Southern California Edison Company
P. O. BOX 800
2244 WALNUT GROVE AVENUE
ROSEMEAD, CALIFORNIA 91770

M. O. MEDFORD
MANAGER, NUCLEAR LICENSING

TELEPHONE
(818) 302-1749

June 2, 1986

Director, Office of Nuclear Reactor Regulation
Attention: Mr G. E. Lear, Director
PWR Project Directorate No. 1
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Gentlemen:

Subject: Docket No. 50-206
Control Room HVAC Design Basis
San Onofre Nuclear Generating Station
Unit 1

As you know, members of the NRR and Region V staff performed an inspection of the San Onofre Unit 1 (SONGS-1) control room HVAC system during the week of May 19, 1986. As part of this inspection, it was requested that SCE provide the NRC with a description of the control room HVAC design basis. Accordingly, enclosed is a document which provides a description of the SONGS-1 control room HVAC design basis and an evaluation of the acceptability of the current system with respect to this design basis.

If you have any questions, please let me know.

Very truly yours,

M. O. Medford

Enclosure

cc: J. B. Martin, Regional Administrator, NRC Region V
F. R. Huey, NRC Senior Resident Inspector, SONGS 1, 2 & 3
D. Willett, Region V Inspector
R. F. Dudley, SONGS 1 Project Manager

8606040077 860602
PDR ADOCK 05000206
Q PDR

A003
1/1

CONTROL ROOM HVAC DESCRIPTION

SAN ONOFRE UNIT 1

DOCKET NO. 50-206

SOUTHERN CALIFORNIA EDISON

ROSEMEAD, CALIFORNIA

Control Room HVAC System

Table of Contents

Figures

I. Introduction

The purpose of this report is to describe the operator radiation exposure design basis of the SONGS 1 control room HVAC system and its current, actual capability. The description of the design basis was established from documentation described below, including that issued at the time the plant was licensed and that resulting from subsequent design changes.

The current, actual capability of the system is based on available information from testing and on visual inspection. The assessment compares actual system performance against the design basis.

II. Design Basis

The design basis described below includes a summary of the system operation relative to the operator exposure design basis dose assessment. Therefore, it is limited to design aspects that limit the post-accident control room operator radiation exposure. Figures 1, 2 and 3 illustrate the various Control Room and Technical Support Center (TSC) HVAC system configurations. Figure 4 provides a plan view of the control room and TSC area.

A. System Description

The SONGS 1 control room HVAC system includes a normal mode of operation and an emergency mode. In the normal mode, the system recirculates air, with fresh makeup air, to the control room and provides cooling as required. In the emergency mode, the fresh air intake is isolated upon a containment isolation signal with cooling provided by the recirculation unit. Makeup air is provided through pre-filters, a high efficiency particulate air (HEPA) filter, and a charcoal adsorber bed. A makeup fan is started manually by the control room operators to force air through the filters. The recirculation unit and emergency makeup unit are single train systems.

B. Operator Dose Design Basis

The design basis of the control room HVAC system with respect to limiting radiation exposure to the control room operators is described in the Final Engineering Report and Safety Analysis (FERSA) (1965) and is repeated in the Final Safety Analysis (FSA) (1970). Specifically, FERSA Section 5.2.8 (FSA Sections 3.3.3.3 and 3.3.3.4) notes that the shielding and ventilation are designed to control the whole body exposure to the operator to 25 rem based on continuous occupancy for the duration of an accident or for a shorter time including exposure during his exit from the plant. This design basis is consistent with the values of 25 rem whole body and 300 rem thyroid from 10 CFR 100. It would appear that the quantitative criteria of 10 CFR 100 were adopted as the acceptance criteria for determining safe conditions for the control room.

Supplement 1 to the FERSA (FSA Section 13.1.4.2), which addresses the consequences of the "maximum hypothetical accident," provides calculated results. The calculated dose to an operator is based on the first 24 hours after the accident. Table 1 provides the results of the FERSA operator dose analysis.

Table 1 FERSA Control Room Operator Dose

Percent of Core Meltdown	Direct Dose	Thyroid Dose
6%	1.5 rem	9 rem
25%	6.0 rem	38 rem
100%	24.0 rem	150 rem

These results are based on the isolation of the fresh air intake on a containment isolation signal and manual initiation of filtered makeup after two hours. Additional information on the filtered makeup is provided in Item 4.7 of Volume VI of the FSA. Specifically, the design basis makeup rate is 1,000 cfm and the filter efficiencies are 99% for the HEPA and 90% for the charcoal.

A single failure of any system component is not postulated. NRC review of the system design and the acceptability of the dose assessment was documented in the October 1966 Safety Evaluation Report (SER) for the Operating License.

