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SUBJECT: Responds to NRC 920312 ltr re resolution of comments on SBO loss of ventilation in control bldg rooms.

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June 11, 1992

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Gentlemen:

Subject: **Docket Nos. 50-361 and 50-362**
Response to the Units 2 and 3 Station Blackout
Safety Evaluation Report
San Onofre Nuclear Generating Station
Units 2 and 3

Reference A: George Kalman to Harold B. Ray, February 6, 1992, "San Onofre Nuclear Generating Station, Units 2 and 3 Station Blackout Analysis (TAC Nos. M68599/68600)."

Reference B: R. Ornelas (SCE) to Document Control Desk (NRC) letter dated March 12, 1992; Same Subject.

By letter dated March 12, 1992 (Reference B), SCE responded to the Nuclear Regulatory Commission's (NRC's) Safety Evaluation Report (Reference A) for the San Onofre Units 2 and 3 Station Blackout (SBO) analysis. In Reference B, SCE committed to provide the NRC with resolution of comments on the Station Blackout Analysis loss of ventilation assumptions/inputs. Accordingly, the Enclosure to this letter responds to each of the loss of ventilation concerns identified in Reference A above.

If you have any questions, or require additional information, please let me know.

Very truly yours,

R M Rosenblum

cc: J. B. Martin, Regional Administrator, NRC Region V
C. W. Caldwell, NRC Senior Resident Inspector, San Onofre Units 1, 2&3
M. B. Fields, NRC Project Manager, San Onofre Units 2 & 3

A050 1/1

Enclosure

STATION BLACKOUT (SBO) - SONGS 2/3

RESPONSES TO SCIENCE APPLICATIONS INTERNATIONAL CORPORATION (SAIC) TECHNICAL EVALUATION REPORT (TER) ON THE EFFECTS OF LOSS OF VENTILATION IN CONTROL BUILDING ROOMS:

By letter dated April 17, 1989, SCE provided its initial response to the Station Blackout Rule to the NRC. This original submittal was supplemented by a second letter dated May 1, 1990. The NRC responded to these submittals by issuance of a Safety Evaluation Report (SER) dated February 6, 1992. The NRC SER requested additional information on several specific issues. By letter dated March 12, 1992, SCE responded to the February 6, 1992 SER. In our March 12 response, SCE committed to provide the NRC with resolution of comments on the loss of ventilation assumptions and inputs. Accordingly, the detailed responses to each of the concerns identified in NRC's SER are provided below.

Background:

SAIC, under contract with the NRC, prepared a TER, SAIC-91/1251 "San Onofre Nuclear Generating Station, Units, 2 and 3, Station Blackout Evaluation," dated December 13, 1991. The TER identified several concerns with regards to the methodology and assumptions used in Station Blackout Calculation M73-116, Revision 1. SAIC's concerns dealt primarily with the temperature rise analyses developed for the Switchgear Room, Distribution Room, Computer Room, Control Room, and the Control Room Cabinet Area.

The SBO calculation assumed Unit 2 was blacked out and Unit 3 was in the emergency shutdown mode with at least one emergency diesel generator operating. The resulting temperatures are expected to be the same if Unit 3 is assumed to be blacked out and Unit 2 is in the emergency shutdown mode.

SAIC's Concerns on the Methodology and Assumptions Used in the Heat Rise Analyses, and SCE Responses:

SAIC #1

"The licensee used normal operating design temperatures as the initial temperatures in its room heatup calculations. In many cases these temperatures were non-conservative (i. e. Computer Room - 72°F, Control Room and Control Room Cabinet Area - 75°F). The licensee needs to use as an initial temperature the maximum temperature allowed by technical specifications. The licensee can choose a lower temperature as an initial temperature if it provides administrative controls to ensure that the room temperature will not exceed this temperature under any circumstances during normal plant operation."

SCE response to #1-Initial Room Temperature

SCE will implement administrative controls and/or procedures to ensure that the temperature in the Distribution Rooms, Computer Rooms, Control Room Area and Control Room Cabinet Areas is maintained in accordance with UFSAR Table 9.4-4. If the temperature in these areas meaningfully rises above the maximum design value (beyond normal control variations), our administrative controls will require action to reduce the temperature to design values.

