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11.0 Radioactive Waste Management

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11.1 Design Basis

The liquid and gaseous radioactive waste management systems will be utilized to reduce radioactive liquid and gaseous effluents such that compliance with the dose limitations of the Selected Licensee Commitments is assured. These dose limitations require that:

1. the concentration of radioactive liquid effluents released from the site to the unrestricted area will be limited to 10 times the effluent concentration (EC) levels of 10CFR 20, Appendix B, Table 2;
2. the exposures to any individual member of the public from radioactive liquid effluents will not result in doses greater than the design objectives of 10CFR 50, Appendix I;
3. the dose rate at any time at the site boundary from radioactive gaseous effluents will be limited to: for noble gases; less than or equal to 500 mrem/yr to the whole body and less than or equal to 3000 mrem/yr to the skin; and for iodine-131 and 133, for tritium, and for all radioactive materials in particulate form with half-lives greater than 8 days; less than or equal to 1500 mrem/yr to any organ;
4. the exposure to any individual member of the public from radioactive gaseous effluents will not result in doses greater than the design objectives of 10CFR 50, Appendix I; and
5. the dose to any individual member of the public from the nuclear fuel cycle will not exceed the limits of 40CFR 190 and 10CFR 20.
6. the Solid Waste Management System shall be used in accordance with a Process Control Program, as described in Section 11.4, such that compliance with the Selected Licensee Commitments is assured.

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11.2 Liquid Waste Management Systems

11.2.1 Disposal Methods and Limits

Liquid wastes from the station are disposed of, under continuous radiation monitoring and control, in one of the following three ways depending on the concentration of radioactivity and quantities involved:

1. Collected, sampled, analyzed, and discharged directly to the tailrace of the Keowee Hydroelectric Plant if the water is required to be monitored during release. If the water does not require monitoring during release, it is discharged to the Chemical Treatment Pond #3.
2. Processed by filtration and/or demineralization, collected, sampled, and analyzed. The filters and/or spent resins are packaged and shipped offsite to an NRC or approved agreement state licensed burial ground. The processed water is discharged directly to the tailrace of the Keowee Hydroelectric Plant if the water is required to be monitored during release. If the water does not require monitoring during release, it is discharged to the Chemical Treatment Pond #3.
3. Processed by filtration and/or demineralization, collected, sampled, and analyzed. The filters and/or spent resins are packaged and shipped to various offsite vendor waste processors. The processed water is discharged directly to the tailrace of the Keowee Hydroelectric Plant if the water is required to be monitored during release. If the water does not require monitoring during release, it is discharged to the Chemical Treatment Pond #3.

Liquid waste effluent is diluted, as necessary in the hydroelectric plant tailrace to permissible concentration limits in accordance with Selected Licensee Commitments. Waste releases from the three units are integrated and controlled by process radiation monitors, interlocks, and by the operator so as not to exceed the appropriate station release limits. Where effluents can be released from more than one location, administrative controls are also provided to insure that station limits are not exceeded.

11.2.2 Disposal System Design

11.2.2.1 General Description

Liquid wastes are accumulated in storage tanks according to the waste source and expected process train. The Auxiliary Building coolant treatment header has been redesigned to facilitate the processing of liquid wastes from the high activity waste tanks, low activity waste tanks, and the miscellaneous waste holdup tanks in the Radwaste Facility. The liquid wastes are directed to the Radwaste Facility for processing by filtration and/or demineralization to segregate impurities for ultimate disposal as per Section 11.4.2. Based on the analysis, water is either reprocessed or released as per Section 11.2.2.2. The Liquid Waste and Recycle System is shown in Figure 11-2.

In addition, vendor supplied equipment may be utilized to process water and reduce waste volumes.

The Interim Radwaste Building (IRB) has the necessary equipment to process liquid waste. However, current operating practice does not make use of these systems. The Radwaste Facility (RWF) systems, as described in Section 11.6.3, are utilized.

When the IRB systems are in use, the IRB floor drains and equipment drains are collected in two sumps. The floor and low activity drains sump collects floor drains and low activity

degassed equipment drains. This sump discharges to the Oconee 3 low activity waste tank in the Auxiliary Building. The floor and low activity sump is vented to the Oconee 3 vent stack.

High activity equipment drains in the IRB are collected in high activity equipment drains sump. Two sump pumps are aligned to transfer the sump contents to the Oconee 3 high activity waste tank in the Auxiliary Building. The high activity equipment drains sump is vented to the suction of the Oconee 3 waste gas compressors via the Oconee 3 waste gas vent header.

The Radwaste Facility floor drains and equipment drains are collected in two sumps. The radwaste curbed area sump collects low activity floor drains and low activity equipment drains. Two pumps are utilized to discharge sump contents to the waste monitor tanks in the Radwaste Facility. High activity equipment and floor drains in the Radwaste Facility are collected in the radwaste shielded area sump. Two sump pumps normally transfer the sump contents to the waste feed tank in the Radwaste Facility.

All piping and equipment in contact with reactor coolant are constructed of corrosion-resistant material. This equipment is arranged and located to permit detection and collection of system losses and to prevent escape of any unmonitored radioactive liquid to the environment. Component data are shown in Table 11-6.

The liquid waste discharge header to the Keowee Hydro tailrace is shown in Figure 11-1.

Waste tanks in the IRB and the Auxiliary Building are vented as necessary to the gaseous waste vent header to provide for filling and emptying without overpressurization or creating a vacuum. In addition, each waste tank is equipped with a relief valve and/or vacuum breaker. Nitrogen is supplied to each waste collection tank for purging to the Gaseous Waste Disposal System as needed.

Flush water is provided at appropriate locations in the system for flushing of piping and components.

11.2.2.2 Operation

Liquid wastes are collected in the Auxiliary Building and are transferred to the Radwaste Facility for processing by filtration and/or demineralization. Although it is not a normal process option, liquid wastes could be transferred to the IRB.

Liquid wastes are released from the Decant Monitor Tank, Recycle Monitor Tanks, and/or the Waste Monitor Tanks in the Radwaste Facility. After the liquid is mixed, sampled, and analyzed, a release rate consistent with dilution flow from the Keowee Hydro Station is determined and the radiation monitor alarm set points adjusted to comply with limits specified in Selected Licensee Commitments. The release is controlled from the Radwaste Facility control room and monitored by 1RIA 33. The RIA will terminate a release on a high alarm setpoint by closing LW-131. The release activity in CPM is recorded in the Radwaste Facility Control Room.

11.2.2.2.1 Deleted per 1996 Revision.

11.2.2.3 Liquid Waste Holdup Capacity

The information in this section is not updated and is included for historical purposes only. Potential waste generation rates are based on data gathered at ONS for years 1977 and 1978 and are found in "Evaluation of Compliance with 10CFR50 Appendix I," June 4, 1976. Actual amounts vary from year to year depending on unit operating history. Actual liquid waste generated is reported in the Oconee Annual Effluent Report in accordance with SLC 16.ll.9.

The liquid waste holdup times are estimated using the following assumptions:

1. The potential liquid waste generation rates are as follows (See Table 11-1): Actual liquid waste generated is reported in the Oconee Annual Effluent Report.

(a) Primary System	161,019 ft^3 per year for 3 units
(b) Spent Fuel Pool	26,349 ft^3 per year for 3 units
(c) Cask Decontamination	17,566 ft^3 per year for 3 units
(d) Component Coolant	17,566 ft^3 per year for 3 units
(e) Service Water	58,553 ft^3 per year for 3 units
(f) Decontamination Room	87,828 ft^3 per year for 3 units
(g) Resin Sluice	23,421 ft^3 per year for 3 units
(h) Miscellaneous System Leakage	351,312 ft^3 per year for 3 units
(i) OTSG Tube Leaks	40,140 ft^3 per year for 3 units
(j) LHST	161,019 ft^3 per year for 3 units
TOTAL	944,773 ft^3 per year for 3 units

2. Design holdup capacity equals the contents of the miscellaneous waste holdup tanks, interim evaporator feed tanks, and condensate monitor tanks A and B which is 83,793 gallons for Oconee 1, 2 and 3.
3. The time for filling and discharging the tanks is 6 hours or less.
4. The tanks fill at a linear rate and the contents are discharged when the tanks become full and are sampled.

From the assumptions above the holdup times are:

Oconee 1 and 2 Holdup Time = 5.25 days

Oconee 3 Holdup Time = 11.46 days

The Radwaste Facility provides primary holdup and processing having 140,000 gallons of storage capacity.

