FLORIDA POWER CORPORATION
CRYSTAL RIVER UNIT 3
DOCKET NUMBER 50-302 / LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST (LAR) #222, REVISION 0
CONTROL ROOM EMERGENCY AND EMERGENCY FILTERS

ATTACHMENT C

STRIKEOUT / SHADOW PAGES

Technical Specifications

Each change is indicated by a shadow box.
Deletions are indicated by strikeout.
Additional and replacement text are indicated by shading.

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.12.1	Operate each CREVS train for ≥ 15 minutes.	31 days
SR 3.7.12.2	Perform required CREVS filter testing in accordance with the Ventilation Filter Testing Program.	In accordance with the Ventilation Filter Testing Program
SR 3.7.12.3	Verify each CREVS train actuates to the emergency recirculation mode on an actual or simulated actuation signal.	24 months
SR 3.7.12.4	Verify CCHE boundary leakage does not exceed allowable limits as measured by performance of an integrated leakage test as specified in approved control room dose calculations.	24 months

5.6 Procedures, Programs and Manuals

5.6.2.11 Secondary Water Chemistry Program (continued)

c. Identification of process sampling points, which shall include monitoring the discharge of the condensate pumps for evidence of condenser in leakage;

d. Procedures for the recording and management of data;

e. Procedures defining corrective actions for all off control point chemistry conditions; and

f. A procedure identifying the authority responsible for the interpretation of the data and the sequence and timing of administrative events, which is required to initiate corrective action.

5.6.2.12 Ventilation Filter Testing Program (VFTP)

A program shall be established to implement the following required testing of the Control Room Emergency Ventilation System (CREVS) per the requirements specified in Regulatory Guide 1.52, Revision 2, 1978, and in accordance with ~~ASME~~ ANSI N510-1975 and ~~ASME N509 1976~~ ASTM D 3803-89 (Re-approved 1995).

a. Demonstrate for each train of the CREVS that an inplace test of the high efficiency particulate air (HEPA) filters shows a penetration ~~and system bypass~~ < 0.05% when tested in accordance with Regulatory Guide 1.52, Revision 2, 1978, and in accordance with ~~ASME~~ ANSI N510-1975 at ~~a~~ the system flowrate of between ~~43,500 cfm ± 10%~~ 37,800 and 47,850 cfm.

b. Demonstrate for each train of the CREVS that an inplace test of the ~~charcoal~~ carbon adsorber shows a ~~penetration and~~ system bypass < 0.05% when tested in accordance with Regulatory Guide 1.52, Revision 2, 1978, and ~~ASME~~ ANSI N510-~~1989~~ 1975 at the system flowrate of between ~~43,500 cfm ± 10%~~ 37,800 and 47,850 cfm.

c. Demonstrate for each train of the CREVS that a laboratory test of a sample of the ~~charcoal~~ carbon adsorber, when obtained as described in Regulatory Guide 1.52, Revision 2, 1978, meets the laboratory testing criteria of ASTM D 3803-89 (Re-approved 1995) at a temperature of 30°C and relative humidity of 95% with methyl iodide penetration of less than 2.5%. ~~shows the methyl iodide penetration less than 1% when~~

(continued)

5.6 Procedures, Programs and Manuals

~~tested in accordance with Table 2 of Regulatory Guide 1.52, Revision 2 and ASME N509-1976 at a temperature of 80°C and 70% relative humidity.~~

5.6.2.12 VFTP (continued)

d. Demonstrate for each train of ~~the~~ CREVS that the pressure drop across the combined roughing filters, HEPA filters and the ~~charcoal~~ carbon adsorbers is ~~≤ ΔP=6"~~ ≤ ΔP=4" water gauge when tested in accordance with Regulatory Guide 1.52, Revision 2, 1976, and ~~ASME~~ ANSI N510-1975 at the system flowrate of between ~~43,500 cfm ± 10%~~ 37,800 and 47,850 cfm.

The provisions of SR 3.0.2 and SR 3.0.3 are applicable to the VFTP test frequencies.

5.6.2.13 Explosive Gas and Storage Tank Radioactivity Monitoring Program

This program provides controls for potentially explosive gas mixtures contained in the Radioactive Waste Disposal (WD) System, the quantity of radioactivity contained in gas storage tanks or fed into the offgas treatment system. The gaseous radioactivity quantities shall be determined following the methodology in Branch Technical Position (BTP) ETSB 11-5, "Postulated Radioactive Release due to Waste Gas System Leak or Failure". The liquid radwaste quantities shall be determined in accordance with Standard Review Plan, Section 15.7.3, "Postulated Radioactive Release due to Tank Failures".

The program shall include:

a. The limits for concentrations of hydrogen and oxygen in the Radioactive Waste Disposal (WD) System and a surveillance program to ensure the limits are maintained. Such limits shall be appropriate to the system's design criteria, (i.e., whether or not the system is designed to withstand a hydrogen explosion).

b. A surveillance program to ensure that the quantity of radioactivity contained in each gas storage tank and fed into the offgas treatment system is less than the amount that would result in a whole body exposure of ≥ 0.5 rem to any individual in an unrestricted area, in the event of an uncontrolled release of the tanks' contents.

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CONTROL ROOM EMERGENCY AND EMERGENCY FILTERS

ATTACHMENT C

STRIKEOUT / SHADOW PAGES

Bases

Each change is indicated by a shadow box. Deletions are indicated by strikeout. Additional and replacement text are indicated by shading.

B 3.7 PLANT SYSTEMS

B 3.7.12 Control Room Emergency Ventilation System (CREVS)

BASES

BACKGROUND

The principal function of the Control Room Emergency Ventilation System (CREVS) is to provide an enclosed environment from which the plant can be operated following an uncontrolled release of radioactivity or toxic gas.

The CREVS consists of two trains with much of the non-safety related equipment common to both trains and with two independent, redundant components supplied for ~~each~~ major items of safety related ~~piece of~~ equipment (Ref. 1). The major equipment consists of the normal duty filter banks, the emergency filters, the normal duty and emergency duty supply fans, and the return fans. The normal duty filters consist of one bank of glass fiber roughing filters. The emergency filters consist of three banks each. The first bank is a roughing filter similar to the normal filters. The second bank is a high efficiency particulate air (HEPA) filter. The third bank is an activated ~~charcoal absorber~~ carbon adsorber for removal of gaseous activity (principally iodine). The rest of the system, consisting of supply and return ductwork, dampers, and instrumentation, is not designed with redundant components. However, redundant dampers are provided for isolation of the ventilation system from the surrounding environment.

The ventilation exhaust duct is continuously tested by radiation monitor RM-A5, which has a range of 10^1 to 10^6 counts per minute. The monitor is set to alarm and initiate the emergency recirculation mode of operation when the airborne radioactivity and/or area radiation level reaches two times the background count rate.

The Control Complex Habitability Envelope (CCHE) is the space within the Control Complex served by CREVS. This includes Control Complex floor elevations from 108 through 180 feet and the stair enclosure from elevation 95 to 198 feet. The elements which comprise the CCHE are walls, doors, a roof, floors, floor drains, penetration seals, and ventilation isolation dampers. Together the CCHE and CREVS provide an enclosed environment from which the plant can be controlled following an uncontrolled release of radioactivity or toxic gas.

(continued)

BASES

Design calculations determine the maximum allowable leakage into the CCHE below which control room operator dose and toxic gas concentrations remain within approved limits. Integrated leak tests of the CCHE determine actual leakage. The difference between allowed and actual leakage is converted to an allowance for breaches (in square inches) that may exist in the CCHE to accommodate normal operating and maintenance activities. Breaches in excess of the calculated area renders the CCHE incapable of performing its function, therefore inoperable. Routine opening and closing of CCHE doors for personnel passage and the movement of equipment is accounted for in the design calculations. A continuous leakage of 10 cubic feet per minute is assumed to account for this. Holding or blocking doors open for short periods of time does not constitute a breach of the CCHE as long as the doors could be closed upon notification of a radiological or toxic gas release.

CREVS has a normal operation mode and recirculation modes. During normal operation, the system provides filtered, conditioned air to the control complex. ~~The control complex consists of the control room, various other offices in the area of the control room, and a controlled access area (CA).~~ including the controlled access area on the 95 foot elevation. When switched to the recirculation modes, isolation dampers close isolating the discharge to the controlled access area and isolating the outside air intake. ~~the system isolates itself from outside air and recirculates filtered air through the same areas with the exception of the controlled access area.~~ In this mode the system recirculates filtered air through the CCHE. This is described in the following paragraph.

(continued)

BASES

BACKGROUND (continued)

The control complex normal duty ventilation system is operated from the control room and runs continuously. During normal operation, the outside air intake damper is partially open, ~~the discharge to outside air damper is open~~ the atmospheric relief discharge damper is closed, the discharge to the controlled access area is open, and the system return damper is throttled. This configuration allows a controlled amount of outside air to be admitted to the control complex. The design temperature maintained by the system is 75°F at a relative humidity of 50%.

Three signals will cause the system to automatically switch to the recirculation modes of operation.

1. Engineered Safeguards Actuation System (ESAS) signal (high reactor building pressure).

2. High radiation signal from the return duct radiation monitor RM-A5.

3. Toxic gas signal (chlorine or sulfur dioxide).

The recirculation modes isolate the ~~control room~~ CCHE from outside air to ensure a habitable environment for the safe shutdown of the plant. In these modes of operation, the controlled access area is isolated from the ~~control room~~ CCHE. ~~and the remaining areas of the control complex.~~

Upon detection of ESAS or toxic gas signals, the system switches to the normal recirculation mode. In this mode, dampers for the outside air intake and the exhaust to the controlled access area will automatically close, isolating the CCHE from outside air exchange. ~~the outside air intake and atmospheric relief discharge dampers will automatically close, isolating the control room envelope from outside air paths,~~ and the system return damper will open thus allowing air in the ~~control complex~~ CCHE to be recirculated. Additionally, the ~~mechanical equipment room exhaust fan,~~ CA fume hood exhaust fan, CA fume hood auxiliary supply fan, and CA exhaust fan are de-energized and their corresponding isolation dampers close. The return fan, normal filters, normal fan, and the cooling (or heating) coils remain in operation in a recirculating mode.

Upon detection of high radiation by RM-A5 the system switches to the emergency recirculation mode. In this mode, the dampers that form the ~~control room envelope~~ CCHE will automatically close. The ~~mechanical equipment room exhaust fan,~~ CA fume hood exhaust fan, CA fume hood auxiliary supply fan, CA exhaust fan, normal supply fan, and return fan are

(continued)

BASES

tripped and their corresponding isolation dampers close. Manual action is required to restart the return fan and place the emergency fans and filters in operation. The cooling (or heating) coils remain in operation.

