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October 6, 2008

U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

ATTENTION: Document Control Desk

Subject: Duke Energy Carolinas, LLC (Duke)
McGuire Nuclear Station, Units 1 and 2
Docket Nos. 50-369 and 50-370

License Amendment Request for Implementation of Alternative Source Term. Response to Request for Additional Information

Reference 1: Duke letter to NRC dated March 20, 2008
Reference 2: Duke letter to NRC dated May 28, 2008

This letter provides the additional information requested by the NRC staff via electronic mail from John F. Stang on September 4, 2008. The NRC staff's questions and Duke's responses are provided in Attachment 1.

The conclusions reached in the original determination that the LAR contains No Significant Hazards Considerations and the basis for the categorical exclusion from performing an Environmental/Impact Statement have not changed as a result of this request for additional information.

A001
NRR

Please contact Lee A. Hentz at 704-875-4187 if additional questions arise regarding this license amendment request.

Sincerely,

Bruce H. Hamilton

Attachment

cc: w/attachment

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OATH AND AFFIRMATION

Bruce H. Hamilton affirms that he is the person who subscribed his name to the foregoing statement, and that all the matters and facts set forth herein are true and correct to the best of his knowledge.

Bruce Hamilton

Bruce H. Hamilton, Site Vice President

Subscribed and sworn to me: October 6, 2008

Date

Lori C. Hildsy

Notary Public

My commission expires: July 1, 2012

Date

ATTACHMENT 1

Additional Information for the Office of Nuclear Reactor Regulation, Division of Risk Assessment, Accident Dose Branch regarding the Implementation of Alternative Source Term License Amendment Request submitted by McGuire.

Question 1

Adoption of the alternative source term (AST) represents a significant change to the current licensing basis (CLB) for McGuire Units 1 and 2. To ensure a complete and accurate safety assessment of the proposed AST license amendment request (LAR), the NRC staff needs to assess the safety significance of all of the changes to the CLB parameters used in the revised AST dose consequence analysis.

Please provide additional information describing all the basic parameters used in the AST loss-of-coolant accident (LOCA) dose consequence analyses. For each parameter, please indicate the CLB value, the revised value where applicable, as well as the basis for any changes to the CLB values. The staff notes that some of the requested information has been provided in various tables throughout the LAR. The staff requests that the information in these tables be expanded to clearly identify all of the changes to the CLB parameters used in the revised AST dose consequence analysis as well as the basis for the changes.

Response

Generation of the new AST analysis provided an opportunity to modernize the McGuire LOCA analysis. Thus, the new AST analysis is not an update to the previous analysis. It is a complete reanalysis of the McGuire LOCA in much the same way that Regulatory Guide 1.183 is a revamping of previous source and radiological analysis guidance. The new analysis is more detailed than the current TID based analysis, as the supporting system models were also updated. The system response modeling contains a better representation of the time dependent behavior of the plant's response to a LOCA. Thus, much of the modeling will not lend itself to a direct comparison in the form of table expansion. In addition, the time-steps for the time dependent models are not the same. Table expansion or adoption of table formatting from LAR tables for similar parameters will be presented where there is correspondence between the data sets.

Source Term

The current licensing basis (CLB) analysis uses a TID-14844 (Reference 1) based source term which only includes noble gases and iodines. Thus, only those values are presented for comparison. The CLB analysis release is made instantaneously and homogeneously. The AST analysis uses a time dependent release as described in Regulatory Guide 1.183 and Section 4.4 of the LAR. Because the CLB analysis release is instantaneous, it is specified in terms of total activity whereas the AST release is time dependent and is specified in terms of a release rate in the LAR. Additionally, the release fractions are different between the two models. Therefore, in order to make an appropriate and direct comparison, the total available core activity will be provided in the table below. Release fractions and timing would then be applied to this data to determine the source term released from the fuel for the analysis.

Comparison of Core Inventory Isotopics for the Current Licensing Basis and AST LOCA Analyses

Nuclide	AST Analysis Core Inventory (Ci)	CLB Analysis Core Inventory (Ci)
Kr83m	1.56E+07	1.40E+07
Kr85m	3.40E+07	3.05E+07
Kr85	1.07E+06	5.81E+05
Kr87	6.96E+07	6.23E+07
Kr88	9.79E+07	8.75E+07
Kr89	1.25E+08	1.12E+08
Xe131m	1.43E+06	1.31E+06
Xe133m	6.72E+06	6.16E+06
Xe133	2.08E+08	1.89E+08
Xe135m	4.51E+07	4.11E+07
Xe135	6.65E+07	4.45E+07
Xe137	1.98E+08	1.76E+08
Xe138	1.98E+08	1.63E+08
I130	2.96E+06	not included
I131	1.04E+08	9.50E+07
I132	1.52E+08	1.39E+08
I133	2.15E+08	1.94E+08
I134	2.47E+08	2.13E+08
I135	2.06E+08	1.85E+08

The source term isotopics were recomputed for the AST analysis in order to modernize the source term and the SCALE code version (described in Section 4.2 of the LAR) used to compute the isotopic inventories. The source isotopics generation model was expanded to bound future potential fuel assembly designs and core reload schemes, as well as bounding a greater range of enrichments and higher fuel exposures. In addition, the new source term analysis was needed to produce the activity inventories associated with the new isotopes specified in Regulatory Guide 1.183. The activities associated with the AST source term are greater than those in CLB source term.

Release Fractions

The release fractions were changed from the Regulatory Guide 1.4 (Reference 2) model in the CLB analysis to the Regulatory Guide 1.183 model in the AST analysis.

CLB and AST Activity Release Models

Nuclide Group	AST Release Model		CLB Release Model	
	Gap Release Phase (30 – 1830 sec.)	Early In-Vessel Phase (0.5 – 1.8 hr.)	Containment (instantaneous)	Sump (instantaneous)
Noble Gases	5%	95%	100%	No Release
Iodines	5%	35%	25%	50%
Other Halogens	5%	35%	No Release	No Release
Alkali Metals	5%	25%	No Release	No Release
Tellurium Metals	No Release	5%	No Release	No Release
Ba, Sr	No Release	2%	No Release	No Release
Noble Metals	No Release	0.25%	No Release	No Release
Cerium Group	No Release	0.05%	No Release	No Release
Lanthanides	No Release	0.02%	No Release	No Release

Releases from the sump are comprised of 50% iodines in the CLB analysis and described in LAR Section 4.4.9 and Regulatory Guide 1.183 for the AST model. Only iodines are released in the sump model, but telluriums are also tracked in the AST sump analysis because they are iodine precursors.

Iodine Specie Fractions

The iodine specie fractions were changed in response to the requirements of Regulatory Guide 1.183. The iodine specie fractions are discussed in Section 4.4.10 of the LAR.