SAIC #2

"For its heatup calculations, the licensee assumed that the air temperature in the surrounding rooms did not change during the SBO event. The licensee needs to confirm that this is the case, and for those rooms in which the temperature is expected to rise during an SBO event, the licensee needs to use the maximum expected temperatures for these rooms."

SCE response to #2-Temperature in Adjacent Areas

The SBO calculation will be updated to include the actual equipment, lighting and cable heat loads in the Unit 3 Control Room Cabinet Area #227 and the effect of this load on the Unit 2 Control Room Cabinet and the Control Room Area will be determined.

Upon completion of the equipment load calculation for the Control Room Area and Control Room Cabinet Area (See Item #10 Response), the interaction between Computer Room #232 and Control Room Cabinet Area #229 will be reviewed to determine whether temperature rise reanalysis is required.

Otherwise, SCE believes the existing analysis to be complete and appropriate, as discussed below:

The SBO temperature rise calculation for Dominant Areas of Concern (DACs) considers the boundary walls as heat sinks if the heat load in the adjacent room is shed during the event. Also, if the normal design temperature of the adjacent room is different from the normal design temperature of the DAC at the SBO initiation, the initial surface temperature of the common wall facing the DAC is the arithmetic average temperature of the two rooms. The above criteria are consistent with NUMARC 87-00 Methodology. Also, the initial temperature in the DAC and the initial temperature of the rooms (areas) surrounding the DAC is assumed to be equal to the maximum design/ambient temperature during normal plant operation.

The effect of increased temperatures in the rooms above and below the DACs was not considered because the Auxiliary Building floors are composed of approximately 12 inches of concrete on metal deck with fire proofing. Since concrete is capable of storing large amounts of heat, the heat generated in the room below the DAC will be stored in the concrete rather than transferred to the DAC.

For example, approximately 60 percent of ESF Switchgear Room #308A floor area is located directly above Control Room Area #228 and Work Area #240, while 40 percent is located directly above the Control Room Cabinet Area #229. The heat load in the control room area, control room cabinet area, and work area will not contribute to the temperature increase in the switchgear room because the switchgear room floor temperature increase is negligible through the SBO coping duration. Therefore, it is conservatively assumed that all floors are adiabatic.

The current temperature rise calculation for the DACs in the Auxiliary Control Building were developed considering the following:

a. Switchgear Room #302A

The Switchgear Room is surrounded by the Cable Riser Gallery on the north, the Corridor on the east, the exterior wall on the west, the Corridor on the south and the Operations Support Center (OSC) Staging Area and Multipurpose Room #404 above.

At SBO initiation, all AC powered heat sources on the blacked out unit, such as switchgear, electrical equipment, cables and lighting in the surrounding rooms are de-energized. Emergency lights and cable loads, from DC power, are the only source of heat in these rooms. The DC loads in the surrounding rooms are very low compared to the AC loads. Our analysis conservatively assumes that the temperature in these rooms will remain constant through the SBO coping duration.

Unit 3 was assumed in the emergency shutdown mode. With the Unit 3 emergency equipment operating, its impact on the blacked out areas is negligible because the Unit 3 areas are being ventilated but without chilled water. It is also expected that the emergency chiller would be available within one hour after SBO initiation.

b. Distribution Room #310B

The Distribution Room is surrounded by the Corridor on the north, a Distribution Room on the east and the west, the ESF Battery Room on the south and the Health Physics Area above.