APPLICABLE SAFETY ANALYSIS

During emergency operations the design basis of the CREVS and the CCHE is to provide radiation protection to the control room operators. The limiting accident which may threaten the habitability of the control room (i.e., accidents resulting in release of airborne radioactivity) is the postulated maximum hypothetical accident (MHA), which is assumed to occur while in MODE 1. The consequences of this event in MODE 1 envelope the results for MODES 2, 3, and 4, and results in the limiting radiological source term for the control room habitability evaluation (Ref. 2). A fuel handling accident (FHA) may also result in a challenge to control room habitability, and may occur in any MODE. However, due to the severity of the MHA and the MODES in which the postulated MHA can occur, the FHA is the limiting accident in MODES 5 and 6 only. The CREVS and the CCHE ensures that the control room will remain habitable following all postulated design basis events, maintaining exposures to control room operators within the limits of GDC 19 of 10 CFR 50 Appendix A (Ref. 3).

The CREVS is not in the primary success path for any accident analysis. However, the Control Room Emergency Ventilation System meets Criterion 3 of the NRC Policy Statement since long term control room habitability is essential to mitigation of accidents resulting in atmospheric fission product release.

LCO

Two trains of the control room emergency ventilation system are required to be OPERABLE to ensure that at least one is available assuming a single failure disabling the other train. Failure to meet the LCO could result in the control room becoming uninhabitable in the unlikely event of an accident.

The required CREVS trains must be independent to the extent allowed by the design which provides redundant components for the major equipment as discussed in the BACKGROUND section of this bases. OPERABILITY of the CREVS requires the following as a minimum:

a. ~~The emergency duty fan is OPERABLE;~~ A Control Complex Emergency Duty Supply Fan is OPERABLE;

(continued)

b. A Control Complex Return Fan is OPERABLE;

c. HEPA filter and ~~charcoal absorber~~ carbon adsorber are not excessively restricting flow, and are capable of performing their filtration functions;

d. Ductwork, ~~valves~~, and dampers are OPERABLE, and air circulation can be maintained; and

e. The CCHE is intact as discussed below.

The CCHE boundary including the integrity of the doors, walls, roof, floors, floor drains, penetration seals, and ventilation isolation dampers must be maintained within the assumptions of the design calculations. Breaches in the CCHE must be controlled to provide assurance that the CCHE remains capable of performing its function.

The ability to maintain temperature in the Control Complex is ~~not addressed in this Technical Specification.~~ addressed in Technical Specification 3.7.18. ~~It is addressed administratively outside of Technical Specifications.~~

APPLICABILITY

In MODES 1, 2, 3, and 4, the CREVS must be OPERABLE to ensure that the ~~control complex~~ CCHE will remain habitable during and following a postulated DBA. During movement of irradiated fuel assemblies, the CREVS must be OPERABLE to cope with a release due to a fuel handling accident.

ACTIONS

A.1

With one CREVS train inoperable, action must be taken to restore the train to OPERABLE status within 7 days. In this Condition, the remaining OPERABLE CREVS train is adequate to perform the ~~control room~~ radiation protection function for control room personnel. However, the overall reliability is reduced because a failure in the OPERABLE CREVS train could result in loss of CREVS function. The 7 day Completion Time is based on the low probability of a DBA occurring during this time period, and ability of the remaining train to provide the required capability.

BASES (continued)

ACTIONS (continued)

B.1 and B.2

In MODE 1, 2, 3, or 4, if the inoperable CREVS train cannot be restored to OPERABLE status within the associated Completion Time, the plant must be placed in a MODE in which the LCO does not apply. To achieve this status, the plant must be placed in at least MODE 3 within 6 hours, and in MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

C.1 and C.2

During movement of irradiated fuel assemblies, if the inoperable CREVS train cannot be restored to OPERABLE status within the associated Completion Time, the OPERABLE CREVS train must immediately be placed in the emergency recirculation mode. This action ensures that the remaining train is OPERABLE, that no failures preventing automatic actuation will occur, and that any active failure will be readily detected. Required Action C.1 is modified by a Note indicating to place the system in the emergency mode if automatic transfer to emergency mode is inoperable.

An alternative to Required Action C.1 is to immediately suspend activities that could release radioactivity and require isolation of the ~~control room~~ CCHE. This places the plant in a condition that minimizes the accident risk. This does not preclude the movement of fuel to a safe position.

D.1

If both CREVS trains are inoperable in MODE 1, 2, 3, or 4, the CREVS may not be capable of performing the intended function and the plant is in a condition outside the accident analysis. Therefore, LCO 3.0.3 must be entered immediately.

E.1

During movement of irradiated fuel assemblies, when two CREVS trains are inoperable, action must be taken immediately to suspend activities that could release radioactivity that could enter the ~~control room~~ CCHE. This places the plant in a condition that minimizes the accident risk. This does not preclude the movement of fuel to a safe position.

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.7.12.1

Standby systems should be checked periodically to ensure that they function properly. Since the environment and normal operating conditions on this system are not severe, testing each train once every month adequately checks proper function of this system. Systems such as the CR-3 design without heaters need only be operated for ≥ 15 minutes to demonstrate the function of the system. The 31 day Frequency is based on the known reliability of the equipment and the two train redundancy available.

SR 3.7.12.2

This SR verifies that the required CREVS testing is performed in accordance with the Ventilation Filter Testing Program (VFTP). The CREVS filter tests are in accordance with Regulatory Guide 1.52, (Ref. 4) as described in the VFTP Program description (FSAR, Section 9.7.4). The VFTP includes testing HEPA filter performance, ~~charcoal absorber~~ carbon adsorber efficiency, minimum system flow rate, and the physical properties of the activated ~~charcoal~~ carbon. Specific test frequencies and additional information are discussed in detail in the VFTP.

SR 3.7.12.3

This SR verifies that each CREVS train actuates to place the control complex into the emergency recirculation mode on an actual or simulated actuation signal. The Frequency of 24 months is consistent with the typical fuel cycle length.

(continued)

BASES (continued)

SR 3.7.12.4

This SR verifies the integrity of the CCHE and the assumed inleakage rates of potentially contaminated air. During the emergency mode of operation, the CCHE is designed to be a closed environment having limited air exchange with its surroundings. Performance of a periodic leak test verifies the continuing integrity of the CCHE within acceptable limits. The frequency of 24 months is consistent with the typical fuel cycle length. The acceptance criteria for the test is leakage that does not exceed the value contained in the approved dose calculations.

REFERENCES

1. FSAR, Section 9.7.2.1.g.
2. CR-3 Control Room Habitability Evaluation Report, submitted to NRC on June 30, 1987.
3. 10 CFR 50, Appendix A, GDC 19.
4. Regulatory Guide 1.52, Rev. 2, 1978.

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CONTROL ROOM EMERGENCY AND EMERGENCY FILTERS

ATTACHMENT C

REVISION BAR PAGES

Technical Specifications

ATTACHMENT TO LICENSE AMENDMENT NO.

FACILITY OPERATING LICENSE NO. DPR-72

DOCKET NO. 50-302

Replace the following pages of the Appendix "A" Technical Specifications with the attached pages. The revised pages are identified by amendment number and contain vertical lines indicating the area of change. The corresponding *spillover pages are also provided to maintain document completeness.

Remove	Replace
3.7-26	3.7-26
B 3.7-60	B 3.7-60
B 3.7-61	B 3.7-61
B 3.7-62	B 3.7-62
B 3.7-63	B 3.7-63
B 3.7-64	B 3.7-64
B 3.7-65	B 3.7-65
------	B 3.7-65A*
------	B 3.7-65B
5.0-18	5.0-18
5.0-19	5.0-19

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.7.12.1	Operate each CREVS train for ≥ 15 minutes.	31 days
SR 3.7.12.2	Perform required CREVS filter testing in accordance with the Ventilation Filter Testing Program.	In accordance with the Ventilation Filter Testing Program
SR 3.7.12.3	Verify each CREVS train actuates to the emergency recirculation mode on an actual or simulated actuation signal.	24 months
SR 3.7.12.4	Verify CCHE boundary leakage does not exceed allowable limits as measured by performance of an integrated leakage test.	24 months

5.6 Procedures, Programs and Manuals

5.6.2.11 Secondary Water Chemistry Program (continued)

c. Identification of process sampling points, which shall include monitoring the discharge of the condensate pumps for evidence of condenser in leakage;

d. Procedures for the recording and management of data;

e. Procedures defining corrective actions for all off control point chemistry conditions; and

f. A procedure identifying the authority responsible for the interpretation of the data and the sequence and timing of administrative events, which is required to initiate corrective action.

5.6.2.12 Ventilation Filter Testing Program (VFTP)

A program shall be established to implement the following required testing of the Control Room Emergency Ventilation System (CREVS) per the requirements specified in Regulatory Guide 1.52, Revision 2, 1978, and in accordance with ANSI N510-1975 and ASTM D 3803-89 (Re-approved 1995).

a. Demonstrate for each train of the CREVS that an inplace test of the high efficiency particulate air (HEPA) filters shows a penetration $<$ 0.05% when tested in accordance with Regulatory Guide 1.52, Revision 2, 1978, and in accordance with ANSI N510-1975 at the system flowrate of between 37,800 and 47,850 cfm.

b. Demonstrate for each train of the CREVS that an inplace test of the carbon adsorber shows a system bypass $<$ 0.05% when tested in accordance with Regulatory Guide 1.52, Revision 2, 1978, and ANSI N510-1975 at the system flowrate of between 37,800 and 47,850 cfm.

c. Demonstrate for each train of the CREVS that a laboratory test of a sample of the carbon adsorber, when obtained as described in Regulatory Guide 1.52, Revision 2, 1978, meets the laboratory testing criteria of ASTM D 3803-89 (Re-approved 1995) at a temperature of 30°C and relative humidity of 95% with methyl iodide penetration of less than 2.5%.

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5.6 Procedures, Programs and Manuals

5.6.2.12 VFTP (continued)

d. Demonstrate for each train of CREVS that the pressure drop across the combined roughing filters, HEPA filters and the carbon adsorbers is $\leq \Delta P = 4"$ water gauge when tested in accordance with Regulatory Guide 1.52, Revision 2, 1978, and ANSI N510-1975 at the system flowrate of between 37,800 and 47,850 cfm.

The provisions of SR 3.0.2 and SR 3.0.3 are applicable to the VFTP test frequencies.

5.6.2.13 Explosive Gas and Storage Tank Radioactivity Monitoring Program

This program provides controls for potentially explosive gas mixtures contained in the Radioactive Waste Disposal (WD) System, the quantity of radioactivity contained in gas storage tanks or fed into the offgas treatment system. The gaseous radioactivity quantities shall be determined following the methodology in Branch Technical Position (BTP) ETSB 11-5, "Postulated Radioactive Release due to Waste Gas System Leak or Failure". The liquid radwaste quantities shall be determined in accordance with Standard Review Plan, Section 15.7.3, "Postulated Radioactive Release due to Tank Failures".

The program shall include:

a. The limits for concentrations of hydrogen and oxygen in the Radioactive Waste Disposal (WD) System and a surveillance program to ensure the limits are maintained. Such limits shall be appropriate to the system's design criteria, (i.e., whether or not the system is designed to withstand a hydrogen explosion).

b. A surveillance program to ensure that the quantity of radioactivity contained in each gas storage tank and fed into the offgas treatment system is less than the amount that would result in a whole body exposure of ≥ 0.5 rem to any individual in an unrestricted area, in the event of an uncontrolled release of the tanks' contents.

