VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

February 4, 2010

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

Serial No.	09-223B
NLOS/GDM	R2
Docket Nos.	50-280
	50-281
License Nos.	DPR-32
	DPR-37

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION UNITS 1 AND 2
LICENSE AMENDMENT REQUEST
MEASUREMENT UNCERTAINTY RECAPTURE POWER UPRATE
SUPPLEMENTAL INFORMATION

References:

1. Letter from Stephen Monarque (NRC) to David A. Christian (Dominion), "Surry Power Station, Units 1 and 2, Issuance of Amendments Regarding the Redefinition of the Exclusion Area Boundary", (TAC Nos. MC8315 and MC83165)", Serial No. 06-701, August 10, 2006

2. Letter from Virginia Electric and Power Company to USNRC, "Virginia Electric and Power Company (Dominion), Surry Power Station Units 1 and 2, License Amendment Request, Measurement Uncertainty Recapture Power Uprate," Serial No. 09-223, January 27, 2010

By letter dated January 27, 2010 (Serial No. 09-223), Dominion submitted a measurement uncertainty recapture (MUR) power uprate License Amendment Request (LAR) for Surry Power Station Units 1 and 2 to increase the rated power of each unit by approximately 1.6%. On the same date, proprietary information (for the Cameron ultrasonic flowmeter) required to support the license amendment request was submitted under separate cover (Serial No. 09-223A).

During a January 12, 2010 conference call, Dominion noted that we would also be providing a supporting submittal to facilitate the NRC's review of the plant accident analyses updates required by and discussed in the MUR power uprate LAR. These updates were identified during the preparation of the Surry MUR LAR. The attached information is being provided to support the NRC's overall MUR LAR review effort.

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Specifically, three independent changes in inputs and assumptions are required to be incorporated into the Surry Units 1 and 2 Steam Generator Tube Rupture (SGTR) and Main Steam Line Break (MSLB) accident analyses revisions as follows:

1. Updated Exclusion Area Boundary (EAB) X/Qs (approved in 2006, Reference 1),
2. Updated reactor coolant source term (change described in the MUR submittal, Reference 2), and
3. Updated steam flow (change described in the MUR submittal, Reference 2).

A discussion of the revised SGTR and MSLB dose consequences, based on the changes in the inputs and assumptions noted above, is provided in the attachment. In addition, the specific effect of the MUR power uprate on dose consequences as described in the MUR submittal is repeated in the attachment. The electronic media files and inputs to the RADTRAD model used for benchmarking are also enclosed in the attachment for the NRC's use as necessary.

In summary, the overall SGTR and MSLB dose consequences, as a result of all changes in inputs and assumptions supporting the MUR submittal, remain below the offsite and control room dose limits in 10 CFR 50.67 and Regulatory Guide 1.183.

If you have any questions or require additional information, please contact Mr. Gary Miller at (804) 273-2771.

Sincerely,

J. Alan Price
Vice President - Nuclear Engineering

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by J. Alan Price, who is Vice President – Nuclear Engineering, of Virginia Electric and Power Company. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 4th day of February, 2010.

My Commission Expires: 4/30/13.

Notary Public

GINGER L. ALLIGOOD
Notary Public
Commonwealth of Virginia
310847
My Commission Expires Apr 30, 2013

Commitments contained in this correspondence: None

Attachment:

- Revised SGTR and MSLB Dose Consequences Based on Changes in Inputs and Assumptions with Enclosed Electronic Media Files and Inputs to the RADTRAD Model Used for Benchmarking

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ATTACHMENT

<u>Revised SGTR and MSLB Dose Consequences Based on Changes in Inputs and Assumptions with Enclosed Electronic Media Files and Inputs to the RADTRAD Model used for Benchmarking</u>

<u>Measurement Uncertainty Recapture Power Uprate License Amendment Request</u>

Virginia Electric Power Company
(Dominion)
Surry Power Station Units 1 and 2

Revised SGTR and MSLB Dose Consequences Based on Changes in Inputs and Assumptions with Enclosed Electronic Media Files and Inputs to the RADTRAD Model used for Benchmarking

By letter dated January 27, 2010 (Serial No. 09-223), Dominion submitted a measurement uncertainty recapture (MUR) power uprate License Amendment Request (LAR) for Surry Power Station Units 1 and 2 to increase the rated power of each unit by approximately 1.6%. During a January 12, 2010 conference call with the NRC staff, Dominion noted that it would be providing a supporting submittal to address plant accident analyses updates, which were identified during the Surry MUR technical review process, in support of the NRC's overall MUR LAR review effort.

Consequently, detailed supporting information is provided herein regarding the dose consequence analyses revised as a result of the MUR power uprate. There are a number of analysis assumptions, plant features, and specific modeling utilized in the calculation of the Steam Generator Tube Rupture (SGTR) and Main Steam Line Break (MSLB) accident analyses. The overall assumptions and modeling are unchanged from the current licensing basis.

