Florida Power
CORPORATION
Crystal River Unit 3
Docket No. 50-302
Operating License No. DPR-72

December 15, 1997
3F1297-39

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: Control Complex Habitability Envelope Request for Additional Information

Reference: FPC to NRC letter, 3F1197-09, dated November 10, 1997, "Control Room Habitability, NUREG-0737, Item III.D.3.4"

Dear Sir:

The purpose of this letter is to respond to a verbal NRC Request for Additional Information relative to the Crystal River Unit 3 (CR-3) Control Complex Habitability Envelope (CCHE). Per telephone conversation of December 8, 1997, the NRC requested a copy of the CR-3 Justification for Continued Operation (JCO) for the Control Room Emergency Ventilation System (CREVS) and the CCHE. A copy of Revision 3 of this JCO, dated December 6, 1997, is attached.

In the referenced letter, Florida Power Corporation (FPC) stated that the results of the CCHE inleakage testing and the revised calculational methodology would be used to demonstrate operability of the CCHE and CREVS prior to restart from the current outage. Consistent with the referenced letter, operability of the CCHE and CREVS has been demonstrated and is documented in the attached JCO. This JCO was prepared consistent with the guidance provided in Generic Letter 91-18, Revision 1, "Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Conditions."

The JCO states that a detailed analysis of the Steam Generator Tube Rupture (SGTR) event was performed and that the Maximum Hypothetical Accident (MHA) remains the bounding event with regard to control room habitability. FPC is preparing a revised Control Room Habitability Evaluation Report to support License Amendment Request #222, "Control Room Emergency Ventilation and Emergency Filters," and expects this report to confirm the conclusions reached in the attached JCO.

No new commitments are made in this letter. If you have any questions concerning this response, please contact Mr. David Kunsemiller, Manager, Nuclear Licensing at (352) 563-4566.

Sincerely,

Walter J Pike for

Robert E. Grazio, Director
Nuclear Regulatory Affairs

A003/1

REG:kdw
Attachment

9712170467 971215
PDR ADOCK 05000302
P PDR

xc: Regional Administrator, Region II
NRR Project Manager
Senior Resident Inspector

ATTACHMENT TO 3F1297-39

JUSTIFICATION FOR CONTINUED OPERATION
FOR THE
CONTROL ROOM EMERGENCY VENTILATION SYSTEM
AND
THE CONTROL COMPLEX HABITABILITY ENVELOPE

DEFICIENCY REPORT INSTRUCTIONS

Precursor Number:			PC 97-4355
Work Request:			N/A
Safety Class:	N/A	Code Class:	N/A

Repair, other than original design [X]

Use-As-Is [ ]

Interim Use-As-Is [ ] Expiration/re-evaluation date ______

Rework (only applicable for ASME Code Class 1, 2 or 3 components) [ ]

Engineering Justification:	SA/USQD Attached [X] N/A [ ]

See attached disposition JCO to PC

SDM – Steven D. McMahan, MC = M. CLARY

SYSTEM ENGINEER REVIEW: KENNETH L. ANDERSON K.L. Anderson 11-29-97

11/29/97 MC Robert J. L... MC 11/29/97 Robert J. Lone 11/26/97
Originator Date

SDM 11-28-97 Jack Wilkinson Jack Wilkinson 11/26/97
Verification Engineer Date

HBO 11/28/97 Harry B Oates SDM for HBO 11-29-97 HARRY B OATES 11/26/97
Engineering Supervisor Date

– N/A –
Quality Systems (as required) Date

– N/A –
ANII (as required) Date

Gregory Stanton 11/29/97
PRC Chairman (as required) Date

PRC Meeting Number 97-159

[signature] MNPO 12-8-97
ADNO or SRO (as required) Date

Note: Pages 4, 19, 21, 22 WERE REVISED AS A RESULT of PRC COMMENTS ON 11/26/97. M. Clary 11/29/97 MC

Pages 3, 6, 6A, WERE REVISED TO ADDRESS LICENSING COMMENTS M. Clary 11/29/97

DEFICIENCY REPORT
Re: PC 97-4355

CHANGE RECORD

CHANGE: N/A	***REASON:*** Original Issue	***DATE:*** 11/26/97
ORIGINATOR: Robert J. Lane *	***VERIFIER:*** Jack Wilkinson *	***SUPERVISOR:*** Harry B. Oates *

CHANGES

Page	Description
	N/A

* See original cover sheet (attached) for signatures.

Change: 1	*REASON:* Comments from 11/26/97 PRC Meeting	*DATE:* 11/28/97
ORIGINATOR: M. Clary *	*VERIFIER:* Steven D. McMahan *	*SUPERVISOR:* Harry B. Oates *

CHANGES

Page	Description
4	added ... "*(corresponding to a filter dP of 4" wg)*"
19	item 2) added "... In addition to satisfying current ITS testing requirements ..." item 9) changed NGRC to PRC
21 & 22	added information regarding spray flow rates: 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 are 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 ltr ser NOE97-2311 dtd 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 1079gpm.

CHANGE: 2	***REASON:*** Incorporate Licensing Comments	***DATE:*** 11/29/97
ORIGINATOR: M. Clary *	***VERIFIER:*** K. Anderson *	***SUPERVISOR:*** * Steven D. McMahan for Harry B. Oates

CHANGES

Page	Description
3	added ..." 3) CR-3 Operating License The CR #3 Operating License contains a requirement to maintain Control Room habitability as specified in the post-TMI requirements of NUREG-0737. However, there is no requirement for the measurement or evaluation of inleakage in accordance with specific requirements. 4) FSAR discussion ..."
6	Added "...See page 6A, that follows..."
6a	Inserted page that read ... " If a radiological accident were to occur which involved the release of radioactive material from the reactor or spent fuel storage area, the CR-3 Radiological Emergency Response Plan would be implemented. The plan provides for staffing the emergency response organization and establishing emergency response actions commensurate with the severity of the event. Actions required in the Emergency Plan Implementing Procedures include dispatching a Health Physics Technician to the Control Complex to monitor radiological conditions, and to provide radiological and meteorological data to the Dose Assessment Coordinator. The Health Physics Technician will perform radiological surveys within the Control Complex, including surveys for airborne radioactivity. Dose Assessment personnel use data collected from surveys to project expected personnel doses. Provisions exist in the Emergency Plan Implementing Procedures for considering administration of potassium iodide (KI) to personnel based on projected dose. A projected dose of 25 REM to an individual has been established as the threshold for considering administration of KI. Control room dose calculations contain very conservative assumptions

	regarding operator presence in the control room. For example, in accordance with the Murphy-Campe methodology it is assumed that the operator is present in the control room continuously for the first 24 hours, then 60% of the time for the next 3 days, and then 40% of his time for the remaining 26 days. Similarly, atmospheric conditions are assumed which channel the release of radioactivity toward the control complex at conditions which maximize the plume concentration, particularly in the first 24 hours of the scenario. Based on the conservatisms that exists throughout control room habitability dose calculations, no doses approaching GDC 19 limits are anticipated in a realistic accident. However, provisions exist in currently approved procedures to monitor actual and projected doses based on measured and observed conditions, and to control personnel exposure. Through the protective features of the control complex evaluated in the control room habitability calculations, and the established emergency response procedures, protection of the control room operators is assured.