The provisions of SR 3.0.2 and SR 3.0.3 are applicable to the Explosive Gas and Storage Tank Radioactivity Monitoring Program surveillance frequencies.

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CONTROL ROOM EMERGENCY AND EMERGENCY FILTERS

ATTACHMENT C

REVISION BAR AGES

Bases

B 3.7 PLANT SYSTEMS

B 3.7.12 Control Room Emergency Ventilation System (CREVS)

BASES

BACKGROUND

The principal function of the Control Room Emergency Ventilation System (CREVS) is to provide an enclosed environment from which the plant can be operated following an uncontrolled release of radioactivity or toxic gas.

The CREVS consists of two trains with much of the non-safety related equipment common to both trains and with two independent, redundant components supplied for major items of safety related equipment (Ref. 1). The major equipment consists of the normal duty filter banks, the emergency filters, the normal duty and emergency duty supply fans, and the return fans. The normal duty filters consist of one bank of glass fiber roughing filters. The emergency filters consist of three banks each. The first bank is a roughing filter similar to the normal filters. The second bank is a high efficiency particulate air (HEPA) filter. The third bank is an activated carbon adsorber for removal of gaseous activity (principally iodine). The rest of the system, consisting of supply and return ductwork, dampers, and instrumentation, is not designed with redundant components. However, redundant dampers are provided for isolation of the ventilation system from the surrounding environment.

The ventilation exhaust duct is continuously tested by radiation monitor RM-A5, which has a range of 10^1 to 10^6 counts per minute. The monitor is set to alarm and initiate the emergency recirculation mode of operation when the airborne radioactivity and/or area radiation level reaches two times the background count rate.

The Control Complex Habitability Envelope (CCHE) is the space within the Control Complex served by CREVS. This includes Control Complex floor elevations from 108 through 180 feet and the stair enclosure from elevation 95 to 198 feet. The elements which comprise the CCHE are walls, doors, a roof, floors, floor drains, penetration seals, and ventilation isolation dampers. Together the CCHE and CREVS provide an enclosed environment from which the plant can be controlled following an uncontrolled release of radioactivity or toxic gas.

(continued)

BASES

BACKGROUND (continued)

Design calculations determine the maximum allowable leakage into the CCHE below which control room operator dose and toxic gas concentrations remain within approved limits. Integrated leak tests of the CCHE determine actual leakage. The difference between allowed and actual leakage is converted to an allowance for breaches (in square inches) that may exist in the CCHE to accomodate normal operating and maintenance activities. Breaches in excess of the calculated area renders the CCHE incapable of performing its function, therefore inoperable. Routine opening and closing of CCHE doors for personnel passage and the movement of equipment is accounted for in the design calculations. A continuous leakage of 10 cubic feet per minute is assumed to account for this. Holding or blocking doors open for short periods of time does not constitute a breach of the CCHE as long as the doors could be closed upon notification of a radiological or toxic gas release.

CREVS has a normal operation mode and recirculation modes. During normal operation, the system provides filtered, conditioned air to the control complex, including the controlled access area on the 95 foot elevation. When switched to the recirculation mode, isolation dampers close isolating the discharge to the controlled access area and isolating the outside air intake. In this mode the system recirculates filtered air through the CCHE. This is described in the following paragraph.

The control complex normal duty ventilation system is operated from the control room and runs continuously. During normal operation, the outside air intake damper is partially open, the atmospheric relief discharge damper is closed, the discharge to the controlled access area is open, and the system return damper is throttled. This configuration allows a controlled amount of outside air to be admitted to the control complex. The design temperature maintained by the system is 75°F at a relative humidity of 50%.

Three signals will cause the system to automatically switch to the recirculation modes of operation.

1. Engineered Safeguards Actuation System (ESAS) signal (high reactor building pressure).

2. High radiation signal from the return duct radiation monitor RM-A5.

(continued)

BACKGROUND (continued)

3. Toxic gas signal (chlorine or sulfur dioxide).

The recirculation modes isolate the CCHE from outside air to ensure a habitable environment for the safe shutdown of the plant. In these modes of operation, the controlled access area is isolated from the CCHE.

Upon detection of ESAS or toxic gas signals, the system switches to the normal recirculation mode. In this mode, dampers for the outside air intake and the exhaust to the controlled access area will automatically close, isolating the CCHE from outside air exchange, and the system return damper will open thus allowing air in the CCHE to be recirculated. Additionally, CA fume hood exhaust fan, CA fume hood auxiliary supply fan, and CA exhaust fan are de-energized and their corresponding isolation dampers close. The return fan, normal filters, normal fan, and the cooling (or heating) coils remain in operation in a recirculating mode.

Upon detection of high radiation by RM-A5 the system switches to the emergency recirculation mode. In this mode, the dampers that form the CCHE will automatically close. The CA fume hood exhaust fan, CA fume hood auxiliary supply fan, CA exhaust fan, normal supply fan, and return fan are tripped and their corresponding isolation dampers close. Manual action is required to restart the return fan and place the emergency fans and filters in operation. The cooling (or heating) coils remain in operation.

APPLICABLE SAFETY ANALYSIS

During emergency operations the design basis of the CREVS and the CCHE is to provide radiation protection to the control room operators. The limiting accident which may threaten the habitability of the control room (i.e., accidents resulting in release of airborne radioactivity) is the postulated maximum hypothetical accident (MHA), which is assumed to occur while in MODE 1. The consequences of this event in MODE 1 envelope the results for MODES 2, 3, and 4, and results in the limiting radiological source term for the control room habitability evaluation (Ref. 2). A fuel handling accident (FHA) may also result in a challenge to control room habitability, and may occur in any MODE. However, due to the severity of the MHA and the MODES in which the postulated MHA can occur, the FHA is the limiting accident in MODES 5 and 6 only. The CREVS and the CCHE ensure that the control room will remain habitable following all postulated design basis events, maintaining

(continued)

BASES

APPLICABLE SAFETY ANALYSIS (continued)

exposures to control room operators within the limits of GDC 19 of 10 CFR 50 Appendix A (Ref. 3).

The CREVS is not in the primary success path for any accident analysis. However, the Control Room Emergency Ventilation System meets Criterion 3 of the NRC Policy Statement since long term control room habitability is essential to mitigation of accidents resulting in atmospheric fission product release.

LCO

Two trains of the control room emergency ventilation system are required to be OPERABLE to ensure that at least one is available assuming a single failure disabling the other train. Failure to meet the LCO could result in the control room becoming uninhabitable in the unlikely event of an accident.

The required CREVS trains must be independent to the extent allowed by the design which provides redundant components for the major equipment as discussed in the BACKGROUND section of this bases. OPERABILITY of the CREVS requires the following as a minimum:

a. A Control Complex Emergency Duty Supply Fan is OPERABLE;

b. A Control Complex Return Fan is OPERABLE;

c. HEPA filter and carbon adsorber are not excessively restricting flow, and are capable of performing their filtration functions;

d. Ductwork, valves, and dampers are OPERABLE, and air circulation can be maintained; and

e. The CCHE is intact as discussed below.

The CCHE boundary including the integrity of the doors, walls, roof, floors, floor drains, penetration seals, and ventilation isolation dampers must be maintained within the assumptions of the design calculations. Breaches in the CCHE in excess of allowed 'unidentified' leakage pathway sizes as specified in approved design calculations must be controlled to provide assurance that the CCHE remains capable of performing its function.

The ability to maintain temperature in the Control Complex is addressed in Technical Specification 3.7.18.

(continued)

APPLICABILITY

In MODES 1, 2, 3, and 4, the CREVS must be OPERABLE to ensure that the CCHE will remain habitable during and following a postulated DBA. During movement of irradiated fuel assemblies, the CREVS must be OPERABLE to cope with a release due to a fuel handling accident.

ACTIONS

A.1

With one CREVS train inoperable, action must be taken to restore the train to OPERABLE status within 7 days. In this Condition, the remaining OPERABLE CREVS train is adequate to perform the radiation protection function for control room personnel. However, the overall reliability is reduced because a failure in the OPERABLE CREVS train could result in loss of CREVS function. The 7 day Completion Time is based on the low probability of a DBA occurring during this time period, and ability of the remaining train to provide the required capability.

B.1 and B.2

In MODE 1, 2, 3, or 4, if the inoperable CREVS train cannot be restored to OPERABLE status within the associated Completion Time, the plant must be placed in a MODE in which the LCO does not apply. To achieve this status, the plant must be placed in at least MODE 3 within 6 hours, and in MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

C.1 and C.2

During movement of irradiated fuel assemblies, if the inoperable CREVS train cannot be restored to OPERABLE status within the associated Completion Time, the OPERABLE CREVS train must immediately be placed in the emergency recirculation mode. This action ensures that the remaining train is OPERABLE, that no failures preventing automatic actuation will occur, and that any active failure will be readily detected. Required Action C.1 is modified by a Note indicating to place the system in the emergency mode if automatic transfer to emergency mode is inoperable.

(continued)

BASES

ACTIONS (continued)

An alternative to Required Action C.1 is to immediately suspend activities that could release radioactivity and require isolation of the CCHE. This places the plant in a condition that minimizes the accident risk. This does not preclude the movement of fuel to a safe position.

D.1

If both CREVS trains are inoperable in MODE 1, 2, 3, or 4, the CREVS may not be capable of performing the intended function and the plant is in a condition outside the accident analysis. Therefore, LCO 3.0.3 must be entered immediately.

E.1

During movement of irradiated fuel assemblies, when two CREVS trains are inoperable, action must be taken immediately to suspend activities that could release radioactivity that could enter the CCHE. This places the plant in a condition that minimizes the accident risk. This does not preclude the movement of fuel to a safe position.

SURVEILLANCE REQUIREMENTS

SR 3.7.12.1

Standby systems should be checked periodically to ensure that they function properly. Since the environment and normal operating conditions on this system are not severe, testing each train once every month adequately checks proper function of this system. Systems such as the CR-3 design without heaters need only be operated for ≥ 15 minutes to demonstrate the function of the system. The 31 day Frequency is based on the known reliability of the equipment and the two train redundancy available.

SR 3.7.12.2

This SR verifies that the required CREVS testing is performed in accordance with the Ventilation Filter Testing Program (VFTP). The CREVS filter tests are in accordance with Regulatory Guide 1.52, (Ref. 4) as described in the VFTP Program description (FSAR, Section 9.7.4). The VFTP includes testing HEPA filter performance, carbon adsorber efficiency, minimum system flow rate, and the physical

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.7.12.2 (continued)

properties of the activated carbon. Specific test and additional information are discussed in detail in the VFTP.

SR 3.7.12.3

This SR verifies that each CREVS train actuates to place the control complex into the emergency recirculation mode on an actual or simulated actuation signal. The Frequency of 24 months is consistent with the typical fuel cycle length.

