SOUTHERN CALIFORNIA
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Dwight E. Nunn
Vice President

June 3, 2004

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20055

Subject: **Docket Nos. 50-361 and 50-362**
Response to Request for Information and Supplement 1 to Proposed Change Number (PCN) 534 Containment Penetrations San Onofre Nuclear Generating Station Units 2 and 3

References:
1. Letter dated August 4, 2003, from Dwight E. Nunn (SCE) to Document Control Desk (NRC), Subject: Proposed Change Number (PCN) 534, "Containment Penetrations"
2. Letter dated December 24, 2003, from A. E. Scherer (SCE) to Document Control Desk (NRC), Subject: Response to Request for Additional Information (RAI) regarding Containment Structure Equipment Hatch Shield Doors

This letter provides additional information in response to NRC questions on Proposed Change Number (PCN) 534. Items 1 through 4 in Enclosure 2 provide additional information to supplement our submittal of December 24, 2003 (Reference 2). Items 5 and 6 in Enclosure 2 are responses to additional questions received from the NRC staff. Additionally, as noted in the response to item 4 in Enclosure 2, this letter provides revised proposed Technical Specification changes. These changes provide additional restrictions to opening of the Containment equipment hatch during core alterations and movement of irradiated fuel. The revised Technical Specifications are provided in Enclosure 3. Revised Bases for Unit 2 are also provided in Enclosure 3 for information.

SCE has evaluated the information in the Enclosures and concludes that there is no change to the previous finding of "no significant hazards consideration."

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A001

SCE requests approval of the proposed amendment by August 2004 to support the San Onofre Unit 3 Cycle 13 refueling outage. Once approved, the amendment shall be implemented within 60 days.

If you have any questions or require additional information, please contact Mr. Jack Rainsberry at 949-368-7420.

Sincerely,

Enclosures:

1. Notarized Affidavits
2. RAI Responses
3. Revised Proposed Technical Specification Pages:
   - A. Proposed Technical Specification pages, Redline and Strikeout, Unit 2
   - B. Proposed Technical Specification pages, Redline and Strikeout, Unit 3
   - C. Proposed Technical Specifications pages, Unit 2
   - D. Proposed Technical Specifications pages, Unit 3
   - E. Proposed TS Bases pages, Redline and Strikeout, Unit 2 (typical for both Units - for information)

cc: B. S. Mallett, Regional Administrator, NRC Region IV
B. M. Pham, NRC Project Manager, San Onofre Units 2 and 3
C. C. Osterholtz, NRC Senior Resident Inspector, San Onofre Units 2 and 3
S. Y. Hsu, Department of Health Services, Radiologic Health Branch

ENCLOSURE 1

NOTARIZED AFFIDAVITS

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Application of SOUTHERN CALIFORNIA	)	
EDISON COMPANY, ET AL. for a Class 103	)	Docket No. 50-361
License to Acquire, Possess, and Use	)	Supplement 1 to
Utilization Facility as Part of	)	Amendment Application
Unit No. 2 of the San Onofre Nuclear	)	No. 220
Generating Station	)	

SOUTHERN CALIFORNIA EDISON COMPANY, et al. pursuant to 10CFR50.90, hereby submit Supplement 1 to Amendment Application No. 220. This amendment application consists of Supplement 1 to proposed Change No. 534 to Facility Operating License No. NPF-10. Proposed Change No. 534 is a request to revise Technical Specification (TS) 3.9.3, "Containment Penetrations." This change will permit the containment equipment hatch to remain open during core alterations and movement of irradiated fuel.

State of California
County of San Diego

Subscribed and sworn to (or affirmed) before me this 3rd day of

June, 2004.

By: [signature]
Dwight E. Nunn
Vice President

FRANCES M. THURBER
Commission # 1295266
Notary Public - California
San Diego County
My Comm. Expires Mar 23, 2005

[signature: Frances M. Thurber]
Notary Public

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

Application of SOUTHERN CALIFORNIA	)
EDISON COMPANY, ET AL. for a Class 103	) Docket No. 50-362
License to Acquire, Possess, and Use	) Supplement 1 to
A Utilization Facility as Part of	) Amendment Application
Unit No. 3 of the San Onofre Nuclear	) No. 205
Generating Station	)

SOUTHERN CALIFORNIA EDISON COMPANY, et al. pursuant to 10CFR50.90, hereby submit Supplement 1 to Amendment Application No. 205. This amendment application consists of Supplement 1 to proposed Change No. 534 to Facility Operating License No. NPF-10. Proposed Change No. 534 is a request to revise Technical Specification (TS) 3.9.3, "Containment Penetrations." This change will permit the containment equipment hatch to remain open during core alterations and movement of irradiated fuel.

State of California
County of San Diego

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By: [signature]
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Vice President

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[signature]
Notary Public

ENCLOSURE 2

RAI RESPONSES

ITEM 1 - RAI # 4

A value of 1000 cfm is assumed for the value of unfiltered inleakage into the control room. Because this value is not based upon a measurement, sufficient justification should be provided to explain why this number is appropriate. Provide sufficient details regarding your control room, design, maintenance and assessments to justify the use of and your plans to verify this number.

SCE to NRC December 24, 2003 Response:

San Onofre Units 2 and 3 Technical Specifications (TS) Limiting Condition for Operation (LCO) 3.7.11 requires the control room boundary to be tested every 24 months to demonstrate that the control room boundary has at least 0.125 inches water gauge positive pressure with respect to the atmosphere. The TS 3.7.11 Bases state that this pressurization prevents unfiltered inleakage. Pressurization tests over the past 10 years show that the lowest positive pressure for a single operating CREACUS train was 0.56 inches of water gauge with respect to the atmosphere.

The San Onofre Units 2 and 3 control room design has numerous features to minimize and prevent control room inleakage. These features include a design in which the Control Room Emergency Air Cleanup System (CREACUS) units are wholly contained within the Control Room Envelope (CRE), effective boundary maintenance as evidenced by the high pressure gradient across the control room boundary during pressurization tests, and the existence of procedures requiring periodic control room boundary integrity inspections, control room damper inspections, and control of CREACUS breaches during routine maintenance activities. Based on the above information, a value of 1000 cfm assumed for the value of unfiltered inleakage is considered conservative.

San Onofre has committed to perform Control Room Envelope inleakage testing in accordance with NRC Generic Letter 2003-01, "Control Room Habitability," to verify actual inleakage. This testing will be completed prior to the Unit 3 Cycle 13 outage that is currently scheduled to begin in September 2004.

Additional Information:

The following additional information is provided to support the conclusion that the assumed Control Room inleakage value of 1000 cfm is considered conservative. The areas of potential vulnerabilities for unfiltered inleakage into the Control Room boundary are discussed with supporting information to demonstrate the SONGS design and boundary maintenance practices have addressed these issues. In addition, preliminary results of the control room inleakage testing are discussed.

Ducting and Housings

All CREACUS ducting is constructed of welded steel plate with gasketed flange joints. Compared to other types of ducting such as commercial, pocket lock, non-seal welded, or non-bolted, the SONGS ducting design has a minimal number of potential leakage paths and is considered to be superior to these other designs.

Most of the ducting is located within the Control Room boundary. The sections of ducting located outside the Control Room boundary, which could be vulnerable to inleakage are not insulated and can be visually inspected. These inspections have not revealed any deficiencies.

There are two other HVAC system ducts, which pass through the boundary and can operate at a higher pressure relative to the control room. These ducts have the same design as the CREACUS ducting described above. These ducts have been leak tested and there are no leaks.

Positive pressure sections of CREACUS ducting inside the boundary, but upstream of the filters, have the same flanged design. Inspections show no deficiencies.

The CREACUS filter units are all located within the boundary. Any inleakage into these housings would be filtered air and therefore is not a vulnerability.

There are six other fan coil units, which provide cooling to the cabinet area of the Control Room. Four of these units are safety related and two of them are non safety related. These units are all located outside the boundary and present a potential vulnerability for outside air inleakage. The emergency units are welded plate and bolted connections with low vulnerability. The non safety related units are sheet metal with screwed connections and present a higher vulnerability to inleakage. The housings, flexible connectors, penetrations, and access doors for all six units have been inspected, tested, and sealed as necessary to prevent inleakage.

Boundary and Boundary Penetrations

The Control Room boundary consists of a poured concrete slab over metal decking for the floor and ceiling. The adjacent walls are primarily concrete. There are some sections of the walls, which are lath and plaster. Included in the boundary are a concrete walled pipe shaft and a concrete walled elevator/stairwell shaft. All accessible walls, floors, ceilings, joints, and HVAC ducting penetrations are routinely inspected and repaired as necessary.

