ANALYSIS OF HABITABILITY
OF THE
SHEARON HARRIS NUCLEAR POWER PLANT
TECHNICAL SUPPORT CENTER

Prepared for

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1. INTRODUCTION

This study is performed to determine the habitability of the Technical Support Center (TSC), after a radiological accident at the Shearon Harris Nuclear Power Plant (SHNPP). General Design Criterion 19 (GDC-19) (Ref. 1) Appendix A to 10CFR50 specifies a radiation exposure limit of 5 rem whole body, or its equivalent to any part of the body of personnel within the facility for the duration of the accident. The analyses presented in this report are provided in two sections. The first section, entitled Direct Radiation Exposure Analysis, addresses direct radiation exposure from 1) local sources of radiation, 2) radionuclides in containment, 3) airborne radionuclides which may leak from containment and are transported to areas adjacent to the TSC and 4) buildup of radionuclides on emergency filtration systems located within the facility. The second section of the report, entitled Exposure to Radionuclides Airborne Inside the TSC, addresses the whole body, thyroid and skin doses to occupants due to intake of airborne radionuclides into the facility. A major loss-of-coolant accident (LOCA) is the design basis event which provides the emergency condition for habitability.

2. DIRECT RADIATION EXPOSURE ANALYSIS

The shielding analysis for the TSC has been performed in accordance with the assumptions stated in Section 12.3.2.16 of the SHNPP FSAR. The source term used in the calculations is described in Section 12.2.1.12.

The TSC is located in the Fuel Handling Building at Elevation 324' and is separated from the containment by an additional six feet of concrete and a minimum distance of 88 feet. Dose rates near the containment due to direct shine are shown on page 12.3A-10 of the FSAR for Region R 27 (area immediately outside containment). All radioactive piping of interest is located below Elevation 261' in the Reactor Auxiliary Building and is separated from the TSC by six feet of concrete and a distance of 110 feet. These sources do not make a significant contribution to dose rates in the TSC. The emergency ventilation system filters, located in the mechanical room of the facility, have been postulated to be the most relatively significant source of direct exposure. Dose rates due to this source at various time intervals in different areas of the facility are shown in Table 1. These dose rates are within the limits for continuous occupancy of the facility.

3. EXPOSURE TO RADIONUCLIDES AIRBORNE INSIDE THE TSC

The TSC is designed with one outside air intake at Elevation 336' (MSL) in the southwest corner of the Fuel Handling Building along the west wall. The room containing the ventilation equipment (charcoal filters, etc.) is in the southwest quadrant separated from the rest of the facility by a 12" block wall.

In an emergency condition or when radiation is detected in the air stream, outside air will be drawn for ventilation and pressurization through the emergency ventilation filtration system (HEPA filter and charcoal adsorber) before it is distributed to the ceiling cavity. A radiation detector at the outside air intake is used for automatic operation of the filtration system. There are low leakage dampers to be used for isolation of air streams, arranged such that untreated air will not infiltrate through the closed dampers.

3.1 Methodology

The habitability of the TSC is assessed against its capability to maintain doses to its occupants below the limits of GDC-19 and SRP 6.4 (Ref. 2) following a design-basis LOCA. Gaseous radionuclides leaking from the containment are the source of the radioactivity reaching the TSC outside air intake (OAI). The radioactivity concentration at the OAI is calculated based on the guidance given in Reference 3. Airborne radionuclides enter the facility as a result of the pressurization makeup air and uncontrolled air in-leakage from opening and closing of the TSC doors. (It should be noted, however, that the latter source of contaminated air into the TSC has been included for conservatism since the TSC design calls for the use of air-locks.) The TSC radionuclide concentration is calculated based on the design values of the filtered air makeup and recirculation flow rates. The dose calculation models are given in Appendix 15.0.A of the FSAR. A conceptual presentation of the emergency ventilation system and air flows is given in Figure 1.

3.2 Assumptions and Parameters

The following assumptions and parameters are used in the habitability analysis:

1) design basis assumptions presented in FSAR Section 15.6.5.4.1 are applied,
2) an accident duration of 30 days,

3) a net free TSC volume of 88,096 ft^3 (2,495 M^3) which allows 10% of the TSC volume for furniture and equipment,
4) radionuclides are uniformly distributed throughout the TSC volume,
5) the TSC outside air intake is located at Elevation 336'; 106 ft. below the containment dome,
6) filter efficiency of TSC emergency ventilation filters for iodine is 99%, representing 4" or greater of charcoal beds,
7) finite cloud correction is applied,
8) a breathing rate of the TSC occupants of 3.47×10^{-4} cubic meters per second for the duration of the accident,
9) occupancy of the TSC is based on the following:

Time Period	Occupancy Factor
0 to 24 hrs.	1.0
1 to 4 days	0.6
4 to 30 days	0.4

10) post accident atmospheric dispersion factors are calculated using recommendations in Reference 3. These X/Qs are then adjusted by applying an overall reduction factor to account for the effects of changes in wind speed, wind direction and occupancy factor. The adjusted X/Qs are:

Time Period	Adjusted X/Q (sec/m^3)
0 to 8 hrs.	3.68×10^{-3}
8 to 24 hrs.	2.17×10^{-3}
1 to 4 days	8.46×10^{-4}
4 to 30 days	2.43×10^{-4}

11) pressurization makeup air flow rates of 800 cfm (minimum) and 1200 cfm (maximum),
12) the fan capacity for air recirculation is 2,400 cfm, and
13) an unfiltered inleakage into the pressurized TSC of 3 cfm.

