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

Subject: Duke Energy Corporation Catawba Nuclear Station Units 1 & 2, Docket Nos. 50-413, 50-414
Proposed Amendments to the Facility Operating License and Technical Specifications to Allow Insertion of Mixed Oxide (MOX) Fuel Lead Assemblies (Additional Information on Revised Dose Evaluations)

By letter dated September 20, 2004 (Reference 1) Duke provided the Nuclear Regulatory Commission (NRC) with revised dose evaluations in support of the license amendment request (LAR) to receive and use four MOX fuel lead assemblies at the Catawba Nuclear Station. On October 7, 2004 the NRC requested additional information related to those revised dose evaluations (Reference 2). By letter dated October 29, 2004 (Reference 3) Duke responded to that Request for Additional Information. This letter and its attachments supplement the Reference 1 and Reference 3 Duke submittals.

The Reference 1 letter provided revised dose evaluations for three events: the loss of coolant accident (LOCA), the locked rotor accident (LRA), and the rod ejection accident (REA). For the LOCA, only the control room dose was revised in Reference 1. As discussed below, the information provided herein is a refinement of the Reference 1 analysis of control room doses following a LOCA. There are no changes to the LRA and REA offsite or control room dose results that were provided in Reference 1.

Attachment 3 of the September 20, 2004 letter (Reference 1) described changes to the LOCA control room dose analysis for cores containing all low enriched uranium (LEU) fuel. Those changes were: (i) an adjustment to account for Emergency Core Cooling System (ECCS) leakage (previously, no leakage was assumed), and (ii) an adjustment to the assumed control room unfiltered inleakage rate from 10 cubic feet per minute (cfm) to 30 cfm. The treatment of ECCS leakage in the Reference 1 analysis was unnecessarily conservative because it included an overly conservative assumption of thirty minutes of high ECCS leakage due to a passive failure at 24 hours following the postulated accident. Duke has performed a revised calculation of the

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impact of accounting for ECCS leakage. As discussed in Attachment 1 to this letter, the revised calculation is consistent with the Standard Review Plan and the Catawba licensing basis, and it provides for an appropriately conservative treatment of ECCS leakage. With this revised calculation, the control room thyroid dose following a LOCA is 12.8 rem, which is substantially lower than the dose value of 21 rem that was presented in Attachment 3 of Reference 1. These results pertain to Catawba cores containing all-LEU fuel.

As described in the March 16, 2004 letter (Reference 4), Duke applies a scaling factor to the all-LEU core doses to account for the impact of four MOX fuel lead assemblies. Therefore, a reduction in baseline all-LEU core dose translates to a reduction in dose for cores containing four MOX fuel lead assemblies. Applying the Reference 4 methodology to the revised all-LEU control room thyroid dose of 12.8 rem results in a thyroid dose of 13.0 rem for a MOX fuel lead assembly core. This result is lower than the value of 21.3 rem which was provided in Reference 1 for a MOX fuel lead assembly core, and it is also within the control room thyroid dose acceptance criterion of 30 rem. Attachment 2 to this letter provides a summary of the previous and revised dose results.

In the September 20, 2004 letter (Reference 1) Duke provided the NRC with updated information on several aspects of the MOX fuel lead assembly license amendment request: the radiological consequences, the No Significant Hazards Consideration analysis, and the environmental report. By this letter Duke is further updating that information where necessary to reflect the new value of 13.0 rem for control room thyroid dose following a LOCA with a MOX fuel lead assembly core. Attachment 3 to this letter shows the impact on radiological consequences results. There was no impact on the No Significant Hazards Consideration analysis (Attachment 6 to Reference 1) or the environmental report (Attachment 7 to Reference 1). These updates result in no changes to the regulatory conclusions that are supported by the LAR.

Offsite doses following a LOCA were not affected by the issues that led to the September 20, 2004 (Reference 1) resubmittal of some dose analysis results for MOX fuel lead assemblies. However, the change in ECCS leakage assumptions described in Attachment 1 to this letter does impact some of the offsite LOCA dose results. The Exclusion Area Boundary (EAB) dose following a LOCA is not affected because EAB doses are calculated for only two hours after the accident, and the ECCS leakage assumption change affects the activity release during the 24-24.5 hour period after the accident. However, the Low Population Zone (LPZ) doses are analyzed for 30 days, and the previous LPZ dose analysis also incorporated the overly conservative assumption of a gross passive failure contribution to ECCS leakage. Therefore, the LPZ thyroid dose results reported in the March 16, 2004 letter to the NRC (Reference 4) are unnecessarily conservative. In order to maintain consistency in the licensing basis, Duke has recalculated the LPZ thyroid dose following a LOCA with the appropriate ECCS leakage assumption (see Attachment 1), consistent with the control room thyroid dose analysis discussed above. The resulting LPZ thyroid doses following a LOCA are 12.7 rem for an all-LEU core and 12.9 rem for a core with four MOX fuel lead assemblies. This contrasts with the March 16, 2004 analysis results of 25 rem and 25.3 rem for the all-LEU and MOX fuel lead assembly cases, respectively. These changes are also reflected in Attachments 2 and 3 to this letter. LPZ thyroid doses following a LOCA were not limiting before this change. They remain non-limiting now, and are even further removed from the acceptance criterion of 300 rem.