In 1974, as part of the NRC review of the FSA, it was determined that the control room filter system was the only filter system being taken credit for in the accident analysis. Therefore, the NRC requested that SCE submit Technical Specifications for the control room HVAC system "in order to ensure high confidence that the systems will function reliably, when needed, at a degree of efficiency equal to, or better than assumed in the accident analysis." These Technical Specifications were incorporated by Amendment No. 14 as Sections 3.12 and 4.11 of the SONGS 1 Technical Specifications. The Surveillance Requirements include requirements to demonstrate the following:

A. Combined pressure drop across all of the filters is less than six inches of water
B. In-place filter efficiencies of $\geq$ 99% DOP removal, and $\geq$ 99% halogenated hydro-carbon removal
C. Laboratory tested charcoal adsorber efficiency of $\geq$ 90% radioactive methyl iodine after 720 hours of service, etc.
D. Fan flow rate within $\pm$ 10% of design flow
E. Circuit operability
F. Automatic closure of the fresh air intake

The NRC's September 1975 SER issuing these Technical Specifications references the 24 hour dose calculations in Section 13.1.4.2 of the FSA.

III. Licensing Review

Subsequent to issuance of the SONGS 1 Operating License, there have been two occasions where the NRC has requested additional review of the SONGS 1 control room HVAC. These are discussed in the following paragraphs.

In 1977, additional information was requested relative to control room operator dose estimates in light of NRC revised dose guidelines and analysis methodology developed since SONGS 1 was licensed. The NRC specifically requested an evaluation of what could be done to reduce the thyroid dose. In response to this request for information, SCE provided a more current analysis of the post-LOCA dose to the control room operators. Consistent with the new NRC analysis methodology, a 30 day accident duration was used. In the interest of reducing the estimated thyroid dose, specific additional actions were identified by SCE. These included: consideration of post-accident shift changes at 8.5 hour periods, donning respirators during the first two hours of an accident, if required, and use of iodine blocking pills.

As part of the 1977 reanalysis, there were various other assumptions which differed from the previous assessment in the FERSA and FSA, including; change in source term, the sphere enclosure building, credit for containment spray, updated meteorology, consideration of leakage from recirculation outside containment, initiation of filtered makeup air with zero time delay, and 11 cfm unfiltered infiltration flow. As part of this review, it was noted that pressure measurements determined that the control room was slightly positive relative to outside atmosphere when the emergency air filtration system was operating. The revised maximum operator dose estimates considering the above factors were 5.9 rem whole body and 13.5 rem thyroid over a 30 day period. There was no NRC SER associated with this review.

In 1980, the NRC requested all licensees to perform an evaluation of control room habitability with respect to current NRC review criteria as part of NUREG-0737, Item III.D.3.4. In response to this request, SCE has made several submittals which compared the present control room HVAC system with current NRC review criteria. The most recent submittal in March 1986 identified SCE's proposed upgrades to satisfy the intent of III.D.3.4. This submittal also included an updated estimate of the 30 day whole body dose (6.5 rem) based on worst case assumptions of damper failure. Thyroid doses were not evaluated based on discussions with the NRC staff, since the modifications that were proposed (i.e., redundant intake dampers) would result in an obvious reduction in thyroid doses.

IV. Design History

The control room HVAC was originally designed to heat, ventilate and condition the control room and adjacent areas. To do this, an air handling unit, complete with outside air inlet pre-filter and cooling coil section was provided. A duct heater was provided for the heating needs. In the event of radioactive contamination, the outside air intake could be realigned to the emergency filtration unit (A-33). The emergency unit contains a HEPA filter as well as a charcoal filter unit. The realignment of the intake was designed for automatic initiation on containment isolation signal. The emergency unit (A-33) was manually started from the control room. The recirculation (A-31) system provided approximately 13,000 cfm under normal conditions, with 1,200 cfm outside air makeup for normal operation and 1,000 cfm for emergency.

In 1981-1982, in response to NUREG-0737 requirements to provide "a TSC habitable to the same degree as the control room for postulated accident conditions" and considering the new personnel and equipment heat loads, a new HVAC system was designed and installed to provide ventilation for the Technical Support Center (TSC) area. The supply and return ducts from the control room HVAC unit were cut and capped so as to supply air only to the Control Area. New ducting was designed for the TSC area. Figures 1 through 3 illustrate this change.

In 1983 and 1984, the control room ceiling was upgraded to meet seismic criteria. This modification resulted in a redesign of the HVAC ducting in the control room as well. A cooling load calculation was prepared for the control room complex and ventilation requirements modified accordingly. The total A31 fan flow was reduced to 10520 cfm with 9325 cfm recirculation.

