September 12, 2002

MEMORANDUM TO: Kahtan N. Jabbour, Acting Section Chief
Project Directorate 2-1
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

FROM: F. Mark Reinhart, Chief**/RA/**
Licensing Section
Probabilistic Safety Assessment Branch
Division of Systems Safety and Analysis
Office of Nuclear Reactor Regulation

SUBJECT: ASSESSMENT OF ATMOSPHERIC DISPERSION AND RADIOLOGICAL DOSE ASSESSMENT FOR FUEL HANDLING ACCIDENT AT H. B. ROBINSON UNIT 2 POWER (TAC NO. MB4632)

We have completed our review of the atmospheric dispersion and the calculated dose consequences of fuel handling accidents for H. B. Robinson Unit 2. We concluded that the doses at the EAB and LPZ would be below the acceptance criteria of Regulatory Guide 1.183. A similar conclusion was reached for the control room operators' doses.

The attached safety evaluation (SE) inputs summarize our assessments. Attachment 1 contains the atmospheric dispersion input. Attachment 2 contains the radiological accident dose consequences input. Any questions concerning the atmospheric dispersion input should be directed to Leta Brown while questions on the radiological consequences of postulated accidents should be directed to Jack Hayes.

CONTACTS: Leta Brown, SPSB/DSSA/NRR
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John J. Hayes, SPSB/DSSA/NRR
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Radiological Analysis

The licensee provided an analysis of the consequences of a fuel handling accident to demonstrate the acceptability of their proposed amendment request. The licensee's analysis was contained in submittals dated March 13, 2002 and August 14, 2002. The detailed analysis was in the March 13th submittal. Resultant doses were modified due to a change in the control room atmospheric dispersion (χ/Q) values which were presented in the August 14th submittal and resulted in the modification of the control room operators' doses.

The licensee's fuel handling accident analysis involved the utilization of the alternate source term and an assessment of two cases. The first entailed a fuel handling accident occurring within containment. The second assumed a fuel handling accident within the fuel building. In both cases, the licensee assumed the dropping of a fuel assembly which resulted in damage to all of the fuel rods in the dropped assembly.

The gap activity from the damaged rods was assumed to be released to the refueling water cavity for the accident within containment and to the fuel storage pool water for the accident within the fuel building. A majority of the gap activity in the elemental form was assumed to be retained in the water. None of the gap activity in the organic form was assumed to be retained by the water. That activity not retained in the water was assumed to be released to the building.

For the accident within the containment, the licensee did not assume operation of the containment purge system as had previous analyses. Thus, no credit was assumed for removal of the airborne iodine from the containment atmosphere by the purge system.

For the fuel handling accident within the fuel building, the licensee assumed that the fuel building ventilation system was operating and that the charcoal adsorber was effective in removing the iodine which became airborne. For both cases, the activity released to the buildings was assumed to be discharged to the environment over a 2-hour period.

The licensee assumed the gap inventory of the damaged fuel rods were in an assembly which had been operated at 1.8 times core average power. The licensee assumed decay times since shutdown from power of 56 hours for the accident within the containment and 8 hours for the accident within the fuel building. It was also assumed that a minimum of 23 feet of water was above the fuel in the refueling cavity for the accident within containment and a minimum of 21 feet was above the fuel in the fuel storage pool for the accident in the fuel building. For these depths, the licensee assumed an overall decontamination factor of 200 for the refueling cavity and 138 for the fuel storage pool.

Control Room Mode of Operation

The licensee's analyses assumed that the control room's emergency filtration system did not begin operation until one hour following the onset of the accident. During the first hour 400 cfm entered the control room through the normal ventilation system unfiltered. In addition, 300 cfm was assumed to leak into the control room unfiltered. After one hour the control room's emergency ventilation system was assumed to begin operation. With it operating, 400 cfm of outside air would be filtered and brought into the control room. In addition, 2600 cfm would be withdrawn from the control room envelope, recirculated and filtered. During the operation of the

control room emergency ventilation system unfiltered inleakage into the control room was assumed to be 230 cfm.