If you have any questions on this matter, please contact Steve Nesbit at (704) 382-2197.

Sincerely,

W. R. Mc Collum, Jr.

References

(1) Letter, Barron, H. B. (Duke) to U. S. Nuclear Regulatory Commission (USNRC), Revised Dose Evaluations, September 20, 2004.
(2) Letter, USNRC to Barron, H. B. (Duke), Request for Additional Information Concerning Mixed Oxide Fuel Lead Test Assemblies, October 7, 2004.
(3) Letter, W. R. Mc Collum (Duke) to U. S. Nuclear Regulatory Commission, Response to Request for Additional Information, October 29, 2004.
(4) Letter, W. R. Mc Collum (Duke) to U. S. Nuclear Regulatory Commission, Corrections to Dose Information, March 16, 2004.

Attachments (3)

Attachment 1 – ECCS Leakage Model and Basis
Attachment 2 - Post-Accident Thyroid Dose Analysis Results
Attachment 3 - Updated LAR Radiological Consequences Information

Oath and Affirmation

I affirm that I, W. R. Mc Collum, Jr. am the person who subscribed my name to the foregoing, and that all the matters and facts set forth herein are true and correct to the best of my knowledge.

W. R. Mc Collum, Jr.

Subscribed and sworn to before me on this 10th day of December 2004.

Notary Public

My Commission expires:

03-09-09

Date

BETTY SHARPE GREGORY NOTARY PUBLIC My Comm. Exp. March 09, 2009 MECKLENBURG COUNTY, N.C.

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NRIA File/ELL - EC05O
MOX File 1607.2304
Catawba Document Control File 801.01– CN04DM
Catawba RGC Date File (J. M. Ferguson – CN01SA)

Attachment 1

ECCS Leakage Model and Basis

Introduction

The Catawba Nuclear Station LOCA analysis includes an ECCS leakage model for both the offsite and control room dose calculations. This model accounts for postulated leakage from ECCS components into the Auxiliary Building during post accident sump recirculation. The leakage is assumed to flash to steam after its release into the Auxiliary Building and be transported to the environment and to receptor locations (EAB, LPZ, control room) through atmospheric processes.

Modeling of ECCS leakage is straightforward since there is only one flow path. Radionuclides are released from the reactor coolant system and transported to the containment sump. They reside in the sump until sump recirculation begins. This operation takes sump water through plant systems and components in the Auxiliary Building where the leaked water flashes to steam. This is a single node model with a flashing fraction applied to the releases. Transport of radionuclides to the receptors is modeled by atmospheric dispersion factors. A time-dependent model is used to compute control room activity. Breathing rates and occupancy factors model the intake by an individual at these locations.

One of the main variables is the rate of fluid leakage from the ECCS. Regulatory guidance is provided in NUREG-0800, the Standard Review Plan (SRP), on the amount and timing of the release. This guidance is a function of the qualification and configuration of the Auxiliary Building Filtered Ventilation Exhaust System (ABFVES).

SRP Requirements for Ventilation Systems and ECCS Leakage

The SRP provides requirements for ECCS leakage modeling. It contains requirements related to source term and activity transport associated with an ECCS leakage model. These assumptions and their associated values were listed and discussed previously in References 1 and 3. The change made in the current model of the ECCS leakage is described in Section III of SRP 15.6.5 Appendix B (emphasis added):

> For a plant that does not provide an ESF atmosphere filtration system, the dose assessment should also include the leakage from a gross failure of a passive component. This leakage should conservatively be assumed to be 50 gallons per minute, starting at 24 hours after the accident and lasting for 30 minutes. For a plant that does provide an ESF atmosphere filtration system in the areas of potential leakage from a gross failure of passive components, such dose assessment need not be performed.

