10.14 CONTROL AND SERVICE AIR SYSTEMS

10.14.1 Power Generation Objective

1. To provide oil-free, control air, dried to a low dewpoint and free of foreign materials, to all pneumatically-operated instruments and controls and final operators, such as control valves, throughout the entire plant and yard.

2. To provide service air to hose connections throughout the plant and yard, and to miscellaneous equipment in the Standby Liquid Control System, Amertap Condenser Tube Cleaning System, Condensate Demineralizer Air Surge System, and the Radwaste System.

10.14.2 Power Generation Design Basis

1. The system shall be capable of supplying all normal plant requirements for control and service air.

2. Loss of control air pressure in any single unit shall not result in tripping of any other unit.

3. Control air shall be filtered and dried. Service air does not require special moisture removal (except moisture separators, traps, and drains) beyond the aftercooler.

10.14.3 Safety Design Basis

Accumulators shall be provided in the containment drywell to assure the Automatic Depressurization System main steam relief valves will be held open, and the inboard main steam isolation valves may be closed following control air failure (see Subsections 4.4 and 4.6). Redundancy for these ADS main steam relief valves is achieved by operation cables that are routed along different paths. Accumulators shall also be provided in the steam and feedwater valve room to assure the outboard main steam isolation valves may be closed.

10.14.4 Description

10.14.4.1 Control and Service Air Systems

Plant control air consists of four 524-SCFM (nominal), 125-psig, and one 1445-SCFM, 120-psig, air compressors, each designed for continuous operation, are connected to a common discharge header which supplies three 266-ft^3 control air receivers. Plant service air has one 910-SCFM (nominal) and one 839-SCFM (nominal), 100-psig air compressors, each designed for continuous operation, are connected to a common discharge header. The 910-SCFM and 839-SCFM

compressors supply one 266-ft^3 and one 48-ft^3 service air receivers. The air receivers are provided with moisture traps.

Service Air for the Radwaste Building is supplied by a separate system. This system consists of three skid mounted compressors with integral air receivers, located in the Radwaste Building. Two of the compressors are 45 CFM displacement type units, with 10.7 ft^3 receivers. The third compressor is a 113 CFM displacement type unit, with a 16 ft^3 receiver. The operation of the compressors is staged to keep the Radwaste Building Service Air System pressure between 95 and 125 psig. The design pressure and temperature for the system is 150 psig and 150°F, respectively. Each receiver is provided with a moisture trap.

Control air compressors A-D, and service air compressors E and F are equipped with intercoolers between stages. The second stage discharge of the A-D compressors is connected to the horizontal, two-stage, water-cooled aftercooler of shell and tube design with moisture separator, which, in turn, is connected to the associated discharge header. The final stage discharge of the E compressor is connected to a horizontal pipeline-type shell and tube design water-cooled aftercooler with a moisture separator, which, in turn, is connected to the associated discharge header. The final stage of the F compressor is connected to an internal shell and tube water cooled after cooler with moisture separator which is connected to the discharge header. Control air compressor G is an electric motor driven, two stage, centrifugal package unit. Service air compressor E is a three stage centrifugal package unit. Service air compressor F is a two stage, rotary screw, package unit. Integral to each compressor are the oil sump, inter/after coolers, oil coolers, and control systems.

The Service Air System provides backup control air through a check valve and a backpressure control valve which opens if control air pressure drops below 85 psig. Thus, the Control and Service Air Systems are normally separate, with the service air acting as a backup to control air. This backpressure control valve can be manually operated from the Main Control Room. Service air is piped from the receiver to conveniently located service outlets throughout the plant (see Figures 10.14-2a and 10.14-2b).

The discharge header from the control air receiver supplies four air dryers, one in each unit plus one standby in Unit 1. The dryers are fully automatic with a timed regeneration cycle based on air dryer size; regeneration purge rate maintains the required dewpoint. There is one dryer for each unit, with one additional standby air dryer which can provide supplemental air to any unit. Each discharge from the Unit 1, Unit 2, Unit 3, and the standby dryers is routed through a cartridge-type filter. Each unit dryer filter station discharges into a 4-inch header which runs the length of the unit. The standby dryer filter station discharges through separate lines to each unit header, with check valves arranged to prevent loss of air pressure in one unit from affecting another unit.

From these unit headers, the control air is routed through 1-1/2-inch branch headers to the various locations in the unit. All of these branch headers are provided with shutoff valves to facilitate additional future control air requirements without requiring complete system shutdown. In addition, the 4-inch control air header for each unit is connected to the adjacent unit through manual valves and an air operated stop valve (between Units 2 and 3 only) which are normally open. The air operated stop valve closes upon loss of air from either Unit 2 or 3 and opens only when air pressure is restored.

During emergencies, the accumulators installed in the steam and feedwater valve room provide sufficient air for closure of the outboard main steam isolation valves. Since air-handling equipment is located in the Turbine Building (a Class II structure), the compressors and air receivers could conceivably be lost during an earthquake. Therefore, for Units 2 and 3, the headers routed to the Reactor Building are provided with manual valves and valves operated from the Main Control Room to facilitate system isolation. For Unit 1, the control air headers routed to the Unit 1 Reactor Building are provided with locally operated manual isolation valves in the Turbine Building. Check valves located inside the Reactor Building are credited for secondary containment isolation upon failure of the control air system following a seismic event, or the lines have been analyzed to maintain the secondary containment inleakage rate less than the SGTS capacity when the building is subjected to an internal negative pressure of 0.25 inch of water (see subsection 5.3.3.5).