There are a large number of penetrations through the control room boundary. Many of these penetrations are cables and conduits. All accessible penetrations including the cables and conduits are routinely inspected for pressure boundary integrity and repaired as necessary. Also, construction specifications require sealing and testing all new or modified control room boundary penetrations. Floor and equipment drains are routinely inspected and filled with water.

Boundary Doors

There are 10 control room boundary doors. All doors are routinely inspected for structural integrity, sealing, latching, and fastener integrity. Also, each door is routinely smoke tested. Any deficiencies are repaired.

Isolation Dampers

There are 5 sets of redundant control room isolation dampers. Three sets of these dampers isolate ducting, which is at a relatively low pressure compared to the outside. All dampers are a bubble tight design with seals on each damper blade. All dampers are routinely inspected, maintained and tested to ensure they seal properly and stroke properly.

Control Room Pressure

Another indication of an effectively maintained control room boundary is the Control Room positive pressure measured during Technical Specification Surveillance Testing. The testing is performed every 18 months. In the last 10 years of testing, the lowest developed positive pressure was 0.56 inches of water. This is significantly greater than the required 0.125 inches of water per Technical Specifications.

Control Room Breaches

A program is in place to provide administrative controls for pre-planned breaches of the control room boundary to support maintenance activities. The controls include restrictions on the delivery of bulk chemicals, heightened awareness of alarms, continuous communication, pre-planned methods to secure the breach, and continuous manning.

Control Room Envelope Inleakage Testing

The Control Room Envelope inleakage testing to verify actual inleakage was conducted from May 18, 2004 to May 25, 2004. The preliminary review of the test data indicates that the control room envelope inleakage rate is well below 1000 cfm. Industry experience indicates that the final results are not expected to change significantly. Formal analysis of the test data and determination of the actual inleakage rates is being performed. As described in SCE's 60-day response to Generic Letter 2003-01 (Reference 1), following the completion of inleakage testing SCE will submit a letter describing how and when the analyses, tests, and measurements were performed and the final results of the testing.

References:

1. SCE to NRC letter dated August 5, 2003, Response to Generic Letter 2003-01 "Control Room Habitability," San Onofre Nuclear Generating Station Units 2 and 3.

ITEM 2 - RAI # 10

What criteria will be used to determine if closure of the Containment is necessary in the event that environmental conditions could impact fuel handling? Has the impact of wind on fuel handling been evaluated (for example, reduced pool visibility due to pool surface disruption)? What steps would be taken in the event of severe weather to minimize the impact of flying debris?

SCE to NRC December 24, 2003 Response:

The Equipment Hatch is at ground elevation (30 feet above sea level) and the refueling deck is at 63 feet. Accordingly, there is a tortuous path between the outside air and the surface of the refueling pool. The procedure for fuel movement is SO23-X-7. This procedure includes general guidance in addition to specific procedure steps, including a verification scan of the top of all core locations to check for debris (step 3.16). This could not be satisfactorily accomplished with disturbed water or water that contains debris. If there were an unacceptable impact on pool visibility, action would be taken to either secure the Containment Hatch or Shield Doors or Core Alteration/Movement of irradiated Fuel would be secured.

Additional Information:

In addition to the guidelines given in the fuel movement procedure, Abnormal Operating Instruction SO23-13-8 (Severe Weather), requires in steps 2.1 and 2.5 (for Units 2 and 3, respectively) to verify "Missile Barrier doors are closed," including the Containment Structure Equipment Hatch Shield Doors. The severe weather conditions that require entry to this procedure include tornado warning, hurricane watch, flash flood watch or warning, or tsunami warning.

ITEM 3 - RAI #s 17 and 18

The response to RAI #17 states that the current SONGS licensing basis atmospheric dispersion factors (χ/Q values) used to evaluate releases from the containment to the control room HVAC intake are applicable for all potential containment release points. This statement is inaccurate. The current licensing basis χ/Q values can be used for newly identified release scenarios only if they are appropriate for the application in which they are being used. The use of the current licensing basis χ/Q value of 3.1E-3 sec/m^3 does not appear appropriate for this radiological analysis. As stated in SONGS UFSAR Section 2.3.4.2, the control room (CR) χ/Q value of 3.1E-3 sec/m^3 is based on the Murphy & Campe diffuse source-point receptor algorithm. This algorithm is applicable when activity is assumed to leak from many points on the surface of the containment in conjunction with a single point receptor (i.e., CR air intake); that is, the activity is assumed to be homogeneously distributed throughout the containment and the release rate is assumed to be reasonably constant over the surface of the building. This is not the situation in this accident scenario where the release is assumed to occur through the open containment equipment hatch shield doors. Releases from open containment equipment hatch shield doors to the CR air intake are typically modeled using the Murphy & Campe point source-point receptor algorithm in lieu of the Murphy & Campe diffuse source-point receptor algorithm.

In addition, the response to RAI #18 states that the CR χ/Q value of 3.1E-3 sec/m^3 is based on a distance of 180 feet between the containment surface and the midpoint of the two CR emergency HVAC intakes. This same χ/Q value is also being used to model releases to the CR normal HVAC intake during the first three minutes of the accident, prior to CR isolation. However, the distance between the Unit 2 containment surface and the normal HVAC is approximately 118 ft, not the 180 ft assumed in generating the CR χ/Q value of 3.1E-3 sec/m^3.

Please either justify quantitatively the continued use of 3.1E-3 sec/m^3 as a bounding CR χ/Q value for this radiological analysis or provide a new set of CR χ/Q values appropriate for the proposed change. An acceptable method for determining a new set of CR χ/Q values is provided in Regulatory Guide 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessment at Nuclear Power Plants.

Additional Information:

As suggested in the RAI, a new set of control room (CR) χ/Q values to define dispersion between a Unit 2 or 3 containment equipment hatch and the control room outside air normal and emergency ventilation intakes has been calculated using the guidance in Regulatory Guide (RG) 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessment at Nuclear Power Plants." The analysis uses the ARCON96 computer code. A comparison of the 0 to 8 hour ARCON96 dispersion values with the 0 to 8 hour current licensing basis (CLB) CR χ/Q value of 3.1E-3 sec/m^3 shows that it is conservative to use the CLB χ/Q value in the dose analysis that supports the license amendment request (PCN-534).

Meteorological Data

The ARCON96 atmospheric dispersion analysis uses actual site hourly meteorological data spanning ten full years of 1993 through 2002. Full year meteorology is used to eliminate bias due to seasonal fluctuations. RG 1.184 Regulatory Position 3.1 states that 5 years of hourly observations are considered to be representative of long-term trends at most sites. The use of ten years of meteorological data satisfies this recommendation, while enhancing the statistical basis for the calculated control room atmospheric dispersion factors due to the expanded meteorological data set.

The input meteorological data identify invalid data by coding such data as either "999" or "9999". In each year, more than 99 percent of the lower level wind speed data are valid. Overall, about 99.8 percent of the lower level wind speed data are valid. Except for year 1994, more than 95 percent of each year's upper level wind speed data are valid. Overall, about 96.5 percent of the upper level wind speed data are valid. Therefore, the meteorological input is representative.

The meteorological tower is located above the plant on the north bluff. The meteorological tower's lower wind instrument is at elevation 10 meters above the north bluff grade. The meteorological tower's upper wind instrument is at elevation 40 meters above the north bluff grade.

The meteorological data was converted to the ARCON96 format presented in NUREG/CR-6331 Section 4.4.2 and RG 1.194 Appendix A, Table A-1.

Consistent with RG 1.194 Regulatory Position 3.1, wind direction is expressed as the direction from which the wind is blowing (i.e., the upwind direction from the center of the site) referenced from true north. A north wind (wind from the north) is entered as 360^{o} and a south wind is entered as 180^{o}.

Consistent with RG 1.194 Regulatory Position 3.1, atmospheric stability is entered as a number from 1 through 7. A stability class of 1 represents extremely unstable conditions, and a stability class of 7 represents extremely stable conditions. Atmospheric stability classes are determined from the ΔT given in the meteorological data.

Non-Meteorological Data Input

RG 1.194 Appendix A Table A-2 discusses input parameters for ARCON96. Per the following table, the ARCON96 analysis complies with the regulatory guidance presented in Table A-2.

