UNION ELECTRIC COMPANY
1901 Gratiot Street, St. Louis

December 21, 1984

Donald F. Schnell
Vice President

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Denton: ULNRC-1001

DOCKET NUMBER 50-483
CALLAWAY PLANT, UNIT 1
INDUCTION OF EXHAUST GASES INTO THE CONTROL ROOM

References: 1) NRC letter dated 11-19-84
2) ULNRC-815 5-7-84
3) ULNRC-782 3-28-84
4) BLSE-13,391 3-21-84

The attached information provides a response to NRC questions transmitted by reference 1 regarding the induction of exhaust gases into the Control Room at Callaway. References 2, 3 and 4 provide previous correspondence and background information on this issue and describe a previous event during which exhaust gases were introduced into the Control Room. This response was prepared in conjunction with our A/E, Bechtel Power Corporation.

As stated previously, we believe the design is adequate to assure control room habitability and the addition of the monitors provides an added level of conservatism for defense-in-depth. Collectively, the following facts support this conclusion: no combustible gases detected in the Control Room during the incident in question, the relatively long period of time required to reach equilibrium concentrations even with a worst case analysis, the probable human detection of malodors at concentrations well below R.G. 1.78 limits and equilibrium concentrations, and the fact that the source (auxiliary boiler) is not normally operating coincident with unit operation. We believe that the attached material will allow your review to be successfully completed.

Very truly yours,

Donald F. Schnell

Donald F. Schnell

JJM/JJS/bjk

Attachments

8412280003 841221
PDR ADOCK 05000483
S PDR

A001
1/1

STATE OF MISSOURI)
)   S S
CITY OF ST. LOUIS)

Donald F. Schnell, of lawful age, being first duly sworn upon oath says that he is Vice President-Nuclear and an officer of Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the s.me for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By Donald F. Schnell
Donald F. Schnell
Vice President
Nuclear

SUBSCRIBED and sworn to before me this 21st day of December, 1984.

Barbara J. Pfaff
BARBARA J. PFAFF
NOTARY PUBLIC, STATE OF MISSOURI
MY COMMISSION EXPIRES APRIL 22, 1985
ST. LOUIS COUNTY

cc: Gerald Charnoff, Esq.
Shaw, Pittman, Potts & Trowbridge
1800 M. Street, N.W.
Washington, D.C. 20036

Nicholas A. Petrick
Executive Director
SNUPPS
5 Choke Cherry Road
Rockville, Maryland 20850

John H. Neisler
Callaway Resident Office
U.S. Nuclear Regulatory Commission
RR#1
Steedman, Missouri 65077

William Forney
Division of Projects and
Resident Programs, Chief, Section 1A
U.S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
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Callaway Resident Office
U.S. Nuclear Regulatory Commission
RR#1
Steedman, Missouri 65077

Jan Stevens, Callaway Project Manager
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Stop P-316
7920 Norfolk Avenue
Bethesda, MD 20014

Item 1 (Please provide) justification for not having readouts in the control room, as called for in Regulatory Position C.3 of R.G 1.78 for the hazardous gases identified.

Response: The evaluation of the event showed that the sense of smell and existing smoke detectors would provide sufficient means of detecting a slow buildup of combustion products in the control room. The CO and CO_2 detectors were added for defense-in-depth. Control room annunciation, "Control Building Toxic Gas High," is provided in the front panel area (RK020), and local indication is provided in the auxiliary building corridor (room 1513) adjacent to the control room. Local indication in an area immediately adjacent to the control room is judged to be adequate due to the slow nature of the event.

Regulatory Guide 1.78 applies to industrial accidents such as those defined in regulatory position C.5 wherein rapid release from a storage container is involved. The detection instrumentation described in regulatory position C.3, when provided, is to be located in the vicinity of the storage containers to detect the escape of the stored gas. The continuous release of combustion products from the auxiliary boiler vent stack is a completely different type of release; therefore, it is inappropriate to apply the recommendations of regulatory position C.3 to the CO and CO_2 instrumentation.

Item 2 (Please provide) emergency procedures as specified in Regulatory Position C.15 of R.G. 1.78.

Response A copy of procedure OTA-RL-RK020, Rev. 1 is attached.

