March 14, 2002

NOTE TO: File

FROM: James H. Wilson, Senior **/s/JHWilson**
Environmental Project Manager
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation.

SUBJECT: INFORMATION PROVIDED BY DUKE ENERGY CORPORATION RELATED TO SEVERE ACCIDENT MITIGATION ALTERNATIVES IN ITS LICENSE RENEWAL APPLICATION FOR THE CATAWBA NUCLEAR STATION, UNITS 1 AND 2 (TAC NOS. MB2031 AND MB2032)

As followup to the NRC request for additional information dated December 10, 2001, related to the staff's environmental review for Catawba license renewal and the Duke Energy Corporation (Duke) response dated February 1, 2002, the staff held two telephone conferences with Duke.

In a telephone conference call held on February 7, 2002, Duke provided additional information to supplement its Catawba Nuclear Station Severe Accident Mitigation Alternatives (SAMA) Analysis Final Report, submitted in the environmental report (ER) for Catawba license renewal. Attachment 1 summarizes the questions asked by the staff, as well as Duke's responses. Duke is currently using Revision 2b to the Catawba PRA, but has not submitted this information to the NRC elsewhere. Attachment 2 is the printout of 2 data files containing the Catawba release category matrices (RCMs) used in the PRA analyses and the modified RCMs assuming the NUREG/CR-6427 weighted early containment failure probabilities.

Another telephone conference call was held on February 25, 2002, to further supplement information in the Catawba ER and the material provided after the February 7, 2002, telephone conference. Attachment 3 summarizes the questions asked by the staff, as well as Duke's responses.

The Duke Energy Corporation (Duke) provided the information in the designated attachments to the NRC staff via e-mails dated February 13 and March 14, 2002. Because the staff may rely on some of this information in its environmental review of Duke's application for renewal of the Catawba Nuclear Station, Units 1 and 2, licenses, this information is being docketed and made publicly available.

Docket Nos. 50-413 and 50-414

Attachments: As stated

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As followup to the NRC request for additional information dated November 19, 2001, related to the staff's environmental review for Catawba license renewal, and the Duke Energy Corporation (Duke) response dated January 29, 2002, the staff held two telephone conferences with Duke.

In a telephone conference call held on February 7, 2002, Duke provided additional information to supplement its Catawba Nuclear Station Severe Accident Mitigation Alternatives (SAMA) Analysis Final Report, submitted in the environmental report (ER) for Catawba license renewal. Attachment 1 summarizes the questions asked by the staff, as well as Duke's responses. Duke is currently using Revision 2b to the Catawba PRA, but has not submitted this information to the NRC elsewhere. Attachment 2 is the printout of 2 data files containing the McGuire release category matrices (RCMs) used in the PRA analyses and the modified RCMs assuming the NUREG/CR-6427 weighted early containment failure probabilities.

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Documentation of Information Provided in Teleconference held on February 7, 2002

1. Provide the release category matrix for the baseline risk study and for the sensitivity case used to develop the response to RAI 4.

   RESPONSE: In determining the risk impact based on the NUREG/CR-6427 weighted value of 34% for early containment failure probability, the Catawba PRA Revision 2b release category matrix (RCM) is modified by reallocating only the release category frequencies for those PDSs identified as SBOs in the RCM such that the early containment failure probability is 34%. From the Catawba PRA Revision 2b analysis the fast station blackout PDSs are 8PI, 8PS, 14PI, 14PS and 20PI, and the slow station blackout PDSs are 4PI, 4PS, 7PI, 7PS, 15PI and 15PS (note that small containment isolation failures are included since some of these PDSs end up in early containment failures) - a description of the PDSs can be found in the section 6.1 of the Catawba IPE report. The early containment failure frequencies in the RCM (RC501 and RC502) were increased proportionally.

   Attached (Attachment 2) is a data file containing the Catawba release category matrices (RCMs) used in the PRA analyses and the modified RCMs assuming the NUREG/CR-6427 weighted early containment failure probabilities.

2. Provide an approximate estimate of the costs associated with implementing the following 2 SAMAs at the Duke plants, broken down by general cost categories, such as engineering, materials, labor, administrative, or equivalent. It is our expectation that: (1) all equipment/hardware would be non-safety related, (2) procedures and any related training would be developed and maintained in accordance with existing plant practices applicable to the severe accident management guidelines, (3) no licensee submittals or changes to the FSAR or technical specifications would be involved.

   RESPONSE:

   Option 1 - (a severe accident management procedure to power a subset of the igniters [e.g., one train] from a portable generator or equivalent ac-independent power source. This change would not address backup power to air return fans. [The generator need not be dedicated or pre-staged if there is sufficient time to locate, position, and connect it prior to the onset of core damage, e.g., several hours in the frequency-dominant SBO.])

   This potential modification would require a 50.59 review which may result in changes to the design and additional costs not contained in the present estimate. This option does not provide for tornado protection of the generating source and is not seismically designed. Seismic and tornado are significant contributors to the overall SBO CDF. Including such features to the design would significantly increase the cost of the option.