ARCON96 Input Parameters for Containment Equipment Hatch Release

Parameter	Acceptable Input	Comments
Lower Measurement Height, meters	Use the actual instrumentation height when known. Otherwise, assume 10 meters.	Used actual measurement height, which is 10 meters above bluff grade. The bluff grade is above the plant grade.
Upper Measurement Height, meters	Use the actual instrumentation height when known. Otherwise, use the height of the containment or the stack height, as appropriate. If wind speed measurements are available at more than two elevations, the instrumentation at the height closest to the release height should be used.	Used actual measurement height of 40 meters above the bluff grade.
Wind Speed Units	Use the wind speed units that correspond to the units of the wind speeds in the meteorological data file.	The raw meteorological data expresses wind speeds in miles per hour. However, these data are pre-processed to convert the wind speeds to meters per second in the resulting MET input files. The ARCON96 input files (*.RSF) are set for wind speeds in units of meters per second. Thus, the units used for wind speeds in the analysis are applied consistently.
Release Height, meters	Use the actual release heights whenever available. Plume rise from buoyancy and mechanical jet effects may be considered in establishing the release height if the analyst can demonstrate with reasonable assurance that the vertical velocity of the release will be maintained during the course of the accident. If actual release height is not available, set release height equal to intake height.	Used the actual release height. Equipment Hatch is 11.58 meters above plant grade.
Building Area, meters^2	Use the actual building vertical cross-sectional area perpendicular to the wind direction. Use default of 2000 m^2 if the area is not readily available. Do not enter zero. Use 0.01 m^2 if a zero entry is desired. Note: This building area is for the building(s) that has the largest impact on the building wake within the wind direction window. This is usually, but need not always be, the reactor containment. With regard to the diffuse area source option, the building area entered here may be different from that used to establish the diffuse source.	Used the 2123.33 square meter cross-sectional area of the containment.

Parameter	Acceptable Input	Comments
Vertical Velocity, meters/second	Note: the vent release model should not be used for DBA accident calculations. For stack release calculations only, use the actual vertical velocity if the licensee can demonstrate with reasonable assurance that the value will be maintained during the course of the accident (e.g., addressed by technical specifications), otherwise, enter zero. If the vertical velocity is set to zero, ARCON96 will reduce the stack height by 6 times the stack radius for all wind speeds. If this reduction is not desired, the stack radius should also be set to zero.	The vent release model is not used.
Stack Flow, meters^3/s	Use actual flow if it can be demonstrated with reasonable assurance that the value will be maintained during the course of the accident (e.g., addressed by technical specifications). Otherwise, enter zero. The flow is used in both elevated and ground-level release modes to establish a maximum χ/Q value. This value is significant only if the flow is large and the distance from the release point to the receptor is small.	Stack flow is set to zero.
Stack Radius, meters	Use the actual stack internal radius when both the stack radius and vertical velocity are available. If the stack flow is zero, the radius should be set to zero.	Stack radius is set to zero.
Distance to Receptors, meters	Use the actual, straight line, horizontal distance between the release point and the control room intake. For ground-level releases, it may be appropriate to consider flow around an intervening building if the building is sufficiently tall that it is unrealistic to expect flow from the release point to go over the building. Note: If the distance to receptor is less than about 10 meters, ARCON96 should not be used to assess relative concentrations.	The Equipment Hatches are on the opposite side of the Containment structure from the Control Room Intakes and are located at plant grade level. The top of the Containment is 181 feet above plant grade and the top of the equipment hatch is 17.5 feet above grade; therefore, it is unrealistic to expect flow from the Equipment Hatch to go over the Containment building. The Equipment Hatch to receptor distances are measured as the shortest path around the Containment ("taut string length"), as allowed by section 3.4 of Regulatory Guide 1.194. The equipment hatch source-receptor distance is not less than 10 meters.
Intake Height, meters	Use the actual intake height. If the intake height is not available for ground level releases, assume the intake height is equal to the release height. For elevated releases, assume the height of the tallest site building.	The actual heights at the centerline of the control room intakes are used.
Elevation Difference, meters	Use zero unless it is known that the release heights are reported relative to different grades or reference datum.	The release and receptor heights are reported with respect to the same grade datum.

Parameter	Acceptable Input	Comments
Direction to Source, degrees	Use the direction FROM the intake back TO the release point. (Wind directions are reported as the direction from which the wind is blowing. Thus, if the direction from the intake to the release point is north, a north wind will carry the plume from the release point to the intake.) Note: some facilities have a "plant north" shown on site arrangement drawings that is different from "true north." The direction entered must have the same point of reference as the wind directions reported in the meteorological data. For ground level releases, if the plume is assumed to flow around a building rather than over it, the direction may need to be modified to account for the redirected flow. In this case, the χ/Q should be calculated assuming flow around and flow over (through) the building and the higher of the two χ/Q s should be used.	SONGS' site arrangement drawings do have a "Plant North" designation that is 57° west of "true north;" consequently, wind directions are corrected to true north as the point of reference. For the scenario of an equipment hatch release, the χ/Q is calculated assuming flow both around and over (through) the containment building, and the higher of the χ/Q values is used.
Surface Roughness Length, meters	Use a value of 0.2 in lieu of the default value of 0.1 for most sites. (Reasonable values range from 0.1 for sites with low surface vegetation to 0.5 for forest covered sites.)	Used value of 0.2. SONGS is a seaside site with low surface vegetation.
Wind Direction Window, degrees Code Default	Use the default window of 90 degrees (45 degrees on either side of line of sight from the source to the receptor).	Used 90 degrees.
Minimum Wind Speed, meters/second Code Default	Use the default wind speed of 0.5 m/s (regardless of the wind speed units entered earlier), unless there is some indication that the anemometer threshold is greater than 0.6 m/s.	Used the default wind speed of 0.5 m/s. The minimum SONGS site met tower wind speed reported is 0.3 mph, or 0.13 m/s. Thus, the anemometer threshold is less than 0.6 m/s.
Averaging Sector Width Constant Code Default	Although the default value is 4, a value of 4.3 is preferred. (A future revision to ARCON96 will change the default to 4.3)	Used 4.3.
Initial Diffusion Coefficients, meters	These values will normally be set to zero. If the diffuse source option is being used, see Regulatory Position 2.2.4.	Used the diffuse source option.
Hours in Averages	Use the default values.	Used the default values.
Minimum Number of Hours	Use the default values.	Used the default values.

Control Room HVAC Intakes

Atmospheric dispersion factors have been calculated for the six combinations representing two activity release locations (Unit 2 and Unit 3 containment equipment hatches) and three control room HVAC intake locations (CR normal, Unit 2 emergency and Unit 3 emergency).

The center of the control room normal air intake is at plant elevation 35.50 feet (10.82 meters). The center of each control room emergency air intake is at plant elevation 43.00 feet (13.11 meters).

Containment Equipment Hatch Release Characteristics

Atmospheric dispersion between the containment equipment hatch and the control room HVAC intakes is modeled as an area (diffuse) source , ground level release.

The Containment Equipment Hatch is a large circular opening through the containment wall. The equipment hatch meets the conditions for a diffuse source as set forth in RG 1.194 Section 3.2.4.8: (1) the release from the hatch will be essentially equally dispersed over the entire opening, and (2) assumptions of mixing, dilution and transport within Containment necessary to meet condition 1 are supported by the interior containment arrangement. Consistent with RG 1.194 Section 3.2.4.8, the initial horizontal and vertical diffusion coefficients ($\sigma_{y,0}$ and $\sigma_{z,0}$) are determined to be 0.97 meters , based on the clear 19-foot diameter of the hatch opening.

The Unit 2 & 3 Containment Equipment Hatches are on the opposite side of their respective Containment structures from the control room air intakes. The containment equipment hatch diffuse release is assumed to be from its mid-height at plant elevation 38.00 feet (11.58 meters). The top of the Containment is 181 feet above plant grade ; therefore, it is unrealistic to expect flow from the Equipment Hatch to go over the Containment building. The Equipment Hatches to receptor distances are measured as the shortest path around the Containment ("taut string length"), as allowed by RG 1.194 Section 3.4. To determine the taut string length, a tangent is drawn from each intake to the side of the containment closest to the equipment hatch. That distance is added to the length of the arc around the containment from the tangent line intersection to the centerline of the hatch.

As requested by RG 1.194 Appendix A.2, since the plume is assumed to flow around the containment building rather than over it, the χ/Q value is calculated assuming flow both around and over (through) the building, and the higher of the χ/Q values is used.

For the containment equipment hatch release, only the cross-sectional area of the containment is used to determine the building wake area. All other intervening buildings, such as the auxiliary building, are conservatively ignored. The building wake area of 2123.33 square meters is the projected area of the containment cylindrical lower portion and the containment upper dome portion.