CHANGE: 3	REASON: Incorporate NGRC Comments	DATE: 12/6/97
ORIGINATOR: M. Clary M. Clary	VERIFIER: Jack Wilkinson Jack Wilkinson	SUPERVISOR: S.D. McMahan for H.B. Dates S.D. McMahan PRC Chair. 12/8/97

CHANGES

Page	Description
1	Changed "multitude" to "number"
6a	Moved contents of page 6A into a new section in under Justification for Continued Operation. Now located under Additional Protective Features section 3. Dose Management. Deleted page 6A
19	Added a discussion regarding vestibules under new heading Additional Protective Features section 1. Vestibules. New section reads as follows: 1. <u>Vestibules</u> CCHE boundary doors represent a significant source of leakage into the CC. There are three double doors and three single doors. Vestibules were added to the three CCHE double doors in 1996, and have proven to be effective in reducing differential pressure across the existing doors. Reducing the differential pressure exerted on the boundary doors has two benefits. First, lower differential pressure reduces leakage around the doors, and second, lower differential pressure allows the door closers to perform more reliably. During this outage, vestibules were added to the single CCHE boundary doors. All of the vestibules have additionally been sealed at interfaces with the CCHE boundary making the enclosures more effective in reducing CCHE boundary door leakage. Control Complex tracer gas testing was performed with the vestibule doors blocked open to assure that the test was conservative. Blocking open the vestibule doors increased conservatism in two ways. First, normal access and egress was permitted during the tracer gas leakage testing which contributed to the measured leakage. Dose calculations

	performed in accordance with standard methods include a factor of 10 cfm of continuous leakage to account for access and egress during an accident. This factor was added to the measured inleakage in performing CR-3 dose calculations. Therefore, the effect of leakage during access and egress was applied twice. In a real event the vestibules would not be blocked open. Since they function similar to an airlock, they would be effective in reducing leakage during access and egress. The second manner in which maintaining the vestibules open during the test was conservative is that the existing boundary door was the only barrier to leakage during the test. In an actual event the vestibule doors would be in their normal closed positions, and would be effective in reducing infiltration into the CCHE through the doors. This feature would be particularly effective in reducing operator dose during the MHA without LOOP scenario where leakage is induced from the Turbine Building into the CCHE due to operation of the ABVS.
19	Added a discussion regarding Auxilary Building filtration under new heading Additional Protective Features section 2. Auxilary Building Filtration. New section reads as follows: 2. <u>Auxiliary Building Filtration</u> Performing dose calculations in accordance with the requirements of NUREG-0737 Item III.D.3.4, Control Room Habitability, includes assuming source terms specified in Standard Review Plan 15.6.5. One aspect of this for a plant that does not have an "ESF atmosphere filtration system," is leakage of 1500 gallons of water contained in engineered safeguards piping outside of containment must be assumed 24 hours following the accident. This amounts to leakage into the Auxiliary Building (AB) of highly contaminated water from the reactor building sump. An ESF atmosphere filtration system is like the CR-3 ABVS with HEPA and carbon filters, however it is required that an ESF system be powered from an onsite power source. Since the ABVS is not powered from an onsite power source, CR-3 control room dose calculations include the required leakage term. This term is responsible for approximately 8 REM of the projected individual control room operator dose of 26.3 REM during the MHA with LOOP scenario. The CR-3 ABVS has redundant fans and filters which are operated continuously during normal operation. Therefore, the system must be maintained in good operating condition. The filters are tested and maintained in accordance with approved procedures that implement regulatory guidance on emergency filter systems. As such, filter efficiency is routinely verified by carbon filter media testing. Evaluations of the FPC power grid performed for station blackout concerns have demonstrated a

	high degree of reliability. Studies have shown that power should be restored to the site in under eight hours following a loss of offsite power due to disturbances on the grid. Therefore, there is a high degree of assurance that the ABVS will be available and capable of performing effectively to reduce radioactivity released from the AB following an event. Calculations show a near linear relationship between AB source term and operator dose. Therefore, using a conservative ABVS filtration efficiency of 75% would result in a dose reduction of approximately 6 REM (8 REM contribution X 0.75 = 6 REM reduction) from the 26.5 REM projected dose for the MHA with LOOP scenario. This reduction in dose is applicable only to the MHA with LOOP analysis. 75% efficiency for ABVS carbon filters has been previously accepted for CR-3 as an interim measure during resolution of reactor building flood level issues, and is already credited in the analysis for the MHA without LOOP.
9	Added "...(NOTE: The isolation dampers were tested in-place and the test boundary exhibited insignificant leakage.)..."
13	Added "...in addition to that measured by the tracer gas leak test..."
13	Reworded sentence to read "...Since other DBAs might not actuate this signal, a review of events has been performed which rely on automatic radiation detection or operator action for isolation..."
21	Summary / Conclusions item 9) required DBA control Room Operator dose analysis to be reviewed and verified prior to NGRC approval of JCO. This action was complete so it was deleted from list.
21	Summary / Conclusions item 7) required administrative controls to fill loop seals prior to Mode 4. This was complete so it was deleted from the list.

JUSTIFICATION FOR CONTINUED OPERATION FOR THE CONTROL ROOM EMERGENCY VENTILATION SYSTEM AND THE CONTROL COMPLEX HABITABILITY ENVELOPE

(Including Mode Change to Start-up and Power Operation)

DESCRIPTION AND PURPOSE

System Readiness Reviews conducted in 1997 during the CR-3 Design Basis Outage identified several issues which potentially impacted control room habitability. A number of actions have been undertaken to address these concerns and significantly improve the level of protection provided for the control room operator. These include (1) modifications to reduce CCHE inleakage by improving the integrity of boundary elements (Ref. 1), (2) CREVS design changes to provide alternate means of mechanical equipment room ventilation and to improve system reliability, and (3) programmatic changes to ensure that the assigned efficiency of the Control Complex charcoal filters is consistent with regulatory guidance (Ref. 2).

The modifications and design changes discussed above 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. The determination of CCHE inleakage and the application of inleakage in dose calculation differs significantly from previous methodology. These differences have been determined to constitute a USQ as stated in an informational report to the NRC on the subject of Control Room Habitability dated 11/10/97 (ref. Docket Letter 3F1197-09). This report stated that a License Amendment Request would be forthcoming from FPC to address this issue. However, as the time required for review and approval of the LAR is not expected to support the unit restart schedule, a Justification for Continued Operation is being prepared to address the safety significance of this USQ and ascertain the acceptability of restart in the interim per the guidance of Generic Letter 91-18, Rev. 1. The specific issues addressed in this JCO are (1) the operability of the Control Room Emergency Ventilation System, and (2) the integrity of the Control Complex Habitability Envelope.