Engineering	$5,000
Materials	$50,000
Installation Labor	$110,000
Maint and Operations	$40,000
TOTAL	$205,000

Option 2 - (a severe accident management procedure to power a subset of the igniters plus one air return fan from an ac-independent power source)

This potential modification would require a 50.59 review which may result in changes to the design and additional costs not contained in the present estimate.This option does not provide for tornado protection of the generating source and is not seismically designed. Seismic and tornado are significant contributors to the overall SBO CDF. Including such features to the design would significantly increase the cost of the option.

Engineering	$50,000
Materials	$210,000
Installation Labor	$240,000
Maint and Operations	$40,000
TOTAL	$540,000

3. Provide the basis for the cost estimates provided for the following 2 SAMAs, and a specific dollar value or range of dollar values (in lieu of the general statement ">1$M"): (1) Install automatic swap-over to high pressure recirculation, and (2) Install automatic swap to RV cooling/other unit RN system upon loss of RN.

RESPONSE:

From Page 7-8 of the Watts Bar SAMA report (reference NUREG-0498, Supp. 1), an alternative considered in the cost benefit analysis was:

> "Category I - Improve Availability of ECCS Recirculation -- Install automatic high-pressure recirculation (I.4) : automate the alignment of ECCS recirculation to the high-pressure charging and safety injection pumps. This would reduce the potential for related human errors made during manual realignment."

On Page 7-9 of the above mentioned report, Table 7.4 (Summary of Value/Impact Study Results) provides the cost estimate for this alternative to be on the order of $2.1 million. This cost estimate applies to both SAMAs (1) and (2).

Documentation of Information Provided in Teleconference held on February 25, 2002

1. Provide a description of the assumptions on which the risk reduction for the 3rd diesel was based (i.e.., diverse but not seismic), and the types of sequences/failures that would not be addressed by the 3rd (non-seismic) diesel.

   RESPONSE: Section 4.3 of the SAMA submittal (see Attachment H of the Environmental Report) provides a discussion of how the seismic and non-seismic initiators were treated separately in the SAMA analysis. The reason for separating out the seismic from non-seismic initiators in the SAMA analysis is that for the seismic initiator extensive plant damage is expected to occur resulting in failures of multiple pieces of equipment/components. Therefore, to mitigate such an event would require substantial upgrades to the plant systems seismic ruggedness. The CDF reductions reported in the SAMA submittal are for the non-seismic initiating events.

   The intent of our estimation of the risk reduction associated with the installation of a third diesel was to maximize the potential benefit by assuming that the third diesel was perfectly reliable, no random failure modes and no common cause connections to the essential diesels. This was to be accomplished by setting the existing diesel generator failure modes to 0 in the cutset file thus eliminating all blackout sequences. In practice, we did this by identifying and setting to 0 the dominant failure modes of the diesel generators, as described in Attachment H of the Environmental Report. Some residual CDF related to diesel failures did remain in the solution. The SAMA analysis estimated the change in CDF from installation of a third diesel to be 1.6E-05. This change comes from the reduction in the CDF contributions from the non-seismic initiators (turbine building flood, LOOP, all consuming turbine building fire, tornado initiators, etc.). Remember that the seismic considerations were addressed independently. This reduction is approximately 89% of the estimated benefit (~1.8E-05) if every single diesel generator failure event had been set to 0 rather than simply addressing the dominant contributors. The change in CDF provided in the SAMA submittal provides a reasonable estimate of the reduction expected by a highly reliable and diverse alternate ac power source.

   The intent was to present a change in CDF consistent with the complete elimination of all diesel generator failure modes, perfect reliability and diversity.

2. Provide a description of the additional risk reduction that would be achieved by making the 3rd diesel seismic, and the types of sequences/failures that not be addressed by the 3rd (seismic) diesel.

   RESPONSE: A sensitivity study has been conducted to evaluate the impact that a third diesel could have on the seismic results. No cost estimate has been developed for providing a seismically qualified diesel. As was done for the non-seismic analysis, the random failure modes of the diesels were removed form the model. The resulting change in CDF is approximately 4E-07. The seismic results are dominated by seismic failures in the 4 kV power system for which improving diesel generator availability provides no benefit.

3. Provide the expected risk reduction for the dedicated power line from the nearby hydro station (i.e., equivalent to adding a 3rd (seismic?) diesel), and the supporting rationale (i.e., that the HCLPF for hydro stations would typically be less than for a seismic diesel).

   RESPONSE: A dedicated and tornado protected line from the Wylie hydro-electric station could provide a CDF reduction similar to the estimate provided for the third diesel in the SAMA analysis. However, the result does not address potential common cause failure of the hydro-electric station as a result of the same tornado that causes the loss of offsite power to occur. The seismic fragilities of the hydro-electric plant would be expected to be lower than most of the essential systems at Catawba.