The following table presents the separation distances and wind directions that characterize the releases from the two containment equipment hatch release point locations to the three control room HVAC intake locations:

CONTAINMENT EQUIPMENT HATCH TO CONTROL ROOM MODELING

Release Point	Control Room Receptor	Separation Distance (meters)	Wind Direction Over / Around Containment (degrees, North = 0)
U2 Ctmt Equip. Hatch	Normal Air Intake	98.1	353 / 11
U2 Ctmt Equip. Hatch	U2 emergency air intake	96.8	355 / 15
U2 Ctmt Equip. Hatch	U3 emergency air intake	126.9	336 / 343
U3 Ctmt Equip. Hatch	Normal Air Intake	124	89 / 82
U3 Ctmt Equip. Hatch	U2 emergency air intake	126.9	90 / 83
U3 Ctmt Equip. Hatch	U3 emergency air intake	96.8	71 / 51

The results of the ARCON96 analysis show that the Unit 2 equipment hatch to Unit 2 emergency air intake release path modeling flow around the containment building has the more conservative atmospheric dispersion (i.e., the maximum atmospheric dispersion factor) during the first 8 hours of a release. The resultant 95th percentile control room atmospheric dispersion factors for this release path, without control room occupancy factors, are :

Time Interval	Equipment Hatch Release Dispersion Factors (sec/m^3)
0 to 2 hrs	7.99E-04
2 to 8 hrs	6.30E-04
8 to 24 hrs	1.77E-04
1 to 4 days	2.23E-04
4 to 30 days	2.03E-04

A comparison of the 0 to 8 hour dispersion values, with the current licensing basis control room χ/Q value of 3.1E-3 sec/m^3, shows that the dose analysis that supports the license amendment request (PCN-534) is conservative.

ITEM 4 - RAI #s 12 and 14

Additional Information:

The response to RAI #12 provided in the December 24, 2003 SCE to NRC letter discussed an additional restriction to opening the containment equipment hatch during core alterations and movement of irradiated fuel. In addition, based on discussions with the staff regarding RAI # 14, an additional restriction is being proposed. Revised Technical Specification pages to reflect the fourth and fifth restrictions are being provided with this response.

The RAI #12 response credited the continuous radiation monitoring system in the discharge of the containment purge whenever the purge is in service and discussed Technical Specification 3.9.3 and station procedures requiring containment purge to be in service whenever core alterations or fuel movement are performed and the equipment hatch is open. This will be in a fourth condition to enable the equipment hatch to be open.

The RAI #14 response discussed the proposed Technical Specification not providing a condition for open equipment hatch being limited to 72 hours post shutdown for the Fuel Handling Accident (FHA). This condition is currently contained in the Licensee Controlled Specifications (LCS) 3.9.101. Because this condition is not in the Technical Specifications an additional restriction is being added to ensure the reactor has been subcritical for at least 72 hours before the equipment hatch is open during core alterations or fuel movement. This will be a fifth condition to enable the equipment hatch to be open.

Item 5 - New RAI

Describe the radiation protection job planning and job-site coverage, and the radiation surveys/personal protection and dose monitoring equipment that will be provided to the crew during this emergency response action. Describe the initial (and continuing) radiological training that will be provided, including whether the crew workers will be qualified and trained to use respiratory protection devices or other means to limit intake of radioactive materials.

Response:

In the case of a fuel handling accident with the Containment Equipment Hatch open the following items will be in place to support closure of the missile shield doors:

- A Health Physics work control plan with specific instructions to Health Physics Technicians regarding maximum calculated dose, stay times, and worker protective actions,
- Four Full Face Negative Pressure respirators with GMR-I-P100 iodine canisters,
- Dose rate meters capable of assessing the radiological conditions during a fuel handling accident,
- Air sampling equipment.

Workers will receive initial and continuing radiation worker training and will be qualified and trained to use respiratory protection devices.

Item 6 – New RAI

The licensee has designated a crew of workers to manually close the containment structure equipment hatch shield doors in the event of an in-containment fuel handling accident during refueling. Provide an estimate of CEDE and DDE for a member of the crew, to ensure that the crew members' doses are consistent with the requirements and exposure guidelines of 10 CFR 50.47(b)(11). List all pertinent assumptions (e.g., airborne source term, stay time, external radiation levels, respiratory protection factors, etc.) taken to develop the dose estimates to these emergency workers.

Response:

An analysis (described below) has been performed that quantifies the exposure to workers should an FHA occur within containment while the containment equipment hatch is open. This analysis modeled:

- A release of airborne radioactivity within containment using the FHA inside containment Analysis of Record (AOR) source term;
- Dispersion of the released activity within the volume of the containment;
- Diffusion of the containment activity out the open equipment hatch over a 30 minute event duration;
- Dispersion of the diffused activity within the air volume trapped between the missile shield doors and the containment outer wall; and
- Calculation of doses to a worker who is present in this trapped air volume for 30 minutes.

The results of the analysis were a 30-minute thyroid inhalation dose of 44.4 Rem, a 30-minute whole body immersion dose of 0.3 Rem, and a 30-minute beta-skin dose of 0.4 Rem.

Using a thyroid weighting factor of 0.03 per Regulatory Guide 1.183 Footnote 7 (Ref. 5.2), the Total Effective Dose Equivalent (TEDE) to a crew member outside the equipment hatch was calculated to be 1.63 Rem.

Analysis

FHA Activity Released Inside Containment

The initial airborne radioactivity released inside containment due to an FHA is shown in the second column of Table 1. These data were taken from Table 8.3-1 of Calculation N-4072-003 (Ref. 5.3), which is the AOR for an FHA inside containment.

The released activity was then dispersed within the containment by dividing by the containment net free volume, which is 1.422E+06 ft^3 (= 4.027E+10 cc) per Section 4.3.1 of Ref. 5.3. The resulting containment activity concentrations are shown in the third column of Table 1.

Table 1 Initial Containment Activity Due to an FHA

Isotope	AOR Initial Containment Activity (Ci)	Initial Containment Activity Concentration (Ci/cc)
I-129	4.570E-05	1.135E-15
I-130	1.190E-02	2.955E-13
I-131	5.400E+02	1.341E-08
I-132	3.300E-07	8.195E-18
I-133	1.260E+02	3.129E-09
I-135	6.920E-01	1.718E-11
Kr-83m	1.180E-08	2.930E-19
Kr-85	2.490E+03	6.183E-08
Kr-85m	2.620E-01	6.506E-12
Kr-87	3.300E-13	8.195E-24
Kr-88	1.350E-03	3.352E-14
Xe-131m	6.150E+02	1.527E-08
Xe-133m	2.070E+03	5.140E-08
Xe-133	9.040E+04	2.245E-06
Xe-135m	8.840E+00	2.195E-10
Xe-135	1.190E+03	2.955E-08

FHA Activity Exiting Containment

The amount of motive force for the movement of airborne radioactivity from inside containment to the outside environment during the time required to close the missile shield doors was judged to be very small and characterized as "no motive force". Therefore, the only mechanism to facilitate the movement of airborne radioactivity from inside containment to the outside environment would be mass diffusion.

An evaluation was performed to characterize the radioisotope diffusion of airborne Iodine, Krypton, and Xenon from containment to the outside environment to allow for the estimation of the radiation exposure to a worker outside the equipment hatch. The results are shown in the second column of Table 2. Details of the diffusion rate analysis are given in Appendix A. Using a 30 minute event duration, the radioisotope activity exiting containment due to diffusion is shown in the third column of Table 2.

Table 2 Radioisotope Diffusion from Containment

Element	Diffusion Rate (Ci/sec per Ci/cc)	Diffusion in 30 Minutes (Ci per Ci/cc)
Iodine	90	1.620E+05
Krypton	172	3.096E+05
Xenon	140	2.520E+05

The Table 2 values were then applied to the containment airborne activity concentration profile at the start of the FHA (Table 1). The results are shown in Table 3.