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11.3 Gaseous Waste Management Systems

11.3.1 Disposal Methods and Limits

Gaseous activity is generated by the evolution of radioactive gases from liquids stored in tanks throughout the station. When this gaseous activity is present outside of specific piping systems or tanks, then it is collected and/or routed through various pathways in the plant. Gaseous wastes are disposed of, at a permissible rate, under continuous radiation monitoring or periodic sampling and control, by any of the following methods depending on the concentration of radioactivity, quantities, and source of the material involved:

1. Release of Auxiliary Building ventilation air and Reactor Building purges to the unit vents.
2. Release of Reactor Building purges through high efficiency particulate and charcoal iodine filters to the unit vents.
3. Release of waste gas directly or through high efficiency particulate and charcoal iodine filters to the unit vents.
4. Diversion to waste gas tanks with controlled release after sampling and analysis through the waste gas system high efficiency particulate and charcoal iodine filters to the unit vents.
5. Release of Radwaste Facility (RWF) HVAC and process exhaust.
6. Release of Penetration Room Ventilation Air to the unit vents.
7. Release of the Hot Machine Shop Ventilation Air through exhaust filters to the outside environment.
8. Release of the CSAE (Condenser Steam Air Ejector) air to the unit vents.
9. Release of the RCP Motor Refurbishment Facility exhaust to the outside environment (when facility ventilation system is operational).

Note that the Reactor Coolant Pump Motor Refurbishment Facility ventilation system and ventilation sampling system were “abandoned in place” in the last quarter of 2004, after completion of the Reactor Head Replacement Project. Electrical power to the ventilation and ventilation sampling systems was disconnected as part of the “abandonment” process. Although the ventilation system equipment and the ventilation system sampler remain in-place, this facility no longer discharges airborne radioactivity to the environment. This paragraph remains as a description of the operation of the ventilation system that was installed in the building to support the Reactor Head Replacement Project. This paragraph also remains in the event power is later restored to the ventilation and ventilation sampling systems. The Reactor Coolant Pump Motor Refurbishment Facility particulate constituents are continuously sampled by a filter paper sampling arrangement during procedurally controlled maintenance activities such as the Reactor Head Replacement Project. The sampling arrangement is periodically replaced and analyzed to quantify and qualify radioactivity present on the filter paper. Because of the type of work conducted in the Reactor Coolant Pump Motor Refurbishment Facility, noble gas and iodine activity is not released via the Reactor Coolant Pump Motor Refurbishment Facility vent. Therefore, noble gas and iodine monitoring capability is not required in the Reactor Coolant Pump Motor Refurbishment Facility.

The tank vent system is processed through carbon and high efficiency particulate filters.

Gaseous wastes are released from the station at a controlled rate so that permissible concentration limits for Unrestricted Areas will not be exceeded at the Exclusion Area boundary,

when averaged over a year in accordance with the requirements of the Selected Licensee Commitments. The concentrations at the boundary are determined after applying appropriate dilution factors derived from on-site meteorological studies (Section 2.3).

Waste releases from the three units are integrated and controlled by process radiation monitors, interlocks, and by the operator so as not to exceed the appropriate station release limits. Where effluents can be released from more than one location, administrative controls are also provided to insure that station limits are not exceeded.

11.3.2 Disposal System Design

11.3.2.1 General Description

All components in the Auxiliary Building and Interim Radwaste Building that can contain potentially radioactive gases are vented to a vent header. The vent gases are subsequently drawn from this vent header by one of two waste gas compressors or a waste gas exhauster. The waste gas compressor discharges through a waste gas separator to one of two waste gas tanks. The waste gas tanks and the waste gas exhauster discharge to the unit vent after passing through a filter bank consisting of a prefilter, an absolute filter, and a charcoal filter. A flow diagram of this system with the necessary instrumentation and controls for operation is shown in Figure 11-3. Component data are shown in Table 11-6. The venting of RWF components that contain potentially radioactive gases is discussed in Section 11.6.3.6.

Oconee 1 and 2 share a Gaseous Waste Disposal System. Oconee 3 has a separate Waste Gas Disposal System, which can be interconnected to the Gaseous Waste Disposal System for Oconee 1 and 2 through double isolation valves between the vent headers. These are normally operated separately, but may be tied together to facilitate maintenance of either of the systems.

The purpose of the Gaseous Waste Disposal System is to:

1. Maintain a non-oxidizing cover gas of nitrogen in tanks and equipment that contain potentially radioactive gas.
2. Hold up radioactive gas for decay.
3. Release gases (radioactive or non-radioactive) to the atmosphere under controlled conditions.

11.3.2.2 Operation

One waste gas compressor is normally in continuous operation with the other compressor in a standby condition. The waste gas compressor takes suction on the vent header and normally discharges into waste gas tank “A” which is used as a surge tank. The vent header pressure control operates a bleedback valve (GWD-1) allowing a continuous circulation of gas through the vent header. As liquid storage tanks connected to the systems are filled, the excess gas is stored in the waste gas tank. As liquid storage tanks are emptied, gas flows from the waste gas tank back into the vent header. As waste gas tank “A” is filled, the inlet valve on waste gas tank “B” (GWD-3) is opened and waste gas tank “A” inlet valve (GWD-2) is closed. The gas in waste gas tank “A” is allowed to bleed back into the vent header and is directed into waste gas tank “B” by the waste gas compressor until the pressure in waste gas tank “A” is at the desired operating pressure. The valves are then repositioned to utilize waste gas tank “A” as a surge tank and waste gas tank “B” for radioactive decay. Gas in waste gas tank “B” is sampled for laboratory analysis to determine the permissible release rate or need for holdup for radioactive decay.

Release of gas from the waste gas tanks to the unit vent is controlled by the waste gas tank outlet valves GWD-4 and GWD-5. The volume of gas discharged to the unit vent is recorded in the Control Room and is documented on the Gaseous Waste Release (GWR) permit governing the release. Monitoring of the gas discharged to the unit vent for radioactivity is provided by a radiation monitor which, on a high radiation signal, will close the valves through which the gas is being discharged. In the event that the applicable radiation monitor is not available for service, two independent samples of the gas to be released are collected. The two samples independently verify the gas activity and serve as the basis for determining the gaseous waste release rate.

The waste gas exhauster is used when large volumes of gas containing little or no radioactivity are available for release to the unit vent. The waste gas exhauster and its isolation valves are interlocked to trip the exhauster and close the isolation valves in case of a high radiation level in the line going to the unit vent. The waste gas exhauster does not normally operate and is normally valved off by the manual valve upstream of GWD-6. Therefore, no unintentional release of significant activity is possible through this line.

Most of the Gaseous Waste Disposal system is located in the Auxiliary Building. Some equipment is located in the Interim Building, namely Interim Waste Gas Decay Tanks 1C, 1D, and 3C and their associated piping and valves. The control of the discharge flow for these tanks is similar to that for tanks “A” and “B” listed above, through the appropriate valves.

All indication and controls for this system are located in the Control Room.

11.3.2.3 Gaseous Waste Holdup Capacity

The information in this section is not updated and is included for historical purposes only. Potential waste generation rates are based on data gathered at ONS for years 1977 and 1978 and are found in "Evaluation of Compliance with 10CFR50 Appendix I," June 4, 1976. Actual amounts vary from year to year depending on unit operating history.

The estimates of potential gaseous waste holdup times are based on the following assumptions: (Assumptions and volumes are approximate and historical in nature) note that actual gaseous waste activity that is released is reported in the Oconee Annual Effluent Release Report.

1. An annual waste gas generation rate of 131,400 ft^3 is evolved from three units (Table 11-1). Oconee I, 2, and 3 contribute 43,800 ft^3 each per year.
2. Four waste gas tanks located in the Auxiliary Building and three waste gas tanks located in the Interin Radwaste Building provide holdup capacity for Oconee 1, 2, and 3.
3. Holdup capacity is as follows:

Auxiliary Building	Oconee 1 & 2	Oconee 3
Auxiliary Building Tanks (ft^3)	2200	2200
Interin Radwaste Building Tanks (ft^3)	2104	1052
Total Storage Volume	4304	3252

4. The times for filling and venting the waste gas tanks are negligible.
5. The waste gas tanks are initially filled with nitrogen at 10 psig and 100°F. The tanks may be filled to approximately 85 psig and 100°F.

11.3.3 Tests and Inspections

Each process radiation monitoring channel will be functionally tested and calibrated periodically to verify proper operation of components and to insure that the desired detector sensitivities are maintained.