Information is being provided that is pertinent to the SGTR and MSLB accidents. Within this supplement to the MUR power uprate LAR, the following information is provided:

- Analysis Assumptions and Key Parameter Values (Including current licensing basis values, revised values, and basis for any changes as a result of the MUR power uprate)
- Dose modeling information applicable to RADTRAD 3.02
- RADTRAD 3.02 input and output files for the major release pathways associated with the SGTR and MSLB accidents (See enclosed electronic media.)
- Benchmark comparisons to analysis results presented in the MUR power uprate LAR, comparing Dominion's LOCADOSE code with RADTRAD 3.02 results

In general, three independent changes in inputs and assumptions are incorporated into the SGTR and MSLB analyses revisions:

1. Updated exclusion area boundary (EAB) X/Qs (approved in 2006, Reference 1)
2. Updated reactor coolant source term (change described in the MUR power uprate LAR, Reference 2)
3. Updated steam flow (change described in the MUR power uprate LAR, Reference 2)

The specific effect of the MUR power uprate on dose consequences is described in the LAR and is repeated in this supplement. The overall SGTR and MSLB dose consequences, revised as a result of the changes in inputs and assumptions supporting the MUR power uprate LAR, remain below the offsite and control room dose limits contained in 10 CFR 50.67 and Regulatory Guide 1.183.

STEAM GENERATOR TUBE RUPTURE (SGTR)

SGTR Analysis Assumptions & Key Parameter Values

The LOCADOSE code is used to calculate the radiological consequences from airborne releases resulting from a SGTR at Surry to the EAB, low population zone (LPZ), and Control Room.

For operation at the proposed MUR power uprate conditions, the RCS coolant activity source term was updated to accommodate the core power increase (2605 MWt), current operation with 18 month fuel cycles and 1% fuel defects. The updated RCS source term indicates an increase in the inventory of long-lived isotopes in the coolant compared to the current license basis values.

The revised SGTR analysis incorporates previously approved EAB X/Q values, an updated RCS coolant activity source term, and conservative increases in accident steam discharge assumptions.

Changes to key SGTR parameters are indicated in Table 1 using a side by side comparison of changed data.

Table 1 - Basic Data and Assumptions for SGTR			
Parameter or Assumption	**Current Licensing Basis**	**Proposed Value**	**Reason for Change**
	Source Term		
1) Primary Coolant Specific Activity Limit DEQ I-131 (µCi/gm)	 1.0	 No Change	
2) Primary Coolant Concentrations at TS Limit (µCi/gm) I-131 I-132 I-133 I-134 I-135	 7.522E-01 2.796E-01 1.222E+00 1.701E-01 6.402E-01	 7.45E-01 3.76E-01 1.23E+00 2.42E-01 7.90E-01	Concentrations updated to reflect RCS inventory for MUR power level.
3) Primary Coolant Noble Gas and Particulate Activity	Normalized to 1 µCi/gm DEQ I-131	No Change	
4) Iodine Spike	335	No Change	
5) Accident-Initiated Spike Duration (hr)	8	No Change	
6) Primary to Secondary Leak Rate	150 gpd/SG	No Change	

Table 1 - Basic Data and Assumptions for SGTR			
Parameter or Assumption	**Current Licensing Basis**	**Proposed Value**	**Reason for Change**
7) Iodine Appearance Rate (includes 335X spike) (Ci/hr) I-131 I-132 I-133 I-134 I-135	 7.680E+03 7.947E+03 1.470E+04 9.904E+03 1.047E+04	 7.550E+03 1.011E+04 1.447E+04 1.315E+04 1.254E+04	Updated to reflect RCS inventory for MUR power level.
8) Pre-Accident Spike Coolant Activity (μCi/gm DEQ I-131)	10	No Change	
9) Iodine Partitioning	PC for iodine = 100	No Change	
10) Iodine Chemical Form of Primary-to-Secondary Leakage (%)	Elemental 97 Organic 3 Particulate 0	No Change	
11) Moisture Carryover in Unaffected Steam Generators	1%	No Change	
12) Tube Uncovery	No tube bundle uncovery assumed. No credit for scrubbing.	No Change	

Table 1 - Basic Data and Assumptions for SGTR			
Parameter or Assumption	**Current Licensing Basis**	**Proposed Value**	**Reason for Change**
13) Secondary Iodine Activity Concentration	0.1 μCi/gm DEQ I-131	No Change	
SGTR Parameters			
14) Reactor Trip Time (sec)	0	No Change	
15) Safety Injection Signal (sec)	247	365	Updated to reflect revised PORV flow rate analysis for "no LOOP" operation
16) Operator Action to Isolate Affected SG (min)	30	No Change	
17) Action to Align RHRS (hr)	8	No Change	
18) Release to Env (hr) Unaffected SG Affected SG	 0 – 8 0 – 0.5	No Change	
19) Reactor Coolant Volume (ft^3)	(density= 45.216 lb/ft^3) 8902	No Change	
20) Initial Steam Generator Liquid Volume (ft^3) Unaffected SG Affected SG	(density= 48.047 lb/ft^3) 4104 2052	No Change	

