Duke Power Company
Catawba Nuclear Generation Department
4800 Concord Road
York, SC 29745

William R. McCollum, Jr.
Vice President
(803)831-3200 Office
(803)831-3426 Fax

DUKE POWER

April 2, 1997

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

Subject: Catawba Nuclear Station, Units 1 and 2
Dockets Nos. 50-413 and 50-414 (TAC M98107, M98108)
Request for Additional Information Regarding the Operating License Amendment for the Steam Generator Tube Rupture Evaluation

By letter dated March 24, 1997 the NRC requested additional information regarding the Technical Specification Amendment request submitted by Duke Power on March 7, 1997. The proposed amendment revises Section 3/4.7.1.6 of the Technical Specifications to require four instead of three steam generator power operated relief valves (PORVs) and Section 15.6.3 of the Updated Final Safety Analysis Report (UFSAR) to require four instead of three PORVs and allow credit for local manual operation of the PORVs. The additional information requested is provided in the enclosure and should supply the technical clarification necessary to complete the amendment request.

We request that you review the additional information on a schedule consistent with the urgency of the original request. If you need additional clarification of the response to the questions or have additional questions please contact Martha Purser at (803)-831-4015.

Sincerely,

William R. McCollum, Jr.

William R. McCollum, Jr.

A001 /1

xc (with attachments):

L.A. Reyes, Regional Administrator, Region II

P.S. Tam, Senior Project Manager, ONRR

R.J. Freudenberger, Senior Resident Inspector, CNS

bxc w/att:

G. A. Copp
M. S. Kitlan
M. T. Cash
J. E. Burchfield
P. R. Newton
M. V. Costello
D. A. Wellbaum
S. W. Brown
P. M. Abraham
M. S. Purser
L. B. Jones
G. B. Swindlehurst
H. P. Smith
A. S. Bhatnager
NCMPA-1
ELL
SREC
PMPA
NCEMC
Document Control File 801.01
Group File 801.01

Response to Request for Additional Information for

Catawba Nuclear Station Units 1 and 2

Regarding Proposed Amendments for the Steam Generator PORVs

Reference: Letter, P.S. Tam to CNS dated March 24, 1997

1. *Provide a dose assessment of the consequences, with respect to Part 100 and GDC 19, of operating in the proposed new configuration which requires manually opening one of the PORVs of the intact steam generators.*

RESPONSE: See Attachment 1. This response includes the previous dose information (from the last dose analysis of record - Ref. 10), the current dose information which is the basis for the administrative limits, and the significant assumptions associated with this information.

2. *The steam generator tube rupture information provided as draft Updated Final Safety Analysis Report (UFSAR) markups is incomplete relative to what is currently in the UFSAR. Provide the assumptions used in the new steam generator tube rupture (SGTR) analysis and the sequence of events, including an explanation of each assumption that is different from the current analysis of record and a discussion of the effect of the change on the parameters analyzed. Include a discussion of the old and new overfill analysis, delay times resulting from the need for local manual operator action and the effects of these delay times, initial steam generator level, final level, margin to overfill, primary and secondary system response, and primary-to-secondary leakage flow rates.*

RESPONSE: The FSAR sections submitted with the Technical Specification Amendment for the S/G PORVs are all the sections that need to be revised at this time. The tables and timelines for SGTR represented in Chapter 15 are related to dose analysis and not S/G overfill. A previous analysis does not exist for overfill since we had relied on the analysis provided in WCAP-10698. Steam Generator conditions considered for the RETRAN overfill analysis are described as follows. Initial Condition: High secondary inventory at the time of the trip is conservative relative to S/G overfill

per WCAP-10698. WCAP-10698 factors in the effect of a turbine runback prior to reactor trip since S/G mass increases with decreasing power in Westinghouse steam generators. This effect was accounted for in the analysis performed with the Westinghouse Model D5 S/G's (originally installed in Unit 1). A turbine runback would result in a power level of ~67% FP at the time of the reactor trip. An initial S/G mass reflective of 55% FP was conservatively assumed. Additional mass was added to account for positive level uncertainty.

The effect of a turbine runback was not modeled in the RETRAN analysis since the BWI steam generators in Unit 1 have essentially constant mass between 25% and 100% FP. A turbine runback would therefore not increase S/G mass prior to a reactor trip in the BWI S/Gs. An initial S/G mass reflective of 100% FP was assumed with additional mass added to account for positive level uncertainty.

Final Conditions: S/G narrow range level is offscale high at the end of the simulations. The margin to overfill is 80 cu.ft. The FSAR will be reviewed again at the completion of the final dose analyses and changes will be submitted at that time if necessary. The additional information requested in Question 2 can be found in Attachment 1 as referenced above.

3. *In the submittal, the BTP RSB 5-1 criteria were used to justify local manual operator action of the steam generator PORV during the SGTR scenario. The SGTR and the BTP RSB 5-1 scenarios are quite different. Can local manual operation of the PORV during a SGTR accident be justified without reliance on the more lax criteria of BTP RSB 5-1?*

RESPONSE: Additional justification for credit taken for local manual operation of an S/G PORV is provided in the response to Question 7 of the Request for Additional Information. The additional justification includes an evaluation of the environmental conditions expected, the guidance and training for the action, the information available to the control room staff to determine that the action is required, etc. Also included is an evaluation of the local manual action against the guidelines of Regulatory Guide (R.G.) 1.97, Generic Letter (G.L.) 91-18, and ANSI/ANS-58.8-1994 (cf. response to Question 7.b, Bullet 12).