At SBO initiation, all AC powered heat sources on the blacked out unit, such as switchgear, electrical equipment and lighting in the rooms, are deenergized. The batteries in the ESF Battery Room provide emergency DC power to the equipment in the Distribution Room. However, the batteries produce negligible heat so it is conservatively assumed that the battery room temperature remains constant. The temperature in the adjacent Distribution Rooms #310A & 310C is expected to increase at the same rate as in Distribution Room #310B because the heat loads are approximately the same. Consequently, the partitions that separate the distribution rooms are not considered as heat sinks. The analysis also assumes that the temperatures in the Corridor and Health Physics Area remain constant through the SBO coping duration because their heat loads (i.e., emergency lights and a small number of computers) are negligible.

c. Control Room Cabinet Area #229

The Control Room Cabinet Area is surrounded by the Cable Riser Gallery on the north, the Radwaste Area on the east, the Computer Room on the west, an opening to the Unit 3 Control Room Cabinet Area #227 on the south and Switchgear Room 308A, Normal and Emergency HVAC Mechanical Equipment Rooms, Corridor and Motor Control Room above.

At SBO initiation, all AC powered heat sources on the blacked out unit, such as switchgear, electrical equipment, cables and lighting in the Cable Riser Gallery, Radwaste Area, Normal HVAC Mechanical Room, Motor Control Room and Corridors are deenergized. Emergency lights and cable loads from DC powered sources provide a fraction of the normal heat load, therefore the analysis assumes that the temperature in these rooms will remain constant through the SBO coping duration. The existing temperature rise analysis for the Control Room Cabinet Area did not take into account the heat being generated by Unit 3 Control Room Cabinet Area #227, therefore the equipment heat load in Unit 3 Control Room Cabinet Area #227 will be determined and its impact on Control Room Cabinet Area #229 calculated.

The effect of increased temperature in the common wall between the Control Room Cabinet Area and the Computer Room #232 also was not considered in our existing analysis. It was assumed that the computers would be taken out of service as soon as the room temperature reached the limiting temperature for computer operation. In this case the temperature rise calculation indicated that the rate of temperature rise in these areas was almost the same and therefore the interaction was not considered. However, since the computers may not be able to be taken out of service immediately following initiation of a blackout event, the effect of their continued operation on Control Room Cabinet Area #229 will be evaluated.

d. Control Room Area #228

The Control Room Area is surrounded by the Units 2 & 3 Control Room Cabinet Areas #227 & 229 on the north, south and east, the Turbine Lab #230, Special Agent Room # 202, Watch Engineer Room #226 & Office #208 on the west and the Distribution Rooms, ESF Battery Rooms and Corridors above.

Based on the SBO calculation (M73-116, Revision 1), the temperatures in the areas surrounding the Control Room Area at elevation 30' on the north, east and the Unit 3 Control Room Cabinet Area #227 are expected to rise at approximately the same rate during an SBO. The temperatures in the areas surrounding the Control Room Area at elevation 30' on the west, the ESF Battery Rooms and Corridors are expected to remain constant through the SBO duration because no heat sources, except emergency lighting, are operating in these areas.

The maximum design temperature of the rooms directly above the Control Room Area is 95°F. However, because the suspended ceiling above the Control Room Area is being used as a supply air plenum (supply air temperature discharged to the plenum with low turbulence is lower than 60°F), it is assumed that the ceiling temperature is initially at 75°F. It should be noted that 75°F is the maximum design temperature in the Control Room Area #228 during normal plant operation. SCE believes that the initial ceiling temperature assumption is appropriate and the result derived from this assumption is conservative.

e. Computer Room #232

The Computer Room is surrounded by the Control Room Cabinet Area, the Stairwell and Corridor on the north, the Control Room Cabinet Area on the east, the HVAC Mechanical Equipment Room on the west, the Turbine Lab on the south and the Corridor, Non-ESF Distribution Room, Non-ESF Battery Room and ESF Switchgear Room above.

Prior to SBO initiation, the ambient temperatures in the rooms surrounding the Computer Room at elevation 30' are maintained at 75°F while the rooms above are maintained at 95°F, maximum. At SBO initiation, all AC powered heat sources in the rooms surrounding the Computer Room are deenergized. However, rooms containing DC powered emergency equipment will continue to produce heat resulting in increased room temperature.