Comparison of Iodine Specie Fractions for CLB and AST LOCA Analyses

Iodine Specie	AST Analysis		CLB Analysis
	Containment Atmosphere	Sump	Containment Atmosphere and Sump
Elemental	4.85%	97%	91%
Organic	0.15%	3%	4%
Particulate	95%	None	5%

Containment Leakage Model and Data

The CLB containment leakage rate model is based upon the difference in the volumes between the upper and lower containment compartments. The AST model apportions containment leakage based upon the penetration process piping diameters. This model is more representative of the postulated leakage locations and is also more conservative than the volume based model. This model was discussed in LAR Section 4.5.3.

The compartment volumes (including the annulus volume) were updated to be consistent with those used in the containment leakage program. The ice condenser volume was included in the calculation of containment free volume (as it is in the containment leakage program) and apportioned between upper and lower containment at the operating deck (most of the ice condenser volume is in upper containment). The inclusion of the ice condenser volumes represents the differences in the upper and lower compartment volumes.

Both analyses utilize the Technical Specification leakage rate L_a at P_a (leakage at maximum containment internal pressure post LOCA), and both reduce that rate by 50% after 24 hours.

Comparison of Containment Leakage Model Parameters
for the AST and CLB LOCA Analyses

Parameter	AST Analysis	CLB Analysis
Upper Containment Volume	826,752 ft^3	6.70E+05 ft^3
Lower Containment Volume	370,623 ft^3	3.68E+05 ft^3
Containment Bypass Fraction After Establishment of Annulus Vacuum	7%	7%
Containment Leakage Rates (L_a at P_a)		
0-24 hrs	0.3% / day	0.3% / day
>24 hrs	0.15% / day	0.15% / day

Annulus and Annulus Ventilation Model

The Annulus Ventilation System (VE) response was remodeled to support the AST LOCA analysis. Like the LOCA analysis, the resulting VE model used in the AST LOCA is more detailed. It models both the exhaust and recirculation modes explicitly. The CLB model does not model recirculation and it includes a very conservative 15% reduction in VE fan flow rate beginning at 900 seconds due to filter fouling.

The base annulus volume was updated to be consistent with the volume used in the VE system response model. The change in the portion of the annulus volume credited is consistent with Regulatory Guide 1.183 as discussed in LAR Section 4.6.3. Neither model credits mitigation by the VE system (100% bypass leakage) until annulus vacuum is established.

The time-steps involved with the two models do not line up for use of additional columns to LAR Table 9. There are not enough similarities between the models for an appropriate tabular comparison. The VE model used in the AST analysis contains almost three times as many time-steps as the CLB analysis. In addition, the new model includes the flows associated with the recirculation mode of the system. The detailed portion of the AST model covers a time span more than three times longer than that in the CLB analysis.

CLB Annulus Ventilation Flow Model

Sequence Number	Time-step Start (sec)	Time-step End (sec)	Discharge Volumetric Flow Rate (cfm)
1	0	34	0
2	34	39	4000
3	39	175	8000
4	175	222	0
5	222	265	8000
6	265	327	0
7	327	363	8000
8	363	449	0
9	449	481	8000
10	481	591	0
11	591	620	8000
12	620	820	0
13	820	846	8000
14	846	1100	0
15	1100	1130	6800
16	1130	1370	0
17	1370	1400	6800
18	1400	1630	0
19	1630	1670	6800
20	1670	1900	0
21	1900	1930	6800
22	1930	2230	0
23	2230	2260	6800
24	2260	2510	0
25	2510	2540	6800
26	2540	2.54E+06	810

Comparison of Annulus and Annulus Ventilation Parameters for the AST and CLB LOCA Analyses

Parameter	AST Analysis	CLB Analysis
VE start time	39 seconds	34 seconds
Time to establish annulus vacuum	71 seconds	112 seconds
Base VE fan flow rate	7200 cfm	8000 cfm
Portion of annulus volume credited	50%	1%
Full Annulus Volume	4.27E+05 ft^3	4.22E+05 ft^3

ECCS Leakage and Partitioning

As discussed in Sections 4.5.5 and 4.5.6 of the AST LAR, the time dependent partitioning model approved for Catawba was adopted for McGuire. This model was shown, in LAR Sections 4.5.5 and 4.5.6, to be conservative for McGuire. As discussed in Section 4.1 of the LAR, Duke maintains a fleet approach to management of its nuclear units and strives to maintain consistent modeling where possible. Adoption of this model allows for consistency between these plants for this model feature, even though the application is slightly more conservative for McGuire. The time dependent values for partitioning were computed for both ECCS leakage paths: Auxiliary Building and Refueling Water Storage Tank (FWST). These values are shown in Tables 7 and 8 of the LAR.

The CLB analysis uses a static model for all ECCS back-leakage releases of 10% for each of the iodine species. This fraction is applied for all times. There is no time dependent component in this model.

Both analyses model one gpm of back-leakage to the Auxiliary Building. The AST analysis models 20 gpm to the FWST while the CLB analysis models 0.5 gpm. In both analyses, the amount of leakage modeled is twice the operational leakage rate permitted by the leakage monitoring program.

ECCS leakage begins at 822 seconds in the CLB model and at 3000 seconds in the AST model. The AST leakage model is discussed in LAR Sections 4.3.4 and 4.5.4. It reflects current system operation.

Containment Sump Volume

The AST LOCA analysis used an updated sump level response prediction model. The CLB model uses equations with slopes and intercepts to model the response of the sump level during the time-step. The AST analysis uses the standard "stair-step" technique. Although neither the number of time-steps nor the times themselves match, the tabulated data from LAR Table 6 is presented beside the CLB sump below. The CLB data reflects the volume at the beginning of the time-step to mimic the “stair-step” information provided for the AST analysis in LAR Table 6. This allows for a valid basis for comparison of the models.

As discussed in the preceding section, CLB model ECCS leakage begins earlier than in the AST model. Thus, its sump volume model is more detailed earlier in the accident. The AST sump model is more detailed later in the accident, reflecting the later leakage initiation time. However, the sump volume has no impact on the activity release or the dose results until the time that ECCS leakage begins.

Comparison of the AST and CLB Sump Water Volume Models

AST Analysis	
Time (sec)	**Sump Volume** (ft^3)
0	0
45	19,000
1560	56,240
1800	59,600
1830	60,020
3000	72,140
3600	74,075
4800	76,900
6000	77,300
8700	77,400
10,200	77,600

CLB Analysis	
Time (sec)	**Sump Volume** (ft^3)
0	0
51.8	19,600
77	21,472
134	25,780
188	29,876
403	37,434
648	43,791
1000	53,326
1400	63,567
1880	75,221
2290	81,578
2630	83,697
3070	85,462
3140	85,815

<u>Containment Air Return System Fan Flow Rate</u>

The CLB analysis uses a Containment Air Return System (VX) fan nominal flow rate of 30,000 cfm whereas the AST analysis uses a lower, bounding flow rate of 29,000 cfm. The AST analysis models a conservative flow rate which makes conservative allowances for the effects of power source degraded voltage and frequency (LAR Section 4.6.4). A VX fan start time of 600 seconds is used in both analyses. Both analyses also credit the response of only one fan.