Table 3 Total Activity Exiting Containment Due to an FHA

Isotope	Initial Containment Activity Concentration (Ci/cc)	Diffusion Factor (Ci per Ci/cc)	Activity Exiting Containment in 30 Min. (Ci)
I-129	1.135E-15	1.620E+05	1.838E-10
I-130	2.955E-13	1.620E+05	4.787E-08
I-131	1.341E-08	1.620E+05	2.172E-03
I-132	8.195E-18	1.620E+05	1.328E-12
I-133	3.129E-09	1.620E+05	5.069E-04
I-135	1.718E-11	1.620E+05	2.784E-06
Kr-83m	2.930E-19	3.096E+05	9.072E-14
Kr-85	6.183E-08	3.096E+05	1.914E-02
Kr-85m	6.506E-12	3.096E+05	2.014E-06
Kr-87	8.195E-24	3.096E+05	2.537E-18
Kr-88	3.352E-14	3.096E+05	1.038E-08
Xe-131m	1.527E-08	2.520E+05	3.849E-03
Xe-133m	5.140E-08	2.520E+05	1.295E-02
Xe-133	2.245E-06	2.520E+05	5.657E-01
Xe-135m	2.195E-10	2.520E+05	5.532E-05
Xe-135	2.955E-08	2.520E+05	7.447E-03

FHA Activity Concentration Outside Containment

To determine the activity concentration outside containment resulting from the FHA, the activity exiting containment in Table 3 was dispersed throughout a volume equal to the air volume trapped between the missile shield doors and the containment outer wall. This volume was determined to be 34 cubic meters as shown in Appendix B. The resulting activity concentrations outside containment are shown in Table 4.

Table 4 Activity Concentration Outside Containment Due to an FHA

Isotope	Activity Concentration Outside Containment (Ci/m^3)
I-129	5.407E-12
I-130	1.408E-09
I-131	6.389E-05
I-132	3.905E-14
I-133	1.491E-05
I-135	8.188E-08
Kr-83m	2.668E-15
Kr-85	5.630E-04
Kr-85m	5.924E-08
Kr-87	7.462E-20
Kr-88	3.053E-10
Xe-131m	1.132E-04
Xe-133m	3.810E-04
Xe-133	1.664E-02
Xe-135m	1.627E-06
Xe-135	2.190E-04

Worker Dose Calculation

The dose calculation for a worker located outside the containment hatch following an FHA within containment was performed using the following parameters:

Parameter	Value	Comment
Exposure time	30 minutes (= 1800 sec)	Conservative estimate of the time needed to manually close the containment structure equipment hatch shield doors.
Breathing rate	3.47E-04 m^3/sec	0-2 hour control room breathing rate from Table 3.10-1 of the FHA AOR (Ref. 5.3).

Thyroid inhalation, beta skin, and whole body gamma immersion doses were then calculated as follows:

$$D_{thy,i} = C_i \cdot (DCF_{thy,i}) \cdot BR \cdot t_e$$
$$D_{skin,i} = C_i \cdot (DCF_{skin,i}) \cdot t_e$$
$$D_{wb,i} = C_i \cdot (DCF_{wb,i}) \cdot t_e$$

where:

$D_{thy,i}$ is the thyroid inhalation dose due to isotope i (Rem)
$D_{skin,i}$ is the beta skin dose due to isotope i (Rem)
$D_{wb,i}$ is the whole body gamma dose due to isotope i (Rem)
C_i is the concentration of isotope i outside containment (Ci/m^3)
$DCF_{thy,i}$ is the thyroid inhalation dose conversion factor for isotope i (Rem/Ci)
$DCF_{skin,i}$ is the beta skin dose conversion factor for isotope i (Rem-m^3/Ci-sec)
$DCF_{wb,i}$ is the whole body gamma dose conversion factor for isotope i (Rem-m^3/Ci sec)
BR is the worker breathing rate (m^3/sec)
t_e is the exposure time (sec)

The dose conversion factors (DCFs) used in the analysis were taken from Table 4.8-1 of the FHA AOR (Ref. 5.3). The results are shown in Table 5, Table 6 and Table 7.

Table 5 30 Minute Thyroid Inhalation Dose Outside Containment

Isotope	Activity Concentration Outside Containment (Ci/m^3)	Thyroid DCF (Rem/Ci)	30 Minute Thyroid Dose (Rem)
I-129	5.407E-12	5.92E+06	2.00E-05
I-130	1.408E-09	7.40E+04	6.51E-05
I-131	6.389E-05	1.07E+06	4.27E+01
I-132	3.905E-14	6.29E+03	1.53E-10
I-133	1.491E-05	1.81E+05	1.69E+00
I-135	8.188E-08	3.15E+04	1.61E-03
Kr-83m	2.668E-15	0	0.00E+00
Kr-85	5.630E-04	0	0.00E+00
Kr-85m	5.924E-08	0	0.00E+00
Kr-87	7.462E-20	0	0.00E+00
Kr-88	3.053E-10	0	0.00E+00
Xe-131m	1.132E-04	0	0.00E+00
Xe-133m	3.810E-04	0	0.00E+00
Xe-133	1.664E-02	0	0.00E+00
Xe-135m	1.627E-06	0	0.00E+00
Xe-135	2.190E-04	0	0.00E+00
		Total Dose	**44.4**

Table 6 30 Minute Beta Skin Dose Outside Containment

Isotope	Activity Concentration Outside Containment (Ci/m^3)	Beta Skin DCF (Rem-m^3/Ci-sec)	30 Minute Beta Skin Dose (Rem)
I-129	5.407E-12	3.710E-04	3.61E-12
I-130	1.408E-09	4.990E-02	1.26E-07
I-131	6.389E-05	3.170E-02	3.65E-03
I-132	3.905E-14	1.320E-01	9.28E-12
I-133	1.491E-05	7.350E-02	1.97E-03
I-135	8.188E-08	1.290E-01	1.90E-05
Kr-83m	2.668E-15	0.000E+00	0.00E+00
Kr-85	5.630E-04	4.246E-02	4.30E-02
Kr-85m	5.924E-08	4.626E-02	4.93E-06
Kr-87	7.462E-20	3.083E-01	4.14E-17
Kr-88	3.053E-10	7.510E-02	4.13E-08
Xe-131m	1.132E-04	1.508E-02	3.07E-03
Xe-133m	3.810E-04	3.150E-02	2.16E-02
Xe-133	1.664E-02	9.697E-03	2.90E-01
Xe-135m	1.627E-06	2.253E-02	6.60E-05
Xe-135	2.190E-04	5.894E-02	2.32E-02
		Total Dose	**0.4**

Table 7 30 Minute Whole Body Gamma Dose Outside Containment

Isotope	Activity Concentration Outside Containment (Ci/m^3)	WB Gamma DCF ($Rem\text{-}m^3/Ci\text{-}sec$)	30 Minute WB Gamma Dose (Rem)
I-129	5.407E-12	3.024E-03	2.94E-11
I-130	1.408E-09	4.980E-01	1.26E-06
I-131	6.389E-05	8.720E-02	1.00E-02
I-132	3.905E-14	5.130E-01	3.61E-11
I-133	1.491E-05	1.550E-01	4.16E-03
I-135	8.188E-08	4.210E-01	6.20E-05
Kr-83m	2.668E-15	2.396E-06	1.15E-17
Kr-85	5.630E-04	5.102E-04	5.17E-04
Kr-85m	5.924E-08	3.708E-02	3.95E-06
Kr-87	7.462E-20	1.876E-01	2.52E-17
Kr-88	3.053E-10	4.658E-01	2.56E-07
Xe-131m	1.132E-04	2.899E-03	5.91E-04
Xe-133m	3.810E-04	7.954E-03	5.45E-03
Xe-133	1.664E-02	9.316E-03	2.79E-01
Xe-135m	1.627E-06	9.887E-02	2.90E-04
Xe-135	2.190E-04	5.736E-02	2.26E-02
		Total Dose	**0.3**

In addition to the above, a Total Effective Dose Equivalent (TEDE) to a crew member outside the equipment hatch was calculated by:

TEDE = (thyroid dose)(thyroid weighting factor) + (whole body dose)

A thyroid weighting factor of 0.03 was used per Regulatory Guide 1.183 Footnote 7 (Ref. 5.2) and the resulting dose to a crew member outside the equipment hatch was then calculated to be:

TEDE = (44.4 Rem)(0.03) + (0.3 Rem) = 1.63 Rem.

RESULTS AND CONCLUSION

Federal regulation 10 CFR 50.47(b)(11) (Ref. 5.4) requires that "means for controlling radiological exposures, in an emergency, are established for emergency workers. The means for controlling radiological exposures shall include exposure guidelines consistent with EPA Emergency Worker and Lifesaving Activity Protective Action Guides." Per the EPA 400-R-92-001 (Ref. 5.5) Table 2-2 "Guidance on Dose Limits for Workers Performing Emergency Services," the dose limit for all activities is 5 Rem TEDE. Per a Table 2-2 footnote, workers performing services during emergencies should limit the doses to the skin to ten times the listed value (i.e., 50 Rem).