SAFETY CLASSIFICATION

CREVS is credited with providing environmental control for personnel comfort and equipment operation, as well as with the protection of control room personnel during radiological and toxic gas events. It is considered to be a safety related system. CCHE integrity is needed to support CREVS in the role of control room personnel protection, but is not considered safety related. The Control Complex structure itself is seismically qualified and considered safety related, but many of the elements of the habitability boundary (ie., doors, penetration seals) are not.

LICENSING BASIS

1) Licensing Background

In 1981, the NRC issued an order to FPC confirming the commitments for TMI related requirements applicable to CR #3. NUREG-0737, Item III.D.3.4, Control Room Habitability, was included in this order. In response to requirements pertaining to this item, FPC performed a comprehensive habitability evaluation of the CR#3 control room and eventually submitted its findings in the form of the revised CR#3 Control Room Habitability Evaluation" report, dated 6/30/87. This report concluded that the Maximum Hypothetical Accident was the limiting event with regards to Control Room Habitability and that thyroid dose was the most challenging criteria. Based on methodology *consistent with* SRP 6.4 guidance, the habitability evaluation found that the MHA would result in a thyroid dose of 26.5 REM. Subsequently, the NRC issued an SER on the findings of the habitability report, stating that the 26.5 REM thyroid dose was less than the 30 REM regulatory limit, and was therefore acceptable. This 26.5 REM thyroid limit is currently taken as the acceptance limit at CR #3 (Ref. 4).

2) ITS Requirements

Section 3.7.12 of the ITS addresses requirements pertaining to the Control Room Emergency Ventilation System, and requires that two CREVS trains shall be operable during MODES 1,2,3 & 4, as well as during the movement of irradiated fuel. The LCO associated with one CREVS train inoperable provides for restoration of the out of service train within 7 days, or be in MODE 3 within 6 hours and MODE 5 within 36 hours. If movement of irradiated fuel assemblies is in process, then CREVS is to be placed into emergency recirculation mode immediately or movement of irradiated fuel suspended immediately. With both trains of CREVS inoperable the plant must enter LCO 3.0.3.

The ITS bases for Section 3.7.12 discusses operation of RM-A5 in support of CREVS, as well as isolation during toxic gas events. It states that the Maximum Hypothetical Accident is the limiting event with regard to Control Room Habitability in MODES 1,2,3 & 4, and provides a general reference to the "Control Room Habitability Evaluation" report dated June 30, 1987 in this regard. The Fuel Handling Accident is identified as limiting in MODES 5 & 6. The ITS bases also state that CREVS 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 10CFR50, Appendix A. Notably, no reference or commitment is provided in the ITS or its Bases to SRP 6.4, "Standard Review Plan for Control Room Habitability". There are no specific requirements regarding CCHE inleakage included in either the ITS or its Bases. Beyond the aforementioned general reference to the "Control Room Habitability Evaluation" report, no discussion or reference is given either on the quantity of inleakage allowable or the manner in which inleakage is determined and applied. It can be considered an implicit requirement that the integrity of the CCHE be demonstrated as adequate to support CREVS in maintaining operator exposure within regulatory limits.

ITS Section 5.6.2.12 defines requirements pertaining to the Ventilation Filter Testing Program at CR #3, and requires that the CREVS filtration units meet minimum requirements regarding penetration, bypass and adsorption. This program requires that inplace testing be conducted which verifies the performance of the CREVS filtration system at a flow rate of 43,500 cfm +/- 10%, and that the pressure drop across the filtration unit be less than 6" wg when operating in this range.

3) CR-3 Operating License

The CR #3 Operating License contains a requirement to maintain Control Room habitability as specified in the post-TMI requirements of NUREG-0737. However, there is no requirement for the measurement or evaluation of inleakage in accordance with specific requirements.

4) FSAR discussion

Section 7.4.5 of the FSAR (Rev. 23) provides information on the elements of control room habitability at CR-3. Specific items discussed include:

- licensing background, including reference to the NUREG-0737, Item III.D.3.4 (Control Room Habitability Requirements), the June 30, 1987 CR-3 Control Room Habitability Evaluation Report, and the May 25, 1989 SER on the same subject

- discussion on allowable CCHE breach area

- discussion on CCHE inleakage, including specific reference to comparison with 0.6 air change per hour criteria

In addition to the above, evaluation of the radiological dose consequences of the MHA and other DBAs are found in Chapter 14 of the FSAR. The consequences of the MHA are presented in section 14.2.2.5.10 and Table 14-54, which reflect a control room operator dose consequence of 22.7 REM based on previous analyses. This section also includes specific discussion of inputs into control room operator dose calculations, including CCHE inleakage, assumptions for ECCS leakage, ABVS filtration efficiency (0%), and post-accident meteorology. Chapter 14 also provides tabulated source terms associated with other DBAs, although no other accidents are specifically assessed with regard to control room habitability.

IMPACT ANALYSIS AND RELIABILITY CONCERNS

CCHE integrity and CREVS performance are primary inputs into the evaluation of control room habitability. The 26.5 REM limit found in the habitability report and the NRC's SER on this subject are based on assumptions regarding these parameters. No specific value for CCHE inleakage is found in the ITS or CR #3 Operating License, but it is implicit that CCHE integrity must be such that dose limits are not exceeded. ITS Basis 3.7.12 does provide a reference to the habitability evaluation report only in identifying that the MHA is the limiting DBA from the standpoint of control room dose consequence, but does not list or reference any specific inputs or assumptions contained in the report. Therefore, revised analyses could change inputs into the Control Room Habitability Evaluation report such as the determination and application of inleakage without affecting the ITS or its Bases, so long as it did not invalidate the conclusion that the MHA is the limiting DBA of record.

ITS Section 5.6.2.12 defines requirements pertaining to the Ventilation Filter Testing Program at CR #3. This program requires that inplace testing be conducted which verifies the performance of the CREVS filtration system at a flow rate of 43,500 cfm +/- 10%, and that the pressure drop across the filtration unit be less than 6" wg when operating in this range. Requirements for the Ventilation Filter Testing Program as implemented by CP-148 require that inplace testing be performed at flow rates within 43,500 cfm +/- 5%, with the tighter limits being conservatively imposed for testing inaccuracies. Revised dose calculations have been performed considering a flow rate of 37,800 cfm, (*corresponding to a filter dP of 4" wg*), which is well below the 41,325 cfm corresponding to the lower end of this range. The impact of this lower flow rate on CREVS operability requirements and control room dose consequences must be evaluated. Also, the apparent disparity between the design flow rate in the ITS and CREVS performance with current plant configuration must be reconciled.

DESCRIPTION OF IDENTIFIED CONCERN

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. CCHE integrity and CREVS performance are primary inputs into the evaluation of control room habitability. The 26.5 REM limit found in the habitability report and the NRC's SER is based on specific assumptions regarding these parameters. The June 30, 1987 habitability report evaluated CCHE integrity based upon calculation methods found in SRP 6.4, which determined that up to 355 cfm of inleakage could be tolerated without exceeding the licensing dose limit. Of this, 285 cfm was assumed to be through unfiltered pathways, and 70 cfm was assumed to be filtered inleakage through inlet dampers AHD-1 and AHD-1D. This value of inleakage was applied as a constant in control room operator dose calculations. Testing identified that, contrary to the assumptions found in the Control Room Habitability Evaluation report, differential pressures across the CCHE inlet dampers was such that leakage was occurring outward, which would correspond to a like amount of unfiltered inleakage at other boundary locations. In addition, differential pressures at all boundary locations differed from that assumed to the extent that leakage less the 355 cfm limit could not be conclusively demonstrated. This condition was reported to the NRC in LER 97-022.

