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SUBJECT: Provides summary of calculated dose consequences of SF cask drop in comparison with General Design Criteria 19. Calculation was performed in response to NRC 980512 RAI.

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10 CFR 50.90

CP&L

Carolina Power & Light Company
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3581 West Entrance Road
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Serial: RNP-RA/98-0194

OCT 29 1998

United States Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2
DOCKET NO. 50-261/LICENSE NO. DPR-23

SUPPLEMENT TO REQUEST FOR STAFF REVIEW
OF SPENT FUEL CASK DROP CALCULATION OF DOSE
CONSEQUENCES IN COMPARISON WITH GENERAL DESIGN CRITERION 19.

Sir or Madam:

This letter provides a summary of calculated dose consequences of a spent fuel cask drop in comparison with General Design Criterion 19. This calculation was performed in response to an NRC Request For Additional Information (RAI) pertaining to NRC review of an unreviewed safety question regarding a potential spent fuel cask drop at the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2. The NRC RAI was issued by letter dated May 12, 1998. The calculation was committed to be provided to the NRC by October 29, 1998.

Attachment I provides an affidavit as required by 10 CFR 50.90. Attachment II provides the summary and results of the calculated dose consequences of a spent fuel cask drop with the valve box covers removed.

A001

If you have any questions concerning this matter, please contact me or Mr. H. K. Chernoff of my staff.

Very truly yours,

Jerry M. Wilkerson

T. M. Wilkerson
Manager - Regulatory Affairs

ALG/ag

040038

Attachments

I. Affidavit
II. Supplement To Request For Staff Review Of Spent Fuel Cask Drop Calculation Of Dose Consequences In Comparison With General Design Criterion 19

c: Mr. L. A. Reyes, NRC, Region II
Mr. R. Subbaratnam, NRC, NRR
NRC Resident Inspector, HBRSEP

United States Nuclear Regulatory Commission
Attachment I to Serial: RNP-RA/98-0194
1 Page

Affidavit

State of South Carolina
County of Darlington

D. E. Young, having been first duly sworn, did depose and say that the information contained in letter RNP-RA/98-0194 is true and correct to the best of his information, knowledge and belief; and the sources of his information are officers, employees, contractors, and agents of Carolina Power & Light Company.

Dale E Young

Sworn to and subscribed before me

this 29th day of October 1998

(Seal) Albert L Garron
Notary Public for South Carolina

My commission expires: March 22nd, 2005

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

SUPPLEMENT TO REQUEST FOR STAFF REVIEW
OF SPENT FUEL CASK DROP CALCULATION OF DOSE
CONSEQUENCES IN COMPARISON WITH GENERAL DESIGN CRITERION 19.

By letter dated August 28, 1997, Carolina Power & Light (CP&L) Company requested NRC review of an Unreviewed Safety Question (USQ) regarding a potential drop of a spent fuel cask at the H. B. Robinson Steam Electric Plant (HBRSEP), Unit No. 2. The NRC review of the CP&L request identified the need for additional information which was submitted to CP&L by letter dated May 12, 1998. CP&L responded to the NRC RAI by letter dated June 17, 1998. In its response, CP&L committed to calculate the dose consequences of a spent fuel cask drop in comparison with General Design Criterion 19 and provide the calculation to the NRC by October 29, 1998. A summary of the calculation and its results are provided below. The original question contained in the NRC RAI dated May 12, 1998, is restated for clarity.

QUESTION 5:

"The August 28, 1997, request states that `The evaluation demonstrates that the release would not be sufficient to initiate the Control Room radiation alarm or pressurization mode of the Control Room ventilation system.' This implies that the doses in the control room are acceptable. However, no results for the control room are provided. Provide the dose consequences to the control room operators during the postulated cask drop accident and compare these results to GDC 19."

RESPONSE:

Summary

The dose calculation provided by letter dated August 28, 1997, was performed to provide occupational exposure information in support of a determination in accordance with 10 CFR 51.22(c)(9) and was not intended to show that the requirements of 10 CFR 50, Appendix A, "General Design Criteria," Criterion 19, "Control Room," are met. A calculation of the dose consequences in comparison with General Design Criterion 19 has been performed.

In the event a spent fuel cask drop occurs containing irradiated fuel for shipment and the shipping cask is being moved with the valve box covers removed, the possibility exists that the fuel can be damaged and a release of activity could occur directly to the environment. The noble gas and iodine activity released from the irradiated fuel could be drawn into the Control Room ventilation system resulting in whole body, thyroid and skin exposure to Control Room personnel. This calculation determined the integrated radiation dose to personnel in the Control Room for a 30 day period following the postulated accident.

The activity was assumed to be released over one minute. The calculation determined the initial concentration of noble gases and iodine in the Control Room using a conservative atmospheric dispersion factor and consideration of a time dependent concentration of activity in the Control Room due to the operation of the ventilation system in the normal (non-filtered) mode. Radioactive decay was considered negligible due to the isotopic inventory consisting of the long lived isotopes of Kr^{85} and I^{129}. The isotopic concentration was integrated to arrive at a cumulative activity. The cumulative activity was adjusted by the occupancy factors for Control Room personnel taken from Standard Review Plan (SRP) 6.4, "Control Room Habitability System," to determine the integrated doses to Control Room personnel. Whole body doses were also adjusted by the geometry factor described in NUREG/CR-6210, "Computer Codes for Evaluation of Control Room Habitability (HABIT)," to account for the finite size of the Control Room.