There is a precedent for taking credit for local manual action within the licensing basis of Catawba Nuclear Station. Credit has been taken for local manual action at Catawba to mitigate the consequences of a Loss of All AC Power (Station Blackout - SBO, cf. Ref. 6, Section 50.63). The Standby Shutdown Facility (SSF) has been provided as an Alternate AC source for a postulated SBO. The immediate response to a SBO is to start the SSF diesel generator. This was represented and approved as a local manual action with a 10 minute time response (Ref. 7-9). As noted below, the total time response associated with the local manual operation of the S/G PORV's is 18 minutes.

4. *On page 15-100 of the FSAR, in the last paragraph, the text is changed from "...bounded by feedwater line break coastdown transient from an elevated RCS temperature...." to "complete loss of flow." This change needs explanation.*

RESPONSE: The text change on page 15-100 in Chapter 15, changing "bounded by feedwater break flow…" to "complete loss of flow" is not directly related to the Amendment request. This is a clarification that will be incorporated in the next UFSAR update and is included because it defines the bounding scenario. (i.e complete loss of flow bounds feedwater line break which bounds S/G tube rupture) This text change will not affect any analysis assumptions.

5. *The second paragraph of Technical Justification and Safety Analysis states: "In Case 2 above, it was demonstrated that S/G overfill occurs." What are assumed and demonstrated times for Case 2?*

RESPONSE: Case 2 analyzed having 1 PORV available for remote operation from the control room with no additional action to open another PORV either locally or remotely. Once a determination was made that overfill would occur, no further review or documentation was performed. This decision was based on the commitment through WCAP-10698 that we would NOT overfill. All documented cases support margin to overfill.

6. *On the same page, the licensee states: "...leaving only one PORV on an intact S/G available to be remotely operated from the control room. Local manual operation of another PORV on an intact S/G with a time delay is credited in this analysis."*

a. *Specify the required operator actions and times associated with the local manual operation.*

RESPONSE:

	ASSUMED		DEMONSTRATED	
Action	Time	Total time	Time	Total time
Travel to the PORV	10 minutes	10 minutes	~8 minutes	8 minutes
Engage the Clevis	2 Minutes	12 minutes	1 minute, 20 seconds	9 minutes, 20 seconds
Fully open the PORV	6 minute	18 minutes	4 minutes, 40 seconds	14 minutes

b. *Clarify the phrase "a time delay is credited."*

RESPONSE: Credit is taken for ***"local manual operation of another PORV on an intact S/G"*** in the analysis of the SGTR. The analysis assumes as an initial condition that the PORV's on all four S/G's are operable. Also assumed is a single failure which renders PORV's on two intact S/G's unavailable for operation from within the control room. The analysis includes the initiation of unit cooldown from the control room with the one intact S/G PORV as per the emergency procedure. The analysis accounts for the local manual operation at a later time of a PORV on one of the two S/G's affected by the single failure. The difference in the times for which these two actions are taken is the "time delay" spoken of in the submittal. The phrase "… is credited" refers to local manual operation.

7. *On the same page, last paragraph, the licensee states: "Therefore, to avoid S/G overfill in light of the single failures identified herein, credit must be assumed for local manual operation of a PORV on at least one intact S/G."*

   a. *State assumptions relative to where an operator(s) will be located prior to taking local manual operation.*

RESPONSE: Operators are assumed to be in the control room. Typically, all NLOs report to the control room during the early phases of any event, and make themselves readily

available for dispatch as required to deal with the event in progress.

b. *Describe the steps and times associated with briefing the operator(s) and ultimately taking the local manual action, including:*

- *the specific operator actions required,*

Operator actions are dictated by Enclosure 3 of EP/1/A/5000/E-3. This enclosure, combined with operator familiarity with the task, lessens the detail required for an adequate briefing. A copy of the Enclosure is attached for reference (see attachment 2). Exact times were not available , but briefing of the operator for this task typically requires less than a minute.

- *potentially harsh or inhospitable environmental conditions expected,*

Radiation doses to an operator performing the local manual action (of opening a S/G PORV with its handwheel) following a design basis SGTR were calculated. Operation of a S/G PORV in the building containing the PORV associated with the ruptured S/G was assumed. Both thyroid and TEDE doses were calculated. It was determined that the doses to an operator would be within the limits of 10 CFR 20, ICRP-26, and ICRP-30. This dose analysis for the operator includes conservative modeling of airborne concentrations in the doghouse (the building in which S/G PORV's are located). The S/G PORV discharges high energy steam beyond the roof of the doghouse. However, it was assumed that meteorological conditions exist which cause the steam to waft back in through openings in the doghouse walls (this phenomenon has never been observed while the PORVs are discharging steam). This assumption also envelops the effect of any steam leaks in the doghouse prior to repair of the leaks.