Containment Spray Models

Containment spray is credited in both analyses. Similar to other parameters, however, the spray model employed in the CLB analysis is static and the AST model uses a time dependent model. Both analyses credit spray flow into containment at 120 seconds. However, because the release in the CLB analysis is instantaneous and homogeneous throughout containment, spray credit begins at that time (120 seconds) and continues until decontamination factors (DF) of 5.5 for elemental iodine and 100 for particulate iodine are reached.

In the AST analysis, the requirement for an instantaneous and homogeneous release is replaced with a time dependent release. This source is released to lower containment. Spray only affects upper containment, so no spray credit is taken until the VX fans start at 600 seconds. VX fans transfer activity (atmosphere) from lower containment to upper containment where it can then be removed by the spray system. The application of spray washout DFs (50 for particulate and 200 for elemental) is described in the notes to LAR Table 10 which shows the time dependent spray model used in the AST analysis.

The CLB analysis uses an elemental spray lambda of 0.89 hr^{-1} and a particulate lambda of 2.40 hr^{-1}. These values are constant during the time that spray is credited (before the DFs are reached).

No credit was taken for organic iodine removal by sprays in either analysis.

Filter Efficiencies

The safety factors in the tables below are computed using the relationship presented in Attachment 2 to Generic Letter (GL) 99-02, as was discussed in AST LAR Section 4.6.11. Adoption of this methodology was made in response to direction from the NRC Staff during the Catawba AST LOCA review (LAR Section 4.6.11). These safety factors are calculated below for the CLB filter efficiencies using the GL 99-02 technique to provide an appropriate basis for comparison.

Elemental Iodine Filter Efficiencies for AST and CLB Analyses

Filter	AST Analysis Elemental Iodine Filter Efficiency	Safety Factor	CLB Analysis Elemental Iodine Filter Efficiency	Safety Factor
Control Room Vent. (VC)	98.1%	2	99%	1.05
Auxiliary Bldg. Vent. (VA)	92%	2	90%	2.5
Annulus Ventilation (VE)	92%	2	95%	1.25

Organic Iodine Filter Efficiencies for AST and CLB Analyses

Filter	AST Analysis Organic Iodine Filter Efficiency	Safety Factor	CLB Analysis Organic Iodine Filter Efficiency	Safety Factor
Control Room Vent. (VC)	98.1%	2	99%	1.05
Auxiliary Bldg. Vent. (VA)	92%	2	70%	7.5
Annulus Ventilation (VE)	92%	2	95%	1.25

Particulate Iodine Filter Efficiencies for AST and CLB Analyses

Filter	AST Particulate Iodine Filter Efficiency	Safety Factor	CLB Particulate Iodine Filter Efficiency	Safety Factor
Control Room Vent. (VC)	99%	20	99%	20
Auxiliary Bldg. Vent. (VA)	98%	2	95%	5
Annulus Ventilation (VE)	98%	2	95%	5

<u>Ice Condenser Credit</u>

The CLB analysis credits removal of elemental iodine by the melting ice. This process begins when the Containment Air Return System (VX) fans start at 600 seconds and it ends when the first ice bed melts at 3569 seconds. Elemental iodine is removed with an efficiency of 30%. Ice was not credited in the CLB analysis with mitigation of organic or particulate iodine.

Conservatively, no credit was taken for iodine removal by the melting ice in the AST analysis, as described in LAR Section 4.6.10. Mitigation from ice melt was not credited due to the change in the iodine specie fractions which greatly reduced the amount of elemental iodine in the source. The reduction in elemental iodine fraction in the new source term results in reduced elemental iodine mitigation credit associated with the melting ice. Although research exists to support crediting particulate iodine removal by ice melt (Reference 3), this approach has not been adopted at this time.

Off-site Receptor Modeling

The off-site dispersion factors established during initial plant licensing are used in both the CLB and AST analyses. The only difference in the breathing rate models for these receptors is in the number of significant figures specified in the associated guidance. The CLB values are taken from Reference 2. The breathing rates are compared in the table below.

Comparison of Breathing Rates for AST and CLB LOCA Analyses

Time	**AST Analysis Off-site Breathing Rate** (m^3/sec)	**CLB Analysis Off-site Breathing Rate** (m^3/sec)
0 to 8 hours	3.5E-04	3.47E-04
8 hours to 1 day	1.8E-04	1.75E-04
1 day to 30 days	2.3E-04	2.32E-04

Control Room Receptor Modeling

As discussed in Section 3.0 of the LAR, control room operator LOCA doses are currently subject to an operability resulting from the tracer gas testing which measured control room unfiltered in-leakage rates greater than the 10 cfm assumed in the CLB calculation. As discussed in LAR Section 4.6.7, and shown in LAR Table 11, the unfiltered in-leakage model in the AST analysis bounds the tracer gas test results.

In order to attempt to provide a valid comparison to the AST analysis, the CLB analysis control room model will be used even though the operability is in place. An attempt will be made to make a valid comparison between the AST analysis and CLB where appropriate. However, these two models are very different.

Control room receptor modeling in the CLB analysis uses a static iodine protection factor (IPF) model. This factor is computed to represent the protection afforded by the control room ventilation system. A value of 65 is computed for the iodine protection factor in the CLB analysis based upon a single Control Room Ventilation System (VC) fan at 1800 cfm. Recirculation is not credited in either model.

The CLB model uses a single composite, or representative, dispersion factor to model all releases rather than explicitly modeling the dispersion associated with each of the individual release paths, as the AST analysis does. The AST analysis employs the current dispersion factor modeling which was included in the submittal (LAR Appendices A, B, and D). These factors were computed for each specific potential release point (LAR Section 4.7.2).

The control room occupancy model is the same for both analyses and the breathing rates are essentially the same (to the number of significant digits used, as was the case for the off-site receptors above). Equally balanced intake flow was inherently modeled in the CLB analysis. VC intake flow balance testing was recently completed to support inclusion of this feature in the AST analysis (see response to Question 5). The time of VC start and the control room volume were updated. A smaller control room volume will result in higher calculated doses due to greater activity concentration.

Comparison of Control Room Model Parameters and Control Room Receptor Models for the AST and CLB LOCA Analyses

Parameter	AST Analysis	CLB Analysis
Time to start control room pressurization	30 seconds	180 seconds
Number of VC outside air pressurization fans credited	1	1
VC outside air pressurization fan flow rate	1800 cfm	1800 cfm
Control room volume	1.07E+05 ft^3	1.16E+05 ft^3
Breathing rate	3.5E-04 m^3/sec	3.47E-04 m^3/sec
VC flow split	65/35	50/50
Control room unfiltered in-leakage pre-pressurization post-pressurization	 625 cfm 210 cfm	 10 cfm 10 cfm

Dose Conversion Factors

Dose conversion factors in the CLB for inhalation (thyroid) doses from iodine are taken from ICRP-30 (Reference 4). Noble gas immersion/external (whole body) doses are calculated using Regulatory Guide 1.109 (Reference 5). Immersion/external (whole body) doses for iodines were computed using dose conversion factors from NUREG/CR-1918 (Reference 6).