The above design changes involved modifications to the distribution of air in the control room. However, there were no changes to the emergency makeup system. As such there were no changes to the control room HVAC system which altered conformance with its design basis relative to operator exposure.

V. Evaluation of Field Test Data

During the recent NRC site inspection on May 20 to 22, 1986, a series of four fan alignments were tested with data gathered by SCE and the NRC. Subsequent to this, SCE has reviewed the data and conducted additional testing, which repeated the four site inspection tests as well as additional tests. These additional tests were performed to validate the dose assessment assumptions in Section VI of this report. While SCE has been unable to resolve all the discrepancies between the two sets of data, the following facts are apparent from review of all the test results (refer to Figures 2 and 3):

1. Under the normal operation mode, fans A31 and A51 running, and fans A50 and A33 not running, the control room and TSC envelope are collectively provided with an oversupply of air, which maintains the two rooms at a significant positive pressure (.4" W.G.) with respect to adjacent areas.

2. Under the design emergency operation mode, with fans A50 and A33 started by the control room operator, and with the outside air dampers closed, the control room and TSC envelope as well as the return air ducting to fan A31 are maintained at positive pressure. The TSC was noted to be at essentially the same pressure as the control room (i.e., within ± 0.01" w.g.).

3. In the unlikely event that all TSC fans are off in the emergency operation mode (outside air dampers closed) with fan A31 running, and fan A33 started by the control room operator, the control room and TSC are maintained at positive pressure. However, the portion of the return air ducting to the A31 unit which is outside of the control room, would be slightly negative with respect to adjacent areas. Also during times when the TSC door 340 is open(ed), there is a flow under door H3-2 into the control room from the adjacent hall space.

4. In all modes, the fan A31 housing downstream of the prefilter was observed to be under a negative pressure as noted by SCE and NRC during the site inspection.

The results above allow the following conclusions:

1. There is no control room in-leakage through walls/floors/ceilings or any other possible flow paths from areas not served by filtered HVAC during the design emergency operating mode since the boundary is pressurized.

2. In the emergency operating mode with the TSC fans off, unfiltered in-leakage to the control room boundary through the return air ducting may occur. Also in-leakage through door H3-2 may occur during the time(s) that TSC door 340 is open(ed). Allowances for this in-leakage were taken into consideration in Section VI.

3. With the possibility of communication of air being from the TSC to the control room, there exists a potential for air from the TSC to infiltrate the control room. Should the TSC contain unfiltered air, this air could infiltrate the control room. Allowances for this in-leakage are included in Section VI.

4. The cooling coil penetration, observed in the A31 unit, would allow an additional unfiltered in-leakage path. Allowances for this additional flow as well as other pathways were made in Section VI.

Although the dose calculations summarized in Section VI allow for the in-leakages described above and conclude that the dose consequences are acceptable, work described in Section VI has been performed to further reduce the amount of in-leakage into the control room.

VI. Operational Assessment

The following is an evaluation of the acceptability of the 1986 current, actual capability of the control room and TSC HVAC systems as well as an evaluation of the effect of the May 1986 HVAC repairs and improvements on the post-accident control room operator doses.

A. May 1986 Current, Actual Capability

As described in Section V, testing and inspections identified potential sources of unfiltered in-leakage not specifically included in previous dose assessments. Examples of these in-leakage paths are:

(1) Cooling coil penetration in A31 housing
(2) Cooling coil condensate drains
(3) Fan A50 motor shaft penetration
(4) TSC damper leakage
(5) Control room HVAC return air duct leakage

An evaluation of post-accident control room operator doses has been performed to determine the effects of this unfiltered in-leakage on calculated dose values. As detailed in SCE's March 28, 1986 submittal regarding control room HVAC, it is concluded that the operator whole body dose is not significantly affected by unfiltered in-leakage. Therefore, the whole body dose has not been reevaluated for this report.

Based on the assumptions of Table 2, which are consistent with the updated analyses performed in the March 1986 submittal except as noted, and the conclusions of Section V, the reevaluation (Table 3) demonstrated that the operator thyroid dose varies with in-leakage. The three credible leakage scenarios presented in Table 3 result in estimated control room operator thyroid doses that are a small fraction of the FERSA and FSA acceptance criteria and also meet current day criteria.

B. System Capability Following Repairs and Improvements

Repairs and improvements are being performed to further reduce the unfiltered in-leakage paths described in Section VI.A. The activities include provision for a cooling coil penetration seal in the A-31 housing, addition of loop seals on cooling coil condensate drains, installation of a shaft penetration seal on fan A50, maintenance of TSC dampers, and improving the joint seal efficiency of control room HVAC return air ducting. A further improvement, intended to provide additional margin, is to minimize leakage paths between the TSC and the control room.