The calculated TEDE of 1.63 Rem and the beta-skin dose of 0.4 Rem meet the dose criteria discussed above. It is therefore concluded that, following an FHA inside containment, workers outside containment who are manually closing the containment structure equipment hatch shield doors will not receive radiation exposures in excess of limits.

REFERENCES

5.1 SCE letter to the USNRC dated August 4, 2003, San Onofre Nuclear Generating Station Units 2 and 3 Docket Nos. 50-361 and 50-362 Proposed Change Number (PCN) 534 Request to Revise Technical Specification 3.9.3, "Containment Penetrations"

5.2 USNRC Regulatory Guide 1.183, July 2000, Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors

5.3 Calculation N-4072-003, Rev. 4, Fuel Handling Accident (FHA) Inside Containment – Control Room & Offsite Doses

5.4 Title 10 of the Code of Federal Regulations, Part 50, Domestic Licensing of Production and Utilization Facilities

5.5 EPA 400-R-92-001, Manual of Protective Action Guides and Protective Actions for Nuclear Incidents

Appendix A
Diffusion Analysis

This appendix characterizes the radioisotope diffusion of airborne krypton, xenon, and iodine radioisotopes from inside containment to the outside environment to allow estimation of the radiation exposure to a worker outside the containment equipment hatch.

Molecular Diffusion

The mass flux of an isotope in air (N_i) is given by Fick's law of diffusion for a gradient in mass concentration:

$$N_i = -D_{AB}\frac{dC_i}{dx}, \quad \text{in units of Curies/(cm}^2\text{-sec)} \qquad \textbf{Equation A-1}$$

(based on Bird, et al., Reference A1, Equation 16.2-3, p. 503)

where

D_{AB} is the mass diffusivity of material A (radioisotope) in B (air), in units of cm^2/sec

$\frac{dC_i}{dx}$ is the concentration gradient of a specific isotope, in units of $(Curies/cm^3)/cm$. The curie concentration is directly proportional to the mass concentration.

x is the distance, in cm. In this analysis, x is taken as the depth of the containment hatch opening, including the steel sleeve.

The flux will be maximized if it is assumed that the concentration approaches zero at the containment exterior, such as would occur if the air outside containment continually sweeps away the activity released through the hatch opening. Maximizing the flux N_i maximizes the concentration gradient dC_i/dx; therefore, the concentration gradient can be approximated as:

$\frac{dC_i}{dx} \approx -\frac{C_i^0}{x}$, where C_i^0 is the concentration of isotope i inside containment.

Therefore, the maximized mass flux can be restated as:

$$N_i^{\max} = -D_{AB}\left(-\frac{C_i^0}{x}\right) = \frac{D_{AB}\cdot C_i^0}{x} \qquad \textbf{Equation A-2}$$

Mass Diffusivity

The mass diffusivity D_{AB} is calculated in accordance with the Chapman-Enskog kinetic theory as given in Equation 16.4-13 of Bird, et al. (Reference A1, p. 511):

$$D_{AB} = 0.0018583\frac{\sqrt{T^3\left(\frac{1}{M_A}+\frac{1}{M_B}\right)}}{p\,\sigma_{AB}^{\;2}\;\Omega_{D,AB}} \qquad \textbf{Equation A-3}$$

where

- D_{AB} = mass diffusivity of material A in B in units of cm^2/sec
- T = temperature in °K
- $M_{A/B}$ = molecular weight of substance A or B
- p = total pressure in atmospheres
- σ_{AB} = Lennard-Jones parameter, in Ångströms
- $\Omega_{D,AB}$ = a dimensionless function of the temperature and of the intermolecular potential field for one molecule of A and one molecule of B.

Table B-2 of Bird, et al. (Reference A1, p. 746) provides values for $\Omega_{D,AB}$ as a function of a term $\kappa T/\varepsilon_{AB}$.

Table B-1 of Bird, et al. (Reference A1, pp. 744-745) provides values of the molecular weight and the Lennard-Jones parameters σ and ε/κ for various substances. The applicable values are shown in Table 8.

Table 8 – Intermolecular Force Parameters

Substance	Molecular Weight	Lennard-Jones Parameters	
	M	σ (Å)	ε/κ (°K)
Kr	83.80	3.61	190
Xe	131.3	4.055	229
I_2	253.82	4.982	550
Air	28.97	3.617	97.0

Per Equation 16.4-15 of Bird, et al. (Reference A1, p. 511), σ_{AB} can be estimated by:

$$\sigma_{AB} \approx \frac{1}{2}(\sigma_A + \sigma_B)$$ **Equation A-4**

Per Equation 16.4-16 of Bird, et al. (Reference A1, p. 511), ε_{AB} can be estimated by:

$$\varepsilon_{AB} = \sqrt{\varepsilon_A \varepsilon_B}$$ **Equation A-5**

The applicable values of the σ_{AB} and $\kappa T/\varepsilon_{AB}$ parameters can therefore be calculated using Table 8, Equation A-4, and Equation A-5. Then, assuming an ambient temperature of 20 °C (i.e., 293 °K), the values for $\Omega_{D,AB}$ are determined by interpolating the lookup values from Table B-2 of Reference A1. The results are provided in Table 9.

Table 9 – Determination of Omega Diffusion Terms

System	σ_{AB} (Å)	ε/κ_{AB} (°K)	$\kappa T/\varepsilon_{AB}$	$\Omega_{D,AB}$
Kr – Air	3.614	135.8	2.16	1.047
Xe – Air	3.836	149.0	1.97	1.080
I_2 – Air	4.300	231.0	1.27	1.287

The mass diffusivities of each isotope can now be calculated using Equation A-3.

$$D_{Kr-Air} = 0.0018583\frac{\sqrt{293^3\left(\frac{1}{83.8}+\frac{1}{28.97}\right)}}{\left(1\times3.614^2\times1.047\right)} = 0.147\ \text{cm}^2/\text{sec}$$

$$D_{Xe-Air} = 0.0018583\frac{\sqrt{293^3\left(\frac{1}{131.3}+\frac{1}{28.97}\right)}}{\left(1\times3.836^2\times1.08\right)} = 0.120\ \text{cm}^2/\text{sec}$$

$$D_{I2-Air} = 0.0018583\frac{\sqrt{293^3\left(\frac{1}{253.82}+\frac{1}{28.97}\right)}}{\left(1\times4.3^2\times1.287\right)} = 0.0768\ \text{cm}^2/\text{sec}$$

Maximized Radioisotope Diffusion Rates

To convert the mass flux for each radioisotope to a release rate, the flux is multiplied by the clear area of the equipment hatch opening. Thus,

$n_i = N_i^{max} A$, where η_i is the release rate and A is the clear hatch opening area, in cm^2.

Therefore, based on Equation A-2,

$$n_i = \frac{D_{AB}\cdot A}{x} C_i^0, \ in\ \frac{cm^3}{\sec}\cdot\frac{Ci}{cm^3}$$ **Equation A-6**

Area of Opening

The containment equipment hatch penetration is a circular opening of radius of 9'-6", with the bottom 1½ feet filled in with concrete to create a level floor at elevation 30'-0" (Dwgs. 23025, Ref. A2, and 23063, Ref. A4). Thus, the area of the opening is given by:

$$A_O = \pi R^2 - \left[R^2\cos^{-1}\left(\frac{R-h}{R}\right) - (R-h)\sqrt{2Rh-h^2}\right]$$

$$= \pi 9.5^2 - \left[9.5^2\cos^{-1}\left(\frac{9.5-1.5}{9.5}\right) - (9.5-1.5)\sqrt{(2\cdot9.5\cdot1.5)-1.5^2}\right]$$

$$= \pi 90.25 - \left[90.25\cos^{-1}\left(\frac{8}{9.5}\right) - (8)\sqrt{26.25}\right] = 273.1\ \text{ft}^2, \text{ or} \sim 2.537\times10^5\ \text{cm}^2$$

Hatch Opening Depth

Per Dwg. 23054 (Ref. A3) section B, the depth of the containment equipment hatch opening from the edge of the flange inside containment to the containment shell outer face is 7'-1½", or 217 cm.

Diffusion Rates

Thus, using Equation A-6 and the mass diffusivities given above, the diffusion rates for each radioisotope are calculated as follows:

$$n_{Kr} = \frac{0.147 \cdot (2.537 \times 10^5)}{217} C^0_{Kr} = 172 C^0_{Kr} \text{ Ci/sec}$$

$$n_{Xe} = \frac{0.120 \cdot (2.537 \times 10^5)}{217} C^0_{Kr} = 140 C^0_{Xe} \text{ Ci/sec}$$

$$n_{I_2} = \frac{0.0768 \cdot (2.537 \times 10^5)}{217} C^0_{Kr} = 90 C^0_{I_2} \text{ Ci/sec}$$

Results Summary

The diffusion rates of airborne krypton, xenon, and iodine radioisotopes from inside containment to the outside environment are summarized below.