By this paragraph, the leakage rate assumed in an ECCS leakage model depends upon the provision of an Engineered Safety Features (ESF) ventilation system. In the case of Catawba, this system is the ABFVES, which is a subsystem of the Auxiliary Building Ventilation System

(ABVS). The ABFVES is a safety related system that includes filtered air flow. The presence of this system meets the SRP requirements for not performing a dose assessment for potential leakage from a gross failure of passive equipment. If a gross failure is not required to be modeled, then the ECCS leakage rate assumed in the calculation of post-LOCA doses is prescribed to be a constant rate set to twice the allowable operational leakage rate.

Initial Licensing of Auxiliary Building Ventilation System

The ABVS (including its subsystems) is mentioned numerous times in the Catawba FSAR at the time the operating license was issued. It is described most prominently and in the most detail in Section 9.4.3.

At the time of initial licensing, the ABVS was described as being composed of two subsystems, one of which is the ABFVES. The ABFVES serves "an engineered safety features function during accident conditions." It also serves "a safety related function." During accident conditions, and in response to an ESF signal, the system is aligned "shutting off air flow from all areas of the Auxiliary Building except for the rooms which contain safety related pumps which are part of the Emergency Core Cooling System (ECCS)." These rooms house safety related pumps from four systems: (1) safety injection, (2) residual heat removal, (3) centrifugal charging, and (4) containment spray. The ABFVES is powered by Class 1E standby power during an ESF actuation.

This description of the ABFVES shows that it was licensed as an "ESF atmosphere filtration system." Additionally, the system was licensed to perform safety related functions and is specifically aligned on an ESF actuation to provide filtered air flow from rooms containing ECCS pumps. These pumps are the pieces of equipment in the ECCS with the capability to provide gross leakage, which is consistent with SRP 15.6.5 Appendix B Section I, and NUREG-0954, the Catawba Safety Evaluation Report (SER), Section 15.4.5.2 which states: "The maximum credible emergency core cooling system (ECCS) leakage outside containment would be due to a pump seal failure." Thus, as a plant that provides "an ESF atmosphere filtration system in the areas of potential leakage from a gross failure of passive components," Catawba was initially licensed without the assumption or modeling of a gross failure of passive components as part of LOCA dose analyses.

The NRC's evaluation of the ABVS is found in Section 9.4.3 of the Catawba SER. Its description, as a system with a safety related filtered exhaust subsystem, mirrors that found in the corresponding Catawba FSAR section. Upon ESF actuation the ABFVES realigns to serve only the ECCS pump rooms.

The Catawba FSAR (at the time the operating license was issued) and the NRC's SER are in agreement as to the operation and classification of the ABVS and the ABFVES. These descriptions of the post accident performance of the ABFVES supported and confirmed the basis for the modeling of ECCS leakage in the initial analyses of Catawba post LOCA accident doses.

Initial Catawba LOCA Dose Analyses and Subsequent Revisions

The initial LOCA analyses models included ECCS leakage and modeled it as a constant value for the duration of the accident. No credit is taken for any radionuclide filtration performed by the ABFVES. Thus, the ABFVES system was credited as an "ESF atmosphere filtration system," but no explicit credit was taken for the removal of any radionuclides by its filters. The gross failure of passive components was not modeled.

The Catawba LOCA models were later revised. The new offsite dose calculation accounted for ECCS leakage, but added the assumption of a gross, passive failure. As before, no credit was taken for radionuclide filtration by ABFVES. The offsite calculation appears to have gone beyond the Catawba licensing basis at the time, but was conservative. As discussed in the September 20, 2004 Duke letter to the NRC (Reference 1), the revised control room analysis did not model ECCS leakage – a nonconservative change. The FSAR was updated to reflect the new offsite and control room dose analyses.

In conclusion, the ECCS modeling performed by the initial Catawba LOCA dose calculations appears to have properly reflected the conditions of the initial Catawba license. No change to the licensing basis or plant configuration has been identified which would invalidate the bases of the ECCS leakage models that were initially used. The ECCS leakage rate and ABFVES filtration modeling assumptions in those initial licensing basis calculations are used in the most recent LOCA dose analyses, the results of which are provided in this letter.

Generic Letter 99-02 Response

The Catawba response to Generic Letter (GL) 99-02 provides information on the testing of charcoal from ESF ventilation systems. Five ventilation systems are listed and discussed. Only one of them is designated as non-ESF (Containment Purge Ventilation System). All others, including the ABVS, are designated as "ESF ventilation systems." The information requested by GL 99-02 was provided for the ABFVES system. There is no implication that the filters are not being used or maintained as operational and creditable components.