An operations shift routines item has been established to weekly check each doghouse for steam leaks. Work requests are issued for any leaks identified. An interim measure is taken for each leak. Each is entered into the Open Item Summary, so that the information is readily available during an event such that an assessment can be made. The environmental conditions in the doghouse are not expected to be inhospitable or harsh.

- *a general discussion of the ingress/egress paths taken by the operators to accomplish functions,*

The preferred pathways to each of the doghouses have recently been added to Enclosure 3 of emergency procedure EP/1/A/5000/E-3 (Steam Generator Tube Rupture) and it's Unit 2 counterpart. For each of the interior doghouses, access is gained by exiting the control room by the normally unused direct access to the Auxiliary building associated with the affected doghouse. It is then a matter of a few steps to the doghouse door. Access to the doghouses during a tube rupture event requires the operators to select special emergency (red) Merlin-Gerlins for dose monitoring. These are maintained at the SRO desk in the control room, directly in the path to Unit 1 interior doghouse, and near the point of dispatch for all four. Use of the Merlin-Gerlins has also been added to the enclosure as a reminder. For each of the exterior doghouses, access is gained via the associated turbine building's exterior door, and across the yard area to the exterior doghouse door. All doghouse doors are CAD doors, for which each operator has access authorization. In the event of blackout at night, flashlights have been demonstrated as adequate to reach the PORVs and are sufficient lighting for operation. A set of emergency flashlights are located in the control room at the center console, and procedural guidance has been added to ensure the operators take a flashlight with them. Egress from the doghouses is the normal Single Point Access, using a paper dose card to record any dose accumulated during the evolution. Note that all returning teams during an event will report to the Operations Support Center (OSC), which is staffed by that time by the Radiation Protection team members.

- *procedural guidance for required actions,*

Operator actions are dictated by Enclosure 3 of EP/1/A/5000/E-3. A copy is attached for reference (see attachment 2).

- *specific operator training necessary to carry out actions including any operator qualifications required to carry out actions,*

Operators have recently been trained in specific routes designated to be used during emergency conditions, use of special Merlin-Gerlins for emergency conditions, detailed instruction on how to manually engage the PORV and operate it locally. This training included times it typically takes to expose the inner shaft, and typical time to open the valve fully. A video was made of two operators actually placing the valve in manual, and times being recorded. This

training has been completed for all available operators. Operators were shown the location of all phone jacks, and phone headsets to be used in the control room and every doghouse. Special ladders are placed in each doghouse to aid the operators in reaching the air equalization valves on the PORV's.

NLO Task N-0092, element #4 (Walk through Local Operation of S/G PORVs) is a part of the initial Job training of each non-licensed operator.

- o *any additional support personnel and/or equipment required by operator to carry out actions,*

No additional support personnel outside of operators are required to perform the task. Note the task requires two operators, both of which are assumed present in the control room. The following equipment is used to enhance the evolution, and in some circumstances may be required to complete the actions. (E.g., flashlights are listed, but are only needed if the event occurs at night and coincident with a blackout and emergency lighting has failed.)

- Emergency Merlin-Gerlins - Stored in the control room, use dictated by the procedure.
- Flashlight - Operators generally have a functional flashlight, but Emergency Flashlights are stored in the control room, with use dictated by the procedure.
- Sound Powered Phones and headsets - The system itself is part of the plant. Headsets are stored in the control room for the control room operator, and in each doghouse for the operators actually operating the PORVs. Use of the headsets is procedurally driven, and exact location of doghouse storage location is provided in the procedure.
- Ladders - The PORVs are close enough to flooring for operation without a ladder by some operators, but ladders are chained in place to ensure they are available if needed. OPS has recently added a check of the ladders to the Operations Monthly Rounds sheets to ensure they are in place for immediate use during an event.

- o *description of information required by the control room staff to determine such operator action is required, including qualified instrumentation used to diagnose the*

situation and to verify that the required action has been successfully taken,

Recognition of the failure of the PORVs to operate may come from diverse indications, but is most likely to be realized due to indicating lights. The absence or decrease in either steam pressure or Tave would provide redundant indication of the presence of the failure. All of these indications are provided with QA1 safety related instruments. Successful operation of a S/G PORV will be readily apparent to the operator at that PORV and communicated to the control room through the sound powered phone system. Indication of successful completion of the local manual action also will appear through the safety related steam pressure, reactor coolant temperature instrumentation, and (depending on the failure) position indication lights of the S/G PORV. Cf. Also the response to Bullet 12 (regarding comparison with R.G. 1.97, G.L. 91-18, and ANSI/ANS 58.8).

- *ability to recover from plausible errors in performance of manual actions, and the expected time required to make such a recovery.*

The single most plausible performance error would be for operators to go to the wrong PORV. This is extremely unlikely with two operators present and communication established with the control room prior to actually operating the valve.

- *How do operator(s) become aware that there is a need for local manual action?*

The operators will be notified by the control room team upon recognition of the PORV failing to respond to the control room controller. Communication of the failure goes from the Operator at the Controls to the procedure reader to the Operators selected to perform the actual task.