As discussed in Section 4.8 of the LAR, these factors were updated to Federal Guidance Report (FGR) 11 and FGR 12 in accordance with Regulatory Guide 1.183.

Question 2

RG 1.183, Appendix I, "Assumptions for Evaluating Radiation Doses for Equipment Qualification," states the following:

"This appendix addresses assumptions associated with equipment qualification that are acceptable to the NRC staff for performing radiological assessments. As stated in Regulatory Position 6 of this guide, this appendix supersedes Regulatory Positions 2.c. (1) and 2.c. (2) and Appendix D of Revision 1 of Regulatory Guide 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants" (USNRC, June 1984), for operating reactors that have amended their licensing basis to use an alternative source term. Except as stated in this appendix, other assumptions, methods, and provisions of Revision 1 of Regulatory Guide 1.89 remain effective."

In evaluating the submittal, the U.S. Nuclear Regulatory Commission (NRC) staff could not determine how the regulatory positions discussed in RG 1.183, Appendix I have been assessed for McGuire Units 1 and 2. Please provide additional information describing how the regulatory positions discussed in RG 1.183, Appendix I have been assessed for McGuire Units 1 and 2.

Response

In addition to Regulatory Guide 1.183 Appendix I, equipment qualification (EQ) is also addressed in Regulatory Guide 1.183 Regulatory Positions 1.3.5 and 6. In both of these two positions, it is stated:

> The NRC Staff is assessing the effect of increased cesium releases on EQ doses to determine whether licensee action is warranted. Until such time as this generic issue is resolved, licensees may use either the AST or the TID 14844 assumptions for performing the required EQ analyses.

Pending the resolution of the cesium issue referred to Regulatory Positions 1.3.5 and 6 in Regulatory Guide 1.183, the McGuire equipment qualification analyses will continue to be based upon the TID-14844 modeling assumptions. Incorporation of Appendix I into McGuire equipment qualification analyses will be evaluated when the resolution of the cesium issue is promulgated.

Question 3

RG 1.183, Regulatory Position 4.3, "Other Dose Consequences," states that:

"The guidance provided in Regulatory Positions 4.1 and 4.2 should be used, as applicable, in re-assessing the radiological analyses identified in Regulatory Position 1.3.1, such as those in NUREG-0737. Design envelope source terms provided in NUREG-0737 should be updated for consistency with the AST. In general, radiation exposures to plant personnel identified in Regulatory Position 1.3.1 should be expressed in terms of [Total Effective Dose Equivalent] TEDE."

In evaluating the submittal, the NRC staff could not determine how RG 1.183, Regulatory Position 4.3 has been assessed for McGuire Units 1 and 2. Please provide additional information describing how Regulatory Position 4.3 has been assessed for McGuire Units 1 and 2.

Response

Regulatory Position 1.3.4 provides guidance for updating analyses based on the previous licensing basis source term once full scope implementation of AST has been approved. Once AST is part of the site's licensing basis this regulatory position requires that "...all characteristics of the AST and the TEDE criteria incorporated into the design basis will be addressed in all affected analyses on an individual as-needed basis." McGuire plans to incorporate AST into these remaining analyses on an as needed basis as described in this Regulatory Position. The response to Question 6 discusses AST incorporation into the control room shine analysis, which was reconstituted as part of the LOCA consequences reanalysis.

Regulatory Guide 1.183 Regulatory Position 1.3.2 states that an evaluation of AST impact was performed and it concluded that the TID based methodology and assumptions generally bound the AST methodology.

> This evaluation determined that radiological analysis results based on TID-14844 source term assumptions...and the whole body and thyroid methodology generally bound the results from analyses based on AST and TEDE methodology. Licensees may use the

applicable conclusions of this evaluation in addressing the impact of the AST on design basis radiological analyses.

Because full implementation of AST at McGuire does not require any physical modification to the plant, it has no impact to the assumptions or inputs to the current TID based analyses. Thus, AST implementation would not impact the conclusions from Regulatory Position 1.3.2, the TID based analyses, their results, or the ability to implement AST in other radiological analyses per the guidance in Regulatory Position 1.3.4.

Question 4

Section 4.3.1 of the LAR states the following:

"The plant's response to a Loss of Coolant Accident involves an integrated and coordinated response of individual systems and components. An analysis of the radiological consequences of the accident needs to include the individual system responses and their coordination into the integrated plant response.

The bounding design basis scenario includes a limiting single failure. Potential single failures of individual pieces of equipment and of whole trains of systems were postulated, including ventilation component failures, and mitigating system component failures to determine the bounding scenario. For McGuire, this scenario is referred to as the "Minimum Safeguards" scenario. In this scenario a power failure results in the loss of one train of the following LOCA mitigation systems:

- ***Containment Spray System (NS)***
- ***Containment Air Return System (VX)***
- ***Annulus Ventilation System (VE)***
- ***Control Room Ventilation System (VC)***

This failure results in the loss of one fan or pump or an entire train of equipment. Thus, the modeled plant response to the LOCA only credits one Containment Spray pump and train, one Containment Air Return fan, one Annulus Ventilation System fan and train, and one Control Room Ventilation fan and filter. In addition, maintenance is assumed in progress on one of the four Control Room Ventilation System inlet valves and that this maintenance has resulted in the blockage of this suction path, leaving one of the four intake paths unavailable. Thus, the Control Room Ventilation System is modeled in its minimum alignment for normal plant operation with two inlets at one intake location open and only one inlet at the other intake location open. Control Room Ventilation System

configuration is controlled via several administrative means including Technical Specifications and Selected Licensee Commitments."

The NRC staff's acceptance of a safety evaluation cannot be based on assuming the fulfillment of licensee commitments. Therefore, please provide additional information describing what particular aspects of the Control Room Ventilation System (VC) are controlled by the selected licensee commitments referred to above. In addition, please state whether or not the fulfillment of these commitments is necessary to ensure that the assumptions and design inputs described in the AST dose consequence analysis, as described in the LAR, remain valid.

Response

This section of the LAR was meant to convey that plant operation and control is affected by a variety of documents and that it is assumed that the plant is operated in accordance with these documents. Among these documents are Technical Specifications, Selected Licensee Commitments, and plant procedures.

Selected Licensee Commitments are contained in *The McGuire Nuclear Station Selected Licensee Commitments Manual* (Reference 7). It is officially designated as Chapter 16 of the Updated Final Safety Analysis Report (UFSAR), but it is maintained as a separate manual. This document is also referred to as the *Technical Requirements Manual* at other nuclear plants. Numerous technical specification requirements were relocated to this manual during the conversion to Improved Technical Specifications (standardized Technical Specifications). As stated in the NRC's Safety Evaluation for McGuire's conversion to Improved Technical Specifications (Reference 8), Technical Specifications that did not meet the four criteria of 10 CFR 50.36 may be relocated to licensee controlled documents subject to the 10 CFR 50.59 change process. Information in this manual is provided regarding systems that are a part of the licensing basis, as described in the UFSAR, but are not of such a level of importance that they need to be under the rigorous control provided by Technical Specifications.