An emergency control air compressor is located in the Unit 1 Control Bay to supply control air for the Unit 1 - Unit 2 Control Room Air-Conditioning System (see Figure 10.14-3). The receiver for this compressor rides on the air supply line leading into the control room. Unit 3 has a similar piping arrangement to provide this emergency air (using the same compressor).

Service air is provided throughout the entire plant.

Two control air compressor motors are powered from the 480-V common station service boards, two are powered from the 480-V shutdown boards, and one is powered from the 4-kV shutdown boards. The two service air compressor motors are powered from the common station service board. Compressors must be manually restarted when shutdown boards are supplied from the diesel generators.

10.14.4.2 Drywell Control Air System

Each reactor unit has a Drywell Control Air (DCA) System that provides control air for the equipment inside the drywell. A nitrogen supplied system is used that has DCA receiver tanks supplied dry, oil free nitrogen at a regulated pressure from the Containment Inerting system (see subsection 5.2.3.8) nitrogen makeup header in

the Reactor Building. Pressure regulators are sized to limit flow to prevent over-pressurizing primary containment should the DCA header pressure boundary fail inside the drywell during an accident. This nitrogen supply will not cause dilution of an inerted drywell. For the volumes of the drywells, pressure increases in the drywell due to operation of pneumatic equipment inside the drywell are very small. Drywell pressure may actually decrease depending on the amount of containment leakage, nitrogen makeup usage, and environmental conditions. Primary containment ventilation, purging and nitrogen makeup are monitored and controlled from the control room. The DCA receivers are sized to provide sufficient control air to assure operation of the drywell equipment in the event of an interruption of the nitrogen source. For each unit on the DCA supply lines upstream and downstream of the drywell penetration, two check valves exist which function as isolation valves. Also, a test connection and two normally open manual valves are present on the supply line. The manual valves are useful in providing backup to the check valves for positive containment isolation. All of this DCA equipment is located in the Reactor Building to protect it from natural phenomena.

The flow path for the DCA System is shown in Figures 10.14-4 sheets 1, 2, 3, 4, 5, and 6. Containment Inerting system nitrogen is continuously supplied at 100 psig via the DCA receiver tanks to the drywell control air headers.

In the event of a Beyond Design Basis External Event (BDBEE) to meet diverse and flexible coping strategies (FLEX) requirements, the Units 1, 2, and 3 DCA systems may be supplied pressurized nitrogen through the existing permanent test connection isolation valves.

The line through drywell penetration X-48 is used only for connecting a temporary air compressor to pressurize containment during performance of the Appendix J containment Integrated Leak Rate Test (ILRT). This line is normally closed with a 3-inch blind, double o-ring flange. The double o-ring flange is equipped with a test connection for Appendix J leak testing.

The DCA air receivers discharge into a common header which in turn supplies compressed air through two penetrations into the drywell and provides compressed air to each of the DCA headers. Each DCA header section, inside the drywell,

supplies pneumatic pressure to one-half of the DCA users including three Automatic Depressurization System (ADS) main steam relief valves, two inboard main steam isolation valves, and either three or four of the remaining main steam relief valves (MSRVs). Because of the control air requirements of the ADS main steam relief valves and inboard main steam isolation valves, accumulators are installed in the drywell to assure sufficient air in emergencies. Each DCA supply line has a check valve inboard and outboard of the drywell. These valves serve as primary containment isolation valves. A test connection and block valve are installed on both sides of the penetration for Appendix J leak testing. An emergency source of nitrogen is furnished at each penetration through a normally closed valve from the Containment Atmospheric Dilution (CAD) system with each CAD train supplying one of the DCA header sections.

Normally, the DCA System furnishes control air for the drywell equipment and the plant Control Air System provides control air for the outboard main steam isolation valves. However, provisions, with closed isolation valves and check valves, are made to use the plant Control Air System to supply the drywell control air and to use the DCA System to supply the outboard main steam isolation valves if the need arises.

10.14.5 Safety Evaluation

The Control and Service Air Systems are not essential to safe shutdown except for the Control Air System accumulators serving the ADS main steam relief and main steam isolation valves. These accumulators are designed as Class I for withstanding the specified earthquake loadings (see Appendix C). In the event of control air failure, accumulator air is trapped by check valves. An emergency compressor is provided to maintain Control Building instrument air so that the Control Building environment can be held within safe limits for the equipment and personnel.

Although the DCA System is not essential for safe shutdown of the plant, it could be effectively utilized during this operation. Therefore, redundant components and a backup source of control air from the plant Control Air System are provided to increase the reliability of these drywell air systems. An emergency backup source of nitrogen from the CAD system is provided to each units' DCA system. Also, portions of the DCA System outside of the drywells are designed to meet Seismic Class I requirements. These portions are for each DCA supply header, from the primary containment penetration out to the outboard check valve.

10.14.6 Inspection and Testing

No special tests are required. Routine visual inspection of the system components, instrumentation, and trouble alarms is adequate to verify system operability.