Table 1 - Basic Data and Assumptions for SGTR			
Parameter or Assumption	**Current Licensing Basis**	**Proposed Value**	**Reason for Change**
21) Initial Steam Generator Steam Volume (ft^3) Unaffected SG Affected SG	(density= 1.723 lb/ft^3) 1 (2 SG modeled as 1 volume) 3889	No Change	
22) LOOP - Unaffected Steam Generator Release to Environment (cfm)	0-88 sec: 0 88-500 sec: 127 500-1800 sec: 0 1800 sec - 2 hr: 41 2 – 8 hr: 37	0-82 sec: 0 82-225 sec: 179 225-427 sec: 66 427-1800 sec: 0 1800 sec - 2 hr: 87 2 – 8 hr: 33	Updated to reflect revised PORV flow rates
23) LOOP - Affected Steam Generator Steam Releases (cfm)	0-88 sec: 0 88-289 sec: 3735 289-1800 sec: 2038	0-80 sec: 0 80-225 sec: 4673 225-1800 sec: 2701	Updated to reflect revised PORV flow rates
24) LOOP - Liquid Break Flow (cfm)	0-88 sec: 91.6 88-289 sec: 79.4 289-1800 sec: 77.0	0-80 sec: 105 80-225 sec: 104 225-1800 sec: 85.2	Updated to reflect revised PORV flow rates
25) LOOP- Flashed Break Flow (cfm)	0-88 sec: 11.3 88-289 sec: 4.5 289-1800 sec: 3.7	0-80 sec: 15.2 80-225 sec: 5.5 225-1800 sec: 6.6	Updated to reflect revised PORV flow rates

Table 1 - Basic Data and Assumptions for SGTR			
Parameter or Assumption	**Current Licensing Basis**	**Proposed Value**	**Reason for Change**
26) LOOP – Affected SG Liquid to Steam (cfm)	0-88 sec: 1330 88-289 sec: 134 289-1800 sec: 73	0-80 sec: 1330 80-225 sec: 168 225-1800 sec: 96.9	Updated to reflect revised PORV flow rates
27) No LOOP - Unaffected Steam Generator Releases (cfm)	0-88 sec: 0 88-393 sec: 177 393-1800 sec: 0 1800 sec - 2 hr: 41 2 – 8 hr: 37	0-341 sec: 0 341-365 sec: 746 365-539 sec: 173 539-1800 sec: 0 1800 sec - 2 hr: 97 2 – 8 hr: 49	Updated to reflect revised PORV flow rates
28) No LOOP - Affected Steam Generator Steam Release to Environment (cfm)	0-88 sec: 0 88-247 sec: 4036 247-1800 sec: 3152	0-263 sec: 0 263-365 sec: 5088 365-1800 sec: 3541	Updated to reflect revised PORV flow rates
29) No LOOP - Liquid Break Flow (cfm)	0-88 sec: 94.1 88-247 sec: 83.4 247-1800 sec: 77.1	0-263 sec: 91.4 263-365 sec: 78.8 365-1800 sec: 72.2	Updated to reflect revised PORV flow rates
30) No LOOP- Flashed Break Flow (cfm)	0-88 sec: 7.6 88-247 sec: 0.68 247-1800 sec: 0.58	0-263 sec: 9.83 263-365 sec: 6.39 365-1800 sec: 0.84	Updated to reflect revised PORV flow rates
31) EAB X/Q (sec/m^3) 0 – 2 hr	4.61E-03	1.76E-03	NRC approved X/Q (Reference 1)

Table 1 - Basic Data and Assumptions for SGTR			
Parameter or Assumption	**Current Licensing Basis**	**Proposed Value**	**Reason for Change**
32) LPZ X/Q (sec/m^3)	<u>Period</u> <u>LPZ</u> 0 – 8 hr 2.01E-04 2 – 24 hr 1.22E-04 24 – 96 hr 4.18E-05 96 - 720 hr 8.94E-06	No Change	
Control Room			
33) Control Room Isolation (sec) LOOP No LOOP	 0 247	 No Change 365	 Revised SI signal time
34) Control Room Emergency HVAC Parameters (cfm) Unfiltered Inleakage Filtered Make-up Air	 500 1000	No Change	
35) Control Room Volume (ft^3)	223,000	No Change	
36) Normal Ventilation Unfiltered Makeup Air (cfm)	3,000	No Change	

Table 1 - Basic Data and Assumptions for SGTR

Parameter or Assumption	Current Licensing Basis	Proposed Value	Reason for Change
37) Filtered Recirculation Air Flow (cfm)	0	No Change	
38) Control Room Make-up Air Flow Filter Efficiency (%) Elemental Organic Particulate	 90 70 99	No Change	
39) Control Room X/Q (sec/m^3) LOOP No LOOP	 0 – 8 hr 3.79E-3 8 – 24 hr 3.09E-3 24 – 96 hr 1.05E-3 96 – 720 hr 2.49E-4 0 – 247 sec: 7.71E-3 247 sec – 8 hr: 3.79E-3	 No Change 0 – 365 sec: 7.71E-03 365 sec – 8 hr: 3.79E-03	There are no changes to the X/Q, just the timing of control room isolation. CLB SI signal occurs at 247 sec. MUR SI signal occurs at 365 sec. (See Item 33, above)

SGTR Modeling

This section describes modeling techniques using RADTRAD 3.02 to represent the SGTR accident. A brief description is provided along with names of the RADTRAD 3.02 input files generated. An electronic copy of the RADTRAD 3.02 files is provided in the enclosure.

The pre-accident spike scenario is broken up into three different RADTRAD models as follows: 1) iodine spike, 2) RCS particulate with no iodine, and 3) noble gas. Daughter production is factored into each model.

The concurrent spike scenario is also broken up into three slightly different RADTRAD models: 1) iodine spike, 2) RCS particulate with 1 µCi/gm DEQ I-131, and 3) noble gas. Daughter production is factored into each model.

Since the Nuclide Inventory Files (NIF) are based on activity in units of µCi/gm, the Plant Power Level in the RADTRAD files has been adjusted to 182.6 to convert the specific activity to total curies based on RCS mass of 1.826E+08 gm. The NIF file associated with the concurrent iodine spike reflects total curies so the Plant Power Level in the concurrent iodine spike runs has been adjusted to 1.