Prior to the current analysis, inleakage was assessed on the basis of guidance found in SRP 6.4, to which FPC is committed "for guidance" only. Using this method, inleakage was assessed by summing the calculated leakage past CCHE boundary elements (ie., doors, penetrations) at a differential pressure of 1/8" wg, then dividing the result by two. Additional "enhancements" were made for inleakage past ventilation system boundary dampers which might be operating at a higher differential pressure and for access / egress. This inleakage value was then applied non-mechanistically into dose calculations to determine operator exposure.

Integrated inleakage testing has been performed to provide an assessment of CCHE integrity. This integrated testing used tracer gas methods to directly measure building inleakage while operating in the post-accident alignment. If a non mechanistic baseline inleakage value were obtained by correcting the tracer gas test results to 1/8" wg, and this value applied as a constant value in dose calculations (as was done previously), the acceptance limit for dose would be exceeded. To calculate dose based on test results, FPC developed a model which predicts inleakage under various differential pressure conditions and so can assess mechanistically induced inleakage under postulated post-accident conditions. The measurement of inleakage and its mechanistic application in dose calculations is a significant change from previous methodology and is expected to produce a result which is more realistic, but might be less conservative. This issue has been determined to represent an unresolved safety question, and is the primary focus of this JCO.

LER 97-022 also identified that past modifications were implemented which added resistance to Control Complex Ventilation System ductwork without fully assessing the impact on recirculation flow rate (Ref. 6). As a result, the system flow rate with clean filters is now somewhat lower than the 43,500 cfm nominal design flow rate referenced in the habitability evaluation and used as an input to obtain the 26.5 REM limit. Subsequent dose calculations have addressed flow rates as low as 39,150 cfm (43,500 - 10%), but evaluation of current conditions predict flow rates on the order of 37,800 cfm assuming 4" wg drop across fouled filters. It is noted that the 4" filter fouling value is less than the 6" currently reflected in the ITS and taken as the combined (HEPA and charcoal) 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. However, the use of a filter fouling limit which is less than ITS requirements must also be assessed.

Finally, numerous changes to assumptions / inputs associated with Control Room Habitability have been implemented under 10CFR50.59 since the habitability report was issued in 1987. Generally, these changes have been assessed individually at the time of their implementation, but without updates to the habitability report to maintain this licensing document consistent with plant design on a real time basis. This JCO includes a matrix which lists the former and current values of habitability evaluation inputs, identifies the iterations associated with each parameter up to the present point in time, and provides a brief discussion for the basis and acceptability of each change.

OPERABILITY EVALUATION

The activities associated with Restart Issue R-12 have improved the performance of CREVS and the CCHE in assuring control room habitability. Redundant bubble-tight dampers have been installed which assure positive closure of ventilation flow paths. Vestibules have been installed on all CCHE boundary doors which provide an extra measure of leak resistance and provide defense in depth for normal operation and wear. An extensive penetration sealing program was conducted to improve boundary leak tightness. Leakage of the habitability envelope has been accurately measured under actual operating conditions using tracer gas test methods.

The modifications and efforts driven by resolution of R-12 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 *(ie., Reg. Guide 1.4 source terms, RB modeling per SRP 6.5.2, meteorology per Murphy Campe).* However, many of the inputs found in the Control Room Habitability Evaluation report have been superceded on the basis of actions associated by R-12, and still others have been revised under 10CFR50.59 since its submittal in 1987. A detailed comparison of significant inputs into current Control Room Habitability analyses vs. those found in the 1987 habitability evaluation report is provided in Table A to this JCO. Notably, the methodology for determination of CCHE inleakage and the manner in which inleakage values are applied in dose calculations is a significant change from previous methodology, including that described in the Control Room Habitability Evaluation report.

Previous dose calculations were based on a model defined in NRC regulatory guidance which determines inleakage at a Control Complex pressure of 1/8" wg., then applies this inleakage as a constant value in dose calculations. This model is a good correlation for more common control room designs which rely on taking contaminated air from outside the envelope, filtering it, and then using this filtered air to pressurize the control room. In this case, pressurization of the habitability envelope to a nominal value of 1/8" is used to prevent inleakage, and is generally accepted as being high enough to overcome the effects of wind, thermal effects, and operation of ventilation systems in adjacent structures. This model does not correlate well to the CR-3 habitability envelope, which is a filtered recirculation system with isolation (no makeup). In this design the bulk pressure in the envelope is neutral, and the 1/8" differential pressure in the NRC's model is used to drive inleakage across the envelope boundary. The quantity of inleakage induced in this manner is used to develop a baseline inleakage value for use in control room operator dose calculations.

FPC has developed its own model for determining CCHE inleakage for the purpose of input into control room operator dose calculations. This model is based on more realistic, but still conservative, considerations of the actual motive forces which would exist for driving inleakage under postulated post-accident conditions. The use of this model is a significant departure from previous methodology and is not described in regulatory guidance, and is considered to be an unreviewed safety question on that basis. The existence of an unreviewed safety question does not necessarily mean that an activity or system condition is unsafe. Rather, it is necessary for FPC to evaluate the safety of the condition and to assess its implications on unit restart as provided in Generic Letter 91-18, Rev. 1. As detailed within this JCO, FPC and its contractors have reviewed the treatment of CCHE inleakage in control room habitability calculations and concluded that the change in methodology is safe and that CREVS operability and CCHE integrity are not compromised. Ultimate resolution of the unreviewed safety question requires either approval by the NRC or placing the system in a condition which has been reviewed.

JUSTIFICATION FOR CONTINUED OPERATION

Relative to the issue of control room habitability, justification for continued operation in all operating MODES is based on establishing the operability of the CREVS and the adequacy of CCHE integrity. Additionally, the existence of other mitigation features, such as vestibules at CCHE boundary doors, source term reduction by the Auxiliary Building filters, and Radiological Emergency Response Plan dose management procedures provide additional assurance of control room personnel protection. A discussion of the basis for operability of the CCHE follows:

CREVS Operability

Operability of CREVS requires that the specific requirements of ITS Sections 3.7.12 and 5.6.2.12 are satisfied and that the bases for these technical specifications are not invalidated. Surveillance Activities required to demonstrate CREVS operability include (1) operating each CREVS train for at least 15 minutes each month, (2) satisfying the ventilation filter testing program, and (3) verifying that each CREVS train actuates to the emergency recirculation mode on an actual or simulated actuation signal every 24 months. Of these criteria, the first and last will be included in post-modification testing associated with damper replacement. The second criteria refers to the requirements of the ventilation filter test program defined in ITS Section 5.6.2.12.