SR 3.7.12.4

This SR verifies the integrity of the CCHE and the assumed inleakage rates of potentially contaminated air. During the emergency mode of operation, the CCHE is designed to be a closed environment having limited air exchange with its surroundings. Performance of a periodic leak test verifies the continuing integrity of the CCHE within acceptable limits. The frequency of 24 months is consistent with the typical fuel cycle length.

REFERENCES

1. FSAR, Section 9.7.2.1.g.
2. CR-3 Control Room Habitability Evaluation Report, submitted to the NRC on June 30, 1987.
3. 10 CFR 50, Appendix A, GDC 19.
4. Regulatory Guide 1.52, Rev. 2, 1978.

BASES

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FLORIDA POWER CORPORATION
CRYSTAL RIVER UNIT 3
DOCKET NUMBER 50-302 / LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST (LAR) #222, REVISION 0
CONTROL ROOM EMERGENCY AND EMERGENCY FILTERS

ATTACHMENT D

CONTROL ROOM POST-ACCIDENT DOSE CALCULATIONS

ATTACHMENT D

CONTROL ROOM POST-ACCIDENT DOSE CALCULATIONS

Purpose

This attachment provides a discussion of calculations for post-accident dose to the control room operator. Specifically, iodine and beta skin doses are assessed. The Maximum Hypothetical Accident (MHA) is taken to be the limiting event from the perspective of Control Room habitability and is initially assessed. MHA with loss of offsite power (LOOP) and MHA without LOOP scenarios are considered. The Steam Generator Tube Rupture (SGTR) is also assessed to evaluate events which might require radiation monitor RM-A5 (for Control Complex Habitability Envelope (CCHE) isolation), and the Fuel Handling Accident (FHA) is assessed to evaluate the source terms and model associated with this event. Inputs for these calculations are listed.

Protection from toxic gas events is dependent on detection and isolation of the CCHE. Calculations demonstrate that adequate detection and isolation capabilities exist for the toxic gas sources located near CR-3. Once isolation is achieved, leakage into the CCHE is of no consequence, even at many times the leakage allowed for radiological events. Since the focus of this document is the determination of allowed leakage for radiological events, toxic gas events are not discussed further in this document.

Background

NRC Inspections and System Readiness Reviews conducted in 1997 during the CR-3 Design Basis Outage identified several issues which potentially impacted control room habitability. The predominant issue pertained to the validity of assumptions for CCHE inleakage. Other notable items of concern included Control Room Emergency Ventilation System (CREVS) recirculation flow rate and carbon filter efficiency. Modifications were made to reduce CCHE inleakage by improving the integrity of boundary elements. Existing boundary dampers were replaced with zero leakage models, and redundant dampers provided at all boundary damper locations. The mechanical equipment room exhaust duct was spared in place, and the CCHE penetration for this duct sealed. Minor CREVS design changes were made to provide alternate means of mechanical equipment room ventilation and to improve system reliability. Programmatic changes were made to ensure that the assigned efficiency of the Control Complex carbon filters was consistent with regulatory guidance.

The findings and modifications arising from resolution of identified issues required that the Control Room operator dose calculations be revised to align inputs and assumptions with plant design. The basic methodology used in these revised calculations is consistent with that found in regulatory guidance and utilized in previous calculations. Determination of CCHE inleakage, performed by tracer gas testing, is different than the previous methodology. Other inputs have also changed and are listed in Attachment E.

The tracer gas test was conducted at a differential pressure of 0.171 inches water gauge (in. wg) using ASTM E 741-1993. The test was based on measuring the inleakage across the CCHE. This condition is representative of the inleakage mechanism applicable to the design of the CR-3 CCHE (zone isolation system with filtered, recirculated air). Using tracer gas test methods, it is possible to set up a test to measure inleakage under conditions which are representative of a specific postulated scenario.

The primary motive forces which might induce a significant differential pressure across the CCHE are taken as wind pressures (assuming a loss of offsite power) and ventilation systems in adjoining structures (no loss of offsite power). In the loss of offsite power scenario, secondary effects such as thermal effects and localized pressures induced by the operation of CREVS become relatively significant and must be considered. Significantly higher differential pressure would be expected assuming no loss of offsite power, but the source term would be lower given that this would necessarily require the Auxiliary Building Filtration System to be in operation.

To fully assess limiting post-accident conditions, both scenarios must be evaluated. This is accomplished by measuring inleakage at a known differential pressure using tracer gas methods, then analytically adjusting this value to correspond with postulated conditions. The wind speeds responsible for the driving CCHE differential pressure were taken consistent with Murphy-Campe assumptions regarding the post-accident meteorology. This standard method for calculating dose utilizes these wind speeds to produce a conservative estimate of the control room operator dose. Using the wind speed to calculate the differential pressure at the four periods defined by Murphy-Campe during the accident, control room operator dose during the accident is 26.5 REM, including 22.8 sq. in. of breach margin in the envelope beyond the conservative inleakage measured during the tracer gas test. FPC is using this mechanistic inleakage approach to demonstrate the operability of the CCHE and CREVS.

Analysis of the MHA was performed using the post-accident model described in Regulatory Guide 1.4 and source terms derived from TID-14844. SRP 6.4 and the Murphy-Campe Paper on Control Room Ventilation System Design were used as guidance documents. The following lists specific assumptions associated with control room dose calculations for the MHA. Additional information pertaining to selected parameters is provided in the discussion that follows. A detailed set of inputs and assumptions is provided in Tables 1 and 2.

Assumptions for the MHA

- This analysis uses 102% of the rated thermal power (2619 MWth).
- The containment free volume is 2,000,000 cubic feet. The sprayed volume is 1,304,000 ft^3 and the remainder is unsprayed.
- Containment air mixing rate is equal to 2 unsprayed volumes per hour between the sprayed and the unsprayed volumes.
- The core fission products released to the free volume are 25% of the total iodine and 100% of the noble gases.
- The core fission products released to the sump water is 50% of the total iodine.
- The iodine species fractions for the free volume are: 0.91 Elemental + 0.05 Particulate + 0.04 Organic.
- The post LOOP/LOCA containment design leakage rate is 0.25% for the first day and 0.125% for the remaining post-accident recovery period.

- Modeling includes continuous Emergency Core Cooling System (ECCS) leakage outside the containment building.
- For the MHA w/ LOOP, modeling includes 30 minutes of 50 gpm ECCS leakage outside the containment building beginning 24 hours after the LOCA initiation event.
- For the MHA without LOOP, credit is taken for the Auxiliary Building Ventilation System carbon filters operating at 75% efficiency.
- The vaporization fraction for the ECCS leakage is not less than 10%
- The iodine removal efficiency for the 2" thick CREVS carbon filter is 95% based on meeting the testing requirements of Reg. Guide 1.52.
- Meteorology extrapolations and control room dose modeling and calculations (when equilibrium conditions are present) are based on the Murphy-Campe methodology for meeting GDC 19 of 10CFR50.
- The containment spray elemental iodine removal cut off is based on a decontamination factor (DF) of 100, and the particulate iodine spray removal constant is based on a DF of 50 for reducing the constant by a factor of 10.
- The spray starts 124 seconds (0.03444 hours) after containment isolation which is assumed to occur instantaneously. This time is more conservative than full flow time specified in Tech Spec 3.6.6.
- During the first 30 minutes post LOOP/LOCA, there is no forced ventilation flow in the Control Complex.
- Fission product solids that might be in the sump water are assumed to be non-volatile and are not released to the environment.
- The sump water volume is assumed not to be reduced due to ECCS leakage.

Discussion of Selected MHA Radiological Dose Calculation Inputs

1) Dose Conversion Factors

FPC applied revised dose conversion factors for Control Complex Habitability dose calculations. Specifically, FPC changed from using International Commission on Radiological Protection Publication 2 (ICRP-2), published 1959, to International Commission on Radiological Protection Publication 30 (ICRP-30), published 1979, and Federal Guidance Report #11, published 1988, for calculating thyroid dose to control room operators.

Dose calculations for internal organs such as the thyroid are performed using dosimetric and metabolic models contained in the ICRP publications. The current NRC Safety Evaluation of FPC's control room habitability is based on the "Control Room Habitability Evaluation Report" submitted to the NRC on June 30, 1987. At that time, ICRP-2 methodology was used for internal dose calculations.

Revised methods for calculating organ dose and relating organ dose to whole body dose were published in ICRP-30, and endorsed for use in this country by the Environmental Protection Agency (EPA) in Federal Guidance Report #11. These documents changed the dose conversion factors that are used to convert a quantity of inhaled radioactive material to organ dose. For the radionuclides of concern, use of ICRP-30 / Federal Guidance

Report #11 dose conversion factors results in the accident thyroid dose to be ~30% lower than previously calculated.

The statutory authority for the use of ICRP-30 and Federal Guidance Report #11 can be found in the Statements Of Consideration for the publication of revised 10 CFR 20 as a Final Rule. In Federal Register 56 FR 23360, published May 5, 1991, and effective June 20, 1991, the use of ICRP-30 and Federal Guidance Report #11 for calculating internal doses is discussed. The NRC addressed a public comment regarding Section 20.1204, "Determination of Internal Exposure," by stating that: "Appropriate parameters for calculating organ doses from radionuclide uptakes can be found in ICRP-30 and its supplements. Dose factors in Federal Guidance Report #11 are also acceptable for use in calculating occupational exposures for compliance with either §§20.1 - 20.601 or with §§20.1001 - 20.2401, except that the individual organ dose values must be used for §§20.1 - 20.601." (Note: §§20.1 - 20.601 were the former sections of 10 CFR 20 that remained in effect concurrent with the revised sections, §§20.1001 - 20.2401, until January 1, 1994, after which §§20.1 - 20.601 were removed from federal law.)

CR-3 Improved Technical Specifications (ITS) include specific activity limits for primary and secondary coolant. Specific activity is measured and reported as DOSE EQUIVALENT I-131, which is a defined term in the ITS. The ITS definition of DOSE EQUIVALENT I-131 specifies that the thyroid dose conversion factors used for this calculation shall be those from ICRP-30.

Evaluations of postulated accidents include estimation of offsite doses that could result from radioactive material releases. A standard assumption applied in determining the amount of radioactive material released is that the reactor coolant activity is equal to the Technical Specification limit. Since DOSE EQUIVALENT I-131 is used as a measure of the permissible concentration of radioactive iodine species in reactor coolant, ICRP-30 is currently being used in the calculations of offsite dose consequences. Therefore, the use of ICRP-30 in revised control room dose calculations is consistent with the current licensing basis of CR-3.

2) Accident Analysis Software (POSTDBA & AXIDENT)
POSTDBA is an internally developed proprietary computer program of Sargent & Lundy for evaluating the radiological consequences of design basis accidents.