The source term fraction for the RCS is 1. Source term fractions for the steam generators are based on affected SG (ASG) volume of 2052 ft^3 and 4104 ft^3 for the two intact SGs (ISG). The source term fractions for the ASG bulk liquid and ISG bulk liquid are 2.3E-02 [2052/ 8902 = 0.23, adjusted for difference in primary-secondary iodine limits (X0.1)] and 4.6E-02 [4104/ 8902 = 0.46, also adjusted for difference in primary-secondary iodine limits (X0.1)], respectively. Initial SG steam activity is assumed to be (0.0007X) the SG liquid activity source term fraction (based upon the mass ratio of steam and liquid in a SG) and an adjustment for partitioning/moisture carryover of 0.01. No noble gases are assumed to be in the initial inventory of the SGs. The pre-accident spike runs incorporate an additional factor (0.1X) to the SG liquid and steam source terms, for the iodine spike model only, since the spike is (10X) for the RCS; this ensures the secondary side DEQ I-131 limit of 0.1 µCi/gm is maintained.

The concurrent spike model uses a Plant Power Level of 1 since the eight hour spike inventory in the NIF file is in total curies. Also, source fraction is set as 1 for the RCS only. The NIF file used for this spike has been modified so that the iodine inventory reflects the total curies due to a (335X) spike over eight hours.

RADTRAD 3.02 Files

SGTR Pre-accident Spike RADTRAD files

Files	Description
sps-rxcoolant.nif	Represents iodine and gross gamma activity equivalent to 1 µCi/gm DEQ I-131
sps-rxcoolant.inp	Federal Guidance Report (FGR) 11 & 12 Dose Conversion Factors (DCFs)
sps-sgtr-rcs-ng.rft	Release Fraction Timing (RFT) file for only noble gases
sps-sgtr-rcs-preaci.rft	RFT file for pre-accident iodine spike only
sps-sgtr-rcs-noi-nong.rft	RFT file for particulate, no iodine, no noble gas
SP500LPNG.psf SP500LPNG.o0	RADTRAD input/output file for only the noble gas component, Control Room Unfiltered Inleakage (CR UFI) = 500 cfm, LOOP
SP500LPI.psf SP500LPI.o0	RADTRAD input/output file for only the pre-accident spike component , CR UFI = 500 cfm, LOOP
SP500LPP.psf SP500LPP.o0	RADTRAD input/output file for only the non-iodine and non-noble gas, CR UFI = 500 cfm component, LOOP
SP010NLNG.psf SP010NLNG.o0	RADTRAD input/output file for only the noble gas component, CR UFI = 10 cfm, no LOOP
SP010NLI.psf SP010NLI.o0	RADTRAD input/output file for only the pre-accident spike component , CR UFI = 10 cfm, no LOOP
SP010NLP.psf SP010NLP.o0	RADTRAD input/output file for only the non-iodine and non-noble gas, CR UFI = 10 cfm component, no LOOP

SGTR Concurrent Spike RADTRAD files

Files	Description
sps-rxcoolant.nif	Represents iodine and gross gamma activity equivalent to 1 μCi/gm DEQ I-131
sps-rxcoolant-sgtr-coinc.nif	Represents total spike activity of I-131 through I-135 based on 335X appearance rate over 8 hours.
sps-rxcoolant.inp	FGR 11 & 12 DCFs
sps-mslb-rcs-fractions-coinc-i.rft	RFT file for only concurrent iodine spike, reflects only the iodine activity in the NIF file released over 8 hours
sps-sgtr-rcs-ng.rft	RFT file for only noble gases
sps-mslb-rcs-fractions.rft	RFT file for Tech Spec RCS activity (all fractions = 1)
SC500LPIP.psf SC500LPIP.o0	RADTRAD input/output file for Tech Spec RCS activity
SC500LPI.psf SC500LPI.o0	RADTRAD input/output file for only the concurrent iodine spike
SC500LPNG.psf SC500LPNG.o0	RADTRAD input/output file for only the noble gas component

Comparison of LOCADOSE and RADTRAD 3.02 SGTR Dose Consequences

The dose summary shown in Table 2 provides a comparison between the results from LOCADOSE versus RADTRAD 3.02. The LOCADOSE results are from the analyses of record (AOR); MUR reported results in the LAR are rounded up from the AOR values.

In general, the models and results produced using RADTRAD 3.02 compare well with the MUR power uprate SGTR dose consequences calculated with LOCADOSE.

Table 2
Summary of SGTR Results

Concurrent I Spike LOOP

	LOCADOSE (A)	RADTRAD (B)	Diff (B / A)
Control Room	1.221	1.221	1.00
EAB (0 – 2 hr)	1.645	1.648	1.00
LPZ	0.199	0.199	1.00

Pre-accident I Spike LOOP

	LOCADOSE (A)	RADTRAD (B)	Diff (B / A)
Control Room	0.885	0.881	1.00
EAB (0 – 2 hr)	1.192	1.136	0.95
LPZ	0.139	0.133	0.95

Pre-accident I Spike No-LOOP

	LOCADOSE (A)	RADTRAD (B)	Diff (B / A)
Control Room	4.277	4.264	1.00
EAB (0 – 2 hr)	0.650	0.610	0.94
LPZ	0.079	0.074	0.94

MAIN STEAM LINE BREAK (MSLB)

MSLB Analysis Assumptions & Key Parameter Values

The LOCADOSE code is used to calculate the radiological consequences from airborne releases resulting from a MSLB at Surry to the EAB, LPZ, and Control Room.