The ventilation filter test program requires that the CREVS filtration units meet minimum requirements regarding penetration, bypass and adsorption. Section 5.6.2.12 of the ITS also requires that the pressure drop across the combined HEPA and charcoal filters be demonstrated as no more than 6" wg when tested at a system flow rate of 43,500 cfm. LER 97-022 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. This is evident in a recent flow evaluation of system performance which a calculated recirculation flow rate of 37,800 cfm with 4" wg across fouled filters.

The use of 4" wg filter fouling limit is less than the 6"wg value currently reflected in ITS section 5.6.2.12 and taken as the combined (HEPA and charcoal) filter fouling limit. Since a 4" wg differential pressure across the filtration unit is expected to correspond to 37,800 cfm, it follows that the flow rate associated with the 6" fouling limit would be lower still. However, current surveillance procedures constrain operation to flow rates at or greater than 41,325 cfm (43,500 - 5%). Operation within this constraint has the effect of limiting filter fouling to a much tighter range than even 4" wg, and ensures both that the level of filter fouling is within the 6" wg ITS limit and that the 37,800 cfm minimum flow rate postulated for dose calculations is met. License Amendment Request, LAR #222 addresses this issue in the ITS, such that CREVS flow rate and allowable filter pressure drop are reconciled.

Reduced flow rate also has the potential to degrade CREVS equipment cooling capability. Issues pertaining to CREVS cooling capability are being addressed separately by Technical Specification Change Request Notice (TSCRN) #210, and are not included in this JCO.

This LER also identified that charcoal testing has been performed in the past using non-conservative temperature and humidity conditions. Charcoal adsorption capability increases with increasing temperature and decreasing humidity. Prior to this outage, laboratory charcoal testing has been performed at a 80 C and 70% RH. However, CREVS system readiness reviews determined that this criteria was *unconservative* with regard to possible post-accident conditions. To address this concern the ventilation filter test program is being revised to require laboratory charcoal testing at 30 C and 95% RH. Prior to restart, laboratory testing will be performed to both the old and new test conditions.

CCHE Integrity

Not a system per se, the CCHE is the physical boundary which is credited with protecting the control room operator from the effects of postulated DBAs or toxic gas events. The CR-3 control room ventilation system design is categorized according to SRP 6.4 as a zone isolation system with filtered, recirculated air. As such, it does not rely on pressurization to limit inleakage, but rather on leaktightness and filtration capability to provide the necessary level of protection. Operability of the CCHE is predicated on demonstrating a level of integrity such that, in conjunction with the operation of CREVS, sufficient protection is provided for the control room operator to ensure that exposure limits associated with DBAs and toxic gas events are not exceeded.

1) Inleakage determination

Previously, CCHE inleakage has been determined on the basis of methodology described in SRP 6.4, which provides a standard means by which to derive a "baseline" inleakage. The basic SRP 6.4 methodology for determining base inleakage in a recirculation system is to measure (or calculate) the air flow required to pressurize the habitability envelope to 1/8" wg, then divide the result by two. This method ensures that all penetrations are subject to test pressure and provides a conservative (but relatively arbitrary) baseline inleakage value. The 1/8" value is not associated with any particular post-accident conditions, but is large enough to minimize the impact of test inaccuracies and local pressure effects. The wind speed necessary to generate this differential pressure is on the order of 15 - 20 mph, much larger than the low wind speeds associated with the 5% worst χ/Q value used in SRP 6.4 to minimize source dispersion. SRP 6.4 test methods would include additional enhancements for inleakage through boundary dampers which may be subject to unusually high differential pressures, and a 10 cfm allowance for personnel access / egress during an accident. Since FPC is committed to SRP 6.4 only as a "guidance" document, there is no commitment to adhere to this methodology, nor is there any requirement to assess building inleakage at a differential pressure of 1/8" wg for the purposes of evaluating Control Room dose consequences.

Although not prescribed by regulatory guidance, application of tracer gas technology is recognized as a means to accurately and directly measure building inleakage and is being increasingly utilized in the nuclear industry for this purpose. 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. Determination of inleakage based on testing under simulated post-accident conditions is a departure from the existing licensing basis for CCHE inleakage, but is justifiable given that this methodology is expected to provide a more accurate prediction of dose consequences and that CR-3 is not committed to SRP 6.4 except as a guidance document. Tracer gas testing under post-accident conditions would have the Control Complex in its emergency recirculation mode, and treat the entire CCHE as a lumped volume. No additional penalty would be required at boundary damper locations because these dampers would be subject to the same pressures during testing as would be expected during post-accident operation. (Note that the latter effect is inconsequential for CR-3 given that bubble-tight dampers will be installed at all boundary isolation locations.) The use of a 10 cfm allowance for access / egress is still applicable, and would be incorporated into the final inleakage result.

Developing a test replicating post-accident conditions requires that the scenario be postulated which provides both realistic and challenging conditions from the standpoint of exposure to source term and maximizing the differential pressure which drives inleakage. The postulated conditions may result in a variance of differential pressure across individual CCHE elements, and are not intended to necessarily test all penetrations to a certain minimum differential pressure. Rather, the objective is to develop a test which realistically and conservatively gauges the overall consequence associated with the limiting post-accident scenario. The 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). 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. Therefore, to fully assess limiting post-accident conditions requires that both scenarios 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.

2) Test Conditions

The tracer gas test model is established based on consideration of site layout, source terms and possible plant operating conditions. In the event of a MHA w / LOOP, given that the vast majority of penetrations are either on the north (Turbine Building) or south (Auxiliary Building) walls of the control complex, it follows that north / south wind directions would tend to maximize CCHE inleakage. Similarly, with no loss of offsite power, the Auxiliary Building supply fans would be secured by radiation monitor RM-A2, causing the Auxiliary Building to develop a negative pressure and inducing leakage through the CCHE in that direction. In either case, the tracer gas test which models these conditions would utilize the Auxiliary Building Ventilation System to induce CCHE inleakage by creating a negative pressure in the Auxiliary Building. The following conditions were prescribed for the tracer gas testing which modeled CCHE inleakage:

- The Control Room Emergency Ventilation System (CREVS) was placed in emergency recirculation mode and operating normally. Both "Toxic Gas" and the "High Radiation" recirculation lineups were tested. All CREVS boundary damper locations were sealed "bubble tight" to duplicate post modification conditions. (NOTE: The isolation dampers were tested in-place and the test boundary exhibited insignificant leakage.)
- All fans in the Turbine Building Ventilation System were secured. The turbine building normally remains well vented to atmosphere through normally open doors, roll out windows and roof vents.
- All fans in the Intermediate Building Ventilation System were secured. Note that conditions in the Intermediate Building are not deemed critical to the test in that relatively few penetrations are on the CCHE / Intermediate Building Wall.
- The Aux. Building Ventilation was operated to test pressure of approximately 0.171" wg negative pressure vs. the Turbine Building. This value is large enough to minimize test inaccuracies and external effects and was sustained for the duration of the test.
- The test was conducted on backshift when personnel traffic is minimized. Since a 10 cfm allowance for access / egress would be analytically applied, minimizing traffic precludes additional penalization for this effect.
- Testing was conducted with vestibule doors blocked open. This conservatively assumes no credit for the additional integrity provided by vestibules.
- All loop seals penetrating the CCHE were verified to be filled prior to testing. Controls are in place to ensure that these loop seals are periodically filled during plant operation.