POSTDBA has been used to support post-accident dose analyses licensing requirements and special dose studies for more than twenty years. It was used to support the initial Byron 1 & 2 and Braidwood 1 & 2 (ComEd) FSAR submittal control room doses. Since B/B uses the NUREG-0800 (Standard Review Plan or SRP) format, dose analyses referenced compliance with the SRP and Regulatory Guides. This computer program was used in the 1980s to investigate Main Steam Isolation Valve leakage on BWRs. Studies were performed for GE Mark II design (ComEd's La Salle County) and GE Mark III design (IPC's Clinton). Zion's current control room design modification is under NRC review, and the supporting post-accident dose analyses were prepared using POSTDBA. At the present time (last quarter of 1997), La Salle and Clinton are having their post-accident doses reanalyzed using POSTDBA.

Computer program POSTDBA performs radiological dose calculations and related analyses for the LOCA in a pressurized water reactor (PWR) or a boiling water reactor (BWR). POSTDBA was originally developed to calculate PWR control room (CR) and offsite doses in accordance with requirements and recommendations of Regulatory Guide (RG) 1.4, RG 1.109, Standard Review Plan (SRP) Section 6.4, and SRP 6.5.2. This program handles containment leakage, additional gaseous leakage (purge and MSIV), and can model liquid leakage (constant and intermittent reactor coolant (RC) boundary releases outside containment) as a separate case in the same computer run. In addition to the dose evaluation, POSTDBA calculates the time dependent airborne concentrations of iodine (using spray removal modeling which handles all SRP 6.5.2 requirements and recommendations) and noble gases for the containment at the CR inlet and in the CR volume. The control room's potential outside air intrusions, iodine filtration, and gamma body, beta skin, and thyroid dose computations are based on the Murphy-Campe approach using time dependent integration techniques. The site meteorology can be entered as a joint frequency table, as predetermined 5th percentile χ/Q values or as effective wind speeds as determined by the Murphy-Campe methodology.

POSTDBA is constructed to allow the user to select the time steps and to control variable parameters for each time step. Initial DBA isotopic iodine and noble gas sources (starting at time = 0.0 seconds) are individually entered, element family release fractions can be applied, and the iodine can be subdivided into specific fractions of chemically different types. Any one or all of the three release pathway rates and the containment spray removal factors can be specified for each time step. Control room ventilation inputs include outside air makeup, recirculation, and unfiltered inleakage. Separate filter efficiencies can be specified for the makeup and recirculation filters.

POSTDBA was revised in 1994 to make the iodine dose conversion factors referenced in Federal Guidance Report #11 (ICRP-30) the default conversion factors. This program will allow manual entry of any of the default iodine conversion factors and/or depth dose conversion factors for gammas and betas. Thus, if surface gamma or beta doses are needed, they can be determined using POSTDBA.

Similar to POSTDBA, Computer program AXIDENT is NUS - SCIENTECH proprietary software developed for radiological dose calculations and related analyses consistent with approved regulatory guidance and recommendations. The AXIDENT Code was developed in the mid-70s by NUS with the primary function to assess the habitability of control rooms during design basis accidents. The AXIDENT code has been used by NUS over the last 17 years (also used by SCIENTECH Inc. since the acquisition of NUS in 1996). In the early 80s, the AXIDENT code was used to prepare a large number of control room habitability studies that were submitted to the NRC in response to NUREG-0737, Action Item III.D.3.4. These original habitability studies typically contained the AXIDENT manual (NUS-1954) which includes a detailed discussion of the code derivation and design inputs (an example being CP&L's Brunswick and H. B. Robinson submittals). Since the original habitability submittal, the AXIDENT code has been used to resolve habitability issues throughout the industry, including the development of new licensing basis analyses. The most recent analyses that were submitted to the NRC in 1997 were prepared for Dresden, Quad Cities, and Brunswick.

3) Reactor Building Spray System
The reactor building spray system was analyzed conservatively using only the spray pump recirculation rate of 1112 gpm for the entire time spray removal credit for iodine is permitted. For calculation purposes, the spray mode of operation is one header at 1112 gpm for the permitted duration of iodine removal credit. The volume of the sprayed region is 65.2% of the total building free volume and the unsprayed volume is 34.8%.

The SPIRT Computer Code was used to evaluate the spray removal constants for elemental iodine. SRP 6.5.2 calculational methods were used to evaluate the spray removal constants for particulate iodine. Organic iodine remains airborne for the duration of the accident. Iodine removal constants derived in CR-3 calculation # I-86-0002, Revision 5 was used as input to this analysis. Additional inputs and assumptions for RB Spray analysis are found in Tables 3 and 4.

4) Control Room Emergency Ventilation System Recirculation Flow Rate
LER 97-022-00 identified that past modifications were implemented which added resistance to Control Complex Ventilation System ductwork without fully assessing the impact on recirculation flow rate. As a result, the system flow rate with clean filters is now somewhat lower than the 43,500 cfm nominal design flow rate. Previous calculations have assessed Control Room dose at values as low as 39,150 cfm (43,500 - 10%). A flow evaluation of current system performance has established a calculated minimum recirculation flow rate of 37,800 with 4" wg across fouled filters. This lower bound is conservatively taken forward for use in Operator dose calculations.

The 4" filter fouling value is less than the 6" currently reflected in the ITS and taken as the combined (HEPA and carbon) filter fouling limit. Current procedures constrain operation within 43,500 cfm +/- 5% and ensure that the 37,800 cfm minimum flow rate requirement for dose calculations is met.

Analysis of MHA with LOOP

SRP 6.4 identifies that locally high differential pressures at boundary damper locations within the control room ventilation system can have the effect of inducing significant leakage across the habitability boundary. The redundant dampers being installed at all CREVS boundary locations are tested to be bubble-tight at 15" wg, and effectively eliminates this concern for the CR-3 CCHE. Subsequently, the only mechanism of getting unfiltered outside air flow into the controlled environment following a LOCA with a LOOP would be to induce it by virtue of differential pressure across outside walls such as would be induced by wind pressure.

Wind speeds can be converted into differential pressure (Δp) in the following relationship:

$P_V = \Delta p = 0.00642\ \rho\ U^2$ inches of water column, where U is the wind speed in mph.

Air density "ρ" for this equation is conservatively taken as that at a temperature of 15° F, and is ($\rho_{15} = \rho_{70} \times T_{70} / T_{15}$ = 0.075 lb/ft^3 x 530°R / 475°R =) 0.0837 lb/ft^3.

The relationship between inleakage and differential pressure for a fixed resistance can be conservatively expressed as $Q = C(\Delta p)^n$, where Q is the inleakage flow rate in cfm, with the flow coefficient C taken as 1. For interpolation to values less than the test condition, the flow exponent "n" is conservatively taken to be 0.5. For extrapolation to values above the test condition, the use of n = 0.5 is non-conservative, and the more realistic value of n = 0.65 is taken from ASHRAE guidance. From this relationship the following equation can be obtained which determines corrected inleakage Qc at any differential pressure Δp_C based on test inleakage Q_T at the corresponding test differential pressure Δp_T:

$$Q_C = Q_T / (\Delta p_C / \Delta p_T)^n$$

Finally, substituting the results from tracer gas testing (462 cfm at 0.171" wg) yields the equation which predicts inleakage of the CR-3 CCHE at any differential pressure:

$$Q_2 = 462 \times (\Delta p_2 / 0.171)^n$$

Since wind pressures are assumed to be the primary motive force under MHA w/ LOOP conditions, inleakage for this scenario is determined by examining meteorological conditions associated with event analysis. SRP 6.4 methodology assumes post-accident meteorological conditions corresponding to the 5% χ/Q value during the critical initial stages of the event in order to minimize dispersion of the radioactive plume as it is carried from the containment building to the Control Complex. The methodology then allows for three incremental increases in wind speed and direction over the duration of the accident due to the extreme improbability that these initial wind conditions would be sustained over an extended period of time.

Based on these considerations, inleakage values are derived for each of the four time intervals over which χ/Q values vary by correcting inleakage at the test differential pressure to the differential pressure induced by the wind speed associated with that interval. These wind induced differential pressures were conservatively calculated using ASHRAE methods. Each of these inleakage values is an input into the appropriate interval in the revised radiological dose calculations such that the wind speed associated with plume dispersion corresponds to that which drives inleakage through the Control Complex boundary.

For the MHA w/ LOOP, it is noted that the use of low wind speeds provides relatively small motive force for inducing leakage through the CCHE. However, parametric studies show that, over the range of interest, increased wind speeds will tend to lower Control Room dose when it is applied uniformly to both χ/Q values and building differential pressure. It is also noted that, at these relatively low wind speeds, the potential effects of thermally induced inleakage becomes significant. Differential pressure across walls induced by differences in inside and outside temperatures (i.e., stack effect) can be pronounced in tall structures, as its magnitude is basically a function of the difference in temperatures across a wall and the difference in height from a given penetration to the building's neutral pressure level.

- The temperature gradient between the Control Complex and adjacent areas at the outset of an accident would be relatively small. Given a source term model wherein the majority of exposure occurs during the initial stages of the event, leakage induced by the stack effect would be minimal during this critical period.

- The neutral pressure level of a building wall tends to be towards the elevation containing the largest leakage area, or in the case of uniform leakage, at the vertical center of the building. The majority of CCHE penetrations are at or near the elevation of the cable spreading room, which is itself just below vertical center of the Control Complex elevation. Since the stack effect results in no appreciable differential pressure at the neutral pressure level and differential pressures which increase with distance from the neutral pressure level, the distribution of CCHE penetrations would tend to minimize the inleakage due to the stack effect.

- At higher wind speeds, the inleakage induced by wind pressure is dominant and stack effect pressure provides a lesser relative contribution to inleakage.

For MHA w/ LOOP, the contribution of stack effect to inleakage was conservatively considered by calculating stack effect pressures during both winter and summer conditions. A uniform temperature of 31 °F was assumed in adjacent areas for winter conditions, while 118 °F was used to assess summertime conditions. The Control Complex itself was assumed to remain at its design temperature of 75 °F. These values were conservatively assumed to remain constant for the duration of the 30 day accident. An average stack effect pressure was calculated, and inleakage associated with this value determined by application of relationship between building differential pressure and inleakage derived from tracer gas test results. This value was then combined with wind induced inleakage using an ASHRAE formula, with a 10 cfm allowance added for access/egress, as follows:

$$Q_{w+s} = (Q_w^2 + Q_s^2)^{0.5} + 10$$

The MHA w/ LOOP analysis also gave consideration to CCHE leakage which might be induced by localized high and low pressure areas induced within the CCHE boundary by the operation of the CREVS. Obviously, any leakage which occurs as a result of local high pressure areas within the CCHE would be outleakage, and of no concern with regard to control room dose consequence. It is also reasonable to assume that inleakage caused solely by virtue of low pressures within rooms or elevations of the CCHE due to ventilation system operation would be induced into the system return ducting.

CREVS distributes air through common supply and return headers. From the common headers, discharge and return branches service each elevation individually to provide heat removal for operating equipment. It is significant that the majority of CCHE penetrations exist on the lower elevations (from the cable spread room elevation down.) Therefore, a relatively small percentage of CCHE inleakage occurs on the control room elevation. Air leaking into lower elevations is induced into the ventilation return duct and passed through the carbon filters before reaching the control room. The assumption that a significant percentage of all CCHE inleakage is actually filtered would not be unrealistic. However FPC has treated all leakage due to wind pressure, stack effects, and access/egress as unfiltered inleakage. This is extremely conservative.