For operation at the proposed MUR power uprate conditions, the RCS coolant activity source term was updated to accommodate the core power increase (2605 MWt), current operation with 18 month fuel cycles, and 1% fuel defects. The updated RCS source term indicates an increase in the inventory of long-lived isotopes in the coolant compared to the current license basis values.

The revised MSLB analysis incorporates previously approved EAB X/Q values, an updated RCS coolant activity source term, and conservative increases in accident steam discharge assumptions.

Changes to key MSLB parameters are indicated in Table 3 using a side by side comparison of changed data.

Table 3 Basic Data and Assumptions for MSLB			
Parameter or Assumption	**CLB Value**	**Proposed Value**	**Reason for Change**
Source Term			
1) Primary Coolant Specific Activity Limit DEQ I-131 (µCi/gm)	 1	 No Change	
2) Primary Coolant Concentrations at Tech Spec Limit (µCi/gm) I-131 I-132 I-133 I-134 I-135	 7.522E-01 2.798E-01 1.222E+00 1.701E-01 6.402E-01	 7.45E-01 3.76E-01 1.23E+00 2.42E-01 7.90E-01	Updated to reflect a revision in core isotopic inventory and fuel management changes
3) Primary Coolant Noble Gas Activity	Based on activity from 1% fuel defects scaled to 1 µCi/gm DEQ I-131	No Change	
4) Accident Initiated (Concurrent) Iodine Spike	500	No Change	

Table 3 Basic Data and Assumptions for MSLB

Parameter or Assumption	CLB Value	Proposed Value	Reason for Change
5) Accident-Initiated (Concurrent) Spike Duration (hr)	8	No Change	
6) Iodine Appearance Rate at the Tech Spec Limit (μCi/sec) I-131 I-132 I-133 I-134 I-135	 6.37E+3 6.59E+3 1.22E+4 8.21E+3 8.68E+3	 6.26E+3 8.38E+3 1.20E+4 1.09E+4 1.04E+4	Updated to reflect a revision in core isotopic inventory and fuel management changes
7) Primary to Secondary Leak Rate (gpm)	1	No Change	
8) Pre-Accident Spike Coolant Activity (μCi/gm DEQ I-131)	10	No Change	
9) Iodine Chemical Form of Primary-to-Secondary Leakage (%)	Elemental 97 Organic 3 Particulate 0	No Change	

Table 3 Basic Data and Assumptions for MSLB

Parameter or Assumption	CLB Value	Proposed Value	Reason for Change
10) Moisture Carryover in Intact Steam Generator	1%	No Change	
11) Steam Generator Iodine Partition Coefficient Faulted SG Intact SG	 1 100	No Change	
12) Secondary Technical Specification Limit on Iodine Activity	0.1 μCi/gm DEQ I-131	No Change	
MSLB Parameters			
13) Operator Action to Close Affected SG Main Steam Isolation Valve (min)	30	No Change	
14) Action to Align RHRS (hr)	8	No Change	
15) Reactor Coolant Mass (gm)	1.826E+08	No Change	

Table 3 Basic Data and Assumptions for MSLB			
Parameter or Assumption	**CLB Value**	**Proposed Value**	**Reason for Change**
16) Faulted Steam Generator Steam Mass (lb_m)	6700	No Change	
17) Initial Steam Generator Liquid Volume (cfm)			
Faulted SG	2052	No Change	
Intact SG	4104	No Change	
18) Faulted SG Release to Turbine Bldg (cfm liquid)		No Change	
0 – 41 sec	1.632E+03		
41 – 181 sec	3.818E+03		
181 – 1800 sec	2.511E+03		

Table 3 Basic Data and Assumptions for MSLB			
Parameter or Assumption	**CLB Value**	**Proposed Value**	**Reason for Change**
19) Intact SG Release to Environment (cfm liquid)			PORV flow rates were increased after 0.5 hours.
0 – 41 sec	1669	1669	
41 – 181 sec	0	0	
181 – 1800 sec	0	0	
0.5 – 2.0 hour	41	74	
2.0 – 8.0 hour	37	45	
20) Turbine Building Volume (ft^3)	6.00E+06	No Change	
21) RCS Volume (ft^3)	8902	No Change	
22) Release points			
MSL Break (Affected SG)	Turbine Building	No Change	
Intact SG	PORV		

Table 3 Basic Data and Assumptions for MSLB			
Parameter or Assumption	**CLB Value**	**Proposed Value**	**Reason for Change**
23) Turbine Building Release to Environment (cfm steam)	Control Room Dose Cases (0.2 volumes/hr min. turnover) 0 – 41 sec 2.416E+06 41 – 181 sec 1.152E+06 181 – 1800 sec 4.296E+05 0.5 – 2.0 hour 2.000E+04 2.0 – 8.0 hour 2.000E+04 EAB and LPZ Dose Cases (12 volumes/hr min. turnover) 0 – 41 sec 3.5960E+06 41 – 181 sec 2.3320E+06 181 – 1800 sec 1.6096E+06 0.5 – 2.0 hour 1.2000E+06 2.0 – 8.0 hour 1.2000E+06	No Change	
24) EAB X/Q (sec/m^3) 0 – 720 hr	4.61E-03	1.76E-03	NRC approved X/Q (Reference 1)