- *What is the total time for operator(s) to complete local manual action assuming time zero is notification that such local manual action is needed?*

A total time of 18 minutes is used for the calculations of this event. Actual demonstrations have been completed in less time and are documented in greater detail in the Table provided as response to RAI 6.a.

- o *Describe task analysis used to determine sequence of local manual actions?*

The procedural guidance is based on the operating instructions supplied in the valve operator vendor's manual (Duke # CNM 1205.10-0279).

Additional detail was added to clarify intent, and to provide plant specific information.

NLO Task N-0092, element #4 (Walk through Local Operation of S/G PORVs) is a part of the initial Job training of each non-licensed operator.

Operations Training developed a Job Performance Measure (JPM) to exercise the local manual evolution, with the operator starting in the control room, and actually walking through the evolution. OP-CN-EP-EP5-006 (Locally Operate S/G PORV during a SGTR)

- o *How were R.G. 1.97, Generic Letter 91-18, and ANSI/ANS 58.8 considered in the analysis of operator actions and times?*

The emergency procedure for SGTR includes steps germane to the scenario evaluated in the submittal. If the PORV on any intact S/G cannot be opened from the control room, then operators are to be dispatched to locally operate that S/G PORV. The presence or absence of a failure which would require the initiation of the local manual action could be considered as a Type A variable as defined in R.G. 1.97 (Cf. Ref. 2. Type A variables are defined as "those variables to be monitored that provide the primary information required to permit the control room operator to take specific manually controlled actions for which no automatic control is provided and that are required for safety systems to accomplish their functions for design basis accident events.")

The position (open/closed) of each S/G PORV is indicated in the control room with lights (red/green). These lights are part of the same safety related circuits as the controls for operation of the S/G PORV's within the control room. There are two possible responses of the position indication lights to the single failure, depending on its nature (a total of six single failures have been identified). In one case, the failure would extinguish all position indication lights associated with the affected S/G PORV's. This effect is a clear and immediate indication of the presence of the failure and the need to perform the local manual operation.

In the second case, the failure would leave power to the lights affected by the S/G PORV's. In this case, the green light would remain on and the red light remain off to indicate that the associated S/G PORV was not opening in response to manual action in the control room. In either case, clear and immediate indication of the presence of the single failure and need to perform the local manual operation of a S/G PORV is provided in the control room. Additional indication of the presence of the single failure would be provided with instrumentation monitoring pressure in the affected S/G's and the reactor coolant temperature. These instrument loops also are safety related. This meets the positions of R.G. 1.97 for instrumentation provided to monitor Type A variables.

The local manual operation of the PORV has been compared to the positions of G.L. 91-18. The local manual action is a substitute for remote manual action (i.e., from the control room), not automatic action. In addition, the local manual action does not require any "dedicated operator." G.L. 91-18 includes regulatory positions regarding "manual action in remote areas." Below is a comparison of the local manual action to these regulatory positions (given in Ref. 3).

As noted above, the emergency procedure for SGTR requires that if a PORV on an intact S/G cannot be opened from the control room, operators are to be dispatched to operate that PORV with its handwheel. Instructions for performing the local manual operation are given in an enclosure to that procedure. Training concerning the failure and the local manual action has been provided to the operators. The ability and timing to get to the area have been evaluated above and determined to ensure successful completion of the action. Radiation doses to an operator performing the local manual action have been calculated and found to be acceptable, as noted above. As discussed above, a weekly surveillance is conducted to identify and initiate repairs of steam leaks in the S/G doghouses (the buildings in which the S/G PORV's are located). The operator will not encounter any temperature or chemical hazard while performing the local manual action following a design basis SGTR. Flashlights are provided and are adequate for the local manual action as discussed above. In addition, emergency lighting is provided in the S/G doghouses. A sound powered phone system, complete with headsets, is provided at Catawba. The procedure enclosure for the local manual operation of the S/G PORV's includes steps for use of the headsets. This ensures clear communication with the control room while the local manual operation of the S/G PORV's is being performed. In summary, it is determined

that the local manual action meets the germane positions of G.L. 91-18.

The time response for the local manual action has been compared to the guidelines of ANSI/ANS-58.8-1994 (Ref. 4). The NRC has written a draft regulatory guide (Ref. 5) in which the staff endorses Ref. 4 "for determining allowable response times for stabilizing the plant by manual operator action (i.e., safety-related operator action) in the event of a design basis event."

The response times for the design basis SGTR with the limiting single failures of concern (i.e., requiring the local manual operation) are listed in a table provided below (in response to Question 8.a). In the table, times assumed in the safety analysis are presented and compared with observed responses.