FPC has not quantified the leakage induced by operation of CREVS, however it is conservatively accounted for as follows. Inleakage induced by CREVS operation is assessed by including an additional penalty of 125 cfm of filtered inleakage. Given that testing was performed with CREVS in operation such that this effect existed at the time, classification of any portion of inleakage as filtered for this reason could be taken as a reduction in unfiltered inleakage. Instead, this filtered inleakage penalty is superimposed on unfiltered inleakage due to wind pressure, stack effects, and access/egress, and is applied for the entire 30 day duration of the event. This again is extremely conservative treatment of inleakage assumptions since the penalty for filtered inleakage is taken both directly in tracer gas test measurements and analytically superimposed again in dose calculations.

Analysis of MHA without LOOP

Given the occurrence of the MHA without a loss of offsite power, the ventilation systems in adjacent buildings are assumed to continue to operate during and after the accident. Increasing levels of radiation in the Auxiliary Building as sensed by radiation monitor RM-A2 would result in a trip of the Auxiliary Building Ventilation System (ABVS) supply fans, resulting in a significantly greater negative pressure in the Auxiliary Building. The Turbine Building is considered to be essentially at atmospheric pressure due to the numerous large openings in that structure. Under these conditions, the post-accident leakage into the Control Room could be significantly higher (especially during the early time steps) than that postulated on the basis of wind pressures (i.e., MHA w/ LOOP).

The release path for this scenario is based on the activity being released from the Containment and subject to initial dispersion as it travels to the Turbine Building Ventilation System intakes and into the Turbine Building. From that point it ultimately enters the Control Room as unfiltered inleakage by the differential pressure induced across the Control Complex. This release path model considers dilution into the large Turbine Building volume as well as minor decay and holdup while the activity is in the Turbine Building.

The evaluation of MHA without LOOP has four distinct changes from the version of the event which assumes LOOP:

(1) given that the ABVS must be in operation to induce the differential pressures of concern, then filtration by the ABVS carbon filters occurs and there is no requirement to assume an ECCS pump seal failure at 24 hours after the accident with a leak rate of 50 gpm for 30 minutes,

(2) the normal ECCS leakage which does occur is assumed to be filtered to 75% efficiency,

(3) the activity will enter the Control Room via the Turbine Building and as such will be subject to some delay due to the buildup and decay in the volume of the Turbine Building, and

(4) inleakage will be constant for the duration of the accident and will not be affected by the wind speed used in the dose analysis. This is conservative in that the wind direction necessary for transport towards the Turbine Building would tend to oppose inleakage through the CCHE towards the Auxiliary Building.

Temperature effects in this scenario are assumed to be insignificant given that continued operation of adjacent ventilation systems minimizes the temperature differentials between these areas and the Control Complex. The 75% efficiency assumed for the Auxiliary Building carbon filters is consistent with that recently allowed for these filters by the NRC in control room habitability analyses. Inleakage induced by CREVS operation is also ignored on the basis that conditions at the time of tracer gas testing are similar to those postulated under these post-accident conditions, such that this factor was present during the tests. As with the MHA w/ LOOP, analysis of this scenario assumes that inleakage is distributed evenly throughout the CCHE volume. CREVS design makes it probable that very little inleakage is introduced into the Control Room from the floors below it without being subject to filtration. Given this and other conservatisms in the analysis, the treatment of MHA without LOOP described above is considered to be a very conservative treatment of this scenario.

Results of MHA Analyses

The results of this analysis shows that the bounding version of the MHA is that associated with the accident occurring with LOOP. Calculations show that a 26.5 REM dose limit can be maintained in this scenario while allowing an additional CCHE breach area of up to 22.8 in^2. The 26.5 REM value corresponds with that in the Control Room Habitability Evaluation report dated June 30, 1987 (as referenced in the ITS Bases), and the NRC's SER in reply dated May 25, 1989. It is concluded that, given that CCHE breach areas are maintained below the value of 22.8 in^2, the level of CCHE integrity is sufficient to meet operability requirements pertaining to radiological consequences of the MHA.

Analysis of other DBAs

A review of other design basis accidents for which CR-3 is licensed was performed to verify that the MHA as analyzed above is the limiting event. This review was based on (1) a review of source terms, (2) a review of the means by which isolation of the CCHE is achieved, and (3) consideration of plant operating conditions (i.e., operating MODES) at the time of the event. This review found that the MHA source term exceeds that associated with all other DBAs as analyzed in Rev. 23 of the Final Safety Analysis Report (FSAR). However, MHA accident analysis assumes that CREVS boundary dampers are isolated essentially from the outset of the event by virtue of the 4 psi Reactor Building High Pressure Engineered Safeguards (ES) signal. Since other DBAs might not provide isolation by this signal, a review of events which could rely on the radiation monitor or operator action to isolate has been performed. Based on this review, a detailed analysis of the Steam Generator Tube Rupture event was performed which demonstrated that isolation of the CREVS was not necessary to maintain operator exposures less than regulatory limits. Further, given any reasonable isolation time either by the radiation monitor or operator action, the MHA remains the bounding event with regard to control room habitability.

The inputs, source terms and dose consequences of the SGTR, as analyzed, are presented in Tables 6 through 9.

Table 1 **Significant Core Iodine and Noble Gas Fission Products** **at the Start of a DB-LOCA(MHA)** **2619 MWT**			
ISOTOPE	**FISSION YIELD**	**Ci/MWT**	**REACTOR BUILDING T=0 AIRBORNE INVENTORY in Ci**
I-131	0.029	2.508E+4	6.5685E+7
I-132	0.044	3.806E+4	9.9679E+7
I-133	0.065	5.622E+4	1.4724E+8
I-134	0.076	6.575E+4	1.7220E+8
I-135	0.059	5.103E+4	1.3365E+8
KR-83M	0.0048	4.152E+3	1.0874E+7
KR-85	0.0029	4.102E+2	1.0743E+6
KR-85M	0.015	1.297E+4	3.3968E+7
KR-87	0.027	2.335E+4	6.1154E+7
KR-88	0.037	3.200E+4	8.3808E+7
KR-89	0.046	3.979E+4	1.0421E+8
XE-31M	0.0003	2.595E+2	6.7963E+5
XE-33M	0.0016	1.384E+3	3.6247E+6
XE-133	0.065	5.622E+4	1.4724E+8
XE-35M	0.018	1.557E+4	4.0778E+7
XE-135	0.062	5.363E+4	1.4046E+8
XE-137	0.059	5.103E+4	1.3365E+8
XE-138	0.0552	4.775E+4	1.2506E+8

TABLE 2 **List of Assumptions and Parameters to Model the Maximum Hypothetical Accident for Control Room Habitability Analysis**	
Parameter	**Value**
Thermal Power (MWt)	2619
Containment Free Volume (ft^3)	2.0×10^6
% Sprayed Volume (ft^3)	65.2(1.304×10^6)
% Unsprayed Volume (ft^3)	34.8(6.96×10^5)
Iodine Fraction Initially Dispersed In Sprayed Volume	0.652
Iodine Fraction Initial Dispersed In Unsprayed Volume	0.348
Air Turnover Unsprayed to Sprayed Volumes	23,200 cfm
Air Turnover Sprayed to Unsprayed Volumes	23,200 cfm
Fraction of Airborne Iodine Activity Released From the Core	0.25
Fraction of Airborne Noble Gases Released From the Core	1.0
Fraction of Sump Iodines Released From the Core	0.5
Elemental Iodine Species (%)	91
Organic Iodine Species (%)	4
Particulate Iodine Species (%)	5
Maximum Decontamination Factor For Removal of Elemental Iodines by Sprays	100
Maximum Decontamination Factor For Removal of Particulates	50
Maximum Decontamination Factor For Removal of Organics	0
Containment Spray Flow Rate-One Header (gpm)	1112
Spray System Actuation Time Post-LOCA(Seconds)	124
Iodine Removal Cutoff (hr)	4.4
Time to Sump Recirulation (Min)	29.95
Elemental Iodine Removal Constant hr^{-1}	20.46 (To a DF of 100)
Particulate Removal Constant hr^{-1}	2.21 (To a DF of 50)
Particulate Removal Constant hr^{-1}	0.221 (After a DF of 50 for 2.01 hours)
Containment Leak Rate (%/Day) 0-24 hr	0.25
Containment Leak Rate (%/Day) 1-30 Days	0.125
Recirculation Loop Leakage-Operational Leakage(cc/hr)	4510 cc/hr for duration of the accident
Recirculation Loop SRP Assumed Leakage	50 gpm for 30 Minutes Starting 24 Hours After Accident
Sump Liquid Volume Post-LOCA ft^3	45,902
Fraction of Recirculation Loop Leakage Flashing to Steam (%)	10

TABLE 3
Summary of Input Parameters Used for Iodine Spray Removal Analysis

Input Parameter	Value
Total Containment Free Volume	2.0×10^6 ft^3
Sprayed Containment Free Volume	65.2% (1.304×10^6 ft^3)
Unsprayed Containment Free Volume	34.8% (6.96×10^5 ft^3)
Spray Nozzle Type	SPRAYCO Model 1713A
Spray Distribution	See Table 2
Number of Drop Sizes	See Table 2
Mean Spray Fall Height-One Header Model	110.5 ft
Spray Flow Rate- One Header Model	1112 gpm
Collection Drop Efficiency	1
Elemental Iodine Partition Coefficient	Standard Review Plan 6.5.2
Normal Temperature at Which Spray Water is Stored	(40-100)°F
Maximum Post -Accident Sump Temperature	275°F
Laminar Boundary Layer Surface Area	4084 ft^2
Turbulent Boundary Layer Surface Area-One Header Model	57,708 ft^2
Water Wall Flow Fraction	0.1
ΔT Across Wall/Gas Boundary	1.0°F
Liquid Volume of Containment Sump	45,902 ft^3
Containment Wall Surface Area Impacted by Sprays-One Header Model	37,900 ft^2
Containment Radius	65 ft

TABLE 4
Spray Distribution for SPRAYCO MODEL 1713A Nozzle

Data Point No.	Drop Size (cm)	Relative Frequency (fraction)
1	3.75-3	.011
2	6.25-3	.027
3	8.75-3	.056
4	1.125-2	.105
5	1.375-2	.095
6	1.625-2	.080
7	1.875-2	.070
8	2.125-2	.051
9	2.375-2	.066
10	2.625-2	.044
11	2.875-2	.026
12	3.125-2	.022
13	3.375-2	.017
14	3.625-2	.020
15	3.875-2	.023
16	4.125-2	.011
17	4.375-2	.011
18	4.625-2	.015
19	4.875-2	.012
20	5.125-2	.013
21	5.375-2	.011
22	5.625-2	.016
23	5.875-2	.012
24	6.125-2	.008
25	6.375-2	.008
26	6.625-2	.007
27	6.875-2	.011
28	7.125-2	.009
29	7.375-2	.011
30	7.625-2	.009
31	7.875-2	.008
32	8.125-2	.007
33	8.375-2	.006
34	8.625-2	.006
35	8.875-2	.008
36	9.125-5	.006
37	9.375-2	.005