Tracer gas testing conducted under these conditions measured an inleakage of 462 cfm in emergency recirculation mode at a differential pressure of 0.171" wg. Using this information, the inleakage at other differential pressures can be predicted by the use of the formula

$Q = C \triangle P^n$, where
Q = air flow in cfm

C = inleakage coefficient
P = differential pressure, and
n = flow exponent.

According to ASHRAE, values of n are typically between 0.6 and 0.7. Values less than 0.171 are estimated by using n = 0.5, which gives conservative results for estimating inleakage at pressures less than the test value. For extrapolation to conditions above 0.171" wg, the use of n = 0.5 is somewhat unconservative, and a more realistic value of n = 0.65 is chosen.

3) Analysis of MHA w / LOOP

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 provide 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. Although the CCHE is a relatively tall structure, the following considerations tend to minimize the impact of this phenomenon on control room operator dose consequence:

- 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 relatively small 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 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 taken 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 to wind induced inleakage using the ASHRAE formula

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

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 ventilation system. 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 dose control room consequence. It is also reasonable to assume that inleakage caused by virtue of low pressures created within the CCHE by the ventilation system would be induced into the system return ducting, and thereby be considered filtered inleakage. Traverse measurements taken during tracer gas testing show that significantly more supply air is directed into the Control Room elevation than that removed by return ducting, resulting in this area being slightly positive with respect to bulk CCHE pressure and, more importantly, to the cable spread room elevation immediately below it. This is significant in that the majority of CCHE penetrations and leakage areas exist on the lower elevations (from the cable spread room elevation down). It follows that a relatively small percentage of CCHE inleakage occurs on the Control Room elevation, and that very little inleakage occurring on the floors below the Control Room elevation is introduced into the Control Room except by virtue of the ventilation system, where it would be filtered in the process. The assumption that a large percentage of all CCHE inleakage is actually filtered would not be unrealistic on this basis. Since the filtration system is considered to be 95% efficient, neglecting these considerations is an extremely conservative treatment of CCHE inleakage.

It can be readily seen that treating all CCHE inleakage as unfiltered is a extremely conservative posture. In revised control room operator dose calculations, 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, stack pressures 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.

4) 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 larger 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 (ie., 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 charcoal 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 Aux. Building charcoal filters is consistent with that recently allowed for these filters by the NRC in control room habitability analyses. (ref. discussion on the ABVS in Table A) 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 in the tests. As with the MHA w / LOOP, analysis of this scenario assumes that inleakage is distributed evenly throughout the CCHE volume, even though test data substantiates 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.

5) 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 in addition to that measured by the tracer gas leak test. 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 29, 1989, and is taken as the acceptance limit at CR-3. 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.

6) 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 (ie., 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 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 ES signal. Since other DBAs might not actuate this signal, a review of events has been performed which rely on automatic radiation detection or operator action for isolation. 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 below:

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 (χ /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	Caculated 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

Steam Generator Tube Rupture Source Term (Both Analyses)	
Isotope	Concentration µCi/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

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+0	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

SGTR ACCIDENT
CONTROL ROOM DOSE (REM)

(without isolation)

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

(with isolation initiated by RM-A5)

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

7) Analysis of Toxic Gas Events

CCHE integrity is also required to provide protection to the control room operator in the event of a toxic gas accident. Reg Guide 1.78 provides information and assumptions for assessing toxic gas accidents with regard to control room habitability. From this document comes the basic criteria that, in the event of a toxic gas accident, appropriate toxicity limits not be exceeded in the control room 2 minutes after initial detection in order to allow the operator adequate time to take action (ie., don an air pack) prior to being overcome. The reg guide allows for detection to be accomplished by personnel (nasal detection) or with automatic detection equipment. CREVS isolation, if required, can be attained either by operator action or by an automatic signal from toxic gas detectors. At CR-3, AP-513 provides the appropriate instructions for the operator in the event of a toxic gas accident, including the use of air packs.

Based on previous evaluations, the locations and quantities of toxic gas storage sites at CR #3 which pose a potential liability to control room habitability and must be specifically addressed are listed below:

Toxic Gas container Size and Location

Toxic Gas	Helper Cooling Towers	CR1/2	CR4/5
Chlorine	17 tons	none	1 ton cylinders
SO_2	50 tons	45 tons	1 ton cylinders

The most limiting source of toxic gas is a SO_2 tank at CR1 which has been administratively limited to storage of 30 tons. I87-0005 Rev. 2, "Control Room SO_2 Concentration from CR1/CR2 SO_2 40 Ton Tank Failures", is the current calculation of record that analyzes this event. Case 1 analyzes a 30 ton tank rupture, with 5700 cfm make-up flow and a 30 second delay between attaining the detector's set point and the dampers reaching the closed position. Inleakage only develops after damper closure. In this scenario, the event is detected and recirculation is automatically initiated. The control room concentration 2 minutes after detection is 29 ppm, vs the 36 ppm limit previously established in the Control Room Habitability Evaluation report.

The following equation from NUREG-0570 converts gas concentrations at the air intake to concentrations in the control complex:

$$C_r(t_j) = C_r(t_{j-1}) + [C_0(t_j) - C_r(t_{j-1})](1 - EXP^{-WdtaT/V})$$

where:

- (t_j) = Control Complex concentration at the j^{th} timestep (ppm)
- $C_0(t_j)$ = Air intake concentration at the j^{th} time step (ppm)
- W = the ventilation/infiltration rate before/after isolation (cfm/60sec/min)
- deltaT = time steps (seconds)
- V = control complex volume (ft^3)

When CREVs shifts to recirculation, W changes from the normal make-up value of 5700 cfm to an inleakage value which is around 10% of the initial make-up flow rate. By virtue of this effect alone, subsequent changes in control room concentration occur much more slowly given that the concentration of toxic gas in outside air remains constant. For this reason the most challenging version of the toxic gas scenario is the non-mechanistic complete tank rupture (rather than longer duration releases of lesser rates). This scenario is modeled by a "puff" for the large quantity of gas which flashes at the time of the accident, followed by a longer term "plume", modeling the subsequent evaporation of the remaining spilled volume. The puff contains a much higher concentration than the plume, but is of such brief duration that most of this release has passed by the Control Complex at the two minute mark and concentration in the outside air is rapidly dropping. Using this model maximizes control room toxic gas concentrations by introducing the highest outside concentration of gas concurrent at the maximum possible flow rate. Control room toxic gas concentration changes after isolation occur very slowly due to the twofold effect of much lower concentration of toxic gas in the outside air, being introduced at a flow rate which is approximately an order of magnitude less. The net effect is that the toxic gas analyses are insensitive to small variations in CCHE inleakage.