The SBO calculation assumed that the temperature rise in the Computer Room has no effect on the Control Room Cabinet Area temperature because it was assumed that the computers would be taken out of service as soon as the room temperature reached the limiting temperature for computer operation. However, the computers may not be taken out of service immediately following a blackout and their continued operation will be evaluated for impact on adjoining areas.

SAIC #3

"Throughout the calculations, the licensee assumes a concrete thermal conductivity of 1.04 Btu/hr-ft-°F. This value has previously been considered too high and therefore non-conservative for SBO analysis. A more appropriate and acceptable value of 0.7 needs to be used."

SCE response to #3-Thermal Conductivity of Concrete

Thermal properties of different construction components for walls and roofs are listed in Table 11, page 26.15, ASHRAE Handbook of Fundamentals, 1989 Edition. The SAIC recommended thermal conductivity value of 0.7 Btu/hr-ft-°F is for lower density concrete. This table indicates a thermal conductivity (K value) of 1.0 Btu/hr-ft-°F for heavyweight concrete, 140 lbs. per cubic foot density.

Also, Table 3A, page 23.8, ASHRAE Handbook of Fundamentals, 1985 Edition indicates that, for masonry materials, the value of thermal conductivity is directly proportional to its density. The concrete mix density used for construction in the Control Building and other safety related building is 145 to 150 lbs per cubic foot. Based on a higher concrete density (145 to 150), SCE used a "K" value of 1.04 in the SBO temperature rise analyses.

In light of the above, SCE considers the current "K" value of 1.04 Btu/Hr.-ft.-°F to be conservative and appropriate.

SAIC #4

"The licensee assumed non-conservative and inconsistent values for the total volume/area that was taken by beams, raised floors, suspended ceilings, equipment, supports, etc. These values ranged from 2% to 10%. The licensee needs to either measure these areas directly, or use a conservative assumption such as 10% if these areas are not known."

SCE response to #4-Net Free Volumes of Rooms

As indicated below, the net free volumes of Switchgear Room 302A, Distribution Room 310B and Control Room Cabinet Area 229 were derived from calculations that documented the as-built design of these rooms based on actual measurements. The net free volumes used in the temperature rise analyses for the Computer Room and the Control Room Area meet the ten percent criteria noted in the SAIC TER.

The existing heat rise analyses used the following net free volumes:

Room Name	Room No.	Gross Volume	Net Free Volume	Percent of Gross Volume
Switchgear	302A	29,026	24,218	82.4 (1)
Distribution	310B	4,730	4,370	92.4 (2)
Computer	232	19,285	17,380	90.1 (3)
Control/Cabinet	229	68,638	57,092	83.2 (2)
Control U-2		27,600	24,840	90.0 (4)

NOTES:

1. An extensive analysis was performed in calculation N4090-5, Revision 1 to determine the area, gross and net free volumes of Switchgear Room 302A using up-to-date design disclosure documents.

2. Extensive analyses were performed in calculation N4090-4, Revision 1 to determine the areas, gross and net free volumes in Distribution Room 310B and Control Room Cabinet Area 229 using up-to-date design disclosure documents.

3. The volume of all cabinets in the Computer Room 232 was calculated (reference M73-116) based on input provided by Controls Engineering. This resulted in a gross volume reduction in excess of seven percent. In addition to the calculated cabinet volume, two percent of the Computer Room gross volume was allowed for beams, suspended ceiling and raised floor structures. The total assumed volume reduction is 9.9 percent.

4. The net free volume of the Control Room Area was calculated assuming ten percent of the room's gross volume is occupied by electrical cabinets, cable trays, air distribution systems and beams. This is consistent with the NUMARC guidelines.

SAIC #5

"The licensee needs to provide a technical justification for its assumption of h_{air} of 1.47 Btu/hr-sq. ft-°F for all rooms and all heat conducting surfaces. Natural convection heat transfer coefficients for air are affected by surface orientation (i.e. vertical or horizontal), air properties, system geometry, and air-to-surface temperature difference. Depending on these parameters, the value of the h_{air} could range from 0.1 to 10.0 Btu/hr.-sq. ft.-°F. The licensee needs to use a justifiably conservative (i.e., low) value of h_{air} for this analysis if a single constant value is to be used throughout the calculations."