The licensee's values for inleakage into the control room were not based upon test data. The licensee has committed to the performance of a leak rate test of the control room envelope prior to implementing the changes proposed in a May 10, 2002 letter. The licensee is expecting to conduct this test during the first quarter of calendar year 2003. In the May 10th letter the licensee committed to (1) providing a single value for inleakage into the control room envelope; (2) revising the analyses in the May 10th submittal if the assumed value for inleakage is lower than the test results; and (3) developing a comprehensive corrective action plan if testing and re-analysis indicates that the current licensing basis cannot demonstrate compliance with GDC 19 of Appendix A to 10CFR50.

Staff Assessment

The staff has performed an independent calculation of the offsite and onsite consequences of a fuel handling accident. Table 1 contains details of the assumptions utilized by the staff in this calculation. In the licensee's August 14th letter, the licensee indicated that the proposed technical specification changes did not remove any technical specification operability requirement for automatic function that would require substitution of manual operator action for the automatic function to mitigate design basis accidents and events. In a September 5, 2002 letter, the licensee confirmed that the automatic actuation function would be required to be functional during a fuel handling accident and that no manual operator actions would be substituted for the automatic actuation. Consequently, the staff's analysis of the control room operators' doses assumed that a fuel handling accident would result in the automatic initiation of the control room emergency ventilation system immediately upon onset of the accident.

The results of the staff's calculations are presented in Table 2. Both the onsite and offsite doses were found to be acceptable for the proposed amendment. It should be noted that the staff is approving the proposed amendment based upon the licensee's commitment to perform a test of the control room envelope's integrity during the first quarter of calendar year 2003. The staff has concluded that this approval is acceptable until the results of the control room test are known given the fact that the potential challenge to the control room operators will be limited since fuel handling operations will occur for a short period of time, October 2002, and due to low probability of a fuel handling accident occurring during this period.

Table 2 Onsite and Offsite Doses Resulting from a Fuel Handling Accident (Rem)

Accident	**EAB**	**LPZ**	**Control Room Operators**
Within Containment	6.0	0.30	1.2
Inside Fuel Bldg.	5.9	0.30	0.53
Regulatory Limit	6.3	6.3	5

Table 1 Assumptions for Fuel Handling Accidents

Parameter	Value
Core Power (MWT)	2346
Total Number of Assemblies in Core	157
Highest Power Discharged Assembly	
Peak to Average Ratio	1.8
Occurrence of Accident (hours after shutdown)	
Within containment	56
Within fuel handling building	8
Damaged fuel rods	one assembly
Gap Fraction	
^{131}I	0.08
^{85}Kr	0.10
Other Noble Gases and Halogens	0.05
Alkali Metals	0.12
Iodine Gap Inventory	
Organic (percent)	0.15
Elemental (percent)	99.85
Refueling Cavity Water Level (ft)	23
Pool DF	
Organic (percent)	1
Elemental (percent)	500
Fuel Storage Pool Water Level (ft)	21
Pool DF	
Organic (percent)	1
Elemental (percent)	173

Fuel Building Adsorber Efficiency	
Elemental (percent)	90
Organic (percent)	70
Control Room χ/Q Value (sec/m^3)	4.15E-3
Offsite χ/Q Values (sec/m^3)	
EAB	1.77E-3
LPZ	8.92E-5
Breathing Rate (m^3/sec)	3.47E-4
Control Room	
Free Volume (ft^3)	20124
Normal Ventilation Flow (cfm)	400
Time to Initiate Control Room Emergency Ventilation System (hr)	0
Makeup Filter Efficiency	
Elemental and Organic Forms of Iodine (percent)	95
Makeup Air Filtration Rate (cfm)	400
Recirculation Air Filtration Rate (cfm)	2600
Unfiltered Air Infiltration Rate (cfm)	
0-1 hour	300
1-8 hours	230
Occupancy Factor	1

X Atmospheric Relative Concentration Estimates

X.1 Meteorological Data

Carolina Power and Light Company (CP&L) calculated new relative concentration (X/Q) estimates for the FHA dose assessment described above using onsite meteorological data collected between calendar years 1988 through 1996. These data were measured at 11 and 62 meters above grade at the Robinson site. The licensee has stated that the tower area is on generally flat terrain with trees approximately 20 to 40 feet in height within about 200 to 250 feet of the measurement tower. The Robinson USAR states that to meet the recommended data recovery cited in Regulatory Guide (RG) 1.23, "Onsite Meteorological Programs," the licensee performs scheduled calibrations in accordance with the Robinson Emergency Plan requirements. Wind and temperature sensors are changed and replaced with calibrated sensors traceable to the National Bureau of Standards. Twin redundant delta temperature sensors are operated simultaneously and comparisons made between the two systems. Data are accessed remotely by a meteorological contractor to review and check for consistency and to periodically compare the data against National Weather Service data. Any erroneous data are discarded prior to archival.