A great deal of conservatism is inherent in the simplistic model described above. To demonstrate this, Cermak Peterka Petersen, Inc., modeled the CR1, 2 and 3 site and performed wind tunnel tests simulating a 30 ton release at the tank, empirically measuring the toxic gas concentration at the control complex intake. This data was input into Sargent & Lundy calculation SL-9929-M-0008 with the above formula to determine the Control Complex toxic gas concentration. This analysis determined a SO_2 concentration in the control complex of 17.9 ppm two minutes after nasal detection *without CCHE isolation*, well below the toxicity limit of 36 ppm. Comparison of this result with the previous analyses which predicted a concentration of 29 ppm with automatic isolation approximately 30 seconds into the event, it is readily apparent that a great deal of conservatism exists in the analytical model

(FPC is in the process of removing the 30 ton tank from CR1 and replacing it with a pelletized system that generates sulfur dioxide gas when needed. This activity will not be completed prior to restart, and the above analysis is valid in the interim period.)

The next most limiting toxic gas source is the Helper Cooling Towers. Currently, there is no SO_2 or Cl_2 stored at this location and this is ensured by a Crystal River Unit 1 "Red Tag" clearance No. 1997-01543. Prior to releasing this clearance, administrative controls will be in place to limit the Helper Cooling Towers to 8 tons of Chlorine and 30 tons of SO_2. I89-0053 Rev. 3, "Control Room Habitability Helper Cooling Tower Project", is the current calculation of record that analyzes ruptures of these tanks. The calculation analyzes the 17 ton chlorine and 50 ton SO_2 tank ruptures and found that automatic isolation was required only to meet the two minute chlorine toxicity limits. FPC has used the new Sargent and Lundy calculation (SL-9929-M-0008 Rev. 0) to evaluate the lower quantities: 8 tons of chlorine and 30 tons of SO_2. This analysis combined the wind tunnel results from the CR-1 SO_2 tank model and traditional atmospheric dispersion mathematical modeling techniques to conclude that CREVs could remain in its normal alignment (ie., no CCHE isolation required) without exceeding Control Room toxicity limits if up to 9 tons of Cl_2 or 50 tons of SO_2 were released. Thus, CCHE inleakage is of no consequence given the new limits of 8 tons and 30 tons for Cl_2 and SO_2 respectively.

Sargent and Lundy calculation SL-9929-M-0008 also analyzed the Cl_2 and SO_2 stored at CR-4/5. This calculation allows for a *4 ton chlorine release* at the CR-4 and 5 cooling towers located 3600 feet from the CR3 control complex intake. There are eight 1 ton tanks with four in service *on a single header* at a time. The assumed accident has one tank fail and the other three leak out though the common piping. The allowable *4 ton* leak bounds this condition so no automatic detection or isolation is needed at CR3 for this source. The one ton sulfur dioxide tanks were not analyzed due to the sulfur dioxide at the Helper Cooling Towers being more limiting. The amount at CR 4 and 5 is less (50 tons versus 1 ton), farther away (3400 feet versus 3600 feet), and has a larger building wake (2 versus 3). Since the calculation allows > 50 tons at the Helper Cooling Towers without automatic detection and isolation, then the CR4 and 5 sulfur dioxide will also not require the same.

Based on the above discussion, it can be seen that the current level of CCHE integrity provides adequate protection for the control room operator for postulated toxic gas events. It is also noted that the updated analyses would support operation without crediting the existing toxic gas detectors. However, it is not the intention of this JCO to delete these monitors, and they will continue to be installed and surveilled as in the past as an additional conservatism.

CCHE breach margin in modes 5 & 6 is based on potential consequences of an SO2 release at Units 1 / 2, for which previous calculations demonstrated that up to 1400 cfm of inleakage could be tolerated with the CCHE initially isolated. Since revised analyses for this event demonstrate that automatic isolation is no longer required, the use of considerably larger inleakage rates (up to as much as the 5,700 cfm makeup rate) could be justified. No increase in the breach margin for modes 5 & 6 is being undertaken by this JCO.

Additional Protective Features

1. Vestibules

CCHE boundary doors represent a significant source of leakage into the CC. There are three double doors and three single doors. Vestibules were added to the three CCHE double doors in 1996, and have proven to be effective in reducing differential pressure across the existing doors. Reducing the differential pressure exerted on the boundary doors has two benefits. First, lower differential pressure reduces leakage around the doors, and second, lower differential pressure allows the door closers to perform more reliably. During this outage, vestibules were added to the single CCHE boundary doors. All of the vestibules have additionally been sealed at interfaces with the CCHE boundary making the enclosures more effective in reducing CCHE boundary door leakage.

Control Complex tracer gas testing was performed with the vestibule doors blocked open to assure that the test was conservative. Blocking open the vestibule doors increased conservatism in two ways. First, normal access and egress was permitted during the tracer gas leakage testing which contributed to the measured leakage. Dose calculations performed in accordance with standard methods include a factor of 10 cfm of continuous leakage to account for access and egress during an accident. This factor was added to the measured inleakage in performing CR-3 dose calculations. Therefore, the effect of leakage during access and egress was applied twice. In a real event the vestibules would not be blocked open. Since they function similar to an airlock, they would be effective in reducing leakage during access and egress. The second manner in which maintaining the vestibules open during the test was conservative is that the existing boundary door was the only barrier to leakage during the test. In an actual event the vestibule doors would be in their normal closed positions, and would be effective in reducing infiltration into the CCHE through the doors. This feature would be particularly effective in reducing operator dose during the MHA without LOOP scenario where leakage is induced from the Turbine Building into the CCHE due to operation of the ABVS.

2. Auxiliary Building Filtration

Performing dose calculations in accordance with the requirements of NUREG-0737 Item III.D.3.4, Control Room Habitability, includes assuming source terms specified in Standard Review Plan 15.6.5. One aspect of this for a plant that does not have an "ESF atmosphere filtration system," is leakage of 1500 gallons of water contained in engineered safeguards piping outside of containment must be assumed 24 hours following the accident. This amounts to leakage into the Auxiliary Building (AB) of highly contaminated water from the reactor building sump. An ESF atmosphere filtration system is like the CR-3 ABVS with HEPA and carbon filters, however it is required that an ESF system be powered from an onsite power source. Since the ABVS is not powered from an onsite power source, CR-3 control room dose calculations include the required leakage term. This term is responsible for approximately 8 REM of the projected individual control room operator dose of 26.5 REM during the MHA with LOOP scenario.

The CR-3 ABVS has redundant fans and filters which are operated continuously during normal operation. Therefore, the system must be maintained in good operating condition. The filters are tested and maintained in accordance with approved procedures that implement regulatory guidance on emergency filter systems. As such, filter efficiency is routinely verified by carbon filter media testing. Evaluations of the FPC power grid performed for station blackout concerns have demonstrated a high degree of reliability. Studies have shown that power should be restored to the site in under eight hours following a loss of offsite power due to disturbances on the grid. Therefore, there is a high degree of assurance that the ABVS will be available and capable of performing effectively to reduce radioactivity released from the AB following an event.