Table 3 Basic Data and Assumptions for MSLB			
Parameter or Assumption	**CLB Value**	**Proposed Value**	**Reason for Change**
25) LPZ X/Q (sec/m^3)	Period / LPZ 0 – 8 hr 2.01E-04 8 – 24 hr 1.22E-04 24 – 96 hr 4.18E-05 96 – 720 hr 8.94E-06	No Change	
Control Room			
26) Control Room Isolation (sec)	0	No Change	
27) Control Room Filtered Flow Following Isolation (cfm)	1000 (starts 1 hour into event)	No Change	
28) Control Room Unfiltered Inleakage (cfm)	500	No Change	
29) Control Room Volume (ft^3)	223,000	No Change	

Table 3 Basic Data and Assumptions for MSLB			
Parameter or Assumption	**CLB Value**	**Proposed Value**	**Reason for Change**
30) Control Room Makeup Air Flow Filter Efficiency (%) Elemental Organic Particulate	 90 70 99	No Change	
31) Control Room X/Q (sec/m^3)	0 – 8 hr 3.79E-3 8 – 24 3.09E-3 24 – 96 1.05E-3 96 – 720 2.49E-4	No Change	

List of Acronyms Used:

CLB – Current License Basis
DEQ – Dose Equivalent
RCS – Reactor Coolant System
MUR – Measurement Uncertainty Recapture
SG – Steam Generator
PC – Partition Coefficient
PORV – Power Operated Relief Valve
RHRS – Residual Heat Removal System
LOOP – Loss of Offsite Power
SI – Safety Injection
HVAC – Heating, Ventilation and Air Conditioning
EAB – Exclusion Area Boundary
LPZ – Low Population Zone

MSLB Modeling

This section describes modeling techniques using RADTRAD 3.02 to represent the MSLB accident. A brief description is provided along with names of the RADTRAD 3.02 input files generated. An electronic copy of the RADTRAD 3.02 files is provided in the enclosure.

The pre-accident spike scenario is broken up into three different RADTRAD models: 1) iodine spike, 2) RCS particulate with no iodine, and 3) noble gas. Daughter production is factored into each model.

The concurrent spike scenario is also broken up into three slightly different RADTRAD models: 1) iodine spike, 2) RCS particulate with 1 µCi/gm DEQ I-131and 3) noble gas. Daughter production is factored into each model.

Since the NIF files are based on activity in units of µCi/gm, the Plant Power Level in the RADTRAD files has been adjusted to 182.6 to convert the specific activity to total curies based on RCS mass of 1.826E+08 gm. The NIF file associated with the concurrent iodine spike reflects total curies so the Plant Power Level in the concurrent iodine spike runs have been adjusted to 1.

The source term fraction for the RCS is 1. Source term fractions for the steam generators are based on affected SG (ASG) volume of 2052 ft^3 and 4104 ft^3 for the two intact SGs (ISG). The source term fractions for the ASG bulk liquid and ISG bulk liquid are 2.3E-02 [2052/ 8902 = 0.23, adjusted for difference in primary-secondary iodine limits (X0.1)] and 4.6E-02 [4104/ 8902 = 0.46, also adjusted for difference in primary-secondary iodine limits (X0.1)], respectively. Initial SG steam activity is assumed to be (0.0007X) the SG liquid activity source term fraction (based upon the mass ratio of steam and liquid in a SG) and an adjustment for partitioning/moisture carryover of 0.01. No noble gases are assumed to be in the initial inventory of the SGs. The pre-accident spike runs incorporate an additional factor (0.1X) to the SG liquid and steam source terms, for iodine only, since the spike is (10X) for the RCS; this ensures the secondary side DEQ I-131 limits are not exceeded.

The concurrent spike model uses a Plant Power Level of 1 since the eight hour spike inventory in the NIF file is in total curies. Also, source fraction is set as 1 for the RCS only. The NIF file used for this spike has been modified so that the iodine inventory reflects the total curies due to a (500X) spike over eight hours.

The dose results represent a composite of the 0.2/hr and 12/hr Turbine Building air changes because the 0.2/hr results in higher control room dose and the 12/hr results in higher EAB and LPZ doses. Maximum two hour EAB doses occurred in the 0 – 2 hour time frame for both pre-accident and concurrent events.

It should be noted that control room ventilation modeling is somewhat unique because it is assumed that the control room is isolated at T=0 and unfiltered inleakage (500 cfm) is from the intakes located in the Turbine Building because the ASG discharges into the Turbine Building. It is also assumed that an additional 500 cfm unfiltered inleakage occurs from the environment. Control room exhaust associated with these 2 inleakage terms is assumed as only 500 cfm even though inleakage totals 1000 cfm. This modeling technique is known to produce higher control room dose consequences and is therefore conservative.