Item 3 (Please provide the) data specified under "Control Room" in Table C-3 of R.G. 1.78.

Response: Refer to items 4 through 6 for the "CHEMICAL" data requested in Table C-3. The control room volume is 190,000 cubic feet. The 1950 cfm makeup air is filtered prior to introduction into the control room. The normal recirculation air system flow is 24,000 cfm. When the control room is in the isolation mode, 2,000 cfm of the 24,000 cfm recirculation flow air stream is filtered, however, 400cfm of the 2,000 is drawn from the control building.

As noted in the response to item 1, this event is very slow to develop and manual isolation of the control room is acceptable.

Item 4 (Provide) the range of chemical characterization of auxiliary boiler exhaust gases. Include variations in fuel characteristics and boiler efficiency.

Response: The range of chemical composition of the auxiliary boiler exhaust gases will vary with the chemical composition of the No. 2 fuel oil being fired. However, the amount of pollutants subject to entrainment in the control room air intake, under certain atmospheric conditions, is much more dependent on the firing rate and the relative concentration or dilution which occurs between the release point and the intake.

The range in characteristics of No. 2 fuel oil is given in Table 1 for the 3 main constituents, i.e., carbon, hydrogen, and sulfur. Table 1 also provides the values assumed in the analyses. These chemicals are oxidized to produce CO_2, SO_2, H_2O, and CO. Because the range of the chemical composition is so narrow and essentially all of the carbon, hydrogen and sulfur become CO_2, H_2O and SO_2, the use of a representative value for these constituents is sufficiently accurate.

Boiler efficiency is a measure of the recovered heat with respect to the total amount of heat released and is approximately 79% for partial and full load operation. Excess air is provided to minimize the amount of CO produced. However, the expected amount of CO has been increased by a factor of 66% for conservatism.

The firing rate at full load is 14.7 gal/min. (800 gm/sec). When oxidized this fuel provides enough sulfur and carbon to produce 5 gm/sec of SO_2, 6 gm/sec of CO, and 2620 gm/sec of CO_2.

Table 1
No. 2 Fuel Oil Range of Analyses

Weight (%)	Range	Assumed
Sulfur	.05 - 0.5	0.3
Hydrogen	11.8 - 13.9	12.0
Carbon	86.1 - 88.2	87.4

Item 5 (Provide) the concentration of exhaust gases at the auxiliary boiler.

Response: The concentrations of SO_2, CO_2 and CO at the auxiliary boiler stack are 760, 57,890 and 21 ppm, respectively. These values have no direct application in determining concentrations at the control room air intake as will be discussed in the response

to item 6. Such concentrations at the outlet of the stack are sometimes misapplied in estimating concentrations at the control room air intake. It is incorrect to multiply these pollutant exhaust concentrations expressed in ppm by the relative concentration (X/Q) parameter to determine pollutant impacts at the control room intake. Though X/Q can be considered a measure of the dispersion which takes place between the stack outlet and this intake, it is not a dimensionless "dilution factor". A relative concentration has units of time per volume and can, therefore, only be multiplied by an emission rate (mass/time) to produce a dimensionally consistent result for concentration (mass/vol). Multiplying the stack outlet concentration (ppm) and relative concentration (sec/M^3) produces an unrecognizable set of units.

Item 6 (Provide) a conservative analysis (in accordance with Reg. Guide 1.78) of the auxiliary exhaust gases at the control room air intake. Include at a minimum concentration of SO_2, CO and CO_2.

Response: Dispersion guidance offered by Regulatory Guide 1.78 was not considered, as it is inappropriate for use with releases affected by building wake conditions. The puff dispersion model outlined in this Regulatory Guide is limited to instantaneous ground level unconfined release applications. Instead, the guidance of Regulatory Guide 1.145 was used. The vent release dispersion equations 1, 2, and 3 provided in regulatory position C.1.3.1 of Regulatory Guide 1.145 were used to assess the degree of mixing or dilution which occurs in the wake region and thereby determine concentrations at the Control Room (CR) intake.