The times to begin operation of the S/G PORV's and to perform the local operation of a S/G PORV affected by the single failure are given relative to reactor trip. Identification of the ruptured S/G is equivalent to the latest credited action ($\mathbf{t_{ECA}}$) following the design basis SGTR. It is clear that the manual local operation of the S/G PORV is not required before this time. This meets the positions of Section 3.1.1. The analyses of the design basis SGTR has shown that there is margin to S/G overfill. Specifically, the local manual and all other operator actions ($\mathbf{t_{SAC}}$) are completed before the ruptured S/G is filled ($\mathbf{t_{Lim}}$). In addition, the break flow ceases ($\mathbf{t_{SFC}}$) prior to the ruptured S/G being filled ($\mathbf{t_{Lim}}$). This meets the position of Section 3.1.2. The local manual action is required only to mitigate the consequences of a SGTR with of one of the single failures of concern (Ref. 1). In the absence of such a single failure, local manual operation of a S/G PORV is unnecessary. Furthermore, the local manual action does not involve identification or correction of any operator error. Therefore, it is determined that the positions of Sections 3.1.3 and 3.1.4 do not apply to this local manual action. In the analysis, credit is taken for initiation of the local manual action at 33 minutes after reactor trip ($\mathbf{t_{trip}} = \mathbf{t_{Ind}}$ by assumption). Completion of the action is assumed 41 minutes after reactor trip. This is greater than value required in Sections 3.1.5 and 3.2.2 to be assumed for the time to perform an operator action outside the control room.

It has been shown in the safety analysis that local manual operation of only one S/G PORV is required to prevent S/G overfill for a design basis SGTR with one of the failures of

concern. This action needs to be performed at only one location (a S/G doghouse). Clearly, the positions of Section 3.2.1 are met. The environmental conditions associated with the action have been evaluated above and found not to be detrimental to the completion of the local manual action (cf. comparison with G.L. 91-18). Also as noted above, both a sound power phone system for communications with the control room and emergency lighting are provided. Steps for both the local manual action and the entry into it are given in an existing emergency procedure. All tools necessary to complete the local manual action (e.g., clevises and stepladders) are provided at the location of each S/G PORV. In summary, it is determined that the positions of Section 3.2.2 are met. The equipment provided to indicate the presence of a SGTR includes safety related instrumentation (Ref. 6). The means to determine the need to take the local manual action are discussed above (cf. comparison with R.G. 1.97). It is determined that the positions of Section 3.3.1 and 3.3.3 are met. The local manual operation is to open a S/G PORV with its handwheel. Successful completion of this operation will be readily apparent to the operator at the scene. Furthermore, the completion of the operation can be communicated to the control room with the sound powered phones. This meets the position of Section 3.3.2.

The time interval of 13 minutes to identify the ruptured S/G has been demonstrated in simulator tests. Additionally, the time interval to perform the local manual action has been demonstrated in both time trials and simulator tests. A safety analysis of the design basis SGTR with one of the failures of concern has been completed.

In summary, it is determined that taking credit for local manual operation of a S/G PORV is in harmony with the germane positions of ANS/ANSI-58.8-1994. Furthermore, local manual action to respond to SBO has been submitted and approved (as noted in the response to Question 3), setting a precedent for this local manual action.

- *Discuss how many operators will perform the local manual action(s)?*

Stations directives require two operators to be dispatched to the doghouse regardless of the reason. This would allow for one operator to perform the local manual action and one to maintain communications with the control room.

- *Discuss errors of omission and commission*

considered in analyzing required local manual actions.

Plausible errors in the performance of the local manual action have been identified and evaluated in the response to Bullet 8 above (ability to recover from plausible errors in performance of manual actions and the expected time required to make such a recovery). In addition, the local manual action is required to mitigate the consequence only of a design basis SGTR ***and a single failure of safety related equipment***. Operator errors of omission and commission are defined in Ref. 4. in the context of the single failure criterion and therefore need not be considered this scenario.

c. What immediate compensatory measures has the licensee taken relative to the amendment request?

Administrative controls have been put into place to require that the PORV's on all four S/G's of each unit be operable with action statements comparable to those of Technical Specification (TS) 3/4.7.1.6. Additional controls have been put into place to limit the I^{131} dose equivalent specific activity in the reactor coolant (compare with TS 3/4.4.8). The latter administrative controls and their bases are discussed in the response to Question 1.

The assumed time response associated with the local manual action has been demonstrated in time trials and simulator tests. Training of the operators concerning the new single failures and the potential need to take local manual action following a design basis SGTR has been conducted as discussed in the response to Question 7.b (Bullet 5 concerning operator training).

8. *On the same page, the last paragraph, the licensee states: "Both time trials and simulator tests have been performed to show that operators can begin local manual operation of a S/G PORV and otherwise respond as assumed in the safety analysis."*

    a. Provide information on time trials and simulator test results.

The new FSAR analysis makes several assumptions of operator responses. Several simulator scenarios were conducted to observe Catawba operator response to the single failure scenario, and to provide realistic operator response times for use in calculations by the safety analysis group. In

all cases, the control room team responded correctly by recognizing the failure of the PORVs to respond from the control room, and by dispatching operators for local operation. Below is a table which summarizes the assumptions and some observed operator responses for comparison. Actual response times for the operators dispatched to the PORVs was recorded and was used as additional input to the calculations. The response to question 6.a contains a more detailed table relating to the local operation of the PORVs.