RADTRAD 3.02 Files

MSLB Pre-accident Spike RADTRAD files

Files	Description
sps-rxcoolant.nif	Represents iodine and gross gamma activity equivalent to 1 µCi/gm DEQ I-131
sps-rxcoolant.inp	FGR 11 & 12 DCFs
sps-mslb-rcs-fractions-preac-i.rft	RFT file for only pre-accident iodine spike, reflects 10X the iodine activity in the NIF file
sps-mslb-rcs-fractions-preac-NG.rft	RFT file for only noble gases
sps-mslb-rcs-fractions-preac-no-i.rft	RFT file for Tech Spec RCS activity with no iodines
MPIP50002i.psf MPIP50002i.o0	RADTRAD input/output file for only the 10 µCi/gm iodine spike component with 0.2 air changes per hour in the Turbine Building
MPIP50002noi.psf MPIP50002noi.o0	RADTRAD input/output file for only the Tech Spec RCS particulate activity component (w/o iodine) with 0.2 air changes per hour in the Turbine Building
MPNG50002.psf MPNG50002.o0	RADTRAD input/output file for only the noble gas component with 0.2 air changes per hour in the Turbine Building
MPIP50012i.psf MPIP50012i.o0	RADTRAD input/output file for only the 10 µCi/gm iodine spike component with 12 air changes per hour in the Turbine Building
MPIP50012noi.psf MPIP50012noi.o0	RADTRAD input/output file for only the Tech Spec RCS activity component (w/o iodine) with 12 air changes per hour in the Turbine Building
MPNG50012.psf MPNG50012.o0	RADTRAD input/output file for only the noble gas component with 12 air changes per hour in the Turbine Building

MSLB Concurrent Spike RADTRAD files

Files	Description
sps-rxcoolant.nif	Represents iodine and gross gamma activity equivalent to 1 µCi/gm DE I-131
sps-rxcoolant-mslb-coinc.nif	Represents total spike activity of I-131 through I-135 based on 500X appearance rate over 8 hours.
sps-rxcoolant.inp	FGR 11 & 12 DCFs
sps-mslb-rcs-fractions-coinc-i.rft	RFT file for only pre-accident iodine spike, reflects only the iodine activity in the NIF file released over 8 hours
sps-mslb-rcs-fractions-preac-NG.rft	RFT file for only noble gases
sps-mslb-rcs-fractions-preac-no-i.rft	RFT file for Tech Spec RCS activity with no iodines
sps-mslb-rcs-fractions.rft	RFT file for Tech Spec RCS activity (all fractions = 1)
MCIP50002i.psf MCIP50002i.o0	RADTRAD input/ output file for only the concurrent iodine spike component with 0.2 air changes per hour in the Turbine Building
MCIP50002wi.psf MCIP50002wi.o0	RADTRAD input/ output file for only the Tech Spec RCS particulate activity component with 0.2 air changes per hour in the Turbine Building
MCNG50002.psf MCNG50002.o0	RADTRAD input/ output file for only the noble gas component with 0.2 air changes per hour in the Turbine Building
MCIP50012i.psf MCIP50012i.o0	RADTRAD input/ output file for only the concurrent iodine spike component with 12 air changes per hour in the Turbine Building
MCIP50012wi.psf MCIP50012wi.o0	RADTRAD input/ output file for only the Tech Spec RCS activity component with 12 air changes per hour in the Turbine Building
MCNG50012.psf MCNG50012.o0	RADTRAD input/ output file for only the noble gas component with 12 air changes per hour in the Turbine Building

Comparison of LOCADOSE and RADTRAD 3.02 MSLB Dose Consequences

The dose summary shown in Table 4 provides a comparison between the results from LOCADOSE versus RADTRAD 3.02. The LOCADOSE results are from the analyses of record (AOR). MUR power uprate reported results in the LAR are rounded up from the AOR values.

In general, the models and results produced using RADTRAD 3.02 compare favorably with the MSLB dose consequences calculated with LOCADOSE. Offsite dose comparisons show LOCADOSE calculating higher doses than RADTRAD 3.02 (anywhere from 4% to 8% higher). Differences noted in calculated control room dose are believed to be an artifact of modeling inconsistencies in RADTRAD 3.02 that were identified in the RADTRAD 3.03 model update. Using an unofficial (demo) version of RADTRAD 3.03, the control room dose was re-evaluated. RADTRAD 3.03 results shown in ( ), seem to confirm the RADTRAD 3.02 logic error and compare favorably to LOCADOSE, with LOCADOSE producing higher doses.

Table 4
Summary of MSLB Results

Concurrent I Spike

	LOCADOSE (A)	RADTRAD (B)*	Diff (B / A)
Control Room	1.516	1.719 (1.422)	1.13 (0.94)
EAB (0 – 2 hr)	0.406	0.373	0.92
LPZ	0.062	0.059	0.95

Pre-accident I Spike

	LOCADOSE (A)	RADTRAD (B)*	Diff (B / A)
Control Room	1.335	1.551 (1.259)	1.16 (0.94)
EAB (0 – 2 hr)	0.395	0.379	0.96
LPZ	0.049	0.047	0.96

* These results were generated using RADTRAD 3.02. It is believed that the reason for the large difference in control room dose is due to a RADTRAD 3.02 logic error identified and corrected in RADTRAD 3.03. This error is associated with multiple release paths from a compartment to the environment causing a conservative error in control room dose, proportional to the number of paths. In this MSLB model, the Turbine Building has 2 discharge pathways to the environment. The values listed in parentheses () were generated using the same input files but were run on a DEMO version of RADTRAD 3.03. Since RADTRAD 3.03 is not part of Dominion's software QA program, the results are presented for information purposes only and should not be used as the basis for any licensing determination.