The CR intake is located about 92' (28m) horizontally from the auxiliary boiler stack which has an inside diameter of approximately 5' (1.52m). The CR intake is about 70' lower than the discharge of the auxiliary boiler stack. With this source (stack)/receptor (intake) configuration, the stack effluent will contaminate the CR intake only if the ambient wind speed is high enough to bend the plume down, such that it will be caught by the building wake, i.e., a wind speed of at least 5 m/sec.

In calculating the X/Q, the atmospheric dispersion coefficients σy, σz associated with neutral (D) stability and 28m distance downwind were extrapolated from figures 1 and 2 of Regulatory Guide 1.145. The σy and σz values calculated were 2.4 and 0.9, respectively. The smallest effective reactor building cross-sectional area (A) was estimated to be on the

order of hundreds of square meters. Based on the calculation procedure and the parameter values listed above, Equation 2 of Regulatory Guide 1.145 becomes the limiting, and therefore the appropriate equation for this application. Note Equation 3 of Regulatory Guide 1.145 and the accompanying meander terms (Σy) were not considered because plume meander cannot be realized in the short distance from the stack source to the CR intake.

The resulting relative concentration (X/Q) from Equation 2 is 1×10^{-2} sec/m^3. Multiplying the X/Q term by the SO_2, CO, and CO_2 emission rates in gm/sec provided in Item 4 above, results in the concentrations at the CR intake. The concentrations at the CR intake are also considered to be the long term equilibrium concentrations in the control room and are provided in Table 2 for full load. Table 2 also provides equilibrium concentrations for a 22% load case. As can be seen, the concentrations of the subject pollutants are lower than those for full load operation.

TABLE 2

EVALUATION OF AUXILIARY BOILER EXHAUST GAS CONCENTRATIONS (PPM) IN THE CONTROL ROOM AIR

COMBUSTION PRODUCT GAS	ESTIMATED EQUILIBRIUM CONCENTRATIONS 100% LOAD	22% LOAD	COMBUSTION PRODUCT CONCENTRATIONS WHEN SO_2 CAN BE DETECTED BY SMELL	RG 1.78 LIMIT	HEALTH EFFECTS
CO	5	1	0.10	1,000	Reference 1 indicates the exposure to 600 PPM for 1 hour will produce a headache. Exposure to 1000-2000 PPM for 2 hours will produce nausea.
CO_2	15,000	3,000	400	10,000	Reference 1 indicates that 30,000 PPM is a 1 hr. inhalation limit. Exposure to greater than 90,000 PPM quickly cause unconsciousness according to Reference 2.
SO_2	20	4	0.5	10	Reference 3 indicates that 0.47 PPM can be detected by smell. Reference 4 indicates that 6-12 PPM will irritate the nose and throat, 20 PPM will irritate the eyes and that 50-100 PPM is the maximum permissible concentration for exposure of 1/2 to 1 hour duration.

REFERENCES: (Table 2)

1. CHRIS, Hazardous Chemical Data, Dept. of Transportation, Coast Guard, 1978.
2. Standard on Carbon Dioxide Extinguishing System, NFPA 12-1980
3. Air Pollution, J. O. Ledbetter, Marcel Dekker, Inc. 1972
4. Dangerous Properties of Industrial Materials, 5th Edition. N. Irving Sax, Van Nostrand Reinhold Co. 1979.

NS

JDM

UNION ELECTRIC COMPANY
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ST. LOUIS, MISSOURI

DONALD F. SCHNELL
VICE PRESIDENT

MAILING ADDRESS:
P. O. BOX 149
ST. LOUIS, MISSOURI 63166

May 7, 1984

Mr. James G. Keppler
Regional Administrator
U. S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, IL 60137

ULNRC- 815

Dear Mr. Keppler:

WITHDRAWAL OF 10CFR50.55(e) REPORT U-71
INDUCTION OF EXHAUST GASES INTO CONTROL ROOM
CALLAWAY PLANT

Ref: ULNRC-782, 3/28/84

This is to clarify the referenced letter which did not specifically conclude whether or not the subject issue is considered a reportable significant deficiency per 10CFR50.55(e).

Union Electric accepts the conclusion of our A/E, Bechtel Power Corporation, that this issue is not a reportable significant deficiency per 10CFR50.55(e).