The VC system possesses two redundant trains as reflected in Technical Specification 3.7.9. The analysis credits only one train of VC (fan and filter), as well as one train each of NS, VX, and VE. Selected Licensee Commitment (SLC) 16.7.6, *Radiation Monitoring for Plant Operations*, describes actions in response to a VC intake radiation monitor alarm. VC intake radiation monitors are not safety-related equipment. They are not modeled nor are any actions based upon their function credited in the analysis. McGuire is categorized as a "dual intake" plant without manual or automatic controls (LAR Sections 4.3.6 and 4.6.9). The AST analysis does not rely upon or credit actions prescribed by this document.

Prior to the conversion to standardized/improved Technical Specifications, the response to a VC intake radiation monitor alarm was contained in Technical

Specification 3/4.3.3. During the conversion to standardized/improved Technical Specifications (Reference 8), this was removed from Technical Specifications and relocated to the *The McGuire Nuclear Station Selected Licensee Commitments Manual* (Reference 7) as SLC 16.7.6 because it did not meet the criteria of 10 CFR 50.36.

Other documents exist in the administration of the plant, such as procedures, which can affect the operation and configuration of the plant and its systems. These documents and changes to these documents are reviewed against the plant's licensing basis using the 10 CFR 50.59 process.

Lastly, the adoption and implementation of Alternative Source Term at McGuire requires no physical changes or modifications to the plant. No Technical Specification changes are necessary for its implementation. Implementation of AST will require administrative updates to plant documents such as Design Basis Documents, calculations, the UFSAR, and other similar documents for configuration management and to update the change to the plant's licensing basis. These documents will be addressed after this License Amendment is approved, during the implementation period.

Question 5

The following statement is made in Section 4.7.2 of the LAR:

"The bounding VC system airflow distribution assumed is 65% from the contaminated stream and 35% from the non-contaminated intake location for all normal VC configurations and alignments. Therefore, the control room atmospheric dispersion factors in Table 16 are multiplied by 65% to reflect McGuire's dual intake classification. The resulting atmospheric dispersion factors shown in Table 17 are applied in the radiological consequences model. The failure of a train of mitigation equipment (including a VC fan train) has no effect on the control room intakes. As previously discussed in Section 4.6.9, these dispersion factors are applicable to the Minimum Safeguards scenario and bound normal VC system alignments and configurations."

It is not clear to the NRC staff how the failure of a VC fan train has no effect on the control room intakes. Please provide additional information describing the basis for the statement that the failure of a train of mitigation equipment (including a VC fan train) has no effect on the control room intakes and how the assumption of a minimum safeguards scenario, which results in the loss of one train of the VC, does not have an effect on the assumption of a flow split of 65% from the contaminated stream and 35% from the non-contaminated intake location.

Response

The Control Room Ventilation System and the modeling of this system are discussed in Sections 4.3.6 and 4.6.9 of the LAR. The attached McGuire Control Room Ventilation System Flow Diagram includes the modeled portion of the system. The system contains two trains (an "A" and a "B" train) which contain the same basic components and are modeled as identical trains. Each train has two air flow inlet paths at each of the two intake locations. The two inlet paths join into a single header for each intake location. Then both intake locations join into a single header which leads to either train's outside air pressurization fan and filter before discharging into the control room.

Each of the inlet paths has two isolation valves that are normally open. As described in LAR Section 4.6.9, the isolation valves fail "as is" and receive no automatic closure demands. No failure mode was identified that will cause an outside air inlet or one of its isolation valves to close simultaneously with a VC fan failure. These valves are only closed for maintenance, radiation alarm, chlorine alarm, tornado on-site, or testing. The position of these inlet isolation valves is independent of the status of the fans.

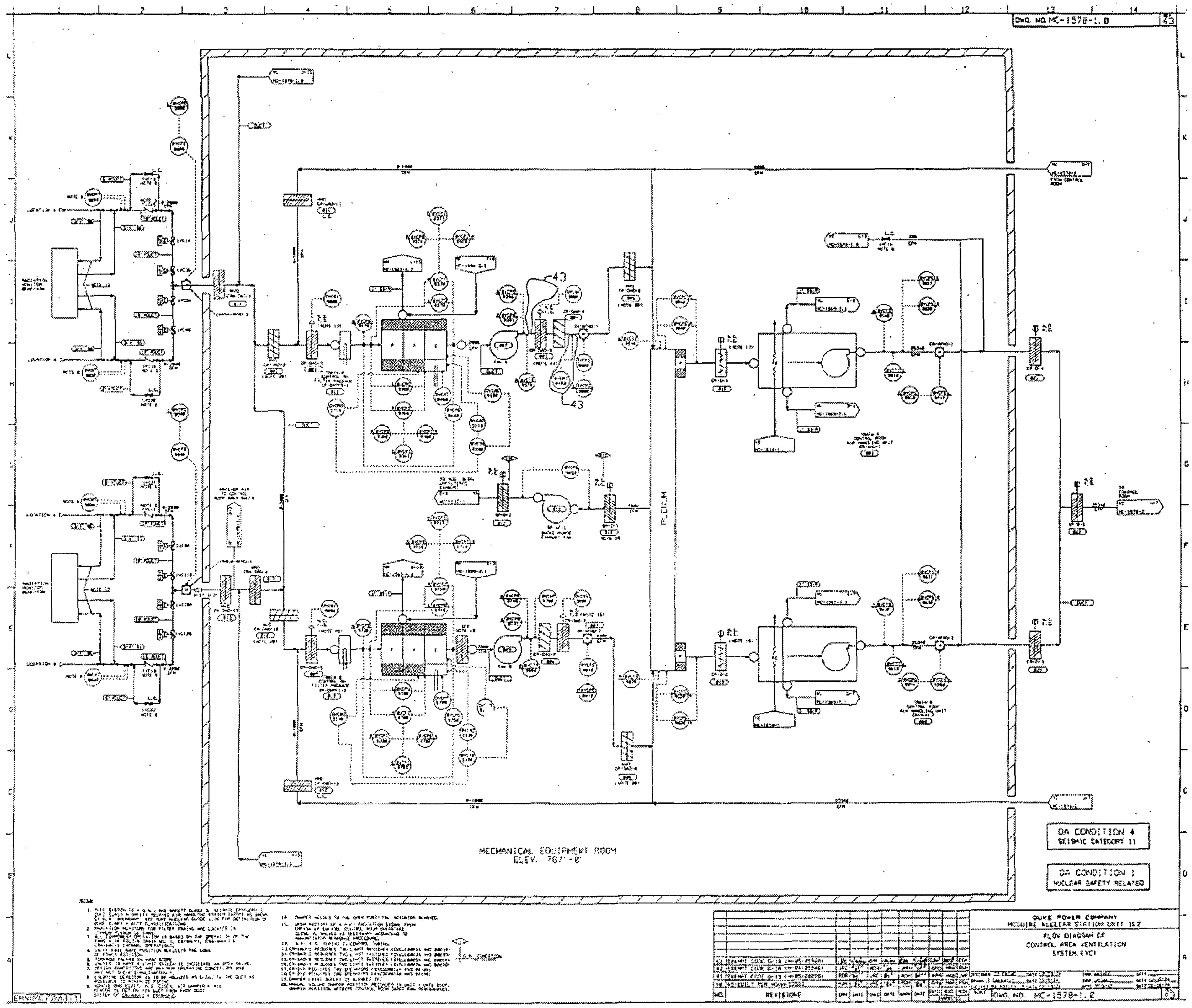
The intake location (supply) headers for both the "A" and "B" train outside air pressurization fans are cross-connected prior to the fans and filters. The cross connection of the intake supplies allows either fan access to outside air from both intake locations. Because the duct routing is not identical between the two trains, it is unlikely that perfectly balanced flow would result in all alignments. This necessitated a model of the potential flow split between the intake headers that would bound normal operational system alignments.