Element	Diffusion Rate (Ci/sec)
Krypton	$172\ C_{Kr}^0$
Xenon	$140\ C_{Xe}^0$
Iodine	$90\ C_{I2}^0$

Using this information, the activity concentration outside containment can be estimated from the isotopic concentrations inside containment.

References

A1. Bird, R. Byron, Stewart, Warren E., and Lightfoot, Edwin N., *Transport Phenomena*. John Wiley & Sons, Inc., New York, 1960.

A2. Units 2 & 3 Drawing 23025, Rev. 7, *Containment Structure Reinforced Concrete Wall Sections & Details, Sht. 3*

A3. Units 2 & 3 Drawing 23054, Rev. 5, *Containment Structure Wall Liner & Inserts Sections & Details Sh. 3*

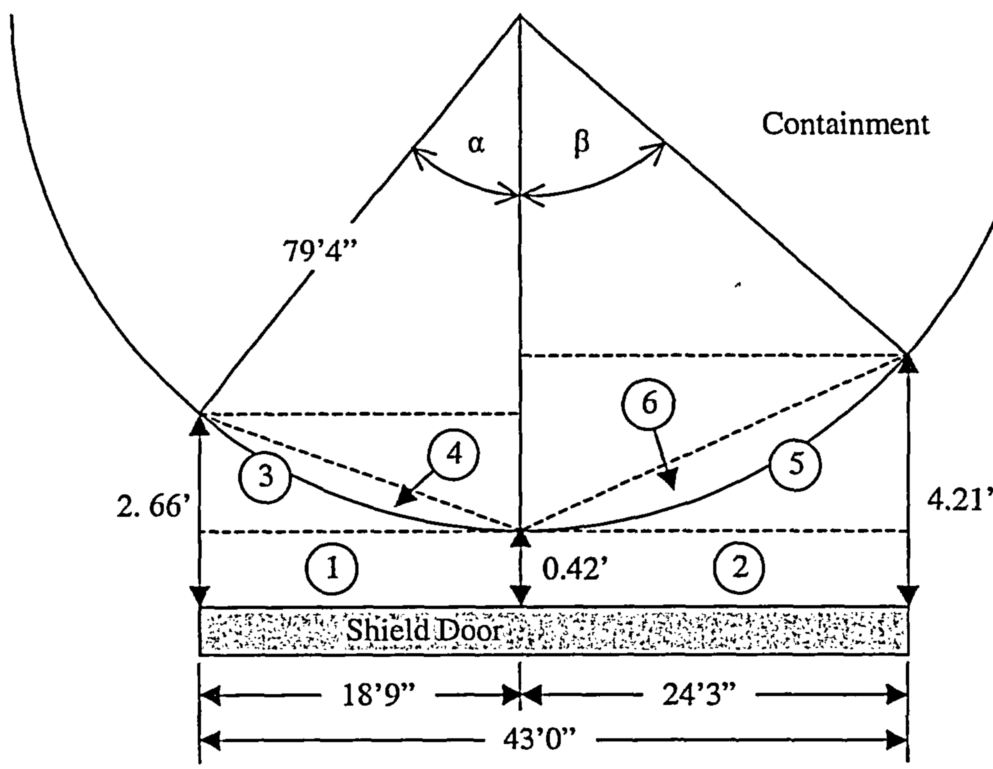
A4. Units 2 & 3 Drawing 23063, Rev. 9 (including DCNs 4 and 5), *Containment Structure Hatches & Locks*

Appendix B

Air Volume Between Shield Doors and Containment

This appendix determines the volume of air between the shield doors and the containment outer wall. This volume is used to estimate the radionuclide concentrations to which a worker outside the equipment hatch would be exposed following a fuel handling accident inside containment.

The figure below is a plan view of the shield door/containment arrangement. This figure is not to scale.



The air volume to be calculated has a height of 19'5" and is defined by the six regions (circled numbers) as follows:

Volume = (Area 1 + Area 2 + Area 3 – Area 4 + Area 5 – Area 6) (19.42 ft)

By geometry:

Area 1 = (0.42 ft) (18.75 ft) = 7.9 ft^2
Area 2 = (0.42 ft) (24.25 ft) = 10.2 ft^2
Area 3 = (0.5) (18.75 ft) (2.66 ft – 0.42 ft) = 21.0 ft^2
Area 5 = (0.5) (24.25 ft) (4.21 ft – 0.42 ft) = 46.0 ft^2

To calculate Area 4 and Area 6, the angles α and β are needed. By geometry:

$\alpha = \sin^{-1}$ (18.75 ft / 79.33 ft) = 13.67°

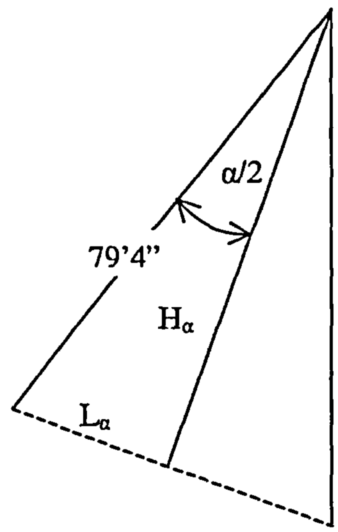
$\beta = \sin^{-1}$ (24.25 ft / 79.33 ft) = 17.80°

The areas of the sectors enclosed by angles α and β are given by:

Sector α = (13.67° / 360°) (π) (79.33 ft)^2 = 750.8 ft^2

Sector β = (17.80° / 360°) (π) (79.33 ft)^2 = 977.6 ft^2

The portion of Sector α that is not Area 4 is shown in the figure below (also not to scale). Subtracting the area of this region from the area of Sector α will give Area 4.



By geometry:

$\sin(\alpha/2) = L_\alpha$ / 79.33 ft

With α = 13.67°, L_α = 9.44 ft. By the Pythagorean Theorem:

$H_\alpha = [(79.33 \text{ ft})^2 - (9.44 \text{ ft})^2]^{0.5} = 78.77$ ft

The two halves of the region are equal, so the area of the whole α triangle shown above is then:

Area of α triangle = (2) (0.5) (9.44 ft) (78.77 ft) = 743.6 ft^2

Subtracting this from the area of Sector α, gives Area 4:

Area 4 = 750.8 ft^2 - 743.6 ft^2 = 7.2 ft^2

By a similar method, L_β = 12.27 ft, H_β = 78.38 ft, and the area of the associated β triangle is:

Area of β triangle = (2) (0.5) (12.27 ft) (78.38 ft) = 961.7 ft^2

Subtracting this from the area of Sector β, gives Area 6:

Area 6 = 977.6 ft^2 - 961.7 ft^2 = 15.9 ft^2

The air volume between the containment and the shield doors is:

Volume = (7.9 ft^2 + 10.2 ft^2 + 21.0 ft^2 – 7.2 ft^2 + 46.0 ft^2 – 15.9 ft^2) (19.42 ft) = 1204 ft^3

Using a conversion factor of 0.0283 m^3/ft^3, gives:

Volume = 34 m^3

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ENCLOSURE 3

Revised Proposed Technical Specification Pages

PCN 534

Attachment A

(Proposed TS Page)

(Redline and Strikeout)

SONGS Unit 2

3.9 REFUELING OPERATIONS

3.9.3 Containment Penetrations

LCO 3.9.3 The containment penetrations shall be in the following status:

a. The equipment hatch closed and held in place by four bolts:

-------------------------NOTE-------------------------

The equipment hatch may be open if all of the following conditions are met:

1) The Containment Structure Equipment Hatch Shield Doors are capable of being closed within 30 minutes,
2) The plant is in Mode 6 with at least 23 feet of water above the reactor vessel flange,
3) A designated crew is available to close the Containment Structure Equipment Hatch Shield Doors,
4) Containment purge is in service, and
5) The reactor has been subcritical for at least 72 hours.

----

b. One door in each air lock closed;

-------------------------NOTE-------------------------

Both doors of the containment personnel airlock may be open provided:

a. one personnel airlock door is OPERABLE, and

b1. the plant is in MODE 6 with 23 feet of water above the fuel in the reactor vessel, or

b2. defueled configuration with fuel in containment (i.e., fuel in refueling machine or upender).