Installation of additional monitors, as described in the reference, will provide an added level of conservatism to our design.

Very truly yours,

Donald F. Schnell

Donald F. Schnell

RPW/RLP/sla

8405150195

UNION ELECTRIC COMPANY
1901 GRATIOT STREET
ST. LOUIS, MISSOURI
March 28, 1984

DONALD F. SCHNELL
VICE PRESIDENT

MAILING ADDRESS:
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ST. LOUIS, MISSOURI 63166

Mr. James G. Keppler
Regional Administrator
U.S. Nuclear Regulatory Commission
Region III
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Dear Mr. Keppler: ULNRC-782

FINAL 10CFR50.55(e) REPORT U-71
INDUCTION OF EXHAUST GASES INTO CONTROL ROOM
CALLAWAY PLANT

On February 24, 1984 Union Electric informed the NRC Region III office of a potential significant deficiency under 10CFR50.55(e) regarding the induction of auxiliary boiler exhaust gases into the Callaway Plant Control Room. This deficiency was reported as a significant deficiency on March 2, 1984. Subsequently, on March 22, 1984, Messrs. Pelke and Choules of the NRC were contacted and it was agreed that a final report would be transmitted to the NRC on or before March 30, 1984.

The event occurred on December 30, 1983 when exhaust gases from the plant auxiliary boiler stack apparently entered the control building air intake as a result of a temperature inversion or a downdraft condition. As a point of reference, the control building air intake penthouse is located approximately 70 feet below and 90 feet southeast of the stack. Control room operators noticed the smell of exhaust fumes for approximately thirty minutes to an hour. During the event, our constructor's safety personnel analyzed the control room atmosphere and determined that the oxygen level was adequate, and there were no measurable combustible gases present. The ventilation system was then switched to the recirculation mode to alleviate the condition. Subsequently, one individual indicated he was nauseated and could not complete his work shift. This individual left the control room and subsequently recovered without seeking medical assistance. Another individual indicated that he was "light headed" but he did not become ill. A third person in the control room revealed that the odor was unpleasant but it did not cause him to become ill. Other personnel were in the control room at the time, and they experienced little discomfort.

From the information available regarding the event, it is indeterminate which combustion gases or concentrations of gases affected the operators. The operator who became ill

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exhibited symptoms similar to that of carbon monoxide and carbon dioxide exposure. Carbon monoxide is the predominant cause of illness from the inhalation of exhaust fumes due to its interference with the transfer of oxygen to the blood. Carbon dioxide has the same effect, but to a much lesser degree. Exposure to these gases is difficult for humans to detect because the gases are colorless and odorless.

Other predominant gases in the exhaust fumes, such as unburned hydrocarbons and sulfur dioxide, produce a characteristic malodor that indicates their presence. These gases can produce the same discomforting effect on an individual; however, the symptoms may be caused by either a physiological reaction or by a psychological response to a disagreeable, but benign odor. For example, the pungent smell of sulfur dioxide produces a repugnant response from most individuals at a concentration well below that which is considered harmful. It is not known what stimulus caused the reaction in some of the individuals in the control room as they recovered shortly thereafter without requiring medical attention. Regardless, fumes were detected by the occupants of the control room and it did prompt them to take necessary corrective action.

Regulatory Guide 1.78 addresses the use of human detection as a mechanism for identifying hazardous chemical buildup although we recognize this means is not appropriate for carbon dioxide and carbon monoxide. Therefore, redundant non-IE monitors for these gases are being installed in the control building air intake duct to alarm operators if unacceptable levels of these gases, as defined by OSHA, are reached.

Our A/E, Bechtel Power Corporation considered the location of the control building air intake duct relative to the auxiliary boiler and diesel generator exhaust stacks in their original design. Based on engineering judgement, they determined that the system design would meet the requirements of Regulatory Guide 1.78 for control room habitability. In addition, the original design provides an ionization-type smoke detector for the air intake duct to alarm the operators of the presence of smoke. However, this detector was not operational at the time of the event and it is indeterminate if its sensitivity can be equated to levels of fumes that would impair operator performance. The smoke detector will be operational prior to fuel load while the gas monitors are expected to be installed and operational prior to ascension above 5% power. If the permanent gas monitors are not operational at that time, portable detection equipment will be utilized within the control room.