Plant testing of the flow split was performed. The testing configurations are described in the table below.

The flow split model of 65/35 was chosen to bound the test results for all of the alignments and configurations of this system that could be expected under normal operations. Therefore, the loss of one fan of control room ventilation does not affect the modeled flow split because the resulting configuration was included in the testing and the determination of the 65/35 flow split. The modeled flow split bounds all of the testing results.

Control Room Ventilation System Flow Balance Testing Alignments

Case	A OAPFT Fan	B OAPFT Fan	Location A Inlet Valves	Location B Inlet Valves
1	Off	Running	All Open	All Open
2	Off	Running	One Closed	All Open
3	Off	Running	All Open	One Closed
4	Running	Off	All Open	All Open
5	Running	Off	One Closed	All Open
6	Running	Off	All Open	One Closed
7	Running	Running	All Open	All Open
8	Running	Running	One Closed	All Open
9	Running	Running	All Open	One Closed


DWG NO MC-1578-1.0
PLENUM
MECHANICAL EQUIPMENT ROOM
ELEV. 767'-0"
QA CONDITION 4
SEISMIC CATEGORY II
QA CONDITION 1
NUCLEAR SAFETY RELATED
DUKE POWER COMPANY
MCGUIRE NUCLEAR STATION UNIT 1&2
FLOW DIAGRAM OF
CONTROL AREA VENTILATION
SYSTEM (VC)
NO.
REVISIONS
DWG. NO. MC-1578-1.2

Question 6

The following statement is made in Section 4.9 of the LAR:

"RG 1.183 also requires that all sources of control room operator dose be included in the computation of dose to control room personnel, and lists several sources for consideration including the impact from:

- ***infiltration of released activity into the control room***
- ***the infiltration of releases from adjacent structures or areas***
- ***radiation shine from radioactive material in containment***
- ***radiation shine from the plume***
- ***radiation shine from activity built up on systems and components***

The infiltration of releases is included in the effluent transport model as described in this submittal. Direct shine impacts were computed separately. This analysis examined and evaluated the impact of these potential sources. The total impact from direct radiation sources is shown in Table 18."

In evaluating the submittal, the NRC staff could not determine what assumptions and methodologies were used in the computation of the direct shine dose to control room personnel. Please provide additional information describing the assumptions and methodologies used in the computation of the direct shine to control room personnel. In addition, please clearly identify all of the changes to the CLB parameters used in the revised AST control room direct shine dose consequence analysis as well as the basis for the changes.

Response

As with the response to Question 1 above, it is difficult to make a direct comparison between the NUREG-0737 based control room shine analysis and the AST based analysis. The new analysis is not an update to the NUREG-0737 shine work. It represents a complete reconstitution of the control room shine analysis for McGuire. The level of detail, the codes, the methodology, and the input values are updated from the previous work. The new shine calculation is lengthily which prohibits a description to the same level of detail in this forum. However, the more salient features of the activity transport and source term determination relative to the effluents models and Regulatory Guide 1.183 will be described in this response. The AST effluents model input values were compared to the CLB model in the response to Question 1. The new control room shine analysis is in conformance with Regulatory Positions 4.2.2 and 4.2.3 of Regulatory Guide 1.183. This is discussed in more detail below.

The NUREG-0737 based analysis models an instantaneous and homogenous release of activity from the fuel consisting of 100% of the noble gases, 25% of the iodines and 0% of the fission products. This release is airborne in the Reactor Building atmosphere to provide a source for shine from the Reactor Building atmosphere and transport to the filters which could impact control room dose. The source term is based upon NUREG-0737 guidance (Reference 9). Dose contributions were evaluated for containment shine and the impacts of filter packages near the control room. The containment source regions consist of those portions of containment within the concrete crane wall, above the crane wall, and outside the crane wall, but within the containment vessel. The impacts of all potential filter and containment shine sources are summed to produce the total impact. A two dimensional point kernel code was employed to compute the initial dose rates. These values were used to compute the integrated 30 day dose rate based upon the behavior of the source term over that period.

Regulatory Guide 1.183 Regulatory Position 4.2.2 requires that the same source term, transport, and release modeling used in the effluents analysis be used for the control room shine analysis, unless non-conservative results would result. So, the new AST shine analysis was produced to be consistent with the AST effluents analysis which was described in the LAR. The LOCADOSE activity transport models used in the effluents analysis were used as a starting point for the shine analysis. However, conservative analyses for effluents and shine which meet Regulatory Guide 1.183 Regulatory Position 4.2.3 require modeling system performances and key parameters in opposing fashions. A conservative effluent analysis attempts to accelerate the release to the environment and minimize mitigation functions, such as filter credit, to maximize the doses to the receptors of interest. For a conservative shine analysis, the opposite is true: activity releases are minimized to keep activity in the plant and filtration credit is maximized for the filter of interest to increase the amount of activity accumulated.

These are inconsistent and contradictory in a coherent (effluent and shine) control room accident analysis. But, this inconsistency ensures that the results are conservative and bounding. In reality, a greater effluent release (and resulting doses) would mean less activity for shine (and less resulting doses). Greater filtration would result in less effluent doses. Additionally, the activity load on each type of filter is concurrently maximized. Therefore, in actuality, for a given activity release, greater filtration by the VE filters (for example) would result in greater activity accumulation on the VE filters, but less activity on the VC filters. But, this type of coherency was consciously avoided in order to conservatively maximize the activity on each type of filter independently.

The new shine models contain much more detail. Three dimensional shielding models were created to mimic the plant arrangement for the analyses of control room dose from containment shine and each of the filter packages. The filters of interest are the VE, VA, and the VC filters due to their proximity to the control room. Each of these potential sources of control room dose was subjected to the full source term activity available to maximize the source at each one, independent of the others. The shielding models include credit for significant structures in the plant including walls and columns.