A signal generator located within the process monitor panel will be used to check the alignment of electronic modules. After the electronic alignment is completed, a remote operated calibration source is actuated to determine proper functioning of the detector.

The flow measuring instrument and controls associated with the gaseous waste effluent lines will be calibrated periodically to insure proper accuracy, measurement, and control of radioactivity releases from the station.

Unless addressed by the Ventilation Filter Testing Program (VFTP) or other approved program, HEPA and Iodine charcoal filters are subject to the following requirements.

In place testing of both the HEPA and Iodine charcoal filters is performed in accordance with ANSI N-510-1975 and/or ASTM D3803-1989. DOP smoke is introduced upstream of the particulate filter and the quantity detected downstream of the filter is measured. The minimum acceptable efficiency for this test of the particulate filter is 99.97 percent. Field tests for the efficiency of Iodine charcoal filters will be performed using refrigerant-11 only. The system will be operating at rated flow. Refrigerant-11 is introduced upstream of the filter to produce an R-11 concentration of 50 ppm. With an upstream concentration of 50 ppm and a test of 2 minutes, the maximum allowable downstream concentration is 0.1 ppm.

11.3.3.1 Deleted Per 2000 Revision

11.3.3.2 Deleted Per 2000 Revision

THIS IS THE LAST PAGE OF THE TEXT SECTION 11.3.

11.4 Solid Waste Management System

11.4.1 Design Bases

As per Selected Licensee Commitment 16.11-5, radioactive wastes shall be processed and packaged to ensure meeting the requirements of 10CFR Part 20, 10CFR Part 71, and Federal and State regulations governing the disposal of solid radioactive wastes.

11.4.1.1 Solid Waste Activities

Solid radioactive wastes are as described in Section 2 of the Oconee Nuclear Station 10CFR Part 61 Waste Classification and Waste Form Implementation Program. This activity is not released to the environment and influences only the shielding required to meet criteria stated in Section 12.3.1.

11.4.1.2 Disposal Methods and Limits

Solid wastes will be packaged to meet applicable regulations and shipped in accordance with DOT regulations to a processor or directly to either an NRC or state licensed disposal facility.

Disposal of slightly contaminated materials within the Company Controlled Area has been approved by the State of South Carolina and the NRC. Prior to disposal onsite, the waste is analyzed and confirmed to have acceptably low radionuclide concentrations. Permission is then obtained from the proper agencies per 10CFR20.2002 requirements. Each application for disposal is evaluated and approved on a case by case basis as determined by material quantities, material type, disposal methods, and radionuclide concentrations.

11.4.2 System Design and Evaluation

The Solid Waste Disposal System provides the capability to package solid wastes for shipment to an offsite NRC or approved agreement state licensed burial facility.

The disposal of the powdered resins may be accomplished by backwashing the resins from the filter elements to a sump in the Turbine Building and then to the Resin Recovery System for processing. The resin is allowed to settle to the bottom of the Backwash Receiving Tanks (BRT) in the Radwaste Facility. The excess water in the BRT is decanted to the Decant Monitor Tank for sampling and release to the environment. The powdered resins may then be used for processing waste. The resins are then prepared for shipment to a processor or directly to either an NRC or state licensed disposal facility

Bead resins can be sluiced to an approved shipping container where they are prepared for shipment to a processor or directly to either an NRC or state licensed disposal facility.

The Process Control Program Manual describes operation of the Solid Radioactive Waste System such that the final product of solidification or dewatering meet all shipping and transportation requirements during transit and meet disposal site requirements when received at the disposal site.

Low level trash such as dry active waste and spent filters are prepared for shipment to a processor or directly to either an NRC or state licensed disposal facility.

11.4.3 References

1. B. J. Youngblood (NRC) letter to H. B. Tucker (Duke) dated May 2, 1986.

THIS IS THE LAST PAGE OF THE TEXT SECTION 11.4.

11.5 Process and Effluent Radiological Monitoring and Sampling Systems

11.5.1 Design Bases and Evaluation

Radiation monitoring of process systems provides early warning of equipment, component, or system malfunctions, or potential radiological hazards. The Process Radiation Monitoring System includes alarms, indications, and recording of data in the Control Rooms. In some cases automatic action is taken upon an alarm condition; in others the alarm serves as a warning to the operator so that manual corrective action can be taken. Radioactive liquid and gaseous waste effluents, particularly, are monitored, coordinated between Control Rooms, and controlled to assure that radioactivity released does not exceed 10CFR 20 and 10CFR 50 Appendix I limits for the station as a whole.

The sensitivity and the ranges of the detectors have been coordinated with system and environmental dilution factors to assure that releases due to normal, transient, and accident conditions will be monitored and that normal releases will not exceed permissible concentrations. The release of radioactive waste will generally be on a batch basis. Waste releases will also be integrated and recorded. Interlocks are provided to terminate any release of liquid or gaseous waste if a pre-set radiation level is reached. The monitoring and controls exerted by the Process Radiation Monitoring System and the operator during the release will also be supplemented by manual sampling, laboratory analysis, and counting prior to release.

Various detectors are also shielded against ambient background radiation levels that would exist in their location due to normal, transient, or accident conditions, so that accurate readings of radioactivity will be obtained.

The process monitors have been given a primary calibration with the particular radionuclides that they are expected to monitor. Their energy response has been determined as an aid in measurement of other radionuclides that may also be encountered. A calibration source, related to primary calibration at the factory, is supplied with the system. The sources are held by Radiation Protection or I & E and used periodically to calibrate the detector. A check source is used only to verify that the detector is functional. Spectrometer grade amplifiers have been supplied with all of the sodium iodide scintillation (NaI) detectors so that they can be used with a gamma analyzer for the identification of the specific radionuclides being monitored.

Monitors are also provided on various non-radioactive cooling water systems to detect leakage from normally radioactive systems due to any component failures and thus prevent their accidental release to the environment. In addition to the manual sampling of waste prior to release, mentioned above, the measurement of radioactivity in other process fluids is also supplemented by manual sampling, laboratory analysis, and counting. This is particularly necessary for beta-emitting radionuclides such as tritium.

11.5.2 Description

The radiation monitoring equipment indications and alarms are located in the Control Rooms from which the systems being monitored are operated. Radiation monitor indications for liquid waste disposal and the Radwaste Facility vent effluents are displayed in the Radwaste Facility Control Room. Indications for unit vent effluents can be displayed in both Control Rooms. Outputs from all process monitor channels are recorded in the RIA computer system or on multipoint recorders. Control Room annunciation of high radiation level is provided for each channel. Most detector assemblies are equipped with a Control Room operated check source.

Table 11-7 lists the process radiation monitors and gives the following information:

1. Channel Number and Function - A Radiation Indicating Alarm (RIA) number has been assigned to each detector. Monitors serving the same function have the same number. Prefix numbers indicate the unit on which the detector is used. No prefix number indicates that the RIA is shared between two or more units. The function shows the system in which the monitor is employed.
2. Type of Detector - The standard detector type identification is given followed by the size of the crystal or the length of the detector. The lead shield thickness which has been applied to obtain the sensitivities indicated is also given.
3. Sensitivity - Monitor sensitivities are indicated in terms of background equivalent concentrations and count rate for the radionuclides listed. Background equivalent information shown in the table defines the ability of the monitor to detect the indicated radionuclide concentrations inside the sampler at a count rate that is equal to that resulting from a gamma field outside the sampler. The lead shielding is designed to reduce the count rate resulting from Cobalt-60 gammas in order to obtain the sensitivities shown. This information is taken from the manufacturer's technical manuals. The Sensitivity column of Table 11-7 is applicable for all process radiation monitors listed except the Main Steam N-16 Radiation Monitors. The Sensitivity column in Table 11-7 is not applicable to the N-16 Radiation Monitors 1, 2 and 3RIA-59 and 1, 2 and 3RIA-60 since there are so many factors that are involved in the computation of the Steam Generator Primary to Secondary Tube Leak rate beside counts per sec gamma e.g., % Reactor Power, Detector Temperature, Location of the Steam Generator of the Primary to Secondary Tube Leak, the Geometry of the Steam Line Piping and the location of the N-16 Detectors relative to the location of the tube leak and relative to the location of the adjacent Main Steam Line.
4. Range - Readout range of monitoring instrumentation, upper range limits, and range overlap between different detectors monitoring the same sample are indicated.