Reported Dose Consequences

Tables 5 and 6 are duplicates of the dose consequences for the SGTR and MSLB analyses reported in the MUR power uprate LAR (Reference 2). Both tables are structured to show, in stepwise fashion, how the resulting offsite and control room dose consequences changed with each change in analysis assumption or input. As described above, the three changes incorporated into the revised SGTR and MSLB analyses are:

1. Updated EAB X/Qs
2. Updated reactor coolant source term
3. Updated steam flow

Columns in Table 5 and 6 are labeled (A – D) in this supplement to provide an easy way to differentiate the step changes that result from each of the three parameter changes.

Column	Description
A	Existing values in the UFSAR
B	Revised EAB dose using the approved EAB X/Qs (New Baseline)
C	Increased dose consequences from the updated RCS source term for MUR power uprate conditions above the new baseline. The increase from B to C represents the increase caused only by the updated RCS source term to bound power uprate conditions.
D	Final dose consequences incorporating increased steam flow. The increase from C to D represents the increase in dose from increasing SG PORV flow necessary to maintain fidelity with analyzed accident flow analyses.

Table 5
Reported SGTR Dose Consequences[1]

Concurrent Iodine Spike - LOOP

	Current UFSAR (Rem TEDE) A	Revised Design Basis Baseline with Approved EAB X/Q (Rem TEDE) B	MUR Analysis with New RCS Source Term (Rem TEDE) C	Increase due to MUR[4]	Proposed MUR Dose Consequences with PORV Flow Increase (Rem TEDE) D	Acceptance Criteria[3] (Rem TEDE)
Control Room[2]	0.7	0.7	0.8	17%	1.3	5
EAB	2.2	0.9	1.0	15%	1.7	2.5
LPZ	0.2	0.2	0.2	17%	0.2	2.5

Pre-accident Iodine Spike - No-LOOP

	Current UFSAR (Rem TEDE) A	Revised Design Basis Baseline with Approved EAB X/Q (Rem TEDE) B	MUR Analysis with New RCS Source Term (Rem TEDE) C	Increase due to MUR[4]	Proposed MUR Dose Consequences with PORV Flow Increase (Rem TEDE) D	Acceptance Criteria[3] (Rem TEDE)
Control Room[2]	0.9	0.9	1.2	28%	4.3	5
EAB	1.7	0.7	0.8	20%	1.2	25
LPZ	0.1	0.1	0.1	24%	0.2	25

1) All dose values have been rounded up to one decimal place.
2) Control room unfiltered inleakage for the pre-accident iodine spike is 10 cfm and for the concurrent iodine spike is 500 cfm. The selection of 10 or 500 cfm of unfiltered inleakage was based on higher dose consequences.
3) RG 1.183 and 10 CFR 50.67
4) The increase is primarily due to an increase in primary and secondary Cs predicted in the updated RCS source term. The percentage change is based on actual calculated doses prior to rounding to the next highest 0.1 Rem TEDE.

Table 6
Reported MSLB Dose Consequences[1]

Concurrent Iodine Spike - LOOP

	Current UFSAR (Rem TEDE) A	Revised Design Basis Baseline with Approved EAB X/Q (Rem TEDE) B	MUR Analysis with New RCS Source Term (Rem TEDE) C	Increase due to MUR[4]	Proposed MUR Dose Consequences with PORV Flow Increase (Rem TEDE) D	Acceptance Criteria[3] (Rem TEDE)
Control Room[2]	0.7	0.7	1.5	137%	1.6	5
EAB	0.4	0.2	0.4	195%	0.5	2.5
LPZ	0.1	0.1	0.1	123%	0.1	2.5

Pre-accident Iodine Spike - No-LOOP

	Current UFSAR (Rem TEDE) A	Revised Design Basis Baseline with Approved EAB X/Q (Rem TEDE) B	MUR Analysis with New RCS Source Term (Rem TEDE) C	Increase due to MUR[4]	Proposed MUR Dose Consequences with PORV Flow Increase (Rem TEDE) D	Acceptance Criteria[3] (Rem TEDE)
Control Room[2]	0.5	0.5	1.4	187%	1.4	5
EAB	0.4	0.2	0.4	209%	0.4	25
LPZ	0.1	0.1	0.1	200%	0.1	25

1) All dose values have been rounded up to one decimal place.
2) Based on control room unfiltered inleakage of 500 cfm.
3) RG 1.183 and 10 CFR 50.67
4) The increase is primarily due to an increase in primary and secondary Cs predicted in the updated RCS source term. The MSLB results are very sensitive to the increase in Cs inventory in the SG liquid and primary-to-secondary leakage because no partitioning occurs in the faulted SG. The percentage change is based on actual calculated doses prior to rounding to the next highest 0.1 Rem TEDE.

References

1. Letter from Stephen Monarque (NRC) to David A. Christian (Dominion) "Surry Power Station, Units 1 and 2, Issuance of Amendments Regarding the Redefinition of the Exclusion Area Boundary", (TAC Nos. MC8315 and MC83165)", Serial No. 06-701, August 10, 2006.

2. Letter from Virginia Electric and Power Company to USNRC dated January 27, 2010 (Serial No. 09-223), "Virginia Electric and Power Company (Dominion), Surry Power Station Units 1 and 2, License Amendment Request, Measurement Uncertainty Recapture Power Uprate."

ENCLOSURE

Electronic Media Files and Inputs to the RADTRAD Model used for Benchmarking

Virginia Electric Power Company
(Dominion)
Surry Power Station Units 1 and 2