The ABFVES as described in the response to GL 99-02 is consistent with both the original licensing basis of the system and how the system is currently operated.

Alignment of Ventilation on ESF Actuation

As when Catawba was initially licensed, in response to an ESF actuation the ABFVES is aligned to the ECCS pump rooms – the locations where a gross, passive failure (from a pump seal) is credible.

Potential Licensing Basis Impacts to ABFVES

A search of licensing correspondence was performed for items that could have impacted the description and operational response of the system to a post accident LOCA and ESF actuation. While numerous letters dealt with the ABVS, and more specifically the ABFVES, no change in basic post-accident function or response was identified in the correspondence. The licensing basis post accident response of the system germane to the modeling of LOCA doses from ECCS leakage remains the same today as it was when the plant was initially licensed.

Technical Specifications

Catawba Technical Specifications (TS) 3.7.12 and 5.5.11 are applicable to the ABFVES. TS 3.7.12 and its basis govern the operation of the system. Surveillance requirements 3.7.12.3 and 3.17.12.4 are provided to provide assurance that the system will perform its post-LOCA functions to respond to an ESF actuation signal and align flow to the ECCS pump rooms, thereby maintaining a negative pressure in those rooms. This ensures that any airflow between adjacent spaces would be toward the ECCS pump rooms. Additionally, the ABFVES filters are included in Technical Specification 5.5.11, Ventilation Filter Test Program. This program controls the testing and performance of filters in ESF-related systems. The ABFVES filters are included in this program.

Current ECCS Leakage Model

The ECCS leakage model that is included in these most recent control room and offsite LOCA dose analyses treats the ABFVES as an "ESF atmosphere filtration system in the areas of potential leakage from a gross failure of passive components" (quote from SRP 15.6.5 Appendix B). The existence of this system negates the need to include a gross failure of a passive component in the post-accident LOCA dose analysis. Therefore, the ECCS leakage is modeled as a constant rate based upon the allowable operational leakage rate. This leakage begins at the time of sump recirculation and continues for the duration of the accident. No explicit credit is taken for radionuclide removal by the filters in the ABFVES.

This treatment is consistent with the Catawba licensing basis and the SRP. The ECCS leakage rate and filtration assumptions are consistent with the ECCS leakage model which was in place during initial Catawba licensing.

The table in Attachment 3 to the September 20, 2004 Duke letter to the NRC (Reference 1) provides parameters used in the analysis of post-LOCA control room dose. The control room dose analysis described in this letter used the same parameter values as the "Current Licensing Basis Analysis Value" column of the aforementioned Reference 1 table except for the ECCS leakage rate assumption. For these current analyses, the ECCS leakage rate is equal to 7520 cc/hr from 0.47 hours through the end of the analysis (30 days).

Control Room Thyroid Dose Results with ECCS Leakage Model

Modeling the ECCS leakage as described herein results in a post-LOCA control room thyroid dose of 4.7 rem due to the ECCS leakage. The containment leakage component of the post-LOCA control room thyroid dose is 8.1 rem. This component is from the activity release from containment as modeled in the September 20, 2004 (Reference 1) analysis. Both components of the dose results are based on 30 cfm unfiltered inleakage into the control room.

For all LEU cores, the total post-LOCA control room thyroid dose is the sum of the ECCS leakage and containment leakage components, or 12.8 rem.

Conclusion

The current ECCS leakage model uses the same leakage rate and filtration assumptions as were used in the initial post LOCA off-site and control room dose analyses. This model is consistent with the requirements of the Standard Review Plan and reflects the Catawba licensing basis.

The ABFVES is a safety related system that is designed for post-accident ESF operation. Upon ESF actuation, dampers align the system so that all airflow is directed through the ECCS pump rooms. These rooms contain the equipment that could result in the gross, passive failure leakage described by the SRP. Since the ECCS pump rooms are maintained at a negative pressure relative to all adjacent spaces, any leakage in the pump rooms would be exhausted and filtered by the ABFVES. Any air flow from adjacent rooms would be drawn toward the pump rooms as well. Recent correspondence and current plant documentation show that the basic post-LOCA design basis response has not changed from initial licensing.

The current ECCS leakage model employed in these most recent analyses uses a constant leakage rate through the duration of the accident and does not take credit for any radionuclide filtration of that leakage by the ABFVES filters. These assumptions mimic those made in the original Catawba LOCA dose analyses and are consistent with SRP guideline for plants with an ESF ABFVES. Therefore, this ECCS model does not represent a change to the Catawba licensing basis.