The following is a description of the various applications of these monitors as they are applied to systems:

1. 1,2 and 3RIA16 and 17 detectors monitor the A and B Main Steam line piping respectively for the presence of radioactivity in the process steam. The primary purpose for these monitors is to aid in the detection of a steam generator primary to secondary leakage fault. Readout and alarms for these monitors are located in the associated control rooms.
2. RIA-31 monitors gross gamma from the Low Pressure Service Water outlets of the A and B Low Pressure Injection Decay Heat Coolers of Units 1, 2 and 3. Samples from the cooler outlets are sequentially automatically valved and monitored. Sample valve scan rate is adjustable from the Unit 1 RIA computer system. Unit 1 control room contains the primary control terminal for the monitor. The output from the radiation monitor is indicated in all three control rooms. Alarms are also provided in the control rooms. The monitor is located inside the turbine building and is shielded to function during a loss of coolant accident, including 100 percent release of fission gases inside the Reactor Building. The monitor is provided to supplement indications from 1, 2 and 3RIA-35.
3. RIA-32 can monitor air from up to 12 locations and 3RIA-32 can monitor air from up to 6 locations, each within the Auxiliary Building for early detection and location of equipment malfunctions. They also are designed to warn personnel of the presence of radiological hazards. Each monitor incorporates a sample pump that continuously draws samples through a three-way valve manifold at the detector. Sample valves are sequenced by the RIA computer system to direct individual samples to shielded beta sensitive detectors.

Detector outputs are logged by the RIA computer system. Loss of sample flow is annunciated in the Control Rooms as a fault alarm detector.

Additionally, RIA-32 and 3RIA-32 are designed to monitor the discharge from the respective units penetration room fans. Manually-selectable sample points permit detection of gaseous activity in the Penetration Room resulting from Reactor Building design leakage following a Reactor Coolant System failure and subsequent release of fission gases into the Reactor Building.

4. RIA-33 is used to monitor total liquid waste effluent from the station. Loss of sample flow is annunciated in the Radwaste Facility Control Room. Interlocks from this monitor automatically terminate a release at preset levels.
5. 1RIA-35, 2RIA-35, and 3RIA-35 continuously monitor samples of LPSW for gross gamma in the main LPSW discharge headers from the Auxiliary Building. The main headers are monitored since they can contain radioactive leakage from normally radioactive systems due to component failures. Upon any indication of radioactivity in the effluent, the component suspected of leaking may be individually isolated thereby allowing repair of components. The detectors are located inside the Turbine Building. They are shielded to function in the presence of increased background from a Loss of Coolant Accident. Loss of sample flow is annunciated in the appropriate Control Room.
6. During times when LPSW temperature is high and greater cooling is desired inside the Reactor Building, chilled water can be provided to the Auxiliary Coolers in lieu of LPSW by a temporary chilled water system during modes 1-4 and to the Auxiliary Coolers and/or the “B” RBCU during modes 5, 6, and no mode. This is accomplished by tying temporary chilled water system piping into a portion of the LPSW piping going to the Reactor Building Auxiliary Coolers and the “B” RBCU. Since the chilled water is isolated from monitoring by 1/2/3RIA-35, grab samples are taken on a periodic frequency and evaluated for gross radioactivity. Grab samples are only required during modes 1-4.
7. RIA-37 and RIA-38 monitor waste gas effluent from Oconee 1 and 2. One instrument channel using a plastic beta scintillation detector (RIA-37) and one instrument channel using a Geiger-Mueller (G-M) tube (RIA-38) provide the dynamic range indicated on Table 11-7. This range covers normal and abnormal operating conditions with overlap as indicated. Interlocks from these monitors automatically terminate release at preset levels. 3RIA-37 and 3RIA-38 are functionally identical and serve the same purpose for Oconee 3. These monitors are shown on Figure 11-3.
8. RIA-39 for Units 1 and 2, and 3RIA-39 for Unit 3, monitor Control Room ventilation using beta sensitive detectors (Section 9.4.1.1). Samples of Control Room air are continuously pumped through shielded samplers. Loss of sample flow is annunciated in the appropriate Control Room.
9. 1RIA-40, 2RIA-40, and 3RIA-40 monitor condenser air ejector off gas effluent to each unit vent (Section 10.4.2) to detect activity in the steam system resulting from a steam generator tube leak. In addition to this protection, 1RIA-16 and 1RIA-17 are located adjacent to the main steam headers. For Oconee 2 and 3, this monitoring function is served by 2RIA-16, 2RIA-17, 3RIA-16, and 3RIA-17, respectively.
10. RIA-41 for Units 1 and 2, and 3RIA-41 for Unit 3, monitor ventilation air in both Spent Fuel Buildings using beta sensitive detectors (Section 9.4.2.1). Samples of Spent Fuel Building air are continuously pumped through shielded detectors. Loss of sample flow is annunciated in the appropriate Control Room.

11. RIA-42 for Units 1 and 2, and 3RIA-42 for Unit 3, monitor recirculated cooling water return from Auxiliary Building for gross gamma activity.

12. 1RIA-43, 1RIA-44, 1RIA-45, and 1RIA-46 monitor Oconee Unit 1 vent for radioactive air particulates, iodine, and gas. A vent monitor incorporates a sample nozzle, a pumping system, and four detector channels. The pump supplies samples to an air particulate monitor (moving filter paper), a fixed charcoal filter that is monitored for iodine, and to two gas monitors. The pump also draws a portion of the sample through an Iodine cartridge and filter paper for effluent analysis. Air particulates are detected by monitoring a moving filter paper with a plastic beta scintillator (1RIA-43). Iodine is monitored with a NaI scintillator (1RIA-44) monitoring a selected gamma energy range. Gaseous activity is detected by a plastic beta scintillator (1RIA-45) for normal ranges. A cadmium telluride solid state detector (1RIA-46) is used in a separate instrument gas channel to extend the dynamic range of the system. Sensitivity and overlap of the gaseous monitoring ranges are indicated in Table 11-7. Collection efficiency for the air particulate filter is 99 percent for particles 0.5 micron and larger. The activated charcoal cartridge type filter has a rated collection efficiency of at least 90 percent for radioiodine in forms anticipated.

    Malfunctions involving loss of sample flow and depleted, torn, or clogged filter paper are alarmed in the Control Room.

    For Oconee 2 and 3, this monitoring function is served by 2RIA-43, -44, -45, -46, and 3RIA-43, -44, –45, -46, respectively.

    When required by Technical Specifications to be operable, interlocks from the gas monitors automatically terminate a Reactor Building purge and close the purge isolation valves on high radiation level in accordance with the requirements of NUREG 0737, Item II.E.4.2.7. These monitors are shown on Figure 6-4.

    4RIA-45 monitors the Radwaste Facility HVAC for noble gas. Particulate and radioiodine activity are continuously sampled by a filter paper and charcoal cartridge sampling arrangement. The sampling filter paper and charcoal cartridge are periodically replaced and analyzed to quantify and qualify radioactivity present in the HVAC system. Noble gas activity is detected by a plastic beta scintillator for normal ranges. Sensitivity of the gaseous monitoring range is indicated in Table 11-7.

    a. 1RIA-47, 1RIA-48, 1RIA-49, 1RIA-49A and associated equipment make up the Reactor Building Airborne Activity Monitoring System for Oconee 1. The equipment provided is functionally identical to that described for the vent monitors except that a separate Iodine cartridge and filter paper are not available for effluent analysis. For Oconee 2 and 3, this monitoring function is performed by 2RIA-47, -48, -49, 49A, and 3RIA-47, -48, -49, 49A, respectively. On high radiation level, interlocks from the gas monitors automatically close the Reactor Building sump line isolation valves.

13. 1RIA-50 monitors Oconee 1 Component Cooling System for gross gamma using a NaI scintillator (Section 9.2.1.7). Sample flow loss is alarmed in the Control Room. For Oconee 2 and 3, this monitoring function is performed by 2RIA-50 and 3RIA-50, respectively.

14. RIA-53 is designed to monitor airborne effluent from the Interim Radwaste Building. One instrument channel using a plastic beta-scintillation detector provides the range indicated in Table 11-7. This range covers normal operating conditions. Interim Radwaste Building particulate and radioactive gas constituents are continuously sampled by a filter paper and charcoal cartridge sampling arrangement adjacent to the RIA-53 skid. The particulate and iodine sampling media are periodically replaced and analyzed to qualify and quantify radioactivity present on the media.