These activities result in the further reduction of unfiltered in-leakage into the control room to the levels estimated in Table 4 and results in the estimated maximum post-accident operator thyroid dose shown in Table 4.

The dose calculation results in Tables 3 and 4 demonstrate that the post-accident operator doses are primarily sensitive to the amount of unfiltered in-leakage to the control room and are not dependent upon recirculation flow rates as long as a positive control room pressure is maintained. The dose calculation results also demonstrate the acceptability of the as-found condition of the control room HVAC, since the calculated dose is within the acceptance criteria and that the repairs and improvements will only improve an already acceptable situation. Therefore, it is shown that the SONGS 1 control room HVAC system has met and continues to meet the acceptance criteria and design basis as described in the FERSA and FSA.

TABLE 2

Thyroid Dose Calculational Assumptions[1]

Parameter	Value
Core Inventory (curies)	
I-131	3.95E7
I-132	5.33E7
I-133	7.35E7
I-134	8.26E7
I-135	7.10E7
Fraction of Iodine Released to Containment and Available for Leakage	25%
Iodine Distribution	
Elemental	91%
Organic	4%
Particulate	5%
Spray System	
Elemental Spray Coefficient	5.32 hr.$^{-1}$
Spray Cutoff	0.866 hr.
Containment Volume	1.2E6 cu. ft.
Containment Leak Rate[2]	0.12%/day for 0 to 4 days 0.06%/day for 4 to 30 days
X/Q at Control Room Intake	
0-8 hrs.	1.5E-3 sec/m^3
8-24 hrs.	1.0E-3 sec/m^3
24-96 hrs.	3.8E-4 sec/m^3
96 hrs.-30 days	1.1E-4 sec/m^3
Recirculation System Source	
Fraction of Iodines in Sump Water	50%
Sump Water Volume	8.53E8 cc
System Leakage (Outside Ctmt.)[3]	2* 625 cc/hr.
Control Room Parameters	
Recirculation Flow	10,520 cfm
HVAC Filter Efficiency	
Elemental	95%
Organic	95%
Particulate	99%
Volumes	
Control Room	18,800 cu. ft.
Control Room and TSC	30,700 cu. ft.

Notes to Table 2

1 Operating crews are assumed to be changed each eight hours. A total of six crews are used. Each shift is assumed to receive exposure over an 8.5 hour period to cover periods of shift change. Respirators are available for the initial 0 to 2 hour period, with a DF of 50. Following the initial period after the accident, when respirators are utilized, iodine blocking pills are used. This preventive action is considered effective in reducing the thyroid dose by at least a factor of 20.

2 The March 1986 submittal assumed 0.12 wt%/day containment leakage for 0 to 24 hours and 0.064%/day for 1 to 30 days.

3 Twice the technical specification limit is assumed for conservatism. This is twice the value assumed in the March 1986 submittal.

TABLE 3

Operators Thyroid Doses - 1986 As-Found Cases

		Case 1	Case 2	Case 3
1.	Control Room Emergency HVAC System	On	On	On
2.	TSC HVAC System	On	On, With Normal OSA Damper Open	Off
3.	Filtered Intake to* Control Room (cfm)	2420	1100	1100
4.	Unfiltered Leakage into Control Room (cfm)#			
	a. Door Opening and Closing	10	10	10
	b. CR HVAC Drain	4	4	4
	c. CR HVAC Openings	163	163	163
	d. CR HVAC Duct	0**	0**	500***
	e. CR Damper	0**	0**	12****
	f. TSC HVAC Drain	5	5	0
	g. TSC HVAC Openings	75	75	0
	h. TSC Damper	358	1200	0
	Total	615	1457	689
	Total for Dose Calc.##	676	1603	760
	Operator Thyroid Dose### 0 to 30 day (rem)	18	28	19

* Measured value increased by 10% to account for measurement inaccuracy.

** When TSC and control room HVAC units are running recirculation supply duct is positive with respect to outside rooms. Thus, no in-leakage through the ducting is assumed.

*** Based on an assumed leakage of 5% of recirculation system flow per the guidance of SMACNA standard, Low Pressure Ducting Construction Standard, 5th Ed., 1976, pg. 1-6.

**** Since no damper leakage was observed, a number of 1% of normal damper flow was assumed.

\# All leakage numbers are calculated based upon observed velocities through the openings, except as noted and except for the 10 cfm door opening and closing number which is per the guidance of SRP 6.4.

Notes to Table 3 (Cont'd)

Total used for dose calculation is increased by 10% to account for measurement inaccuracies.

Doses based on postulated accident in Unit 1. As described in September 26, 1977 submittal, the Unit 1 accident is more limiting than a postulated Unit 2 or 3 accident.