Action	ASSUMED	OBSERVED
Throttling of CA	Throttle CA when S/G reached normal operating level.	Throttle CA when S/G reached normal operating level.
Identify and isolate the ruptured S/g	13 minutes after the reactor trip.	Identified S/G 12 minutes after the trip and began isolation. Isolation was complete at 14 minutes.
Begin Cooldown	23 minutes after reactor trip.	21 minutes after reactor trip.
Operators reach the second PORV	33 minutes after reactor trip	31 minutes after the reactor trip. (Operators dispatched at 23 minutes after reactor trip. Travel time is ~8 minutes)
Second PORV begins to open	35 minutes after reactor trip	33 minutes after reactor trip.
Second PORV full open	41 minutes after reactor trip	37 minutes after reactor trip
Begin NC depressurizing	3 minutes after cooldown is complete.	2 minutes and 10 seconds after cooldown is complete.
Terminate S/I	3 minutes after completion of NC depressurization.	3 minutes after completion of NC depressurization

b. Consider simulator tests for at least 80 percent of plant operators.

The overall time from initiation of a an FSAR tube rupture to the point of safety injection termination is conservatively calculated to be on the order of 55 to 60 minutes. Extensive time validations conducted in 1994 resulted in termination times ranging from 34 to 48 minutes, with the average at about 45 minutes. Recent scenarios , using current communication techniques and operator practices, continue to demonstrate termination times in the range of about 48 minutes. Consistent operator performance within the required times indicate there is no

need to initiate a special testing program at this time. Note the Steam Generator Tube rupture is an annual required exercise, and discussions are under way whether to model this years scenario for these conditions.

9. *Discuss the necessity for and your commitment to update the SGTR analysis information (e.g., operator actions and times) provided to the staff that was used as the basis for its findings and conclusions in the safety evaluation dated May 14, 1991.*

Operator Actions and times for the SGTR event will not directly correlate to those provided in the May 14, 1991 safety evaluation. The results of those time trials were based on the accident scenario presented in the WCAP-10698 and no longer apply based on the newly identified single failure. A comparison of the applicability of the criteria in Section 4 of the SER dated May 14, 1991 is as follows:

1. Provide simulator and emergency operating procedure training related to SGTR. Response: criteria is met in new scenario. (See responses in question 8 of this submittal)

2. Ensure plant specific operator times are consistent with WCAP-10698. Response: WCAP-10698 is not bounding for the new single failure. Operator action times continue to provide margin to overfill. (New times are available in questions 6 and 8 and Attachment 1 of this submittal)

3. Utilizing typical control room staff show operator action times assumed in the analysis are realistic. Response: The table in question 6a shows the additional operator actions assumed in the analysis vs. the demonstrated times. Question 8b discusses the plan for future simulator testing.

4. Complete demonstration runs to show that the SGTR accident can be mitigated with margin to overfill. Response: (see questions 6,7 and 8 of this submittal)

5. This criteria still does not apply.

REFERENCES

1) Letter, W.R. McCollum to US Nuclear Regulatory Commission, "Catawba Nuclear Station, Units 1 and 2, Dockets Nos. 50-413 and 50-414 Request for Facility Operating License Amendment Steam Generator Tube Rupture Evaluation," March 7, 1997.

2) Regulatory Guide 1.97.

3) U.S. Nuclear Regulatory Commission, "Information to Licensees Regarding Two NRC Inspection Manual Sections on Resolution of Degraded and Nonconforming Conditions and on Operability (Generic Letter 91-18," Inspection Manual Part 9900, Operable/Operability Ensuring the Functional Capability of a System or Component, Section 6.7.

4) American Nuclear Society, Time Response Design Criteria for Safety-Related Operator Actions (An American National Standard), ANSI/ANS-58.8-1994.

5) USNRC, Draft Regulatory Guide DG-1040 Time Response Design Criteria for Safety-Related Operator Actions.

6) Code of Federal Regulations, Volume 10, Part 50.

7) Letter, H.B. Tucker to U.S. Nuclear Regulatory Commission, "Catawba Nuclear Station Docket Nos. 50-413 and 50-414 TAC Numbers: 68527 and 68528 10CFR50.63, Requirements for Station Blackout," April 17, 1989.

8) Letter, H.B. Tucker to U.S. Nuclear Regulatory Commission, "Catawba Nuclear Station, Units 1 and 2 Docket Nos. 50-413 and 50-414; Requirements for Station Blackout," April 4, 1990.

9) Letter, Robert E. Martin to M.S. Tuckman, "Station Blackout Analysis for Catawba Site (TAC NOS. M68527 and M58628)," January 10, 1992.

10) Letter, M.S. Tuckman to USNRC, "Supplement to Replacement S/G Proposed TS Amendments," August 27, 1996.

ATTACHMENT 1

Duke Power Company
Catawba Nuclear Station
S/G Tube Rupture Dose Analysis Assumptions & Inputs

Accident Scenario (All Analyses): Steam Generator (S/G) Tube Rupture (SGTR) with Loss of Offsite Power (LOOP) postulated to occur concurrent with reactor trip.

Single Failure:

Previous Analysis: The single failure is a stuck open Power Operated Relief Valve (PORV) on the ruptured S/G.

Current Analysis: The single failure is postulated to occur within a channel of the Vital Instrumentation and Control Systems, resulting in loss of control power to two S/G PORV's.

Final Analysis: The limiting single failure will be as assumed in the current analysis, subject to completion of a failure modes and effects analysis.