15. RIA-54 monitors the Unit 1 and 2 Turbine Building sump and stops pumps during loss of power or high activity. 3RIA-54 monitors the Unit 3 Turbine Building sump and stops pumps when high radioactivity levels are detected.

16. 1RIA-56, 2RIA-56 and 3RIA-56 are designed to monitor gross gamma activity in each unit vent stack. The detector is an ion chamber located on the vent stack with the readout in the control room. The monitor provides very high range monitoring capabilities for gaseous effluents exiting the unit vent under accident conditions.

17. 1, 2, 3RIA-57 and 58 are designed to monitor gross gamma activity in each unit containment building. These post-accident monitors are coaxial ion chambers with readouts in each control room. The monitors are located in the east and west penetration room associated with each unit. 1, 2, and 3RIA-58 have recorders in the Control Rooms.

18. The Hot Machine Shop Vent particulate and radioiodine constituents are continuously sampled by a filter paper and charcoal cartridge sampling arrangement. The sampling arrangement is periodically replaced and analyzed to quantify and qualify radioactivity present on the filter paper and/or cartridge. Because of the type of work conducted in the Hot Machine Shop, and because of the location of the Shop to the Auxiliary Building (and its associated ventilation system), noble gas activity is not released via the Hot Machine Shop vent. Therefore, noble gas monitoring capability is not required in the Hot Machine Shop.

19. Note that the Reactor Coolant Pump Motor Refurbishment Facility ventilation system and ventilation sampling system were “abandoned in place” in the last quarter of 2004, after completion of the Reactor Head Replacement Project. Electrical power to the ventilation and ventilation sampling systems was disconnected as part of the “abandonment” process. Although the ventilation system equipment and the ventilation system sampler remain in-place, this facility no longer discharges airborne radioactivity to the environment. This paragraph remains as a description of the operation of the ventilation system that was installed in the building to support the Reactor Head Replacement Project. This paragraph also remains in the event power is later restored to the ventilation and ventilation sampling systems. The Reactor Coolant Pump Motor Refurbishment Facility radioactive particulate and radioiodine effluent is continuously sampled by a filter paper and charcoal cartridge sampling arrangement during specified maintenance activities such as the Reactor Head Replacement Project. Note that due to work sequencing, radioiodine is not expected to be available for release from the facility; however, sampling for radioiodine is conducted to allow proper accounting of effluent in the event that radioiodine is identified. The sampling media is periodically replaced and analyzed to quantify and qualify radioactivity present on the filter paper and/or cartridge. Because of the type of work conducted in the Reactor Coolant Pump Motor Refurbishment Facility, noble gas activity and (byproduct) tritium activity are not released from the facility vent. Therefore, noble gas monitoring capability and tritium sampling capability are not required in the Reactor Coolant Pump Motor Refurbishment Facility.

20. 1, 2 and 3RIA-59 and 1, 2 and 3RIA-60 are N-16 Main Steam Line Radiation Monitors (Note: These are not to be confused with the Regulatory Guide 1.97 Main Steam Line Monitors described in Section 7.5.2.54 of this UFSAR.) 1, 2 and 3RIA-59 and 1, 2 and 3RIA-60 are specifically configured to detect N-16 gamma radiation. 1, 2 and 3RIA-59 and 1, 2 and 3RIA-60 each consists of the following components:

    a. An N-16 Radiation Scintillation Detector (the detector consist of a NaI(T1) 3”X2” crystal, Photo multiplier tube, embedded Am-241 seed source, and a Temperature sensor) located adjacent to the Main Steam Line on the fifth floor Turbine Building

b. A Local Process Display Unit (LPDU) which is a microprocessor that converts the gamma counts per second to gallons per day leakage based on the geometry of the Steam Generators and length of the Steam Lines from the Steam Generator to the Detector location and Reactor Power. The LPDU sends output signals to the OAC and the PMC and the Control Room View Node. The LPDU has an input signal from the ICS which corresponds to the Core Thermal Power Best % Reactor Power.

c. An Uninterruptible Power Supply (UPS) that feeds power to a Signal Power Junction Box and to alarm relays located in a Signal Junction Box.

d. Alarm relays that actuate Control Room Stat Alarms upon receipt of a signal from the LPDU that a Rad Monitor Fault has occurred or Rad monitor leakage rate setpoint has been reached.

21. Deleted per 2005 update

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11.6 Radwaste Facility

11.6.1 General Description

11.6.1.1 Safety Evaluation

The radwaste facility was evaluated under a 10CFR 50.59 safety evaluation and was found not to involve an unreviewed safety question. In accordance with 10CFR 20.305, pursuant to 10CFR 20.302 (now addressed in 10CFR 20.2004, pursuant to 10CFR 20.2002), Duke requested NRC approval to operate a low-level radioactive waste incinerator, discussed in Section 11.6.3.3, under the ONS Operating License and Technical Specifications (Reference 1). The NRC transmitted their safety analysis (Reference 2) which concluded that operation of the incinerator would not diminish the safe operation of ONS nor present an undue hazard to public health and safety.

11.6.1.2 Site Characteristics

The site is located south of the Unit 3 Turbine and Auxiliary Buildings. The yard grade elevation in this area is about 796 feet (MSL). Approximately 80 ft. southeast of the facility the yard fill slopes downward at 2 to 1 (horizontal to vertical) to original ground about 55 ft. below.

The test borings encountered a profile of materials consisting from the ground surface of fill residual soil, partially weathered rock and finally rock or refusal materials. The thickness of fill varied from 18 to just over 70 feet within the proposed facility. The fill soils classify primarily as micaceous silty sands with included clayey layers of low to moderate plasticity.

The fill consistency based on the standard penetration test is loose to dense. The fill appears to be relatively well compacted overall based on penetration resistances. The standard penetration resistances range from less than 5 to greater than 40 blows per foot with values predominantly between 21 and 30 blows per foot.

Below the fill soils, the residual materials weathered from the parent bedrock were encountered. The residual profile consists of a variable thickness of soil underlaid by partially weathered rock. The residual soils primarily are silty sands or sandy silts. The standard penetration test values range from 4 to over 100 blows per foot.

Beneath the fill and residual soils, the test borings encountered refusal materials at depths of 30 to 85 feet below the present surface. The nature of the refusal materials was investigated by rock coring procedures. The rock classified as mica-gneiss.

11.6.1.3 Facility Description

The Radwaste Facility is designed to process liquid and solid radioactive wastes. The wastes are separated into clean water and concentrated contaminants. The concentrated contaminants are prepared for disposal and the clean water is discarded or recycled for use in the station. The wastes consist of miscellaneous liquid waste (radioactive equipment drains and floor drains, etc.) reactor coolant, powdered resin, and miscellaneous radioactive trash (gloves, paper, etc.)

Liquid wastes are processed by an appropriate combination of equipment (filter, demineralizer, and/or evaporator) in the Liquid Waste and Recycle System. (The evaporator is in a state of 'dry layup' and is not in use.) Contaminants collected by the demineralizers and filters are sent to the

Dewatering System. Boric acid concentrated from reactor coolant by the evaporator are reused or sent to the Solidification System as are the waste concentrates.

Powdered resin used in the Condensate Polishing Demineralizers are collected and monitored in the Resin Recovery System. The resin can be used to process water from the LW System and/or the Laundry Hot Shower Tanks. Excess water will be removed from contaminated resin and the resin sent to the Volume Reduction System or vendor supplied liners for dewatering. The Liquid Waste and Recycle System is shown in Figure 11-2.

The Volume Reduction System (in dry layup) incinerates combustible wastes. The dried product (ash & salts) and wet wastes will be packaged to meet Federal and State regulations.

11.6.1.4 QA Condition Classifications and Inspection Program

11.6.1.4.1 Perspective

Duke Power Company's Quality Assurance program covers four QA conditions. Quality Assurance Condition 2 (QA 2) applies to radwaste systems and follows the guidance of Regulatory Guide 1.143. Regulatory Guide 1.143 lists systems to which it applies but does not contain criteria for determining applicability.

The criteria herein adopted for the application of QA 2 are based on the “as low as reasonably achievable” (ALARA) concept of radiation protection and generally relate to routinely expected occurrences. The criteria generally result in determinations which are consistent with Regulatory Guide 1.143.

11.6.1.4.2 General Criteria

An item or activity is ALARA related and a QA program is applied if:

a. Functional unavailability, lack of effectiveness, or non-catastrophic failures impair the ability to meet the ALARA objective for effluent releases.

b. Require routine maintenance or repair of anticipated failures would cause excessive or easily avoidable occupational exposure.