SCE response to #5-h_{air} (h Constant for Air)

NUMARC 87-00 specifies in detail an acceptable method for determining the steady state temperature for an area that has experienced a blackout. The equations used are simplified based on the specific conditions expected during this scenario. Consequently, there is a significant amount of conservatism designed into the derived equations that enables them to be used at several different nuclear power plants. The SONGS 2/3 calculation utilizes a transient heat transfer analysis that more accurately predicts the time dependent area temperature, as discussed below.

The heat transfer coefficient, $h = 1.47$ Btu/hr-ft^2-°F, used in determining the temperature for the DACs for SONGS 2 and 3, was taken from the 1985 ASHRAE Fundamentals Handbook. The specific surface conductance used is for still air on a vertical, nonreflective surface (ϵ=.90). This value is conservatively used for all surfaces including the ceiling. (The comparative heat transfer coefficient in the ASHRAE handbook for a ceiling is 1.63 Btu/hr-ft^2-°F.)

In order to validate the heat transfer coefficient used in the SONGS analysis, an evaluation was prepared to determine the heat transfer coefficient for a representative room. The Vital Power Distribution Room was evaluated because the final calculated temperature (118.5°F) through the SBO coping duration was close to the limit (120°F). Any reduction in the heat transfer coefficient will reduce the heat rejected from the room and subsequently increase the room temperature.

Two modes of heat transfer need to be considered, Free Convection and Radiation. The methods and equations used are consistent with that specified in <u>Introduction to Heat Transfer</u>, by Frank P. Incropera and David P. DeWitt, 1985. The following assumptions are used in this evaluation for the SBO coping duration:

1. The temperature of the radiating surface (i.e. panels, cabinets, etc.) is 20°F higher than the surrounding air temperature. This is reasonable because the cabinets do not have forced air cooling.

2. The temperature difference between the room air temperature and the wall (or ceiling) surface temperature is 15°F for steady state conditions.

The following design input was used in the evaluation:

1. The height of the room is 18.75 ft.

2. The ceiling dimensions are 17.375 ft X 14.52 ft.

3. The emissivity of the equipment located in the distribution room is 0.9 (the equipment is painted).

Prior to SBO initiation, the room air temperature and the wall temperature are assumed to be the same. Consequently, the heat transfer coefficient is initially low because it is a function of the difference in temperature between the room air and the wall. Most of the equipment generated heat is removed from the room by the ventilation system. Immediately after SBO initiation, the ventilation system is not available, therefore the change in temperature with respect to time (dT/dt) is high. The convection heat transfer coefficient increases because the temperature difference between the air and wall increases and several minutes into the event, $dT_{air}/dt \approx dT_{wall}/dt$. At this point and through the event duration, the heat transfer coefficient stabilizes because the difference between the air temperature and the wall temperature is approaching constant values. The evaluation that was performed calculates the steady state heat transfer coefficient for both radiation and convection (thermal conductivity).

The following heat transfer properties were used to determine the heat transfer coefficients:

Property	Value	Remarks
Thermal Conductivity for air-K	.0156 Btu/hr-ft-°F	At T_f=111 °F
Prandtl Number-Pr	.72	At T_f=111 °F
Acceleration due to gravity-g	32.2 ft/s^2	
Wall Temperature-T_w	103.5 °F	
Air Temperature-T_∞	118.5 °F	
Kinematic Viscosity-ν	.186x10^{-3} ft^2/s	At T_f=111 °F
Stefan-Boltzmann Constant-σ	5.67x10^{-8} W/m^2-°K^4	
Panel/Cabinet Temperature-T_e	140 °F	assumption

The results of this evaluation provided values of h_a that are higher than 1.47.

The evaluated heat transfer coefficient for the wall and the ceiling for a representative room are higher than the value used in the SONGS SBO Temperature Rise Calculation. Had these higher and more accurate values been used in the calculation, a lower room temperature would have resulted. Consequently, using h_{air} = 1.47 in M73-116 is conservative.

