, the acceptance criteria were that the supply header pressure must not decrease more than 10 psig over seven hours. This ensures that, assuming 1.0 scfh per valve design leakage for seven days, the ADS air supply system (i.e., the accumulators in combination with

the backup air supply system) can maintain sufficient capacity to actuate each ADS valve twice at 70% of drywell design pressure and actuate a single SRV 100 times. By performing this test as described, the test verified the pressure boundary integrity as required by the ASME Code in addition to testing the leak-tightness of other portions of the system. The second refueling outage was the first time that this particular test was performed.

Test Results

In February 1991, during the second refueling outage, tests of the Division I and II ADS air accumulators were successfully performed. The inservice/pressure test of the Division II ADS accumulator/backup air supply system was also successfully performed. However, the inservice/pressure test of the Division I ADS accumulator/backup air supply system performed on February 25, 1991 was unsuccessful due to unidentified causes of system leakage. The measured leak rate (i.e., pressure decrease) was approximately 198 psig over seven hours (28.29 psig/hour). This corresponds to a 39-hour supply before the backup air supply system pressure would decrease below the minimum required to provide the required valve actuations.

Investigation into the cause of the measured leakage concluded that its source was upstream of the ADS accumulator check valves since the results of the accumulator tests indicated almost no leakage in those portions of the system. It was noted during the test that relief valve 1IA-128B was relieving due to seat leakage of pressure regulating valve 1IA-044B. The seat leakage of the pressure regulating valve allowed the downstream piping to pressurize to the relief setting of 1IA-128B (200 psig maximum) thus causing it to open.

Connections in the piping system upstream of the accumulator check valves were leak checked and several flanges and compression fittings were found to be leaking. These leaks were repaired. In addition, the packing was adjusted on several valves. However, no parts were available to repair/replace the leaking pressure regulating valve 1IA-044B.

On March 1, 1991, the Division I inservice/pressure test was performed again. The leak rate determined during this second test was 76 psi over seven hours (10.84 psi/hour). This corresponds to at least an 80-hour supply before the backup air supply system pressure would decrease below the minimum required to provide the required valve actuations.

Evaluation

The results from the March 1, 1991 test demonstrated that the Division I accumulator/backup air supply contained

sufficient capacity to perform two ADS actuations and 100 single SRV actuations and provide makeup for system leakage for at least three days without makeup. (This determination was based upon the measured leak rate with additional margin included for the design leakage of 1.0 scfh per valve.) Illinois Power (IP) determined that these test results were sufficient to demonstrate the ability of the ADS accumulator/backup air supply system to perform its short-term requirements as described in NEDE-24956.

The above determination was supported by a safety evaluation and a USAR change which revised, under the provisions of 10CFR50.59, the duration for which the ADS accumulator/backup air supply must be maintained without makeup. IP determined that a minimum of two days of air supply without makeup was adequate based upon the ability to reasonably connect makeup air supplies during this time period considering the radiological conditions following a postulated design basis accident at the existing makeup supply connection outside the diesel generator building. Based upon the Post-Accident Shielding Study performed for CPS in response to NUREG-0737 item II.B.2, IP determined that the whole body dose rate at the makeup supply connection would be approximately one rem/hour one day following the postulated accident and approximately one-half rem/hour after seven days.

In addition to obtaining a tank truck or bottled air from offsite suppliers, compressed air is readily available from an existing AC powered air compressor at the fill station, although this compressor is not connected to a standby electrical power system. IP contacted vendors in the area and determined that, even if offsite power were not available, a portable generator or diesel driven air compressor could reasonably be expected to be delivered and connected in less than two days.

Conclusion

In summary, IP has determined that a minimum two-day backup air supply is adequate for short-term ADS/SRV operability. Radiological conditions at the existing makeup supply connection are favorable enough that makeup air supplies could reasonably be expected to be established in this time period to ensure at least a 100-day, post-accident ADS air supply. As a result, IP has determined that, despite the current leakage of the ADS accumulator/backup air supply system, the system is still capable of performing its required safety functions.