4. Provide a brief description of the SAMA on which the $205K and $540K estimates were based. This information is needed in order to put the various cost elements (engineering, materials, installation labor, and maintenance) in perspective. The response should clarify whether the SAMA/cost estimates: assume the generator is dedicated? pre-staged? would be located inside or outdoors?; include the cost of a pad or enclosure building? power cables (and their approximate length)? installing disconnects? routine surveillance and maintenance costs for remaining plant life?

   RESPONSE: The design requires an installed dedicated diesel because powering of the igniters needs to occur prior to the onset of core damage. The diesel is located outdoors for ventilation and exhaust considerations. Initiation and operation of the diesel will occur prior to the onset of core damage and thus will be covered by the emergency operating procedures rather than the severe accident management guidelines which are entered after core damage occurs.

   The cost estimates provided assumed one new dedicated diesel generator set, prestaged and located outside on a concrete pad for each station. No enclosure was included in the estimate. Approximately 900 feet of cable and nine circuit breakers would need to be installed and are included in the cost estimate. Initial procedure development costs were included in the cost estimate. However, ongoing routine surveillance and maintenance costs were not included. Also, this cost estimate does not include tornado protection of the diesel generator set nor does it include any seismic design .

5. Based on information provided in response to RAI 6c and RAI 8 (Table 8-3), it appears that installation of a watertight wall, if it achieves the same risk reduction as "manning the SSF 24 hours a day", may be cost beneficial. In this regard, please:

   a. Provide the estimated risk reduction (CDF and person-rem) and averted risk benefit for the alternative SAMA involving installation of a watertight wall. Describe which sequences/failure modes are eliminated by the SAMA, and which ones would remain.

RESPONSE: To estimate the maximum benefit associated with installing a watertight wall around the 6900/4160V transformers the same methodology implemented in the SAMA submittal is used here. This alternative has the potential to significantly reduce the risk associated with severe accident sequences involving turbine building flood initiators. Therefore, it is assumed that the installation of this watertight wall would completely eliminate the turbine building flood initiator severe accident sequences from the cut set file. To determine the maximum risk reduction possible for this alternative the turbine building flood initiator was set to 0 in the cut set file. The maximum estimated CDF reduction is 1.4E-05 per yr with a person Rem risk reduction of 12.4 person-Rem.

Based on these risk reduction values, over the 46-year current and license renewal period the maximum estimated benefit is approximately $1.1 million (averted public exposure = $3.4E+05, averted onsite cleanup cost = $2.1E+05, averted onsite exposure cost = $6.8E+03, averted offsite property damage cost = $7.0E+04, and averted power replacement cost = $4.5E+05).

The estimate of the benefit provided above is based, as is the SAMA submittal, on Revision 2b of the Catawba PRA. Catawba has recently installed reactor coolant pump seals that use o-ring materials that perform better at high temperature. This plant modification is expected to reduce the probability of a reactor coolant pump seal LOCA following a loss of seal cooling. Since a large fraction of the core damage sequences initiated by the turbine building flood involve seal LOCAs, the modification will reduce the CDF contribution form the flood and consequently reduce the change in CDF associated with the construction of a watertight wall. A sensitivity study has been performed to estimate the impact of the new seals on the benefit calculation. Considering the performance of the new seals, the change in CDF associated with the construction of the wall is estimated to be 1E-05. The estimated benefit is less than $870,000 with a person Rem risk reduction of 15.1 person-Rem.

b. Provide a description and breakdown of the major costs that contribute to the estimated cost of $500K to install a watertight wall.

RESPONSE: The estimated cost to install this modification in one Catawba unit is $250K. The estimated cost breakdown is $75K for engineering, $25K for materials, $150K for installation labor. Ongoing costs (i.e., maintenance of a sump pump) have not been included in this estimate. These cost estimates are for scoping purposes only and are subject to change.

6. Provide a breakdown of the Catawba SBO CDF in terms of internal events, seismic, fire, flood, tornado, etc.

RESPONSE:

INTERNAL		
INITIATOR		Core Damage Freq. (per yr)
T1	Reactor Trip	1.6E-08
T2	Loss of Load	1.0E-09
T3	LOOP	1.6E-06
T4	Loss of Main Feedwater	1.1E-09
T9	Loss of RN	9.3E-09
T11	Loss Of 4160 V Essential Bus	9.6E-08
FTB	Turbine Building Flood	1.3E-05

EXTERNAL		
INITIATOR		Core Damage Freq. (per yr)
FACTB	All Consuming TB Fire	1.7E-07
FCBLR	Cable Room Fire Causes A Loss Of CCW	1.8E-08
FETB	ETB Fire Initiating Event	1.5E-09
FCR	Control Room Fire Causes A Loss Of KC	1.0E-08
SEISMIC	Seismic	8.4E-06
TORNF4	Plant Struck By F4 Or F5 Tornado	4.4E-07
TORNSW	Tornado Causes LOOP	1.5E-06