Computation of doses over the 30 day period (as discussed in LAR Section 4.3.7) were achieved by explicitly integrating the activity transport over that period, converting the activities to a gamma spectrum, and then using that as the source input to the shielding models. The shielding models then produced the resulting doses.

Synopsis of Control Room Shine Modeling Features

- Filters of interest in each transport case are modeled to be 100% efficient for particulates and iodines. Noble gases are retained in the modeled filter nodes for the purpose of accounting for isotopes produced during their decay. But, noble gases are not included in the final source terms provided to the shielding models as they would pass through the filters.
- No unfiltered (containment) bypass leakage is modeled when deriving sources for the VE filter. All containment releases and leakages are modeled as being filtered. No release from the equipment hatch was modeled when deriving the VE filter source term.
- ECCS releases are modeled for their impact on filter activities. The VE filters are not affected by the ECCS release scenario. Therefore, ECCS releases are modeled only for the activity accumulation on the VC and VA filters.
- In the VC filter model, unfiltered leakage to the environment increases the activity available to the control room filters. Thus, the equipment hatch releases were retained when computing VC filter activity. Because the VC filters draw air from the environment at large, they are affected by both scenarios. But, control room unfiltered in-leakage bypasses the filters which decreases accumulated VC filter activity. Therefore, no control room bypass leakage (unfiltered in-leakage) is modeled when deriving the VC filter activity source.
- The equipment hatch release path was suppressed for the VA filter activity accumulation model. The leakage to this filter is postulated to bypass the annulus and go into the Auxiliary Building. The equipment hatch releases are made directly to the environment, and are not available to the VA filters. Suppression of this path increases the amount of activity available to the filters. The VA filters draw air from the Auxiliary Building and are affected by both the containment bypass and ECCS leakage scenarios.
- Containment spray is credited in the derivation of all sources except the VE filter sources. The spray model shown in the table below takes much less spray removal credit than did the effluent model shown in LAR Table 10. The lambdas are smaller than those in the effluent model and the credited spray initiation time is later. This provides margin between the shine analysis spray model and the effluents analysis spray model to

accommodate any future changes to the operation of the spray system and its response to a LOCA.

- A constant 10% partitioning model is adopted for ECCS releases to the Auxiliary Building. Use of this model is conservative as it results in greater activity releases than if the NUREG/CR-5950 partitioning model from the effluents analysis (LAR Sections 4.5.5 and 4.5.6) had been used. The activity release rates associated with the shine source term ECCS release models (combination of ECCS leakage rate and partitioning) bound those used in the effluents models.
- Conservative control room dispersion factors were used for the VC filter activity models. These factors included the 65/35 VC intake flow split. They bound VC system configurations and alignments (as discussed in the response to Question 5). Also, the 0-2 hour factors were applied over the first eight hours to bound the times that the largest effluent releases are predicted to occur.

Spray System Modeling for Containment Shine Analyses

Start Time (sec)	**End Time** (sec)	**Elemental Spray Lambda** (hr^{-1})	**Particulate Spray Lambda** (hr^{-1})
0	5400[1]	**0**	**0**
5400	7000[4]	**0.20**	**8.25**
7000	24,600	**0.20**	**0.825**
24,600	30,000	**0.19**	**0.825**
30,000	40,000	**0.19**	**0.825**
40,000	46,000	**0.18**	**0.825**
46,000	86,400	**0 (No credit)** [2]	**0.825**
86,400	end	**0 (No credit)** [3]	**0 (No credit)** [3]

[1] Spray is not credited with iodine removal until 5400 seconds.
[2] After 46,000 seconds, spray washout occurs (in the base model) for elemental iodines (DF reaches 200) and credit ceases for elemental spray removal.
[3] Spray is not credited for iodine removal after 24 hours.
[4] At 7000 seconds the spray lambdas swap from injection based to recirculation based.

<u>Activity Transport Models</u>

Five filter activity flow path models were created to fully account for all potential activity flows into each filter.

- Reactor Building Releases to VC Filters
- ECCS Leakage Releases to VC Filters
- Reactor Building Releases to VE Filters
- Reactor Building Releases to VA Filters
- ECCS Leakage Releases to VA Filters

A bounding model was also created for determining the upper and lower containment atmosphere source term activity. For this shine source, no releases from the containment are modeled: neither the equipment hatch nor the VE system is modeled. Only one train of VX is modeled to maintain a higher activity concentration in lower containment, because it is anticipated that this region will provide most of the impact, as the lower containment compartment includes those portions of the Reactor Building at the same elevation as the control room. Reduced spray credit was taken as shown in the table above.

The LOCADOSE transport files serve the same purpose as they did for the effluents analysis: to transfer activity between plant systems and components (nodes) during accident progression. The transport file produces an output file that consists of the nodal activities for each time-step. The activity summary function of the LOCADOSE code is then invoked to integrate these activities over each time-step. The activity summary module uses the activities and associated time-steps from the transport output file to produce a table of activities for each isotope that are also integrated over each time-step in the transport model.

Further processing of these results incorporates the control room occupancy factors and removes the noble gases to produce integrated 30 day source activity inventories for each filter and for the Reactor Building atmosphere. These inventories include daughter products, which were tracked (production and decay) during the transport modeling.

The discussion below summarizes the transport and source term generation models. A description of all of the physical parameters which comprise the shielding model is not practical. Because the effluent models were used as the starting point for the shine source term transport modeling, the changes relative to the effluents model will be highlighted. As previously discussed, in order to provide conservatism for the shine model many parameters were required to be changed to retain as much activity as possible, as opposed to releasing as much activity as possible.

Reactor Building Atmosphere Source for Reactor Building Shine

As was done in the effluents model, the source was released into lower containment. The timing and release fraction model from the effluents model was retained. One VX fan was modeled, consistent with the effluents model, but no transport out of the Reactor Building was modeled: containment leakage and the annulus ventilation system were not modeled. Besides VX and the source term release, the only other component to this model is the reduced spray credit previously described. By not releasing any activity from the Reactor Building due to leakage or VE, this analysis bounds any potentially postulated values associated with these parameters. Activity is maximized in the Reactor Building; only the spray system is credited with activity removal, but that credit is reduced relative to the effluents model. One VX fan is conservative to maintain activity concentration high in lower containment longer. This results in a greater impact on the control room as the control room elevation is within the modeled lower containment compartment.

Reactor Building Source Transport to the VC Filters

In this model, releases to the environment are maximized for transport to the VC filters. This maximizes activity retention on this filter. Two trains of VE are modeled with the fans performing at their maximum allowed flow rates for a total flow of 17,600 cfm. Reduced VE filter efficiencies of 90% for elemental and organic iodine and 95% for particulate are modeled to bound the effluents modeled efficiencies. The reduction in VE filtration credit is conservative because less activity is removed by this filtration compared to the effluents model. Thus, the VE model is established, for this transport case, to maximize releases available to the VC filter while taking reduced mitigation credit.