The technical justification for using h_{air} = 1.47 was prepared for the Distribution Room. This room was arbitrarily selected because the calculated temperature at t = 4 hours was close to the NUMARC temperature limit. Similar justifications were not prepared for the remaining rooms because of the complexity of the calculation and its iterative nature. However, SCE believes that similar calculations for the remaining rooms would produce similar results. The technical justification for using this value in the Distribution Room will be documented in the next revision of Calculation M73-116.

SAIC #6

"The use of 3/4 inch and 1 inch thick gypsum plaster board as being equivalent to one or two foot thick concrete is incorrect for heat transfer calculations. The gypsum plaster does not provide as high a heat capacity as concrete. All of the analyses that credit gypsum as having the heat capacity of concrete need to be reperformed either with the gypsum surface area removed or explicitly accounted for with its own thermal properties and wall thickness."

SCE response to #6-Heat Capacity of Gypsum (Plaster) Board vs. Concrete

To address the SAIC TER concern, SCE plans to use "PCFLUD," Microcomputer Program, Version 3.7 in performing the Temperature Rise Reanalysis for the above DACs during SBO. The "PCFLUD" Program has the capability to handle different types of envelope (heat sink) materials. However, as discussed below, a preliminary analysis using "PCFLUD" has indicated that the current SCE/Lotus methodology is within the allowable tolerance of ten percent.

The boundaries of the Control Room Cabinet Area consists of concrete ceiling, concrete wall (east) and combination gypsum/plaster on metal studs construction. The steps taken in arriving at the use of a 2-foot thick equivalent concrete envelope were documented in the temperature rise analysis (M73-116) for this room. The "equivalent" concrete thickness was used because the SCE/Lotus methodology can only handle one type of envelope construction material.

For comparison, a preliminary temperature rise analysis for the Control Room Cabinet Area was performed using "PCFLUD" that has the capability to handle different types of wall (heat sink) construction materials. At the time Calculation M73-116 was developed, "PCFLUD" was not available for use at SCE. The "PCFLUD" program was procured in March 1992 and is currently being validated. This comparison run was performed to determine which method would provide a more conservative result. With all inputs constant and varying only the room envelope composition, the slope of the temperature rise curve using the SCE methodology is essentially the same as that derived using "PCFLUD" method during the first 20 minutes after SBO initiation. The slope of the "PCFLUD" temperature rise curve increases slightly compared to the SCE methodology through the balance of the SBO coping duration. With "PCFLUD", the expected temperature at the end of the SBO coping duration (one hour) is 113.04°F compared to the SCE methodology of 111.1°F. Based on this, using the "PCFLUD" method in the temperature rise analysis will provide a more conservative result compared to the current SCE/Lotus method. However, use of the SCE methodology is acceptable because it provided a result that is within (2.03 percent) the allowable tolerance of ten percent.

SAIC #7

"The licensee needs to provide a technical justification for the selection of a Δi of one minute and a Δx of one inch (0.0833 foot) in the methodology. A sensitivity study in which these parameters are varied would provide evidence that these particular values of Δi and Δx are suitably conservative for this analysis."

SCE response to #7-Sensitivity Selection of Δi and Δx

The current temperature rise analyses (M73-116) provided the justification for selecting the time increment (Δi) of one minute and the node thickness (Δx) of one inch (0.0833 foot). <u>Introduction to Heat Transfer</u> (1985), By

Frank Incropera and David DeWitt indicated that for transient heat transfer analyses using the Finite-Difference (Explicit) Method:

> "the solution for the nodal temperatures should continuously approach steady-state values with increasing time. However, with the explicit method, this solution may be characterized by numerically induced oscillations, which are physically impossible. The oscillations may become unstable, causing the solution to diverge from the actual steady-state conditions. To prevent such erroneous results, the prescribed value of Δi must be maintained below a certain limit, which depends on Δx and other parameters of the system. This dependence is termed a **stability criterion**, which requires that the coefficient associated with the node of interest at the previous time is greater than or equal to zero."

$$1 - 2BioF_o - 2F_o \geq 0$$

$$F_o\ (1 + Bio) \leq 1/2$$

$$F_o \leq \frac{1}{(1 + Bio)}$$

where:

$Bio = h\Delta x/k$,

$F_o = \alpha\Delta i/\Delta x^2$, and

$\alpha = k/\rho c$.