11.6.1.4.3 Implementation

a. Eliminating pressure boundary leakage of ALARA related piping systems (delineated on flow diagrams as Class E) is an ALARA related function, but pipe hangers and supports do not perform an ALARA related function because they are provided to prevent gross failure rather than leakage. Experience has shown that conventional power piping has a very low rate of gross failure but leakage is not unusual. Therefore, pipe hangers and supports are not QA Condition 2.

b. The pressure boundary of piping systems with only occasional radioactivity, very low radioactivity, and drains are not ALARA related. Generally, this applies to closed loop cooling and process steam, streams normally releasable without treatment and floor drains.

c. Equipment, parts, and components not part of an ALARA pressure boundary are functionally ALARA related if their failure would prevent the system from performing its intended function greater than 10% of a calendar quarter (about 10 days). Since most electrical equipment and small mechanical equipment can be repaired in this time, they are generally excluded.

d. Only the containment of leaks and spills within the structure is an ALARA related function which requires a QA 2 program by these criteria. Therefore, a QA 2 program will be applied to the “Bathtub Portion” of the radwaste facility structure.

11.6.2 Structures

11.6.2.1 Description of Building

The Oconee Radwaste Facility consists of two separate adjoining structures, separated by a 3 inch expansion joint, both supported by poured in place reinforced concrete mats. One structure is primarily of reinforced concrete construction with structural walls serving also as shielding for radioactive components or materials. The other structure is primarily of braced structural steel construction with floors of reinforced concrete on metal deck and conventionally formed reinforced concrete columns and floors supporting large tanks. Exterior walls are insulated metal siding on steel girts. Interior walls are gypsum wallboard on metal studs and concrete masonry.

11.6.2.2 Design Bases

The structures are modeled as space frames using the McDonald Douglas version of ICES STRUDL, a structural design language computer program. The two dimensional finite element capabilities of STRUDL are used to represent walls and slabs while one dimensional beam elements are used for beams and columns. The supported points of the model have spring stiffnesses representing the force-deflection relationship of the underlying soil, thus differential settlement is accounted for. A modal and shock spectrum analysis was performed using the capabilities of the STRUDL DYNAL feature of the STRUDL program up to Elevation 799+6 as a minimum.

Both portions of the Radwaste Facility are designed and erected so that all liquid inventory will be contained within the structures in the event of pipe or tank ruptures caused by a seismic event or from other causes. Therefore, the reinforced concrete mats and a concrete wall of sufficient height to contain the entire liquid inventory are designed to withstand the effects of seismic loads as well as conventional loads. Loadings due to failure of the upper structure portions during the seismic event were not considered. Design, procurement and erection meet the requirements of the Duke Power Company Quality Assurance Condition 2 (QA2) program up to Elevation 799+6. A wall erected to Elevation 799+6 (bathtub) can contain the entire liquid inventory of the building.

For the east side of the facility, between column lines B and F, the framing is primarily of structural steel, and the structural design includes the effects of seismic and conventional loads. Design, procurement, and shop fabrication of the structural steel meet the requirements of the Duke Power Company QA 2 Program. Structural steel erection meets AISC requirements, but has no formal Quality Assurance requirements. The south-east portion of this area is reinforced concrete up to the floor at Elevation 819+0. The floor, supporting large tanks, is not designed to seismic requirements; the concrete columns are designed for seismic loadings except that the tie bars are reduced in size and number from the requirements for seismic forces, to permit ease in construction.

The west side of the facility, between column lines G and K, is a reinforced concrete structure, and the analysis and design include the effects of seismic and conventional loads up to the bottom of the floor slab at Elevation 819+0. Design, procurement and construction of these parts meet the requirements of the Duke Power Company QA program. The floor slab at Elevation 819+0 and all reinforced concrete elements above this floor, except for load bearing

walls, are analyzed and designed for conventional loads only, with good engineering practice applied to design, procurement and construction. The design of load bearing walls above Elevation 819+0 includes seismic loads with no Quality Assurance requirements applied to design, procurement or construction.

Independent loads are calculated on the following bases:

11.6.2.2.1 Wind Loadings

The design wind velocity is 95 mph at 30 ft. above the nominal ground elevation. According to ASCE Paper 3269, “Wind Forces on Structures,” this represents the greatest wind velocity with a recurrence interval of 100 years. ANSI A58.1-1972, “Building Code Requirements for Minimum Design Loads in Building and Other Structures,” recommends that buildings with a height-to-minimum horizontal dimension ratio exceeding five should be dynamically analyzed to determine the effect of gust factors. However, since this structure has a height-to-width ratio less than five, a gust factor of unity is used in determining wind forces. Tornado and tornado missiles are not included as a design load.

11.6.2.2.2 Water Level Design

The yard grade is at elevation 796+0. All openings into the structure will be no lower than 797+0. A 2'-6" minimum height curb is provided to contain any accidental spillage within the facility. The yard is provided with a surface water drainage system.

11.6.2.2.3 Dead Loads and Equipment Loads

A density of 150 1b/ft^3 is used for reinforced concrete dead weight computations. Structural steel weights are based on their nominal weight per foot as given in the AISC “Manual of Steel Construction”, eighth edition. Weights of metal decking and siding are taken from supplier's catalogs. Weights of equipment, tanks, etc., weighing more than 1000 lbs are taken from information supplied by the manufacturer. An additional load of 150 lb/ft^2 is applied to floors, except for the drum storage area, and roofs in the reinforced concrete structure to account for suspended piping, electrical cable tray and small miscellaneous equipment weighing less than 1000 lbs. In the drum storage area, the additional load is 2250 lb/ft^2.

Additional loads of 50 lb/ft^2 on floors and 30 lb/ft^2 on roofs are applied in the structural steel portion, for the same reason. Where cable tray is banked, the cable tray loading are calculated and applied as additional equipment load. A dead load of 20 lb/ft^2 is applied to areas covered by grating.

11.6.2.2.4 Live Loads

In the concrete portion, a live load of 125 lb/ft^2 is applied to floors and roof. In the structural steel portion, a live load of 150 lb/ft^2 is applied to floors and 20 lb/ft^2 is applied to roofs. A live load of 100 lb/ft^2 is applied to areas covered by grating.

11.6.2.2.5 Seismic Design

A nonlinear finite element soil-structure analysis (FLUSH) is used to generate seismic response at the ground surface due to bedrock motion. The rock motion input is a synthetic 5%g time history developed so that response spectra derived from that motion envelope the NRC Regulatory Guide 1.60 curves. The design response spectra are developed using procedures set forth in NRC Regulatory Guide 1.60, with maximum ground acceleration in both horizontal

and vertical directions obtained from the soil-structure interaction analysis. Response spectra analyses are performed for both horizontal directions. Vertical earthquake loads are obtained by applying the maximum vertical acceleration to static loads.

11.6.2.3 Loads and Loading Combinations

The loads and combinations thereof used in the analysis and design of the Radwaste Facility are described below:

1. Normal Loads

   Normal loads are those loads to be encountered during normal facility operation.

   They include the following:

   D - Dead loads, including permanent equipment loads and hydrostatic loads.

   L - Live loads, including any movable equipment loads and other loads which vary with intensity and occurrence, such as soil pressure.

2. Severe Environmental Loads

   Severe environmental loads are those loads that could infrequently be encountered during the facility life.

   Included in this category are:

   E - Loads generated by the Operating Basis Earthquake

   W - Loads generated by the design wind specified for the facility.

11.6.2.3.1 Load Combinations for Concrete Structures

U designates the section strength required to resist design loads and is based on methods described in ACI 318-77. The following load combinations will be satisfied:

1. U = 1.4D + 1.7L
2. U = .75 (1.4D + 1.7L + 1.7W)
3. U = .75 (1.4D + 1.7W)
4. U = .9D + 1.3W
5. U = .75 (1.4D + 1.7L + 1.87E)
6. U = .75 (1.4D + 1.87E)
7. U = .9D + 1.43E

11.6.2.3.2 Load Combinations for Steel Structures

S designates the section strength required to resist design loads and is based on the elastic design methods and the allowable stresses defined in Part I, Sections 1.5.1, 1.5.2, 1.5.3, 1.5.4 and 1.5.5 of the AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," seventh edition.

Y designates the section strength required to resist design loads and is based on plastic design methods described in Part 2 of AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," seventh edition.