TABLE 4 (BPC VERIFY)

Operator Thyroid Doses - Post 1986 Outage Condition Case

1.	Filtered Intake to Control Room	1100 cfm
2.	Unfiltered In-Leakage	
a.	Door Opening and Closing	10 cfm
b.	Duct Leakage (1% of Recirculation Flowrate*)	200 cfm**
c.	Damper Leakage (1% of Damper Flowrate*)	50 cfm**
d.	In-leakage from TSC On/Off#	350***/0 cfm
	Total	610/260 cfm
	Total for Dose Calculation##	670/290 cfm

Operator Thyroid Dose ###

0 to 30 days 18/14 rem

* 1% recommendation is based on the SMACNA High Pressure Duct Construction Standard, 1975, Chapter 10, for the type of ducting installed at SONGS 1, once it is sealed.

** For the duct leakage, two times the recommended 1% leakage is used to account for incomplete sealing of duct and/or degradation of seal. For the damper leakage, a number approximately four times the recommended 1% is used to account for degradation of the damper condition.

*** A maximum value based upon control room boundary between the control room and TSC performing within a calculated value that is based upon recent test results.

\# TSC "On" also assumes that the TSC HVAC outside air damper is open to provide unfiltered air to the TSC.

\## Total used for dose calculation is increased by 10% to account for measurement inaccruacies.

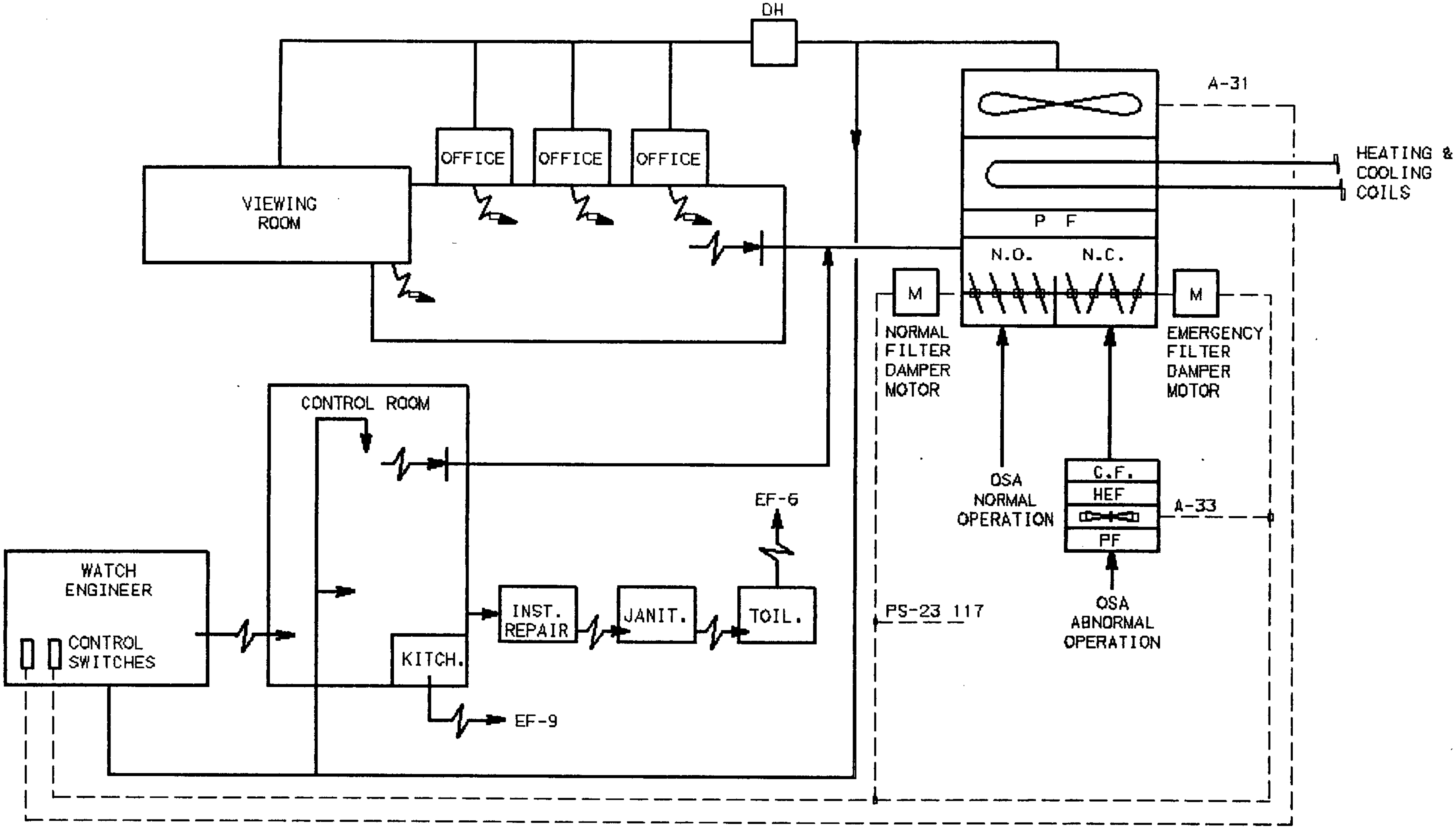
\### Doses based on postulated accident in Unit 1. As described in September 26, 1977 submittal, the Unit 1 accident is more limiting than a postulated Unit 2 or 3 accident.