TABLE 4 (continued)
Spray Distribution for SPRAYCO MODEL 1713A Nozzle

Data Point No.	Drop Size (cm)	Relative Frequency (fraction)
38	9.625-2	.005
39	9.875-2	.005
40	1.013-1	.004
41	1.038-1	.005
42	1.063-1	.004
43	1.088-1	.005
44	1.113-1	.005
45	1.138-1	.005
46	1.163-1	.004
47	1.188-1	.005
48	1.213-1	.005
49	1.238-1	.007
50	1.288-1	.005
51	1.313-1	.002
52	1.338-1	.002
53	1.413-1	.001
54	1.438-1	.001
55	1.613-1	.001
56	1.738-1	.002

TABLE 5
List of Assumptions and Parameters Used to Model the Control Room for the Control Room Dose Habitability Analysis

Parameter	Value
Mode of Operation	Zone Isolation With Filtered Recirculated Air After 30 Minutes
Habitability Envelope Free Volume (ft^3)	364,922
Control Room Free Volume(ft^3)	88,000
Unfiltered Infiltration Rate (SCFM)	
0-8 hrs	153.0
8-24 hrs	247.0
1-4 days	377.0
4-30 days	832.0
Filtered Recirculation Flow Rate (SCFM)	37,800
Recirculation Carbon Filter Bed Depth (Inch)	2
Filter Efficiency for Iodines(%)	95
Control Room X/Q values (sec/m^3)	
0-8 hrs	9.00×10^{-4}
8-24 hrs	5.31×10^{-4}
1-4 days	2.03×10^{-4}
4-30 days	5.94×10^{-5}
Thyroid Dose Conversion Factors	ICRP-30
CR Breathing Rate m^3/sec	3.47×10^{-4}

Table 6

SGTR INPUT

Parameter	Value	Comments
Thirty Four Minute Isolation Time		
Source Term (34 min. Isolation Analysis)	-	
Reactor Coolant Pressure	2200 psia	
Average Temperature of the reactor coolant	579 F	
Volume of the unsprayed region	1 ft^3	Assumption for instantaneously release to atmosphere.
Volume of the sprayed region	1 ft^3	Assumption for instantaneously release to atmosphere.
Projected Containment area of wind wake	1852 m^2 or 19,933.2 ft^2	
Elemental Iodine Fraction	0.91	
Particulate Iodine Fraction	0.05	
Organic Iodine Fraction	0.04	
Control Room Volume	364,922 ft^3	
Purge flow rate to atmosphere	100 ft^3/min	Assumption for an instantaneous release to the atmosphere.
Control Room Breathing Rate	3.47E-04 m^3/sec	
Intake (c'/Q') 0-2 hour	9.0E-04 sec/m^3	
0-8 hour control room effective wind speed	1.2 m/sec	
8-24 hour control room effective wind speed	2.034 m/sec	
1-4 day control room effective wind speed	5.320m/sec	
4-30 day control room effective wind speed	18.182 m/sec	
occupancy factor	1.0	Incorporated into the Effective Wind Speeds
Unfiltered leakage into the control room	523 cfm	Calculated on CCHE differential pressure of 0.20 " wg.
Control room makeup air flow	5335 ft^3	Assumed design goal of 5700 cfm less the unfiltered leakage
Recirculation of air in the control room	37,800 cfm	
Iodine Partition Factor (0 - 34 minutes)	10^{-2}	Release factor through the steam relief valves
Iodine Dose Conversion Factors	ICRP30	
Gamma Correction Factor for Control Room Dose	0.0	POSTDBA Default Values.

Primary to Secondary Leakage through affected Steam Generator	435 gpm	
Primary to Secondary Leakage through unaffected Steam Generator	1 gpm	
Recirculation Filter Efficiency	95% for iodine species	
Eight Hour Isolation Analysis: Uses the above input and assumptions unless same variable is shown below.		
Eight hour isolation source term	-	
Iodine Partition Factor (0 - 34 minutes)	10^{-2}	Release factor through the steam relief valves
Iodine Partition Factor (34 minutes - 8 hours)	10^{-4}	Release factor through the condenser

Table 7

Steam Generator Tube Rupture Source Term
(Both Analyses)

Isotope	Concentration mCi/ml
Kr-85m	1.54
Kr-85	8.94
Kr-87	0.84
Kr-88	2.69
Xe-131m	2.40
Xe-133m	2.79
Xe-133	250.0
Xe-135m	0.93
Xe-135	5.96
Xe-138	0.51
I-131	3.17
I-132	4.81
I-133	3.75
I-134	0.499
I-135	1.92

Table 8 Steam Generator Tube Rupture Activity Released		
Isotope	Activity Released (Ci) (34 min. Isolation)	Activity Released (Ci) (8 hour Isolation)
Kr-85	5.02E+02	7.08E+03
Kr-85m	8.64E+01	1.22E+03
Kr-87	4.71E+01	6.66E+02
Kr-88	1.51E+02	2.13E+03
Xe-131m	1.35E+02	1.90E+03
Xe-133m	1.57E+02	2.21E+03
Xe-133	1.40E+04	1.98E+05
Xe-135m	5.22E+01	7.37E+02
Xe-135	3.34E+02	4.72E+03
Xe-138	2.86E+01	4.04E+02
I-131	1.78E+02	2.51E+03
I-132	2.70E+02	3.81E+03
I-133	2.10E+02	2.97E+03
I-134	2.80E+01	3.95E+02
I-135	1.08E+02	1.52E+03

Table 9

SGTR ACCIDENT
CONTROL ROOM DOSE (REM)

(without CREVS isolation)

	Thyroid Dose	Wholebody
Thirty-four Minute Steam Generator Isolation	7.23 E-1	8.91 E-3
Eight Hour Steam Generator Isolation	8.14 E-1	1.03 E-1

(with CREVS isolation initiated by RM-A5)

	Thyroid Dose	Wholebody
Thirty-four Minute Steam Generator Isolation	3.20 E-2	7.31 E-3
Eight Hour Steam Generator Isolation	3.33 E-2	8.78 E-2

FLORIDA POWER CORPORATION
CRYSTAL RIVER UNIT 3
DOCKET NUMBER 50-302 / LICENSE NUMBER DPR-72

LICENSE AMENDMENT REQUEST (LAR) #222, REVISION 0
CONTROL ROOM EMERGENCY AND EMERGENCY FILTERS

ATTACHMENT E

COMPARISON OF INPUTS TO CONTROL ROOM HABITABILITY ANALYSES

ATTACHMENT E

COMPARISON OF INPUTS TO CONTROL ROOM HABITABILITY ANALYSES

Parameter	Value in 6/30/87 Submittal	Value in Current Analysis	Comments
Reactor Building Spray Actuation Time	71 seconds	124 seconds	Revision 3 to Calculation I86-0003 (dated 7/6/93) used a two minute RB spray delay time based on request from FPC. Since then I86-0003 has been revised several times and uses 124 seconds as a conservative RB actuation time. This value is obtained by using 120 seconds for RB spray actuation plus 4 seconds for RB pressure to go from 0 psig to 30 psig after a LOCA. More realistic values for RB Spray initiation time are found in Calculation M94-0004 Rev. 0 (dated 1/26/94), which determined the full RB spray actuation time from initiation, to diesel start, including block loading, pump starting, header fill time and time to reach full flow. Calculation shows RB spray A reaching full flow in 81.1 seconds and B train reaching full flow in 86.1 seconds. This calculation modeled the spray system completely and included all the maximum expected delay times.
Reactor Building Spray Flow Rate	1500 gpm	1112 gpm	In the 6/30/87 Habitability Evaluati[illegible]n, RB spr[illegible] v[illegible] described as full flow (3000 gpm), half flow (15[illegible]gpm). No differentiation was made between initial injection and recirculation flow rates. Reviewing OP-405 Rev. 31, RB Spray System, which was in effect in 1987, has recirculation spray flow set at 1150 gpm to 1250 gpm. Calculation I90-0022 Rev. 0, 3/12/91, determined that with RB spray controller set at 1500 gpm (during initial injection), the actual RB spray flow could be as low as 1397 gpm considering instrumentation error. In recirculation with RB spray controller set at 1200 gpm, the spray flow could be as low as 1112 gpm. Calculation I86-0002 Rev. 5, 1/16/96, determined containment spray removal constants using the new instrument error corrected flow values of 1397 gpm (injection phase) and 1112 gpm (recirculation phase). Spray constants associated with the lower value of 1112

			gpm is used in revised dose calculations. The instrument loop uncertainties for spray flow indication and control were being reviewed concurrent with performing the revised dose calculations. As a contingency, the revised dose calculation looked at a containment spray flow rate of 1000 gpm and found that it was essentially the same as the 1112 gpm case. The calculation concludes that containment spray rate of 1000 gpm can be tolerated. Balliet to Widell letter NOE97-2311 dated 11/11/97, shows that when spray is being supplied from the RB Sump, the actual flow may be 121 gpm below the indicated flow of 1200 gpm. Thus, the lowest value may be 1079 gpm.
Reactor Building Sump Volume	490,182 gal ($65,532\ ft^3$)	343,347 gal ($45,902\ ft^3$)	The habitability submittal assumes the liquid sump volume as 490,182 gallons (7.48 gal/ft^3 or 65,532.353 ft^3). Calculation I86-0003 Rev. 1, 5/2/91, referenced GCI calculation DC-5515-084-1-ME, Rev. 0, dated 3/26/90 that calculated new RB sump volumes based on eliminating NaOH tanks and switching to TSP baskets (MAR 88-05-01-01). New volumes were based on cubic feet and were referenced to 130° F. New volume was determined to be 500,718.7 gal or 66,941 ft^3. Calculation I86-0003 Rev. 6, 3/30/95, then switched to 45,902 ft^3 or 343,347 gallons. This figure was the output from Calculation M95-0007. An important design reference for Calculation M95-0007 was Calculation M95-0005, Minimum BWST Level to Prevent Vortexing Rev. 0. EOP-8 swaps from BWST to RB sump starting at 15'. An instrument error of 1.2' was used in BWST level calculations. EOP-8 requires swapping over when BWST is less than 15' and has to be complete by 7' to prevent BWST vortexing. (5.5' from Calculation M95-0005) These low level considerations reduced the amount of BWST water going into the RB sump significantly.
Reactor Building Sump Additive / pH	8.5	7 - 7.6	The 1987 habitability evaluation report contained spray solution pH Table 4.1-1, Results of Drawdown Analysis for a Minimum of 6.0 wt % Sodium Hydroxide in the Storage Tank. This table listed five RB spray cases with initial spray pH and time post-LOCA for spray pH to reach 8.5. The iodine removal constants were calculated using SRP 6.5.2 Rev. 1.

