DSAR-14.20

Safety Analysis

Waste Liquid Incident

Rev 1

Safety Classification: Safety

Usage Level: Information

Change No.:	**EC 69954**
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Fort Calhoun Station

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14.20 Waste Liquid Incident

14.20.1 General

A waste liquid incident is considered to be any accident that results in the release of waste liquid, and its accompanying activity, to the environment. There are two types of accidents to be considered:

a. Release of liquid waste caused by the rupture of, or leakage from, a radioactive waste disposal system component.

b. Accidental release of liquid waste from one of the two monitor tanks, or one of the two hotel waste tanks to the circulating water discharge tunnel.

Note that some of the assumptions and operating conditions presented in this section are no longer applicable in the permanently defueled state. The analyses presented in this section remain conservative in the permanently defueled state and do not require reanalysis, so all discussion relative to the calculational conditions and assumptions are retained in this section.

14.20.2 Release from a Component

The three largest components in the liquid waste system are a waste holdup tank, a monitor tank, and a spent regenerant tank. Each of the three waste holdup tanks can hold up to 6,100 cubic feet of liquid, and is approximately 7.6 times larger than a monitor tank, which in turn is slightly larger than a spent regenerant tank. A waste holdup tank would have the highest activity of the three types of tanks considered, since it receives reactor coolant wastes that have not been processed in the radioactive waste disposal system. Therefore, a rupture of, or leakage from, a waste holdup tank is the worst case.

The design aspects of the waste holdup tanks are described in Section 11.1.2. Each tank is completely contained within an individual compartment constructed of thick concrete. These compartments are located in a tornado-proof area of the auxiliary building. Each compartment has an individual drain to the auxiliary building sump. Liquid is pumped from the sump into one of the radioactive waste disposal system spent regenerant tanks. Each compartment drain is normally valved out. Small bore bypass lines to the auxiliary building sump are installed with their take-offs upstream of each drain valve. These lines, which are also valved, provide a means of checking for leakage from a tank into its compartment. Any leakage from piping and fittings external to a waste holdup tank compartment would drain to the nearest auxiliary building sump and enter the waste disposal system.

Each waste holdup tank is equipped with liquid level indications, liquid level alarm, and a pressure relief valve. Liquid flow into and out of the tanks is manually controlled and is subject to prescribed administrative procedure.

The liquid radwaste system components in the Radioactive Waste Processing Building are inside of a room with an entrance curb and a sump that discharges to the Radwaste System in the auxiliary building. Liquid flow into this area is administratively controlled. The principal risks of a leak are 1) flexible hose failure, and 2) liquid waste overflow from a liner or high integrity container that is being used to process and package waste for disposal.

14.20.3 Accidental Release to Circulating Water Discharge Tunnel

The monitor tanks and hotel waste tanks are the only source for the release of liquid waste to the environment. Prior to waste release to the circulating water discharge tunnel, one of the two monitor tanks is filled with treated liquid waste, which is thoroughly mixed and then sampled. The hotel waste tanks generally contain very low activity level liquid wastes from the laundry drain header. A radiochemical analysis is made and if the activity level is suitable for release within the limits of 10 CFR Part 20 the batch is released at a controlled rate. If the activity level would result in release above 10 CFR Part 20 limits the batch is either kept in the tank or returned to the waste disposal system for further treatment.

In order to make a controlled release, seven manually controlled valves between the monitor tanks and the overboard discharge header must be opened as shown in P&ID 11405-M-9. Ten manually controlled valves between the hotel waste tanks and the overboard discharge header must be opened as shown in P&IDs 11405-M-7 and 11405-M-9. One of these valves is pneumatic and of fail-closed design; a radiation monitor installed in the discharge line automatically closes this valve if the waste activity reaches the higher setpoint as discussed in Section 11.2.3. High radiation is annunciated in the control room (CR) at both of the two setpoints. The liquid effluent activity is continuously indicated and recorded in the control room. The alert setpoint is set to alarm at a lower activity than the alarm setpoint that trips the effluent valve, thereby providing ample warning of rising activity.

14.20.4 Conclusions

A rupture of one of the waste holdup tanks or leakage from other Radwaste Disposal System (RWDS) components is unlikely; however, any spillage or leakage of radioactive liquid waste would be retained within the facility.

Administrative controls, multiple valving, fail-safe features, and reliable instrumentation and controls provide assurance against the release of radioactive liquid waste to the environment in excess of 10 CFR Part 20 limits.

14.20.4.1 DELETED

14.20.5 Release from Radioactive Waste Processing Building

As part of implementation of the Alternative Source Term the airborne release from a Liquid Waste Tank Failure (LWTF) was calculated. The Exclusion Area Boundary (EAB), Low Population Zone (LPZ), and control room doses due to airborne radioactivity releases following a LWTF were recalculated and documented in Reference 14.20-1.

Regulatory Guide (RG) 1.183 does not address a LWTF. The accident scenario is FCS specific and represents a very conservative model. Table 14.20-1 lists some of the key assumptions/parameters utilized to develop the radiological consequences following the LWTF and documented in Reference 14.20-1.

As part of plant decommissioning and emergency planning exemption the EPA PAG (Reference 14.20-5) provides guidelines for doses. Reference 14.20-4 calculates the 4 day dose as discussed in the EPA PAGs (Reference 14.20-5).