Reactor Building leakage is modeled in the same manner as it was for the effluents analysis including unfiltered leakage through the equipment hatch. In order to maximize the activity on the VC filters, two VC fans were modeled at their maximum permitted flow rate for a total air flow through the filters of 4400 cfm, although the activity will be applied to a single filter location in the shielding model. No unfiltered in-leakage to the control room was included as this flow and activity would bypass the filters and not be available for accumulation on the VC filters. The spray model discussed above was included in this model. The 0-2 hour dispersion factors were used for the first eight hours of the model to bound the potential times of greatest activity releases. The VC intake imbalance flow split model (65/35) was retained. The VC filters were modeled as 100% efficient for all isotopes. As previously discussed, noble gases were also collected in the filter node to include any filterable daughter products produced. The noble gases were then removed in post processing of the activity results.

ECCS Leakage Source Transport to the VC Filters

The ECCS release model uses the same source term as the ECCS model for the effluents analysis. It includes telluriums in addition to the iodines so as to include iodine daughter products which could be produced in the sump during the duration of the problem. However, because only iodines are released, only iodines are trapped by the filter in this model. Similar to the modeled transport of Reactor Building releases to the VC filter, the VC system is modeled with two trains with VC maximum fan flow, with no unfiltered in-leakage, and with 100%

VC filter efficiency for iodines. The 0-2 hour dispersion factors are used over the first eight hours with the flow split model retained.

A conservative and constant 10% partitioning model which is applied to the one gpm leakage to the Auxiliary Building to bound the effluents model. The FWST release uses a constant release rate of 5.0E-05 cfm which is over twice the highest effluents analysis FWST release rate shown in Table 8 of the LAR. Using the largest release fraction from LAR Table 8, this release rate equates to about 59 gpm of leakage. Reduced credit is taken for VA filtration by reducing the VA filter efficiencies for this model to 90% for elemental and organic iodine and 95% for particulates. These efficiencies are conservative relative to those credited in the effluents model. The reduced VA filter efficiency will make more activity available to the VC filters. The time dependent sump model described in LAR Table 6 is applied in this model as well.

Reactor Building Source Transport to the VE Filters

For this model and scenario, an attempt was made to push activity releases to the VE systems and the annulus. Containment leakage is not included in the model. All leakage, including bypass leakage, is sent to the annulus and the VE system. This retains activity in the annulus for processing by the VE system. One VX fan is modeled to maintain a larger activity concentration in lower containment for a longer period of time. Since the proportion of leakage to the annulus is greater from lower containment (60%) than from upper containment (40%), this serves to maximize activity transfer to the annulus. No credit is taken for spray. The VE filters are 100% efficient. Because the filters are perfectly efficient, all activity which enters the annulus is assumed to be captured by the filters. Thus, it is not necessary to explicitly model the flow characteristics of the VE system. Noble gases are removed in the post processing of the data as previously described.

Reactor Building Source Transport to VA Filters

While the VA filters were not modeled in the Reactor Building release scenario in the effluents analysis, activity leakage into the Auxiliary Building was postulated. This activity was discharged via the unit vent without mitigation because it is not available to the filtered portion of the VA system in response to a LOCA. Nevertheless, it is conservative to include this activity for filter activity accumulation because including it would raise the amount of activity modeled on the filters. This is another example as to how a modeling feature that is not conservative for the effluents release scenario is conservative for the shine scenario.

This model mimics the Reactor Building release to the VE filters previously described, but the annulus/VE filter node is replaced by a VA filter/Auxiliary Building node. Thus, rather than pushing activity to the annulus, it is pushed to the Auxiliary Building as containment leakage. The VE system is not modeled.

All activity leaving the Reactor Building is leaked to the Auxiliary Building as bypass leakage. One VX fan is modeled to maintain a higher activity concentration in lower containment for a longer period of time. Reduced spray credit is taken via the spray model previously reviewed. The VA filters are assumed to be 100% efficient. Once again, noble gases are removed in the post processing of the data as previously discussed.

ECCS Leakage Source Transport to VA Filters

This model is similar to the ECCS leakage to the VC filter transport model discussed above, except that there is no leakage modeled from the FWST. The VA filters are inside the plant, so it is postulated that they will be exposed to only the ECCS leakage to the Auxiliary Building. A one gpm leak is retained from the effluents model and the conservative and bounding 10% partitioning model is applied. The same iodine and tellurium source term associated with the effluent ECCS leakage model is applied, but because only iodine as released, the VA filters are modeled as 100% efficient for iodines. The time dependent sump model described in LAR Table 6 is retained in this model, as well.

Shielding Models

The shielding code utilized for this analysis is the point-kernel code QAD-CGGP-A (QAD, Reference 10). This is a standard code for shielding applications. The source input for this code is supplied in terms of gamma spectrum groups. Therefore, it is necessary to convert the integrated isotopics from the transport models into a gamma spectrum for shielding model input. The ORIGEN-S code from the SCALE code suite (LAR Section 4.2.2) is used for this purpose. The isotopes comprising the integrated source are entered into ORIGEN-S and a gamma spectrum is produced. A nine group gamma spectrum was chosen for this analysis.

Three dimensional modeling of the physical plant is performed in QAD. The main plant structures located between the sources and the control room were modeled including walls and columns. Doorways and significant penetrations were also included. Unless these potential openings are welded shut, they were modeled as open. In the Reactor Building only the main structures were included in the model, such as the primary shield wall, the crane wall, the containment vessel, and the external Reactor Building wall. No equipment was modeled or credited for shielding. In the Reactor Building model, no credit was taken for equipment despite the presence of large components such as steam generators and reactor coolant pumps. Shielding models were executed for each of the individual filters modeled and for the Reactor Building source.

Each of the shielding models used the same control room receptor locations. The impacts of each source for each receptor location were tabulated and summed for a total dose at each receptor location. In order to bound the potential for single or multiple train operation, the entire filter source was placed on each system filter and the maximum dose to a receptor location from either of the filters was used as the dose from that system. This result bounds a postulated system response with either filter solely or by both filters. The limiting total receptor dose was used as the shine component dose to the control room operator reported in LAR Section 4.9.

Thus, of the five bulleted items in Section 4.9 of the LAR (and reflected in the question posed), the first two, infiltration of activity into the control room and from external spaces, were included in the effluents analysis submitted in the LAR as discussed in Sections 4.6.7 and 4.7.3. The other three were evaluated in the shielding analysis described above. The "external operator shine dose" reported in Section 4.9, Table 18 of the LAR includes the impact from the final three bulleted items.

Conclusion

In summary, the control room shine source term modeling was based upon the effluent analysis transport models. The effluent transport model was adapted to the specific activity transport problem being analyzed as described above. The source term isotopics, release fractions, timing, and iodine specie compositions from the effluents model were retained in the shine source determination models. Parameters were modified as discussed above to afford a very conservative result by forcing activity toward or containing it in the potential shine source of interest. Each of these models applied the full source to that path and combined the results from all of the sources to each receptor location to derive the bounding control room receptor dose result. The shine modeling meets the requirements of Regulatory Guide 1.183 Regulatory Positions 4.2.2 and 4.2.3.

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