For all LEU cores, with ECCS leakage modeled as described herein, the total post-LOCA control room thyroid dose is 12.8 rem, which is within the 30 rem acceptance criterion.

Attachment 2

Post-Accident Thyroid Dose Analysis Results

Accident	Unit	Exclusion Area Boundary		Low Population Zone		Control Room	
		Limit (rem)	Dose (rem)	Limit (rem)	Dose (rem)	Limit (rem)	Dose (rem)
Locked Rotor	1	30	26.9 (23.6)	30	4.6 (4.1)	30	1.0 (0.9)
	2	30	27.8 (22.0)	30	4.5 (3.6)	30	1.4 (1.1)
Rod Ejection	1	75	22.3 (21.8)	75	17.8 (17.4)	30	6.6 (6.4)
	2	75	31.5 (30.7)	75	19.8 (19.3)	30	8.9 (8.7)
LOCA	Both	300	90.2 (89)	300	**[12.9 (12.7)]**	30	**[13.0 (12.8)]**

Note 1: The first dose values in a column correspond to a core with four MOX fuel lead assemblies. The second dose values (in parentheses) are the current LEU thyroid dose values for Catawba.

Note 2: This increase in dose due to MOX fuel is calculated as described by Duke in the March 16, 2004 letter to the NRC (Reference 4).

Note 3: The numbers shown in **bold** and brackets [ ] are changes relative to the results reported in Attachment 4 to the September 20, 2004 letter to the NRC (Reference 1). These changes result from the change in ECCS leakage assumption as described in Attachment 1 to this letter.

Attachment 3

Updated LAR Radiological Consequences Information

Attachment 5 to the September 20, 2004 letter to the NRC (Reference 1) updated information that had been provided regarding dose analyses for cores containing four MOX fuel lead assemblies. The changes discussed in this letter result in further modifications to some of the information in prior submittals. Those modifications are shown below in **bold** and brackets [ ]. Only the affected sections of the prior submittals are provided below.

November 3, 2003 Response to NRC Request for Additional Information Dated July 25, 2003

Question 3:

b. Provide the numeric results of the analyses discussed in Sections 3.7.3, 4.2.1.3, and 5.6.3.1 in terms of the whole body and thyroid dose quantities, or total effective dose equivalent (TEDE), as appropriate to the licensing basis of Catawba and McGuire. Include offsite and control room doses.

Response

Table Q3(b)-1
Offsite and Control Room Doses with LEU Cores and Projected Doses with MOX Lead Assembly Cores for LOCAs with TID and AST Releases

Receptor	TID Dose Limit (Rem Thyroid)	All LEU Core & TID Releases (Rem Thyroid)	MOX Lead Assemblies & Increased TID Releases (Rem Thyroid)	TEDE Dose Limit (Rem TEDE)	All LEU Core & AST Releases [2] (Rem TEDE)	MOX Lead Assemblies & Increased AST Releases (Rem TEDE)
EAB	300	89	90.2	25	7.2	7.3
LPZ	300	**[12.7]**	**[12.9]**	25	4.0	4.1
Control Room	30	**[12.8]**	**[13.0]**	5	2.7	2.7

[2] Reference Q3(b)-3

March 1, 2004 Response to NRC Request for Additional Information Dated February 4, 2003

Attachment 5 to the September 20, 2004 letter to the NRC (Reference 1) added Tables Q1-1, Q1-2, and Q1-3 to the "Response Conclusion." Tables Q1-2 and Q1-3 are further modified as shown below.

Table Q1-2
Projected NRC Computation of Locked Rotor, Rod Ejection, and LOCA LPZ Thyroid Doses for CNS Units 1 and 2 with Four MOX Lead Fuel Assemblies

Accident	CNS Unit 1	CNS Unit 2	Limit
Locked Rotor	4.7 Rem	4.6 Rem	30 Rem
Rod Ejection	17.9 Rem	19.8 Rem	75 Rem
LOCA	[12.9] Rem	[12.9] Rem	300 Rem

Table Q1-3
Projected NRC Computation of Locked Rotor, Rod Ejection, and LOCA Control Room Thyroid Doses for CNS Units 1 and 2 with Four MOX Lead Fuel Assemblies

Accident	CNS Unit 1	CNS Unit 2	Limit
Locked Rotor	1.0 Rem	1.4 Rem	30 Rem
Rod Ejection	6.6 Rem	9.0 Rem	30 Rem
LOCA	[13.0] Rem	[13.0] Rem	30 Rem