Analysis Methodology:

Previous Analysis: The mathematical models for RCS iodine concentration, S/G concentration, etc., and associated EXCEL spreadsheet of Reference 1 was used. These models have been reviewed by the NRC Staff (i.e., the MSLB dose calculation for Interim Plugging Criteria Amendment). The activity concentration and transport equations of Reference 1 are not solved simultaneously. Additionally, even though the equations solve the differential equations for RCS iodine activity and S/G activity in closed form, this solution technique holds variables constant for each given time step. Source term assumptions are as outlined in the Standard Review Plan (coincident and pre-existent iodine spike).

Current Analysis: The solution methodology is the same as in the previous analyses.

Final Analysis: The Bechtel computer code LOCADOSE will be used. The concentration and activity transport equations are posed in the same manner as they are in Reference 1. The equations are solved simultaneously. That is, a more precise mathematical solution technique, which does not hold variables constant for given time steps, is employed by this computer code. Benchmark cases against our current technique indicates that the more accurate Bechtel methodology shows a reduction of ≈ 15% in calculated doses with identical input.

Thermal Hydraulic Input:

Previous Analysis: A RETRAN02 analysis is performed with assumptions associated with the analysis of radiological consequences:

Current Analysis: The results of the RETRAN02 analysis of S/G overfill were projected onto a time line associated with the mitigation of radiological consequences. Additional conservative assumptions were made as noted below.

Final Analysis: A RETRAN02 analysis will be performed for inputs to the dose calculation as was done in the previous analysis.

Flash Fraction:

Previous Analysis: The primary side temperature at the inlet to the S/G tube region was taken from the RETRAN02 output. A secondary side temperature of 500 °F was assumed in the SGTR calculation noted in Reference 1 as a conservatism. In previous analyses, RETRAN02 output for secondary side conditions were used to compute flash fractions.

Current Analysis: The primary side conditions were taken from RETRAN02 analyses in the same manner as in the previous analyses. Lower bounds on secondary side pressure were assumed. These lower bounds are 920 psia before trip, 850 psia for the first 36 minutes after trip, and 970 psi afterwards. This information is based on the analyses of S/G overfill following SGTR postulated to occur at Unit 2. These values are lower than the calculated values of transient secondary side pressures for either unit.

Final Analysis: RETRAN02 output for both primary and secondary conditions at the inlet to the S/G tube region will be used in the final analysis.

Bypass Fraction:

Previous Analysis: Bypass flow was calculated to occur for only 16.8 sec in the RETRAN02 analysis of inputs for the dose calculations of Reference 1 (i.e., for the period of tube bundle uncovery).

Current Analysis: Bypass flow was assumed to occur for the first 5 minutes after reactor trip. A bypass fraction of 12% was assumed based on a review of the analysis of dose inputs, WCAP-13132, and previous analyses of radiological consequences of SGTR. This assumption was made as a conservatism to provide analytical margin in the absence of a precise analysis of thermal hydraulics inputs for the dose analysis. In discussions with Corporate Safety Analysis (responsible for the RETRAN02 analysis for dose inputs), it is expected that no bypass flow will occur. In the dose calculations, the penalty for bypass was added to calculated values of flash fraction to give a combined value for flash and bypass releases (the bypass fraction is RCS water droplets entrained within the flash fraction and released offsite during periods of tube bundle uncovery).

Final Analysis: Bypass fractions will be computed based on the results of the specific RETRAN02 analysis of dose inputs and a review of WCAP-13132.

Dose to the Operator Performing the Manual Valve Manipulations

A CEDE dose calculation for iodine intake was performed (utilizing ICRP-30 methodology), as well as an external dose calculation with the QAD-CGGP computer code. These results were summed to indicate the TEDE dose, which is below the ICRP-30 and 10 CFR 20 limit of 0.05 Sv (or 5 rem). The thyroid dose is below the ICRP-30 and 10 CFR 20 limit of 0.5 Sv (or 50 rem in any one year for worker exposure). Only iodine was included in the dose calculation. It was assumed that all other isotopes (i.e., the noble gases) would rapidly disperse and not cause worker dose from intake.

Reference 1: M. S. Tuckman Letter to USNRC, August 27, 1996, "Supplement to Replacement SG Proposed TS Amendment" (dose analysis of record for SGTR, Locked Rotor and Rod Ejection), TAC M90566