In summary, we believe that necessary steps are being taken to assure control room habitability. The addition of CO/CO_2 monitors coupled with the smoke detector and human detection of malodors provides a Control Room ventilation system design which

assures that control room occupants have adequate warning of these potential environmental conditions. This is our final report regarding this matter.

Very truly yours,

Donald F. Schnell

JJS/JJM/glp

cc: B. L. Forney, NRC Region III
Richard DeYoung, Director, I&E
NRC Resident Inspectors, Callaway Plant (2)
Missouri Public Service Commission

1, 4AQ
+RLP
+WSS
+JJM

Bechtel Power Corporation 7855

Engineers — Constructors

15740 Shady Grove Road
Gaithersburg, Maryland 20877-1454
301 — 258-3000

RECEIVED

MAR 26 1984

NUCLEAR ENGR

Mr. Nicholas A. Petrick
Executive Director, SNUPPS
5 Choke Cherry Road
Rockville, MD 20850

MAR 21 1984

BLSE: 13,391 File: M-OGK
Bechtel Job Number 10466
SNUPPS Project
Potential 10CFR50.55(e)
Report on Auxiliary Boiler Gases

Ref: 1. SFR 2-GK-45A

Encl: Evaluation of Reported Induction of Auxiliary Boiler Exhaust Gases into the Control Room

Dear Mr. Petrick:

In response to an oral request by SNUPPS (S. Seiken), enclosed is our evaluation of the incident at Callaway involving auxiliary boiler flue gas being drawn into the HVAC intake. This incident was reported by Reference 1.

Very truly yours,

J. H. Smith
Project Engineering Manager

JDH:mmf
cc: F. D. Crawford, w/1
D. W. Capone (3), w/3
M. L. Johnson, (3), w/3
R. Glover, w/1
G. L. Fouts, w/1
F. T. Rhodes, w/1
W. H. Sheppard, w/1
S. J. Seiken, w/1

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WSS		/	/		✓			
JJM		/	/		✓			

RETURN COMMENTS TO J. J. STDECKL N - CODE 470

Enclosure A to BLSE 13,391

EVALUATION OF REPORTED INDUCTION OF AUXILIARY BOILER EXHAUST GASES INTO THE CONTROL ROOM

I. INTRODUCTION

This report is provided to document the evaluation of an unusual event that occurred at the Callaway site on 12/30/83 during which exhaust gasses from the auxiliary boiler were apparently introduced into safety related areas including the control room. This event was documented in SFR-2-GK-45A. Also, Union Electric reported the event to the NRC as a potential reportable deficiency under 10 CFR 50.55(e) because of their belief that a potentially generic design problem may exist.

This report provides 1) background information on the event and the design provisions pertinent to the event, 2) an evaluation of the exhaust gas concentrations at the control room intake and buildup within the control room, 3) the published health effects of exposure to the potential concentrations, and 4) recommendations and conclusions drawn on the event.

II. BACKGROUND AND DESIGN

The auxiliary boiler stack is located east of area 5 of the auxiliary building which connects the reactor and turbine buildings. The auxiliary boiler stack inside diameter is 5'-0" and it discharges at elevation 2150. The control building air intake penthouse (roof elevation 2080) is located approximately 70' below and 90' due west of the stack. The auxiliary boiler was operating at reduced load when the emissions from the stack were reportedly observed to rise from the stack and then flow downward to the roof of the auxiliary building and flow over the powerblock with the appearance of a fog. The control building was eventually isolated following detection (smell) of fuel oil fumes.

Smoke detector GK-XSH-119 mounted in the fresh air intake line 061-5NL-58" was not operable. This detector is an ionization type detector which operates most effectively on particle sizes from .01 to 1.0 microns. Most particles of fuel oil combustion would be in this range and would be detected by this detector. Ionization detectors are very sensitive to particulates; however, there is no rating which can be equated to concentrations of particulates present in the auxiliary boiler emissions. Also, there are similar ionization detectors mounted in the control room ceiling. These detectors were not operable during the incident.