For comparison, a heat rise analysis (preliminary run), using SCE/Lotus Method, was also developed for the Control Room Cabinet Area using the same values in the current analysis except the following:

a. Δx = 1/2 inch (current value is 1 inch)

b. Δi = 30 seconds (current value is 1 minute)

This analysis provided a resultant (final) temperature of 110.2°F compared to 111.1°F one hour after initiation of SBO. The current values of Δx and Δi provided conservative temperature values through the SBO coping duration. This comparison showed that reducing Δx and Δi by 50 percent provided a reduction in final temperature equivalent to 0.81 percent. Use of the smaller increments reduces the calculation conservatism.

Based on the above discussions, SCE plans to continue using Δx = 1 inch and Δi = 1 minute in the temperature rise reanalyses of the DACs because these values meet the "stability" criterion and the accuracy requirements for SBO.

SAIC #8

"The licensee assumed four people would occupy the control room during an SBO event with a heat source of 250 Btu/hr person. The heat load assumed by the licensee is non-conservative. A more appropriate value of 250 watts (853 Btu/hr) needs to be used, as recommended by the ASHRAE Handbook. In addition, the licensee needs to justify the assumption that only four persons will occupy the control room during an SBO. Our experience suggests that a value of ten persons is more appropriate.

"Assuming a heat load of 250 watts per person for ten people results in a total personnel heat source of approximately 8,500 Btu/hr, compared to 1,000 Btu/hr assumed by the licensee."

SCE response to #8-Occupant Count and Occupant Heat Load

Although NUMARC 87-00 does not require Licensees to account for the occupancy heat gains for DACs during SBO, the Temperature Rise analysis for the Control Room Area will be revised to account for heat gains from eleven operators. The number of operators (nine plus 25%) is based on the Minimum Shift Crew Composition (Technical Specification, Table 6.2-1) with Unit 2 and Unit 3 both normally operating. This is the plant operating condition postulated at the SBO initiation. Per the referenced table, Control Room occupancy consists of one Shift Supervisor, one Senior Reactor Operator, three Reactor Operators, three Auxiliary Operators and one Shift Technical Advisor. Two people were added to account for personnel such as Nuclear Plant Operators and TSC personnel who may intermittently gain access to the Control Room. Because Units 2 & 3 are sharing a common Control Room, SCE's license was approved with one less Shift Supervisor, Senior Reactor Operator and Reactor Operator/Auxiliary Operator than two individual reactor units operating with a dedicated Control Room each.

The SAIC TER recommended use of 250 watts per person based on ASHRAE handbook.

A review of the ASHRAE 1977 Fundamentals Handbook, Chapter 25, Table 16 indicates the following:

a. For **standing, light work (retail store, bank operation)** the total adult male heat gain is 235 watts (800 Btu/Hr).

b. Distribution of heat gains (from the adjusted group) is 50% sensible and 50% latent, based on the total heat gains per person.

Occupancy in the Control Room Area is equivalent to **standing, light work.** The total heat gain of 800 Btu/Hr consists of sensible and latent heat gains.

For the purpose of this calculation, the sensible heat gain per person is 800 x .50 = 400 Btu/Hr and the latent heat gain per person is 800 x .50 = 400 Btu/Hr. This calculation only considers sensible heat gain. The sensible heat gain per person and the number of occupants combination is expected to provide a conservative resultant temperature because the Temperature Rise Analysis for the Control Room Area was developed for a coping duration of 1 hour. As such, sensible heat load factors for intermittent occupancy should be applied to TSC occupants and Nuclear Plant Equipment Operators accessing the Control Room Area. The recommended sensible heat load factors are listed on Chapter 25, Table 17, ASHRAE <u>Handbook of Fundamentals</u>.