VII. Summary and Conclusions

The design basis of the SONGS 1 control room HVAC system is described in the FERSA and FSA. Specifically, the design basis is to control the whole body exposure to the Control Room operator to 25 rem. In addition, an estimated post-accident control room operator thyroid dose of 150 rem was also reported in the FERSA and FSA. Technical Specifications to assure that the filtration system is maintained in a condition to support assumptions in these assessments are incorporated as Sections 3.12 and 4.11 of the SONGS 1 Technical Specifications.

Based on dose reevaluations provided in this report, the SONGS 1 control room HVAC system meets all previously submitted dose assessments and acceptance criteria. However, repair and improvement activities are being performed to enhance the condition of control room and TSC HVAC systems, and to improve the postulated post-accident operator dose consequences. Repair and improvement activities performed during the current outage are not necessary to meet FERSA and FSA acceptance criteria; however, they serve to improve the postulated post-accident control room environment.

LAB:6855F



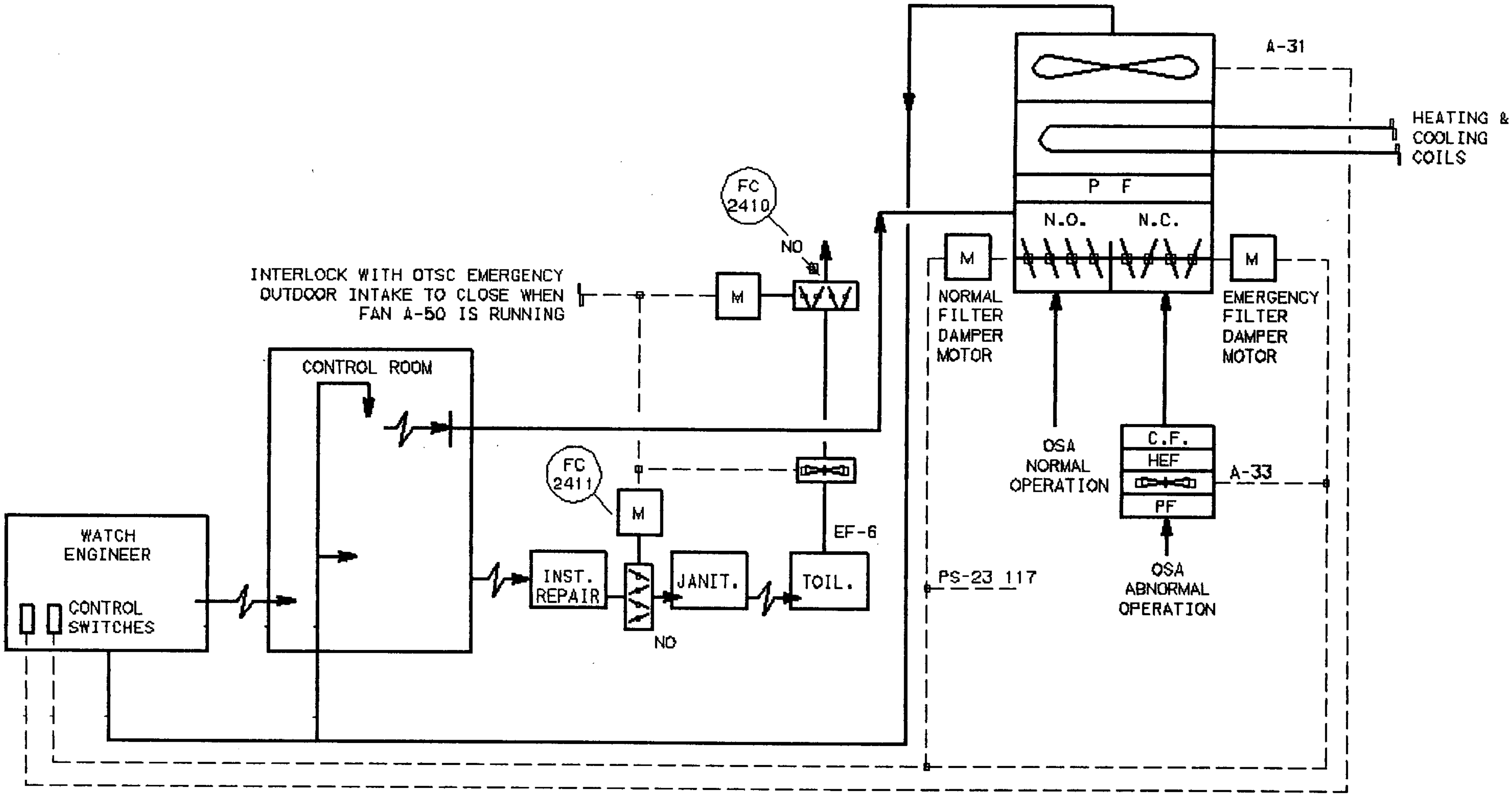
CONTROL ROOM AREA

HEATING, VENTILATING & AIR CONDITIONG

FIGURE 1

(PRIOR TO TSC INSTALLATION)

TSC.DGN



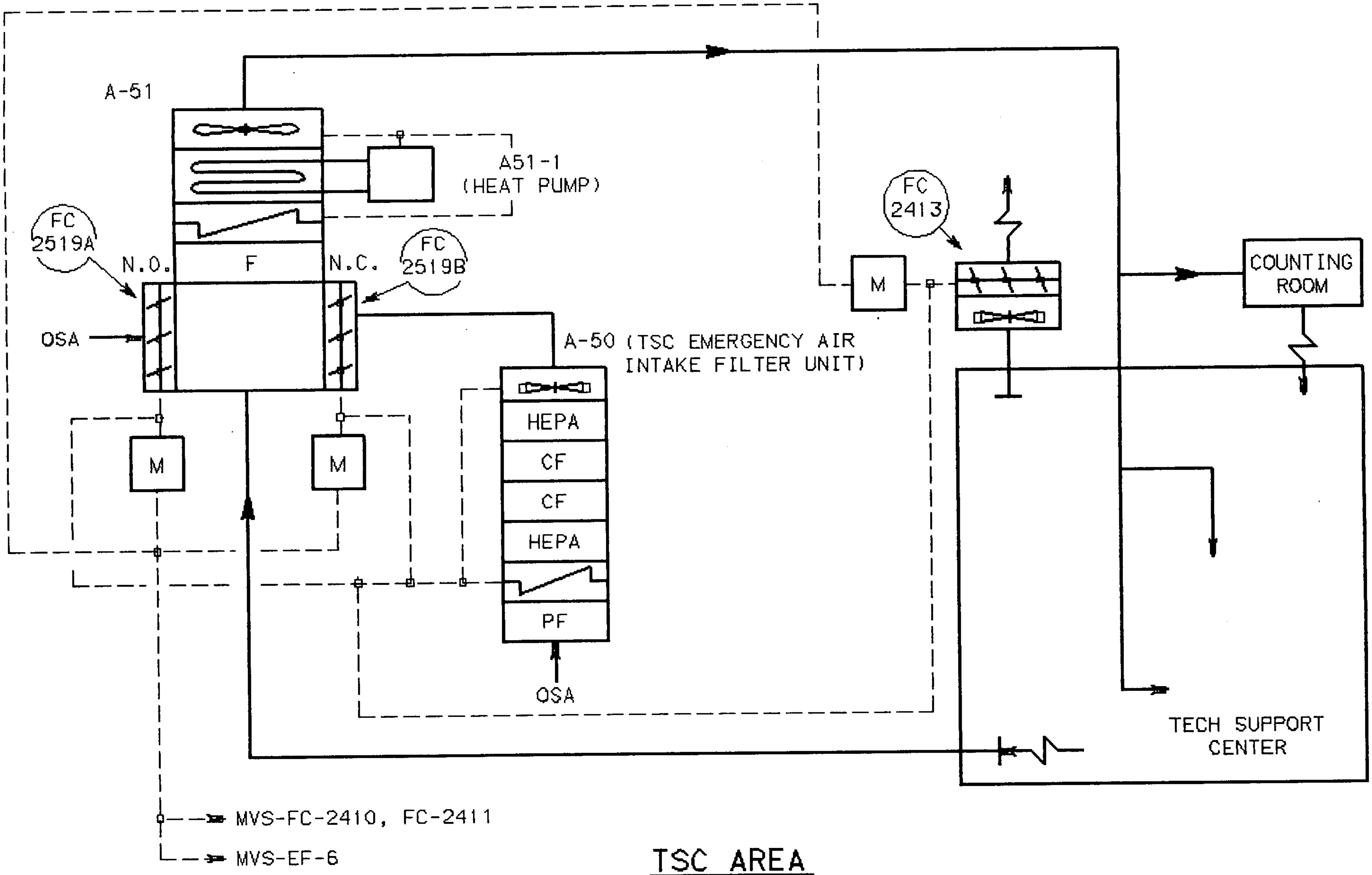
CONTROL ROOM AREA

HEATING, VENTILATING & AIR CONDITIONG

FIGURE 2

(AFTER TSC INSTALLATION)