Calculations show a near linear relationship between AB source term and operator dose. Therefore, using a conservative ABVS filtration efficiency of 75% would result in a dose reduction of approximately 6 REM (8 REM contribution X 0.75 = 6 REM reduction) from the 26.5 REM projected dose for the MHA with LOOP scenario. This reduction in dose is applicable only to the MHA with LOOP analysis. 75% efficiency for ABVS carbon filters has been previously accepted for CR-3 as an interim measure during resolution of reactor building flood level issues, and is already credited in the analysis for the MHA without LOOP .

3. Dose Management

If a radiological accident were to occur which involved the release of radioactive material from the reactor or spent fuel storage area, the CR-3 Radiological Emergency Response Plan would be implemented. The plan provides for staffing the emergency response organization and establishing emergency response actions commensurate with the severity of the event. Actions required in the Emergency Plan Implementing Procedures include dispatching a Health Physics Technician to the Control Complex to monitor radiological conditions, and to provide radiological and meteorological data to the Dose Assessment Coordinator. The Health Physics Technician will perform radiological surveys within the Control Complex, including surveys for airborne radioactivity. Dose Assessment personnel use data collected from surveys to project expected personnel doses. Provisions exist in the Emergency Plan Implementing Procedures for considering administration of potassium iodide (KI) to personnel based on projected dose. A projected dose of 25 REM to an individual has been established as the threshold for considering administration of KI.

Control room dose calculations contain very conservative assumptions regarding operator presence in the control room. For example, in accordance with the Murphy-Campe methodology it is assumed that the operator is present in the control room continuously for the first 24 hours, then 60% of the time for the next 3 days, and then 40% of his time for the remaining 26 days. Similarly, atmospheric conditions are assumed which channel the release of radioactivity toward the control complex at conditions which maximize the plume concentration, particularly in the first 24 hours of the scenario. Based on the conservatisms that exists throughout control room habitability dose calculations, no doses approaching GDC 19 limits are anticipated in a realistic accident. However, provisions exist in currently approved procedures to monitor actual and projected doses based on measured and observed conditions, and to control personnel exposure. Through the protective features of the control complex evaluated in the control room habitability calculations, and the established emergency response procedures, protection of the control room operators is assured.

SUMMARY / CONCLUSIONS

Based on the above discussion, it is concluded that, upon completion of certain actions, CREVS performance and CCHE integrity is adequate to (1) protect the control room operator in toxic gas events and DBAs for which CR #3 is licensed, such that regulatory limits are not exceeded, (2) meet operability requirements defined in the ITS, and (3) not invalidate the assumptions and conclusions of the ITS bases. Meeting these requirements is deemed adequate and appropriate basis for plant operation in any mode with regard to control room habitability. Specific actions which must be implemented and the timing with which they must be completed to support this evaluation prior are listed below:

1) Complete modifications and post modification testing associated with replacing CREVS boundary dampers and improvements to CCHE integrity. Post-modification CREVS flow testing and balance must verify that the Control Room elevation remains slightly positive with respect to the cable spread room elevation. This action must be completed prior to MODE 4

2) Complete test requirements associated with the Ventilation Filter Testing program defined in ITS 5.6.2.12. *In addition to satisfying current ITS testing requirements,* charcoal testing is to be performed at conditions of 30 C and 95% RH, consistent with LAR # 222. This action must be completed prior to MODE 4

3) Complete surveillance requirements associated with ITS Section 3.7.12. This action must be completed prior to MODE 4

4) Submit LAR # 222 to request licensing changes associated with CREVS, including charcoal test requirements, surveillance requirements on CCHE integrity, breach margin and reconciliation of CREVS flow rate and filter dP. This is a followup action which should be completed as soon as feasible, but for which no specified completion time is given.

5) Administrative measures must be in place to ensure that CREVS is in recirculation mode prior to fuel movement until such time as updated FHA analyses finds this is not necessary. At that time, this JCO can be revised as appropriate. This action must be completed prior to any movement of fuel.

6) Administrative measures must be in place to ensure that quantities of toxic gases stored on site do not exceed the limits evaluated herein. CR-1/2 "red tag" clearances are currently in effect. These clearances or equivalent measures are to remain in place.

~~7) Administrative measures pertaining to loop seals must be updated to maintain the newly installed seals full. *This action must be completed prior to MODE 4.*~~ (Complete).

8) Procedures controlling allowable CCHE breach margin must be updated to reflect an breach margin limit of 22.8 in.^{2} in MODES 1-4. Breach margin limits for MODES 5 and 6 will remain at their previous levels for the time being. This must be completed prior to MODE 4.

~~9) All vendor Calculations used to assess DBA control room operator dose analyses must be reviewed and verified. This action must be completed prior to NGRC approval of this DR / JCO.~~ (Complete)

10) All vendor Calculations used to assess Toxic gas accident control room operator exposure analyses must be reviewed and verified. This action must be completed prior to MODE 4.

REFERENCES

1. FPC CR#3, MAR 97-07-05-01 "Control Complex Emergency Ventilation"

2. CP-148, Rev. 2, "Ventilation Filter Testing Program," FPC CR3, 8/30/96.

3. FPC SA/USQ For Sargent & Lundy Calculation SL-9929-M-009 R1

4. NRC letter 3N0589-25 to FPC dated 5/25/1989, "Crystal River Unit 3 - Control Room Habitability Evaluation (NUREG-0737 Item III.D.3.4) (TAC No. 64805)"

5. License Amendment Request (LAR) #222 R0, "Control Room Emergency Ventilation System and Control Room Habitability"

6. FPC CR#3, MAR 77-04-11, "Control Complex Ventilation Cooling Coils AHHE"

TABLE A

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 Evaluation, RB spray flow is described as full flow (3000 gpm), half flow (1500 gpm). No differentiation was made between initial injection and recirculation flow rates. Reviewing GP-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 are 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 ltr ser NOE97-2311 dtd 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 1079gpm.*
Reactor Building Sump Volume	490,182 gal (65,532 ft3)	343,347 gal (45,902 ft3)	The habitability submittal assumes the liquid sump volume was as 490,182 gallons (7.48 gal/ft^3 or 65,532.353 ft^3) This volume was 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. 186-0002 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 Jose calcs.
MHA Source Terms	Based on TID 14844 and a power level of 2594 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, <u>*75% efficient*</u> 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 the control 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 charcoal 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 charcoal 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 bounded by the MHA/LOOP 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 hasn't changed, but filter testing has been upgraded to utilize more challenging criteria. Previous charcoal testing was performed at 80 C at 30% RH, test program has been revised to evaluate charcoal 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 Modifications	As described in the habitability report	As modified by R-12 modifications	The following modifications are being implemented to address the concerns associated with Restart Issue R-12. 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 shall be 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, is to be 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, is being locked open and abandoned in place. Two new bubble tight dampers, AHD-2C and AHD-2E, shall be 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, are being 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 are being 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 are being 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. • Small bore drain pipes penetrating the CCHE are being fitted with loop seals to prevent inleakage though the lines. These will be 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 elsewhere in the "JUSTIFICATION FOR CONTINUED OPERATION" section, this JCO.

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.