Summary Table of SGTR Dose Analyses for Catawba Nuclear Station

Parameter	Previous Analysis	Current Analysis (note 4)
Assumed Failure	Stuck Open PORV on Ruptured S/G	EPL Failure Which Causes Two S/G PORVs to be Incapable of Opening From Control Room, Two Trains of ECCS Remain Operable
^{131}I Dose Equivalent Concentration	1 μCi/gm for Coincident Iodine Spike, 60 μCi/gm for Pre-existent Iodine Spike	0.46 μCi/gm for Coincident Iodine Spike, 26 μCi/gm for Pre-existent Iodine Spike (note 6)
Range of Flashing Fractions	≤ 0.23	≤ 0.26 (note 1)
Range of Break Flows (lbm/min)	≤ 2240	≤ 3600 (note 5)
Integrated Break Flow (lbm)	173,000	275,000
Steam Mass Released from Ruptured S/G (lbm)	254,000	589,000
EAB χ/Q (s/m^3)	4.78E-4	4.78E-4
Response Times (Min)		
SGTR Initiation	0.002	0.002
Rx Trip	20	20
Aux Feed Throttle (note 2)	N/A	25
Ruptured S/G Isolation	35	34 (note 3)
Initiate RCS Cooldown with One PORV	50 (2 S/G PORVs)	44
Manually Open Another S/G PORV	N/A	64
Open PZR PORV to Depressurize RCS	73.5	68
Terminate S/I	76.8	76
Break Flow Terminated	76.8	106
EAB Thyroid Dose Results for the Pre-Existent Iodine Spike	63.4	57.0
EAB Thyroid Dose Results for Coincident Iodine Spike (Rem)	22.4	22.0

Notes:

(1) *Flashing fractions for new case do not assume specific RCS and S/G conditions in the calculations. Future RETRAN02 calculations for specific conditions will be performed, from which a revised dose calculation will be performed. The current state involves flashing fraction assumptions which include conservative boundary conditions for RCS temperature (high) and S/G pressure (low). The limiting flash fraction also includes a penalty for bypass as discussed above (page 2).*

(2) *This is not significant for doses.*

(3) *The PORV on the ruptured S/G is assumed not to be closed (i.e., it is assumed to cycle). The reduced setpoint versus the code safety valve setpoint maximizes the calculated break flow for the S/G overfill analysis.*

(4) *All times for the "current" analysis are based on RETRAN02 results for the S/G overfill analysis.*

(5) *Unit 2 break flows were used for both units. These values envelope Unit 1 break flows due to the larger diameter S/G tube in the D model S/G versus the replacement S/Gs for Unit 1.*

(6) *These D.E.I. restrictions are temporary, and will be in effect until final RETRAN02 calculations are performed by Corporate Safety Analysis and final dose calculations are performed by Catawba site Nuclear Engineering.*

(7) *The projected state of the future dose analysis is outlined on previous pages.*

(8) *No information has been provided on the intact S/Gs since there is no significant contribution to doses.*

(9) *In the "previous analysis," break flow was taken to be terminated with termination of S/I. In the "current analysis," some additional break flow is calculated based on the timing of ending Reactor Coolant System depressurization and termination of S/I. The affect on doses is considered not to be significant. Break flows following termination of S/I decrease rapidly. Additionally, flash fractions in this time period are computed to be very low (between 0 and 0.02).*

(10) *Control Room Operator doses are not reported in Chapter 15 of the Catawba UFSAR for the SGTR accident. However, these doses were calculated for the cases outlined herein; resultant doses are within GDC-19 limits and Standard Review Plan guideline values.*

ATTACHMENT 2

<u>NOTE</u> Emergency flashlights and Merlin-Gerlins are available in the control room.

1. **Obtain the following:**

__ • Flashlight
__ • Merlin-Gerlin.

<u>NOTE</u> The following are the preferred routes to the doghouses:

- Outside doghouse (1A and 1D S/G) - Through southeast door of Unit 1 turbine building
- Inside doghouse (1B and 1C S/G) - Through southeast control room exit to the auxiliary building.

2. **Establish communications with the control room as follows:**

a. Obtain sound powered phones from storage on 594' elevation.

__ • Outside doghouse (DH-594, EE-44, Rm 591)
__ • Inside doghouse (DH-594, EE-52, Rm 572).

b. Establish communications from the nearest phone jack at the selected S/G PORV(s):

__ • Outside doghouse (DH-635, FF-43, Rm 591)
__ • Inside doghouse (DH-625, FF-53, Rm 572).

3. **Place S/G PORV(s) in local operation as follows:**

   a. Select desired PORV(s):

   __ • 1SV-19 (S/G 1A PORV Manual Ctrl) (DH-635, FF-GG, 43-44, Rm 591)
   __ • 1SV-13 (S/G 1B PORV Manual Ctrl) (DH-635, FF, 53-54, Rm 572)
   __ • 1SV-7 (S/G 1C PORV Manual Ctrl) (DH-635, FF, 52-53, Rm 572)
   __ • 1SV-1 (S/G 1D PORV Manual Ctrl) (DH-635, FF-GG, 44-45, Rm 591).

__ b. Unscrew clevis from manual override shaft.

__ c. Turn handwheel in the "close" direction to expose actuator shaft below manual override shaft.

__ d. Slide clevis onto actuator shaft.

__ e. Open equalizing valve on side of PORV actuator.

__ f. Turn handwheel to position valve plug as desired.

4. **<u>WHEN</u> directed by the control room, <u>THEN</u> restore S/G PORV(s) to control room control as follows:**

__ a. Notify the control room to transmit an appropriate actuating signal from MCB to the valve positioner to correspond to approximate valve plug position.

__ b. Close equalizing valve on side of PORV actuator.

__ c. Turn handwheel until pressure is relieved from the clevis and actuator shaft.

__ d. Remove clevis from actuator shaft.

__ e. Turn handwheel until manual override shaft is fully extended.

__ f. Screw clevis onto manual override shaft.