TSC.DGN



TSC AREA

HEATING, VENTILATING & AIR CONDITIONG

FIGURE 3

TSC.DGN

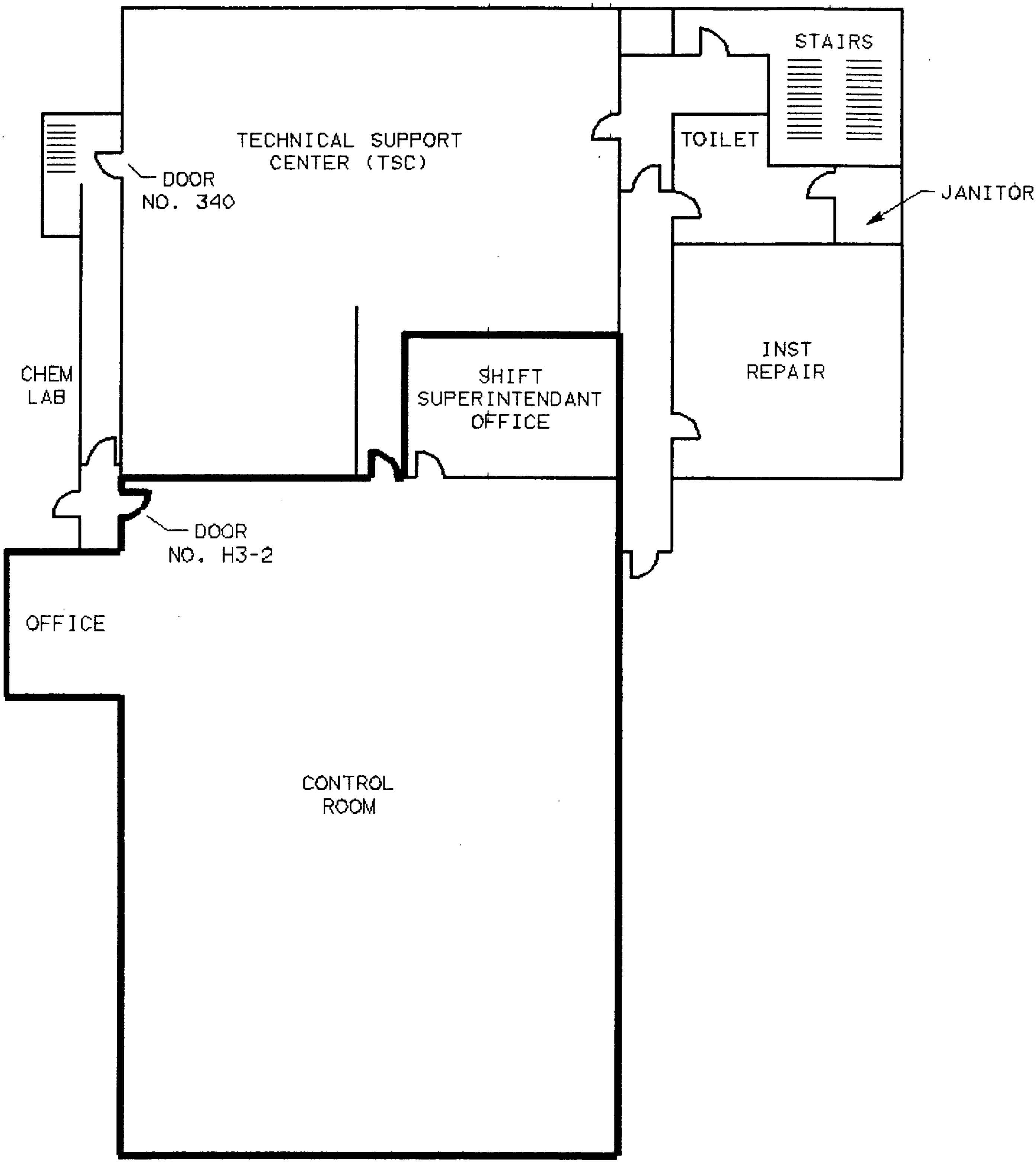


FIGURE 4

CONTROL ROOM PLAN VIEW

TSC.DGN