The maximum liquid radionuclide inventory was documented in Reference 14.20-2 for radioactivity releases following a Liquid Waste Tank Rupture. The maximum liquid radionuclide inventory in the Radioactive Waste Processing is the activity accumulated in the Filtration and Ion-Exchangers (FIX), which is located in Room 506. This room is seismic, curbed, and steel lined and coated to form a seismic resistant sump, which will retain the total inventory of the liquid radioactivity in an unlikely event of a rupture of a FIX tank. The liquid inventory will then be pumped back to the existing tanks and thus no liquid will be released to the environment. Evaluation of other liquid waste tanks have indicated that, their contents will also not be released to the environment.

However, the following conservative scenario is postulated in the current DSAR to address a potential worst-case airborne release following a LWTF. This scenario is considered FCS licensing basis. A fraction of the halogen activity accumulated in the resin of the FIX is assumed released into the water upon tank rupture and a portion of the activity in the water becomes airborne and is released into the environment. All noble gases generated due to decay of halogens in the FIX tank are also available for release after tank rupture.

The following are the bases used in determining the airborne activity release for a rupture of a FIX tank.

The Filtration and Ion Exchange system is used to treat the high level liquid waste generated in FCS. The influent to the FIX is the contents of the waste holdup tanks, and the effluent from the FIX is discharged to the monitor tanks. The worst-case liquid source in the holdup tanks is untreated primary coolant waste. The holdup tanks also receive reactor coolant waste via the letdown system, which has been treated by purification demineralizers. Other input streams to the holdup tanks have lesser activity concentrations. Therefore, a conservative feed stream source to the FIX is the weighted-average activity of untreated primary coolant and the letdown purification demineralizer treated primary coolant.

Design reactor coolant system (RCS) equilibrium activity concentrations (i.e., 1% defective fuel) is accumulated in the FIX at the maximum design flow rate (50 gpm) for sufficient time until the equilibrium activity is achieved. The activity inventory in the FIX is calculated taking into consideration decay and daughter buildup.

The explicit site boundary and control room dose calculation for Liquid Waste Tank Failure using the AST is documented in Reference 14.20-3 and 14.20-4. Upon the tank rupture, 10% of the halogen inventory on the ion exchanger resin is assumed instantaneously and non-mechanistically transferred to water. In addition, 10% of the halogen inventory in the water is assumed airborne and released to the atmosphere. Also, 100% of the noble gases generated by decay of halogens in the FIX tank are also instantaneously released to the atmosphere. The activity available for release from a LWTF is presented in Table 14.20-2. Upon tank failure, the LWT activity is instantaneously released as a "puff" to the environment via the radwaste building exhaust nozzle.

Accident Specific Control Room Model Assumptions

The FCS control room ventilation system is assumed to be in the normal operation mode for this assessment; i.e., the control room ventilation normal intake flow (1000 cfm ± 10%) enters the control room unfiltered. The remaining control room parameters utilized in this model are discussed in Section 14.1. The EAB, LPZ and control room dose following a LWTF is presented in Table 14.20-2.

Table 14.20-1 – Analysis Assumptions and Parameter Values – Liquid Waste Tank Failure

Inventory	Table 14.20-2
Environmental Release	"puff"
Release Point	radwaste building exhaust nozzle
CR Emergency Ventilation	Not Credited

Table 14.20-2 – Liquid Waste Tank Activity

Nuclide	LWT Activity (Ci)
Kr 83m	7.32E-01
Kr 85m	7.37E-04
*Kr 85	2.18E-06
Kr 87	1.25E-04
Kr 88	0
Kr 89	0
Xe 131m	2.81E+01
Xe 133m	1.13E+01
Xe 133	3.88E+02
Xe 135m	1.00E+01
Xe 135	6.51E+01
Xe 137	0
Xe 138	0
Br 83	7.32E-03
Br 84	7.74E-04
Br 85	7.37E-06
Br 87	1.25E-06
*I129	6.54E-06
I130	1.81E-02
I131	2.62E+01
I132	1.18E+00
I133	3.89E+00
I134	2.09E-02
I135	6.51E-01
I136	5.67E-06

***NOTE:** The EAB analysis was redone for decommissioning to reduce the size of the EAB. The activity of the tank was conservatively chosen as the activity calculated for the operating plant but eliminating any isotopes with short half-lives. KR-85 and I129 is the activity used in the EAB analysis (Reference 14.20-4)

EAB total effective dose equivalent (TEDE) doses were calculated for the worst two-hour period. For the LWTF case the worst two-hour period was for 0 to 2 hours after the release (Reference 14.20-4). LPZ and CR doses were also calculated (Reference 14.20-3). Dose criteria were identified in DSAR Section 14.1.

Table 14.20-2

Location	AOR TEDE Dose (rem)	Regulatory Limit (rem)
EAB	6.991E-07	0.50
LPZ	0.01	0.50
Control Room	0.32	5.00

The 4 day EAB dose is 7.020E-04 mrem TEDE which is less than the EPA PAG guidelines (Reference 14.20-5) of less than 1 rem TEDE.

14.20.6 Specific References

14.20-1 Implementation of Alternative Source Terms Site Boundary and Control Room Dose Analyses for Fort Calhoun Station, January 2001, Stone and Webster

14.20-2 OPPD Calculation FC06802, Revision 3, Environmental Radioactivity Release Inventories Following a Waste Gas Decay tank Rupture and Liquid Waste Tank Rupture

14.20-3 OPPD Calculation FC06822, Revision 5, Site Boundary and Control Room Doses Due to Airborne Release following a Liquid Waste Tank Failure (using Alternate Source Terms)

14.20-4 OPPD Calculation FC08792, Revision 0, Site Boundary (EAB) Dose Following a Liquid Waste Tank Rupture Accident in Support of a Reduced EAB distance during Decommissioning

14.20-5 EPA-400/R-17/001, PAG Manual: Protective Action Guides and Planning Guidance for Radiological Incidents