----

c. Each penetration providing direct access from the containment atmosphere to the outside atmosphere shall be either:

1. closed by a manual or automatic isolation valve, blind flange, or equivalent, or

2. capable of being closed by an OPERABLE Containment Purge System.

APPLICABILITY: During CORE ALTERATIONS,
During movement of irradiated fuel assemblies within containment.

PCN 534

Attachment B

(Proposed TS Page)

(Redline and Strikeout)

SONGS Unit 3

3.9 REFUELING OPERATIONS

3.9.3 Containment Penetrations

LCO 3.9.3 The containment penetrations shall be in the following status:

a. The equipment hatch closed and held in place by four bolts;

------------------------NOTE------------------------

The equipment hatch may be open if all of the following conditions are met:

1) The Containment Structure Equipment Hatch Shield Doors are capable of being closed within 30 minutes,
2) The plant is in Mode 6 with at least 23 feet of water above the reactor vessel flange,
3) A designated crew is available to close the Containment Structure Equipment Hatch Shield Doors,
4) Containment purge is in service, and
5) The reactor has been subcritical for at least 72 hours.

----

b. One door in each air lock closed;

------------------------NOTE------------------------

Both doors of the containment personnel airlock may be open provided:

a. one personnel airlock door is OPERABLE, and

b1. the plant is in MODE 6 with 23 feet of water above the fuel in the reactor vessel, or

b2. defueled configuration with fuel in containment (i.e., fuel in refueling machine or upender).

----

c. Each penetration providing direct access from the containment atmosphere to the outside atmosphere shall be either:

1. closed by a manual or automatic isolation valve, blind flange, or equivalent, or

2. capable of being closed by an OPERABLE Containment Purge System.

APPLICABILITY: During CORE ALTERATIONS,
During movement of irradiated fuel assemblies within containment.

PCN 534

Attachment C

(Proposed TS Page)

SONGS Unit 2

3.9 REFUELING OPERATIONS

3.9.3 Containment Penetrations

LCO 3.9.3 The containment penetrations shall be in the following status:

a. The equipment hatch closed and held in place by four bolts;

-------------------------NOTE-----------------------------
The equipment hatch may be open if all of the following conditions are met:
1) The Containment Structure Equipment Hatch Shield Doors are capable of being closed within 30 minutes,
2) The plant is in Mode 6 with at least 23 feet of water above the reactor vessel flange,
3) A designated crew is available to close the Containment Structure Equipment Hatch Shield Doors,
4) Containment purge is in service, and
5) The reactor has been subcritical for at least 72 hours.

----

b. One door in each air lock closed;

-------------------------NOTE-----------------------------
Both doors of the containment personnel airlock may be open provided:

a. one personnel airlock door is OPERABLE, and

b1. the plant is in MODE 6 with 23 feet of water above the fuel in the reactor vessel, or

b2. defueled configuration with fuel in containment (i.e., fuel in refueling machine or upender).

----

c. Each penetration providing direct access from the containment atmosphere to the outside atmosphere shall be either:

1. closed by a manual or automatic isolation valve, blind flange, or equivalent, or

2. capable of being closed by an OPERABLE Containment Purge System.

APPLICABILITY: During CORE ALTERATIONS,
During movement of irradiated fuel assemblies within containment.

PCN 534

Attachment D

(Proposed TS Page)

SONGS Unit 3

3.9 REFUELING OPERATIONS

3.9.3 Containment Penetrations

LCO 3.9.3 The containment penetrations shall be in the following status:

a. The equipment hatch closed and held in place by four bolts;

-------------------------NOTE-----------------------------
The equipment hatch may be open if all of the following conditions are met:
1) The Containment Structure Equipment Hatch Shield Doors are capable of being closed within 30 minutes,
2) The plant is in Mode 6 with at least 23 feet of water above the reactor vessel flange,
3) A designated crew is available to close the Containment Structure Equipment Hatch Shield Doors,
4) Containment purge is in service, and
5) The reactor has been subcritical for at least 72 hours.
----

b. One door in each air lock closed;

-------------------------NOTE-----------------------------
Both doors of the containment personnel airlock may be open provided:

a. one personnel airlock door is OPERABLE, and

b1. the plant is in MODE 6 with 23 feet of water above the fuel in the reactor vessel, or

b2. defueled configuration with fuel in containment (i.e., fuel in refueling machine or upender).
----

c. Each penetration providing direct access from the containment atmosphere to the outside atmosphere shall be either:

1. closed by a manual or automatic isolation valve, blind flange, or equivalent, or

2. capable of being closed by an OPERABLE Containment Purge System.

APPLICABILITY: During CORE ALTERATIONS,
During movement of irradiated fuel assemblies within containment.

Attachment E

(Proposed TS Bases Pages)

(Redline and Strikeout)

SONGS Unit 2 (Typical for both Units)

LCO

This LCO limits the consequences of a fuel handling accident in containment by limiting the potential escape paths for fission product radioactivity released within containment. The LCO requires any penetration providing direct access from the containment atmosphere to the outside atmosphere to be closed except for the OPERABLE containment purge and exhaust penetrations and the containment personnel airlock.

For the containment personnel airlock, this LCO ensures that the airlock can be closed after containment evacuation in the event of a fuel handling accident. The requirement that the plant be in Mode 6 with 23 feet of water above the fuel in the reactor vessel or defueled configuration with fuel in the containment (i.e., fuel in the refueling machine or upender) ensures that there is sufficient time to close the personnel airlock following a loss of shutdown cooling before boiling occurs.

LCO part a. is modified by a NOTE:

-------------------------NOTE----------------------------

The equipment hatch may be open if all of the following conditions are met:

1) The Containment Structure Equipment Hatch Shield Doors are capable of being closed within 30 minutes,
2) The plant is in Mode 6 with at least 23 feet of water above the reactor vessel flange,
3) A designated crew is available to close the Containment Structure Equipment Hatch Shield Doors,
4) Containment purge is in service, and
5) The reactor has been subcritical for at least 72 hours.

These restrictions include the administrative controls to allow the opening of the containment equipment hatch during CORE ALTERATIONS or movement of irradiated fuel in the containment provided that 1) The Containment Structure Equipment Hatch Shield Doors capable of being closed within 30 minutes, 2) The plant is in Mode 6 with at least 23 feet of water above the reactor vessel flange, 3) A designated crew is available to close the Containment Structure Equipment Hatch Shield Doors, 4) Containment purge is in service, and 5) The reactor shall be subcritical for at least 72 hours. The Containment Structure Equipment Hatch

(continued)

BASES (continued)

LCO (continued)

Shield Doors include flashing on the top and sides of the shield doors which act to retard or restrict a release of post-accident fission products. The capability to close the containment shield doors includes requirements that the doors are capable of being closed and that any cables or hoses across the opening have quick disconnects to ensure the doors are capable of being closed within 30 minutes. The 30 minute closure time for the containment shield doors is considered to start when the control room communicates the need to shut the Containment Structure Equipment Hatch Shield Doors. This 30-minute requirement is significantly less than the fuel handling accident analysis assumption that the containment remains open to the outside environment for a two-hour period subsequent to the accident. Placing containment purge (either main purge or mini purge) in service will ensure any release from containment will be monitored.

The administrative controls will also include the responsibility to be able to communicate with the control room, and the responsibility to ensure that the containment shield doors are capable of being closed in the event of a fuel handling accident. These administrative controls will ensure containment closure would be established in the event of a fuel handling accident inside containment.

~~This~~ LCO part b. is modified by a NOTE~~ote~~ which allows ~~to keep~~ both doors of the containment ~~personnel~~ airlock to be open provided:

a. one personnel airlock door is OPERABLE, and

b.1 the plant is in MODE 6 with 23 feet of water above the fuel in the reactor vessel, or

b.2 defueled configuration with fuel in containment (i.e., fuel in refueling machine or upender).

(continued)

BASES (continued)

LCO (continued)	The OPERABILITY requirements ensure that the airlock door is capable of performing its function, and that a designated individual located outside of the affected area is available to close the door. For the OPERABLE containment purge and exhaust penetrations, this LCO ensures that these LCO penetrations are isolable by the Containment Purge Isolation System. The OPERABILITY requirements for this LCO ensure that the automatic purge and exhaust valve closure times specified in the UFSAR can be achieved and therefore meet the assumptions used in the safety analysis to ensure releases through the valves are terminated, such that the radiological doses are within the acceptance limit.
APPLICABILITY	The containment penetration requirements are applicable during CORE ALTERATIONS or movement of irradiated fuel assemblies within containment because this is when there is a potential for a fuel handling accident. In MODES 1, 2, 3,

(continued)