Staff performed a review of the meteorological data submitted by CP&L using the methodology described in NUREG-0917, "Nuclear Regulatory Commission Staff Computer Programs for Use with Meteorological Data." Further review was performed using a computer spreadsheet. Joint wind speed, wind direction and atmospheric stability data recovery were in the upper 90 percentiles other than in 1996. In 1996 joint recovery of one group of measurements was slightly less than 90 percent. Examination of the data revealed infrequent occurrences of wind data remaining unchanged for two or more consecutive hours more often or for a longer duration than would be expected due to typical meteorological processes. This suggests that data recovery may have been slightly less than cited above. However, even with the uncertainty, staff estimates that the recovery is still well above 90 percent and the uncertainties should not have a significant impact on the licensee's relative concentration (X/Q) estimates for this dose assessment. Thus, joint data recovery for the nine year period met the recommendations of RG 1.23.

While there was some year-to-year variability in reported atmospheric stability during the nine year period, frequency of occurrence as a function of time of day was consistent with expected meteorological conditions. With only a few exceptions, stable and neutral conditions were reported to occur at night and unstable and neutral conditions during the day. The longest continuous occurrence of a single unstable category was 11 consecutive hours.

Wind direction frequency occurrence at both the lower and upper levels showed distinct bimodal flow reflecting the site area topography. Winds at the lower level were predominantly from the north northeast, south and south southwest. Winds at the upper level were mostly from the north northeast, southwest and south southwest. Year-to-year frequency of occurrence within those directions was more variable at the upper level than the lower level. Wind speed data indicated a relatively high occurrence of light winds at the lower level with more year-to-year variability in the frequency of light winds than at the upper level. The lower measurements may have been impacted by trees in the neighborhood of the tower. Standard

practice recommends that potential obstructions be a minimum of ten times their height away from measurement instrumentation. Thus, trees twenty feet tall should be at least 200 feet from the measurement tower.

X.2 EAB and LPZ Relative Concentration Estimates

The licensee calculated X/Q values for the exclusion area boundary (EAB) and low population zone (LPZ) using site-specific inputs and the PAVAN computer code. The PAVAN code, documented in NUREG/CR-2858, "PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Plants," uses the methodology described in Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants." The licensee made calculations for an EAB distance of 425 meters and LPZ distance of 7242 meters. Releases were assumed to be ground level.

X.3 Control Room Relative Concentration Estimates

CP&L used the ARCON96 methodology (NUREG/CR-6331, Revision 1, "Atmospheric Relative Concentrations in Building Wake") for calculation of control room X/Q values with a modification to the surface roughness length and averaging sector width constant. Both modifications are acceptable to the staff. Calculations were made for postulated releases from the closest point of the containment building and from the Fuel Handling Building wall to the Control Room intake. Both were assumed to be ground level point releases.

X.4 Conclusion

Staff has reviewed the inputs to the PAVAN and ARCON96 codes and found them to be generally consistent with staff practice, site configuration drawings, and other information provided by CP&L. Although staff thinks that trees may have an influence on meteorological measurements at the Robinson site, staff does not have sufficient basis for concluding that the impact is significant enough to reject the dose assessment for this amendment given the assumptions used in the calculations. Based on this review, the staff finds the X/Q values listed in Table X acceptable for use in this dose assessment.

Table X
Robinson Relative Concentration (X/Q) Values

Offsite X/Q values (s/m^3)

EAB	0 - 2 hrs	1.77 E-3
LPZ	0 - 2 hrs	8.92 E-5

Onsite X/Q values (s/m^3)

	FHA in Containment	FHA in Fuel Handling Building
0-2 hrs	4.15 E-03	1.24 E-03
2-8 hrs	2.74 E-03	8.97 E-04
8-24 hrs	1.17 E-03	3.62 E-04
1-4 days	8.18 E-04	2.58 E-04
4-30 days	6.74 E-04	2.14 E-04