The following load combinations are used for the elastic working stress method:

1. S = D + L
2. 1.33S = D + L + E
3. 1.33S = D + L + W

In load combinations 2 and 3, S is increased by one-third in accordance with Section 1.5.6 in the AISC specification.

The following load combinations are used for the plastic design method:

1. Y = 1.7D + 1.7L
2. Y = 1.3D + 1.3L + 1.3E
3. Y = 1.3D + 1.3L + 1.3W

Note: Loadings that include seismic factors are used as a design basis to design the “bathtub”.

11.6.3 Mechanical Systems

11.6.3.1 Liquid Waste and Recycle System

11.6.3.1.1 Design Bases

The Liquid Waste and Recycle System (LW) is designed to appropriately process all excess radioactive water generated at the station. Decontaminated water will be reused by the station as make up or released to the environment as appropriate. Generally, chemistry limits control recycle and radioactivity limits control discharge. Contamination removed from processed water will be transferred to the Volume Reduction and Solidification System for packaging and shipment to an approved processor or disposal facility.

Note: The HPD Evaporator System is placed into a 'dry layup' condition until operating economics can justify its use, and because of this water is not reclaimed for use/reuse by the station.

11.6.3.1.2 System Description

Four 10,000 gallon Feed Tanks are provided for batching reactor coolant and miscellaneous waste. These tanks are managed as needed to receive waste from the plant.

Feed pumps, process filters, demineralizers, and demineralizer fines filters are provided in pairs, each designed for ≤ 50 gpm. One 30 gpm evaporator is provided to be used either for concentration of boric acid from reactor coolant or, if necessary, for use with a filter and demineralizer to provide the greatest available decontamination for waste. An additional train of six demineralizers is available to process liquid waste. Sufficient crossconnection is provided so that two independent streams can be processed simultaneously. Possible lineups are: 1) a feed pump, filter, demineralizer, demineralizer fines filter, evaporator processing reactor coolant and 2) a feed pump, filter, demineralizer, and demineralizer fines filter processing miscellaneous floor drains. Other “normal” situations exist with total process rates from 5 to 100 gpm.

Six 10,000 gallon monitor tanks are provided for checking processed water quality and scheduling transfers. Water may be released to the environment through a radiation monitor or be transferred to Chemical Treatment Pond #3.

If dilution is required, processed water is released through a radiation monitor coordinated with a flow meter. The monitor will terminate discharge if it detects activity in excess of the setpoint.

The setpoint is determined based on laboratory analyses. The setpoint guards against errors in the laboratory results. Compensatory action is taken if the laboratory analysis can not be coordinated with the monitor's setpoint (monitor out of service or activity below capability of the monitor to detect). Independent samples are taken and analyzed instead of using the continuous monitor.

11.6.3.2 Powdered Resin Recovery System

11.6.3.2.1 Design Bases

The Powdered Resin Recovery System is designed to collect and sample each sluice (backwash) from the Condensate Polishing Demineralizer Backwash Sump and to separate water from spent resin. The sump can contain both bead and powdered resins from various demineralizers. In addition, the System can use the spent resin to process liquid from the Laundry Hot Shower Tanks, and the Liquid Waste System.

11.6.3.2.2 System Description

Each backwash is sent to one of the two Backwash Receiving Tanks, BRT-A, or BRT-B. There the resin is transferred to the Contaminated Backwash Receiving Tank (CBRT) where it can be used to process additional waste water.

The resin in the backwash receiving tanks may also be used to process laundry and hot shower water and to process/reprocess miscellaneous waste. This is accomplished by agitating the water and resin, then proceeding with the decanting as described above.

Backwashes are allowed to settle. After sufficient settling has occurred, the excess water is decanted. The decanted water is directed through the Resin Fines to the Decant Monitor Tank (DMT). Here the water is sampled and directed to one of two locations; 1) Liquid Waste System, or 2) Chemical Treatment Pond. The contaminated resin is transferred to the Facility Truck Bay and/or Drum Storage Facility for dewatering in DOT approved shipping containers.

The dewatered containers are sampled, prepared and shipped to a NRC disposal facility or vendor-site for further volume reduction.

11.6.3.3 Volume Reduction and Solidification System

11.6.3.3.1 Design Bases

The Volume Reduction and Solidification System (VR) is designed to prepare radioactive wastes for shipment and disposal, and to minimize the volume of waste shipped.

Note: The VR system (incinerator and dry product handling and drumming portions) has been placed in a layup condition until operating economics can justify its use.

11.6.3.3.2 System Description

In order to prepare wastes for shipment and minimize the volume of waste, wet wastes (e.g., contaminated oil, powdered resins) and dry trash are incinerated and the scrub liquor produced is completely dried. The results of both fluid bed processes are a dry, free-flowing mixture of salt granules and ash. This sand-like material is then packaged to meet Federal and State regulations. Resin which is too radioactive to incinerate will be solidified and/or packaged to meet Federal and State regulations.

The incinerator may be fed resin slurries, contaminated oil or shredded trash. Fluidizing air is electrically heated for startup and thereafter maintained by the combustion process. Liquid sprays (resin slurry or condensate) are provided to control temperature.

All normal operations of the Volume Reduction and Solidification System involving radioactive material are carried out remotely from the Radwaste Control Room. A remote control crane moves new drums from the clean fill stations to the waste drumming stations, stores or retrieves drums in the storage pit, and loads truck-mounted shielded casks used to ship solidified waste off site for disposal.

11.6.3.4 Instrument and Breathing Air Systems

These systems are described in Section 9.5.2.

11.6.3.5 Equipment Cooling System

11.6.3.5.1 Design Bases

The Equipment Cooling System is designed to remove heat from the components of the Liquid Waste Processing System and Radioactive Waste Solidification System. This system also supplies cooling water to the Radwaste Facility air compressors and HVAC coolers, and supplies service water for the facility.

11.6.3.5.2 System Description

The generating plants Condenser Circulating Water System serves as the suction source for the Equipment Cooling System. Two duplex basket-type strainers reduce particulate size to 1/16" and two 100% capacity EC Supply Pumps rated at 2400 gpm, @ 160 ft. deliver flow to the secondary side of two plate-type heat exchangers. The primary side flow is circulated by two 100% capacity EC Circulating Pumps rated at 1600 GPM @ 85 ft. This flow provides cooling for the Liquid Waste Evaporator and the Volume Reduction System. An auxiliary supply is taken off the EC Supply Pump discharge for miscellaneous service water use.

11.6.3.6 Heating Ventilation and Air Conditioning

11.6.3.6.1 Design Bases

The Radwaste Facility HVAC consists of a Ventilation System and an Air Conditioning System. The principal objectives of the HVAC System are to supply sufficient filtered fresh air to maintain an aseptic condition, control the temperature for effective operation of process equipment, meet the “ALARA” related consideration with air flow by supplying air to clean areas and exhausting air from high radiation areas and to sample the exhaust air to monitor the release of airborne radioactive material from the building.

11.6.3.6.2 System Description

11.6.3.6.2.1 Ventilation System

The Ventilation System will supply filtered and tempered air to each area in sufficient quantity to reduce the heat build up and keep the temperature below 110 degrees in the process areas. A positive exhaust system will be used to exhaust a quantity of air from each area which is sufficiently larger than the supply air to maintain a directed flow of air in the building. The

exhaust air quality will be monitored. A filter train including rough, HEPA and charcoal filters will be used for the exhaust air from tank vents and fume hoods to minimize the emission of contamination from the building. There will be no recirculation of air to any process area.

11.6.3.6.2.2 Air Conditioning System

The Air Conditioning System will supply tempered and dehumidified air including fresh air to each area. The areas to be air conditioned include, but are not limited too, the control room, the count room, the Chem. & HP Lab, the Men and Women's Clean Change Areas, the Supervisor's office, and the clean and contaminated maintenance shops. The Contaminated Maintenance shop and the personnel areas will be air conditioned with 100% fresh air.

11.6.3.7 Drains

Roof drains and clean floor drains are piped to the station storm drain system.

Personnel area drains that are potentially contaminated are pumped to the facility sumps.

Sanitary drains are piped to the on-site sanitary sewer collection piping system.

Contaminated process and floor drains are piped to the facility sump.

11.6.4 Remote Control System

11.6.4.1 Design Bases

The Radwaste Remote Control System is designed to provide a means for operating the various mechanical and electrical systems in the Radwaste Facility from a centralized control area. This design will minimize the requirements for manning the facility, and will minimize the radiation exposure to the operator. While it is impractical to control all functions from a centralized location, remote control is employed in a practical manner where possible, particularly in situations involving radiation exposure to the operator.