Callaway Plant Operating Experience (CPOE) 84-1, which was attached to the start-up field report, indicated that carbon monoxide readings were taken and were near the unacceptable levels. Based on

discussions with both control room personnel and DIC safety personnel it is evident that no carbon monoxide readings were taken. In fact no readings of any specific gas or gases are known to have been made. The only readings made (by DIC) were those of oxygen level and flamable vapors. Oxygen levels were normal and no flammable vapors were detected.

III. EVALUATION

An evaluation of tne maximum expected levels of CO, CO_2 and SO_2 at the intake to the control building was performed. The distance (vertical and horizontal) between the stack discharge and the control room intake, the arrangements of buildings, the wind speed and dispersion factors were considered for stack effluents trapped in a building wake.

Wake effects are not significant for low wind speeds. The minimum wind speed which is considered to be capable of producing a sufficient downdraft to entrap the bouyant exhaust stack emissions during full load operation is 5 m/sec. Slower wind speeds would allow the emissions to continue to rise. Stack emissions into higher wind speeds are judged to be less of a concern due to the higher turbulence, mixing, and dilution with pervailing wind stream. Since wind speeds above ground level increase with the height above grade the wind velocity at 150 feet would be approximately twice the nominal ground wind speed.

Based on simplified conservative calculations and engineering judgement, dulution of release point concentrations by a factor of 100 is considered to be conservative for full and partial load when estimating control building intake concentrations. Since the supply to the control room is 1950 cfm and the control room volume is 190, 000 ft^3. This ventilation flow rate provides one air change every 97 minutes. Therefore, after 97 minutes the control room concentration would be approximately ½ of the concentration of that in the fresh air intake. After several hours the concentration in the control room would approach the concentration at the air inlet.

Table 1 provides a summary of the evaluation results, the Regulatory Guide 1.78 limits as defined on Table C-1, and a statement of health effects related to exposure to the three exhaust gases of concern.

Equilibrium concentrations for the three gases were calculated for full load and 22% load. The analysis assume that the individual gases remain thoroughly mixed and dilute by a factor of 100 following release from the stack. Also shown are the concentrations of CO and CO_2 which would exist when SO_2 first becomes detectable by smell (~.5 ppm).

Upon detection of the smell of SO_2 the control building air intake could (and should) be isolated and makeup air from any source could be eliminated. If this were done, the control room concentrations would not significantly exceed those indicated (CO = .12 ppm, CO_2 = 364 ppm

and SO_2 = .5 ppm). Alternatively, the control room could be placed in the pressurization mode which would reduce the rate of buildup inside the control room while providing a source of outside air to the control building through the pressurization intake louvers located on the west wall of the control building at elevation 2018. The concentrations at that location is conservatively estimated to be a factor of 10 less than the control building normal ventilation opening.

IV. HEALTH EFFECTS

Table 1 provides an indication of expected health effects for the three exhaust gases of concern. The concentrations, exposure times and effects were taken from the noted references. As indicated in Table 1 adverse health effects occur at higher concentrations than the Regulatory Guide 1.78 recommended limits for CO_2 and SO_2. For CO the regulatory guide limits are 200 times greater than the estimated equilibrium concentrations. No adverse health effects due to CO are anticipated at the calculated levels.

For CO_2, the concentrations (400 ppm) at the time when SO_2 can be smelled is well below regulatory guide recommendations of 10,000 ppm. At equilibrium concentrations (several hours after start of the event) at partial load (22%) the CO_2 concentration only reaches 3000 ppm. The equilibrium CO_2 concentrations at full load can exceed the regulatory guide recommendations; by 50%. This concentration is a factor of 2 below the 1 hour exposure limit of reference 1 and is not expected to cause significant health effects within the time period of concern.

For SO_2, the regulatory limit of 10 ppm is a factor of 20 above the smell threshold. Partial load equilibrium concentration (4 ppm) is below the regulatory guide recommendations and would not irritate the nose or throat. The full load equilibrium level (20 ppm) is twice the regulatory guide recommendation and could irritate the eyes of the control room staff.