In summary, the occupant heat gain, that will be used in the temperature rise reanalysis of the Control Room Area, will be revised to indicate a total of eleven people with 400 Btu/Hr-person sensible heat gain. This is based on standing, light work occupancy.

SAIC #9

"In its Control Room heatup analysis, the licensee assumed a total heat source of 90,000 Btu/hr consisting of 1,000 Btu/hr from personnel, 17,065 Btu/hr from lights and 71,755 Btu/hr from equipment. Based on our experience with similar two unit sites with shared Control Rooms, this heat loads appear to be too low. Based upon the loads identified by the licensee for each inverter and information contained in the plant UFSAR, we conclude that the Control Room heat load identified by the licensee is non-conservative. Our calculations indicate that the total load is more than a factor of two larger than what was assumed by the licensee. Thus, the licensee needs to provide justification for its assumed Control Room heat load and perform a new control room heatup analysis, if necessary."

SCE response to #9-Equipment and Lighting Heat Loads

The personnel heat load used in the SBO calculation was based on Calculation M73-41, Revision 6 that used 4 people in the Unit 2 Control Room Area. Although the Control Room is common, M73-41 was developed on a per unit basis. The total number of personnel in the Units 2 & 3 Control Room Area is eight. Because the temperature rise is calculated for the entire area (Units 2 & 3), using M73-41 as basis, our original analysis should have used eight people in the Control Room.

As discussed in Response #8 above, the SBO reanalysis will incorporate the Technical Specification requirement of nine Control Room occupants adjusted to eleven for conservatism.

To address the concern raised in the TER regarding assumed non-conservative equipment heat loads in the Control Room Area, SCE is preparing a calculation to document the actual equipment, lighting and cable heat loads in the Control Room Area during SBO. Included also in this calculation is the documentation of the equipment, lighting and cable heat loads in the Switchgear Room, Distribution Room, Computer Room and Control Room Cabinet Area during SBO. If there is any significant change to the load, a temperature rise reanalysis will be performed on the affected DACs. The revised temperature rise reanalyses will be transmitted to the NRC by February 11, 1993.

SAIC #10

"The licensee states that the Control Room panels face the Control Room Cabinet Area. In its heat transfer analysis, the licensee assumed that 50% of the heat loss from the Control Room panels are dissipated to the Control Room Cabinet Area and that 100% of the heat loss is dissipated to the Control Room Area. This assumption is non-conservative. The licensee needs to assume that 100% of the heat loss is dissipated to both the Control Room area and the Control Room Cabinet Area."

SCE response to #10- Equipment Heat Loads in the Control Room and Control Room Cabinet Area

The temperature rise analyses (Calculation M73-116) performed for the Control Room Area and the Control Room Cabinet Area did not assume (see Assumption 3.10) that the Control Room panels face the Control Room Cabinet Area as indicated in the TER. SCE believes it is sufficiently conservative to assume that 50% of the heat load is dissipated to the Control Room Cabinet Area because of the following:

a. The status monitoring lamps (incandescent), annunciators, instruments and switches are flush mounted to the bench boards directly facing the Control Room Area and heat from these components will radiate directly to the Control Room Area.

b. Only a small number of heat producing components are located inside the cabinets.

c. All other heat producing components such as relays and resistors and resistors are mounted in auxiliary cabinets that are located in the Control Room Cabinet Area.

As noted in our response to SAIC Concern #9, the temperature rise analyses will be revised if there is a significant change to the equipment heat loads. In any temperature rise reanalyses for the Control Room Area and the Control Room Cabinet Area, SCE will determine the total heat generated by the control panels that form the boundary between the Control Room Area and the Control Room Cabinet Area. SCE will assume that 100 percent of the heat load generated by these panels is dissipated in the Control Room Area and, for conservatism, assume that 50 percent of this load is dissipated in the Control Room Cabinet Area. Other heat generating equipment located within each area (i.e. Control Room Area and Control Room Cabinet Area) will be assumed to dissipate 100 percent of its load to that area.