3.3 Results and Conclusion

The inhalation and submersion doses to the whole body, skin and thyroid of a TSC occupant are presented in Table 2. The direct shine doses are not included because of their negligible contribution. The results indicate that the doses are within the GDC-19 and SRP 6.4 guidelines of 5 rem for whole body and 30 rem for skin and thyroid. The Technical Support Center is therefore designed to be habitable in the event of a design-basis LOCA.

References:

1. 10CFR50, Appendix A, GDC 19
2. Standard Review Plan (NUREG-0800), Section 6.4 .
3. Nuclear Power Plant Control Room Ventilation System Design for Meeting General Criterion 19, K G Murphy and K M Campe, 13th AEC Air Cleaning Conference, 1973

TABLE 1

Direct Shine Doses to TSC Personnel From
Radioactivity on Emergency Ventilation System Filters
(MREM/HR)

AREA	1 HR	1 DAY	1 MONTH
Decon Facility	5.1	13.2	0.07
NRC Team	0.5	1.2	0.006
Outside Agencies	0.4	1.0	0.005
Accident Assessment	0.1	0.4	0.002
Command Team	1.1	2.8	0.014

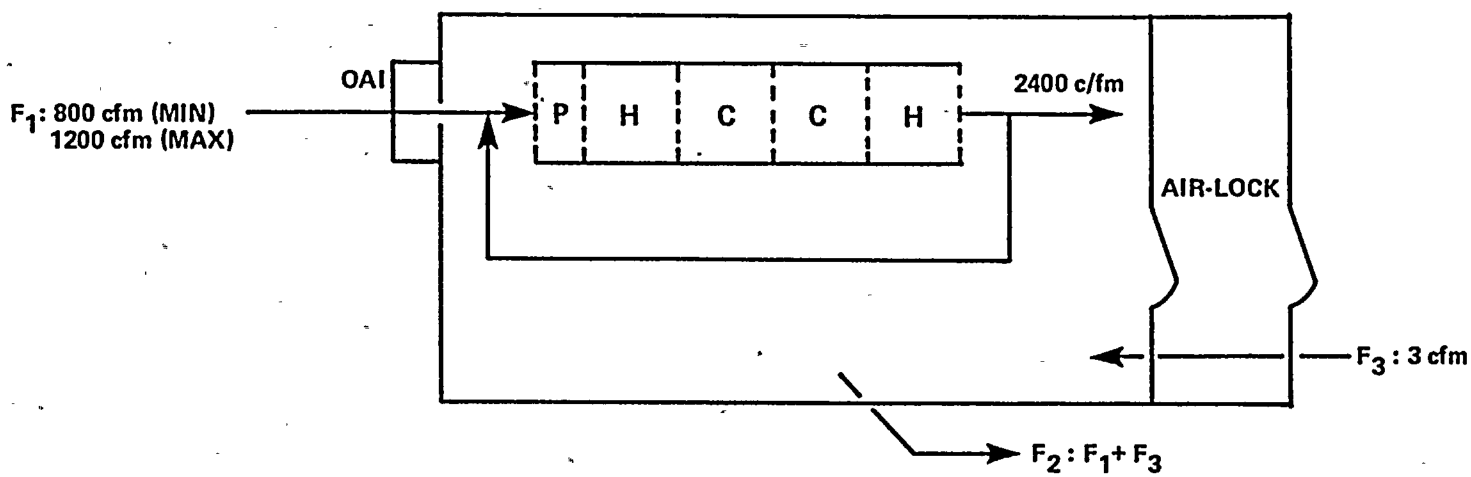
TABLE 2

Inhalation and Submersion Doses to TSC Personnel Following a Design-Basis Loss-of-Coolant Accident (REM)

Pressurization Makeup Air Flow Rate (CFM)	30-Day Doses		
	Whole Body	Skin	Thyroid
800	0.8	19	19
1200	0.9	20	26

FIGURE 1

TECHNICAL SUPPORT CENTER
EMERGENCY VENTILATION SYSTEM
AIR FLOW DIAGRAM



NOTES:

OAI : OUTSIDE AIR INTAKE
P : PRE-FILTER
H : HEPA FILTER
C : CHARCOAL ADSORBER