IV. CONCLUSIONS AND RECOMMENDATIONS

Insufficient factual information is available to draw a conclusion as to what may have caused several personnel in the control room to become nauseated. Taking as fact the reported observation of the boiler stack plume and our conservative calculations, it may be concluded that the possibility does exist for drawing some of the boiler plume into the normal HVAC intake. It is believed that CO or CO_2 were not present in sufficient quantities to have caused the nausea. It is possible that the personnel may have reacted to the SO_2 or unburned hydrocarbons.

Confirming the disposition to SFR 2-GK-45A, it remains our position that the ionization smoke detector in the HVAC inlet duct would have alerted the control room personnel to the presence of smoke in a timely manner had it been in operation at the time. Although not specifically addressed in the SFR disposition, the similar ionization smoke detectors in the control room ceiling would have provided additional protection had they been in operation.

Of more importance is the fact that the fumes were obviously smelled by the personnel. As stated in regulatory position C.7 of Regulatory Guide 1.78 with regard to detection, "Human detection may be appropriate if the buildup of the hazardous chemical in the control room is at a slow rate due to slow air turnover". Human detection, as a backup to the smoke detectors, would appear to be appropriate in this instance. Although not addressed in the SFR, these diverse means of detection would be effective for the emergency diesel generator exhaust gases.

The plant operators should be advised of the potential for the reoccurrence of this event and the appropriate actions to take following its detection by the ionization detector and the sense of smell.

In summary, this event and the lack of combustion gas detectors in the intake to the control room is not reportable under 10 CFR 50.55(e). The original disposition of the SFR has been determined to be acceptable and no modifications to the plant are recommended.

TABLE 1

EVALUATION OF AUXILIARY BOILER EXHAUST GAS CONCENTRATIONS (PPM) IN THE CONTROL ROOM AIR

COMBUSTION PRODUCT GAS	ESTIMATED EQUILIBRIUM CONCENTRATIONS 100% LOAD	22% LOAD	CONCENTRATIONS WHEN SO_2 CAN BE DETECTED BY SMELL	RG 1.78 LIMIT	HEALTH EFFECTS
CO	5	1	.10	1,000	Reference 1 indicates the exposure to 600 PPM for 1 hour will produce a headache. Exposure to 1000-2000 PPM for 2 hours will produce nausia.
CO_2	15,000	3,000	400	10,000	Reference 1 indicates that 30,000 PPM is a 1 hr. inhalation limit. Exposure to greater than 90,000 PPM will quickly cause unconsciousness according to Reference 2.
SO_2	20	4	.5	10	Reference 3 indicates that .47 PPM can be smelled. Reference 4 indicates that 6-12 PPM will irritate the nose and throat, 20 PPM will irritate the eyes and that 50-100 PPM is the maximum permissible concentration for exposures of ½ to 1 hour duration.

REFERENCES:

1. CHRIS, Hazardous Chemical Data, Dept. of Transportation, Coast Guard, 1978.
2. Standard on Carbon Dioxide Extinguishing System, NFPA 12-1980
3. Air Pollution, J. O. Ledbetter, Marcel Dekker, Inc. 1972
4. Dangerous Properties of Industrial Materials, 5th Edition. N. Irving Sax, Van Nostrand Reinhold Co. 1979.

TITLE UNABBREVIATED:	WINDOW TITLE:
CONTROL ROOM TOXIC GAS HIGH	CTRL RM TOXIC GAS HI

ALARM	TRIPPED	RESET
High Carbon Monoxide High Carbon Dioxide	25 ppm 2500 ppm	Isolates on Trip

1.0 IMMEDIATE ACTIONS

1.1 Verify alarm by visual indication on GK-AII-222 and GK-AII-223.

1.2 Initiate Control Room Ventilation Isolation.

1.2.1 Observe the lights on the ESF Status Panel under CRVIS to verify that Control Room Pressurization Fans, Control Room A/C units and filtration fans and Class 1E A/C units are running.

1.2.2 Ensure the Control Building Supply Fan, Control Building Exhaust Fans, and Access Control Exhaust Fans are off and associated dampers are closed.

2.0 SUBSEQUENT ACTIONS

2.1 Restore Normal Control Room Ventilation when RRIS or direct observation and or sampling at the penthouse indicate the problem no longer exists.

3.0 INSTRUMENTS

3.1 GK-AIS-222

3.2 GK-AIS-223