11.6.4.2 System Description

The Radwaste Control Room (RCR) is located in the clean portion of the building where there are no radiation shielding requirements. A cable spreading room is provided behind the RCR to allow for control board and relay cabinet cable access.

Control boards designed by several different vendors as well as Duke-designed boards are located in the RCR. The electrical project engineer coordinates between all parties to insure as much compatibility between boards as is reasonably achievable. Human factors aspects of the control room and control board designs including color coding, control board enhancement, process mimics, operator/control interfaces, and RCR personnel traffic patterns are taken into consideration.

Since the RCR is the primary area of personnel activity for this facility, the Fire Detection System central alarm station as well as any other “Facility protective” monitors are located there. Annunciators, instrumentation, and control devices are installed as necessary to satisfy the intent of the Remote Control System purpose.

11.6.5 Fire Detection System

11.6.5.1 Design Bases

The Radwaste Fire Detection System is designed to provide early warning at a central location in the event of a fire or conditions preceding the break out of a fire.

11.6.5.2 System Description

The Radwaste Fire Detection System central alarm station is located in the Radwaste control room. Individual strings of various types of detectors emanate from the central alarm station to provide detection in selected areas of the facility. Detector locations and types (ionization, fixed temperature, rate-of-rise, etc.) are determined by the fire protection engineer.

The detection system installed is of the two-wire type which will allow trouble alarm indication. This design approach should minimize personnel radiation exposure encountered in maintaining the system. An alarm is provided in the Oconee plant (e.g., Unit 3 control room) to notify the plant operations personnel of a fire in the Radwaste Facility.

11.6.6 Radiation Monitoring System

11.6.6.1 Design Bases

The Radiation Monitoring System is designed to accurately monitor process, area and noble gas radiation within the facility. Particulate and iodine collection samplers are also installed in the exhaust system.

11.6.6.2 System Description

The Radiation Monitoring System consists of the components with their respective parameters as listed in Table 11-7.

11.6.7 Radiation Protection

11.6.7.1 Facility Design Features

The mechanical and electrical equipment is separated into clean, nonradioactive areas, curbed areas and shielded areas. Radioactive components are separated from each other to allow maintenance without subsequent exposure from nearby components. Radioactive equipment with valves is provided in a valve gallery containing the valves and remote valve operators in an intermediate radiation area. Separation of system piping is also stressed to eliminate exposure in these galleries. Air regulators and other instrumentation associated with valve and system operation are located outside of the valve gallery, inside of the labyrinth entrance in a lower zone.

Feed tank exposure is minimized by using stainless steel lined rooms. Mixer motors for these tanks are located above the shielded tank room.

Process particulate filters are the backflushable type to eliminate exposure with filter replacement and are remotely operated.

Process resin demineralizers are used for ion removal.

All equipment suspected of crud accumulation is flushed prior to maintenance. Periodic piping review insures minimum piping crud traps.

The Volume Reduction System layout utilizes several individually shielded cubicles to separate components containing the majority of the radioactive material from the mechanical components such as the pumps and blowers which contain small amounts of radioactive material and which are expected to require periodic maintenance. In addition, the components containing the majority of the radioactive material are all fitted with decontamination nozzles so that the radioactive salts can be flushed from the system and the components readily decontaminated prior to required maintenance.

11.6.7.2 Shielding

11.6.7.2.1 Source Terms

Radiation source terms for the Radwaste Facility are separated into three systems; the Liquid Waste and Recycle System (LW), the Resin Recovery System, and the Volume Reduction and Solidification System (VR). The liquid waste source terms are derived by OSC-1696, “Radwaste Facility LW Source Terms.” The resin recovery source terms are derived by OSC-1823, “Oconee Radwaste Facility Contaminated Powdex Source Terms.” The volume reduction and solidification source terms are derived by OSC-1824, “Oconee Radwaste Facility VR System Source Terms.” These calculations either reference ANSI N237-1976/ANS-18.1, “Source Term Specification,” or utilize computational code, N-237BURP, C-6.11-8, November 1977, Rev. 1 for the determination of source strengths.

11.6.7.2.2 Radiation Zone Designations

Radiation area and zone designations used at the Radwaste Facility for protection of operating personnel and the general public are described in UFSAR Chapter 12. Radiation zone designations used to evaluate the maximum integrated doses for electrical equipment qualification are listed in the Environmental Qualification Criteria Manual (EQCM).

During the design and construction of the low-level radioactive waste incinerator, radiation zones were established for the Radwaste Facility, per Regulatory Guide 8.8, to reflect the design maximum dose rate expected to exist during incinerator operation. Since the incinerator has never operated and is now abandoned, the design basis radiation zones established for operation of the incinerator (updated in 1993 to reflect the revision of 10 CFR 20) are listed below for historical information. The dose rates and work areas of the facility as it is currently used is monitored by Radiation Protection personnel to assure that the intent of the zones to maintain ALARA dose to workers is achieved.

HISTORICAL INFORMATION IN ITALICS BELOW NOT REQUIRED TO BE REVISED

Zone I: Designation for areas adjacent to the station site where Duke Power Company does not normally exercise authority to control access. In accordance with applicable regulations (10CFR 20.1301(a)(1)), the dose rate in these areas does not exceed 0.1 rem/yr.

Zone II: Areas within the station site where the station staff is expected to work continuously. For conservatism, the limiting dose rate is selected as 0.5 mrem/hr. This is comparable to the criteria given in 10CFR 20.1302.

Zone III: Areas within the station where staff occupancy is expected to be periodic rather than continuous. An employee could, however, remain in these areas and not exceed 5.0 mrem/hr.

Zone IV: Includes infrequently occupied work locations where the dose rate exceeds continuous occupational levels but access need not be physically restricted. The limit dose rate for this zone is designated as 50 mrem/hr. The precautions given in 10CFR 20.1601, 1602, and

1901 through 1905 for Radiation Areas are employed where local dose rate levels in Zone IV warrant.

Zone V: Encompasses all areas of the station where the dose rate exceeds that of Zone IV. Access to these areas is physically restricted, and Radiation Protection surveillance is required for occupancy, if any. The precautions given in 10CFR 20.1601, 1602, and 1901 through 1905 for High Radiation Areas are employed where local dose rate levels in Zone V warrant.

11.6.7.2.3 Shield Wall Thickness

The KAP VI computer code is used to determine the shield wall thickness for each component. KAP VI utilizes the point kernel technique to calculate radiation levels at detector points located within or outside a complex radiation source geometry.

11.6.8 References

1. H. B. Tucker (Duke) letter to H. R. Denton (NRC) dated June 10, 1985.

2. J. F. Stolz (NRC) letter to H. B. Tucker (Duke) dated October 30, 1986.

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11.7 Conventional Wastewater Treatment Systems

11.7.1 Design Bases

The Oconee Nuclear Station uses chemical processes to treat water for use in both the Reactor Systems and Steam and Power Conversion Systems. Many of these chemical processes are governed by regulatory criteria. For example, the National Pollutant Discharge Elimination System (NPDES) establishes criteria for chemical concentrations released from the station. The bases for the Conventional Wastewater Treatment Systems are to provide a means to treat wastewater prior to release so that it can meet regulatory criteria.

11.7.2 System Description

The Conventional Wastewater Treatment System as seen in Figure 11-4 consists of three treatment ponds: CTP#1, CTP#2, and CTP#3. CTP#1 and CTP#2 are parallel ponds with either in service as conditions warrant to provide treatment. Pumps are provided for recirculation and as a means for controlled discharge from CTP#1 or CTP#2 to CTP#3. The Conventional Wastewater Treatment System receives input from various drains and sumps throughout the plant. These ponds are controlled and monitored using approved plant operating procedures.

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11.8 Radiological Ground Water Protection Program

By 2006, industry experience had confirmed that spills, leaks and equipment failures at several commercial U.S. nuclear sites had led to inadvertent ground water contamination. Details of these experiences were documented by the Nuclear Regulatory Commission in NRC information Notice (IN) 2006-13: "Ground-water Contamination Due To Undetected Leakage of Radioactive Water" (July 10, 2006). Lessons learned from these experiences were captured through the development of a series of industry guidelines. Using the Nuclear Energy Institute (NEI): "Groundwater Protection Final Guidance Document", NEI 07-07 (August 2007), Duke Energy has established a radiological ground water protection program at Oconee Nuclear Station

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