			BAW-2044, "Elimination of Containment Spray Additive", was a B & W study to determine how to convert to from NaOH storage tank to TSP. With TSP, the initial RB spray pH will be around 4-5 because that is the pH of the BWST water. After the water mixes with the TSP in the RB flooded level and RB spray is swapped to recirculation, then the RB spray water pH increases to the range of 7-7.6. FPC installed the TSP baskets by MAR 88-05-01-01. GCI revised Calculation I86-0002, Containment Spray Removal Constants (Iodine Removal) to Rev. 2 and calculated the CR-3 specific iodine removal constants using SRP 6.5.2 Rev. 2 methodology in 1991. I86-0002 Rev. 5, 1/16/96, recalculated the total containment spray iodine removal constants for 1397 (1500 gpm with largest maximum negative error) and 1112 gpm (1200 gpm with largest maximum negative error). These constants are considered to reflect current plant design and configuration, and are used in revised dose calcs.
MHA Source Terms	Based on TID 14844 and a power level of 2595 MWth	Based on TID 14844 and a power level of 2619 MWth	The higher power rating was incorporated based on recent licensing activities regarding a CR #3 power uprate. This action has not been completed, but the post-accident source term associated with the higher power rating has been incorporated into dose calculations. Since the source term is determined based on a per megawatt basis per TID-14844, the use of the larger MWth rating results in a source term slightly higher than that which would be predicted with the lower power rating. This is clearly a conservatism (not a USQ) given that the plant is still licensed to the lower value.
Auxiliary Building Filtration	0% efficient	0% efficient in LOOP events, 75% efficient in events for which power is assumed to be maintained.	By letter dated September 13, 1989 (3F0989-01), FPC submitted a revised licensing basis for the CR-3 Loss of Coolant Accident (LOCA) and the Makeup System Letdown Line Failure Accident (LLFA) offsite radiological consequences to eliminate the credit for the Auxiliary Building Ventilation System (ABV) due to lack of safety grade power. FPC re-evaluated the offsite radiological consequences of a LOCA using the same methodology for fission product release as that used to evaluate the CR-3 control room habitability in its June 30, 1987 habitability report (3F0687-16), i.e., no credit for Auxiliary Building filters.

			During calculational verification efforts relative to the Reactor Building (RB) flooding issue, FPC identified that the control room habitability dose is adversely effected by the change in RB flood volume. This affect was documented in FPC letter to the NRC dated June 4, 1990 (3F0690-04). The habitability report postulates a gross failure of a passive component which causes a 50 gpm leak for 30 minutes at 24 hours. It was considered that since CR-3 does have a filtration system associated with the areas containing the Engineered Safeguards (ESF) systems and passive failures such as that postulated to cause the 50 gpm leak have not been considered as part of the CR-3 licensing basis, the gross failure of a passive component would not be postulated in the CR-3 control room habitability dose analyses. Discussion with the NRC regarding the RB flooding issue and the adverse effect on control room habitability dose resulted in the FPC analyses including the postulated gross failure of a passive component causing a 50 gpm leak for 30 minutes at 24 hours with the ABV system in service with 75% efficient carbon filters for iodine removal (3F0690-06 and 3F0690-13). The NRC documented acceptance of this in its letter to FPC dated June 21, 1990 (3N0690-15) as an interim measure until the RB flooding issue was permanently resolved. Subsequent to replacement of Sodium Hydroxide spray additive solution with TSP baskets, calculations were performed which demonstrated acceptable dose sequences without the ABVS filters and credit for their operation was discontinued. In revised dose analyses, the ABVS filters are assumed to be operating for any event which assumes that the Auxiliary Building is at a high negative pressure. Under these conditions, the ABVS supply fans are assumed to be tripped and the exhaust fans discharging through the carbon filtration system and out the stack. Differential pressures across the CCHE on the order of 0.20" wg would be expected, which would result in leakages considerably higher than that associated with MHA/LOOP. However, given that the ABVS is assumed to be operating throughout the event, per SRP 15.6.5 no 50 gpm leak would be postulated at 24 hours into the event, and "normal" ECCS leakage would be subject to filtration. Thus, this scenario is well bounded by the MHA/LOOP scenario with respect to Control Room Habitability.

			In the event of a MHA w/ LOOP, no credit is taken for ABVS filtration for the duration of the 30 day accident period.
CREVS Flow Rate (recirc mode)	43,500 cfm	37,800 cfm	43,500 cfm is the original design flow rate of the CREVS, and is the value used to determine IPF in the 6/30/87 habitability report. Dose consequences were later evaluated at 43,500 - 10% (39,150 cfm) corresponding to the allowable range of operation found in ITS Section 5.6.2.12 relative to the filter test program. During a system readiness review it was recognized that previous modifications had been made which reduced system flow rate without adequately assessing the effect on CREVS. Revised dose analyses incorporate a value of 37,800 cfm, based on consideration of current system capabilities under dirty filter conditions.
CREVS Filtration Efficiency	95%	95%	Filtration efficiency has not changed, but filter testing has been upgraded to utilize more challenging criteria. Previous carbon testing was performed at 80 C at 30% RH, test program has been revised to evaluate carbon at 30 C and 90% RH. Criteria for inplace filter testing is penetration and system bypass of <0.05%.
CCHE / CR Volume	355,311 ft^3 / 85,573 ft^3	364,922 ft^3 / 88,000 ft^3	Original volumes were based on an internal memo from Gilbert. CCHE volume was estimated by calculating the volume of the entire envelope, then subtracting 10% for internal walls and contents. Updated volumes were calculated based on a room by room survey performed by S&L for use in Control Room heat up evaluations.
CREVS / CCHE Configuration	As described in the habitability report	As modified	Figures C-1 and C-2 provide a schematic of the pre- and post-modification configurations. Note that except as otherwise stated, pairs of dampers replacing a single damper receive the same control signals and act in unison, such that system logic is not changed. • Damper AHD-99, which brings supply air to the Ventilation Equipment Room is being removed and a permanent blank installed. New supply and return registers are installed in the ductwork (164' elevation) which will now serve as the ventilation for this area. This will eliminate AHD-99 as a potential source of inleakage. • Existing damper AHD-12, located in the supply duct to the CA, has been removed and replaced with two new bubble tight dampers, AHD-12 and

			AHD-12D. • Existing damper AHD-2, located in the exhaust duct to the outside, has been locked open and abandoned in place. Two new bubble tight dampers, AHD-2C and AHD-2E were installed in series in the exhaust path. AHD-2C will be normally closed. • The position of recirculation air damper AHD-3 will be established during the process of balancing the system for the normal operating mode. • Dampers AHD-1 and AHD-1D, located in the air intake duct, are being disabled and abandoned in place. Two new bubble tight dampers, AHD-1C and AHD-1E, have been installed in series on the inlet duct. Dampers AHD-1C, AHD-2C and AHD-3 will retain positioners which provide a manual override feature. This feature allows operators to position these dampers to modulate the outside airflow as required for purging smoke or other contaminants from the CCHE. • Mechanical Equipment Room Ventilation Air Handling Fans, AHF-21A/B and associated dampers AHD-24, AHD-25, AHD-26, and AHD-27 have been spared in place and the associated CCHE penetration sealed. This portion of the system originally exhausted air from the Mechanical Equipment Room, Elevator Equipment Room, lavatory, kitchen and toilet. This eliminates another potential source of inleakage into the CCHE. • New supply and return registers have been installed in the ductwork in the Mechanical Equipment Room. This will provide ventilation to this portion of the CCHE during both normal and recirculation modes. • A skid mounted air handling unit consisting of a fan and a charcoal filtration unit will be installed to ventilate the Elevator Equipment Room, lavatory, kitchen and toilet. This system is non-safety and non-seismic and will vent approximately 1,000 cfm by way of a field connection to a non-safety related (NSR) duct. This system will not create a penetration to the outside environment.

			• Small bore drain pipes penetrating the CCHE have been fitted with loop seals to prevent inleakage though the lines. These have been added to a queued work request in the work controls system which maintains CCHE drain line loop seals. • Vestibules have been installed over all CCHE boundary doors, and have been sealed to provide maximum leaktightness. These vestibules provide a means to test individual CCHE boundary door leaktightness, as well as reducing inleakage associated with CCHE access/egress. In addition to the above modifications, an extensive effort was undertaken to survey CCHE penetrations and seal as required to minimize inleakage. As a result of this work, it is concluded that conduit penetrations do not pose a significant liability to CCHE integrity. Penetrations associated with electrical cable banks were inspected and sealed to the extent feasible with existing procedures and materials, but some leakage paths remain through the interstitial spaces between individual cables. Additional work is being planned to improve the sealing of penetrations with the most significant leakage.
CCHE Inleakage	Estimated on the basis of summation leakage past CCHE boundary elements per SRP 6.4	Measured by tracer gas testing and analytically corrected to predict inleakage under postulated post-accident conditions	See detailed discussion pertaining to inleakage in Attachment D.
Dose Conversion Factors	ICRP2	ICRP30	The NRC Safety Evaluation of FPC's control room habitability is based on the "Control Room Habitability Evaluation Report" submitted to the NRC on June 30, 1987. At that time, ICRP-2 methodology was used for internal dose calculations. Revised methods for calculating organ dose and relating organ dose to whole body dose were published in ICRP-30, and endorsed for use in this country by the Environmental Protection

			Agency (EPA) in Federal Guidance Report #11. For the radionuclides of concern, use of ICRP-30 / Federal Guidance Report #11 dose conversion factors results in the accident thyroid dose to be ~30% lower than previously calculated. CR-3 Improved Technical Specifications (ITS) include specific activity limits for primary and secondary coolant, which is measured and reported as DOSE EQUIVALENT I-131. The ITS definition of DOSE EQUIVALENT I-131 specifies that the thyroid dose conversion factors used for this calculation shall be those from ICRP-30
Software			Accident Analysis Software (POSTDBA) Computer program POSTDBA is Sargent & Lundy proprietary software which performs radiological dose calculations and related analyses for the LOCA in a PWR or a BWR. POSTDBA was originally developed to calculate PWR control room (CR) and offsite doses in accordance with requirements and recommendations of Regulatory Guide (RG) 1.4, Standard Review Plan (SRP) Section 6.4, and SRP 6.5.2., and was revised and revalidated most recently in 1994. POSTDBA is constructed to allow the user to select the time steps and to control variable parameters for each time step. The variables include containment spray iodine removal rates; post-accident source release rates (iodine and noble gases) and any iodine filtration; χ/Q changes; CR parameters (makeup, inleakage, iodine removal, breathing rates, and occupancy factors); plus the fractions of elemental, particulate, and organic iodine released to the environment. The first and the following time steps can be used to vary most of the variables, and if needed, the first time step can be used to model a delayed release. This degree of user control allows other types of accidents to be analyzed. Similar to POSTDBA, Computer program AXIDENT is NUS - SCIENTECH proprietary software which performs radiological dose calculations and related analyses.