Activity Released

The activity released was determined using the ORIGIN-2 code and multiplying the results by the appropriate radial peaking factors from Regulatory Guide 1.25, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors (Safety Guide 25)." The activity assumed 100% clad damage from seven fuel assemblies contained in the cask. The resulting activity released to the atmosphere from the cask drop was calculated to be 1.44E+04 Curies of Kr^{85} and 6.9E-02 Curies of I^{129}.

Integrated Control Room Activity

The previous calculation described in CP&L letter dated August 28, 1997, determined that the release from the dropped fuel cask would be insufficient to cause initiation of the Control Room radiation alarm and subsequent operation of the Control room ventilation in the emergency mode. The initial activity concentration was therefore determined by calculating the activity at the intake, multiplying the activity concentration at the intake by the intake flow rate and release duration, and dividing the result by the Control Room volume. Removal by the Control Room ventilation system during the initial buildup inside the Control Room was neglected because the release duration was short. The initial activity concentration was determined by dividing the released activity by the release duration and multiplying the resulting release rate by the atmospheric dispersion coefficient for the intake location. The Control Room has only one outside air intake.

The atmospheric dispersion factor was determined in accordance with Figure 2(A) of Regulatory Guide 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors," Revision 2. The horizontal distance between the area where the cask could be dropped and the Control Room intake is approximately 70 meters. The atmospheric dispersion factor obtained from Regulatory Guide 1.4, Figure 2(A) is 6.0E-02 seconds per cubic meter. Since the released activity would pass by the containment and the Auxiliary Building to reach the Control Room intake, the atmospheric dispersion factor was reduced by a factor of three (3) to account for building wake effects.

After the first minute, the released activity is assumed to have passed the intake and no additional activity is drawn into the Control Room. Since the isotopes involved have long half lives, no radioactive decay is assumed. Deposition was neglected to provide a conservative result. The Control Room exhaust flow was the only assumed removal rate since the ventilation system recirculation flow is unfiltered in the normal mode. The resulting activity concentration in the Control Room was a simple decaying exponential calculation that was integrated over each of the three time periods with different Control Room personnel occupancy factors given in SRP 6.4, Table 6.4-1, "Summary Sheet for Control Room Dose Analysis."

The resulting integrated activity in the Control Room was calculated to be 8.0E-02 microCurie-Hours per cubic centimeter of Kr^{85} and 3.8E-07 microCurie-Hours per cubic centimeter of I^{129}.

Integrated Doses

The integrated Deep Dose Equivalent (DDE) to a Control Room occupant was calculated by multiplying the integrated activity in the Control Room by the DDE Dose Conversion Factors (DCFs), summing the results, and dividing by the geometry factor that accounts for the Control Room being a finite space instead of the semi-infinite cloud. The resulting DDE to a Control Room occupant was calculated to be 3.5E-03 rem.

The Thyroid Committed Dose Equivalent (CDE) to a Control Room occupant was calculated by multiplying the integrated iodine activity in the Control Room by the breathing rate and thyroid CDE DCF. The resulting thyroid CDE to a Control Room occupant was calculated to be 7.8E-04 rem.

The Shallow Dose Equivalent (SDE) to a Control Room occupant was calculated by multiplying the integrated activity in the Control Room by the SDE DCFs and summing the results. The resulting SDE to a Control Room occupant was calculated to be 1.2E+01 rem.

Summary

The above information indicates that the completed calculations of radiological consequences, as a result of a spent fuel cask drop with the valve box covers removed, have been performed in accordance with generally accepted practices and methods. The calculation shows the dose consequences to be conservative in comparison with General Design Criterion 19 values.

Table 1
Summary of Values

Assumptions

Activity Released:	1.44E+04 Curies Kr^{85} 6.9E-02 Curies I^{129}
Release Duration	1 minute
Atmospheric Dispersion Factor	2.0E-02 sec/cubic meters (all time periods)
Control Room Intake Flow	400 cfm
Control room Exhaust Flow	400 cfm
Control Room Volume	20,124 cubic feet
Occupancy Factors	
0-24 hours	1
1-4 days	0.6
4-30 days	0.4
Breathing Rate	3.47E-04 cubic centimeters per hour (Regulatory Guide 1.4[1])
Dose Conversion Factors	
Kr^{85} Deep Dose Equivalent (DDE)	1.8E+00 (Regulatory Guide 1.109[2])
I^{129} DDE	4.7E+00 (Radiological Health Handbook[3])
I^{129} Committed Dose Equivalent CDE	5.9E+00 (ICRP 30[4])
Kr^{85} Shallow Dose Equivalent SDE	1.5E+02 (Regulatory Guide 1.109)
I^{129} SDE	1.3E+01 (Radiological Health Handbook)
Geometry Factor	$1147\ V^{-0.338}$

Results

Integrated Dose	Calculated	General Design Criterion 19
DDE	0.0035 rem	5 rem
Thyroid CDE	0.00078 rem	30 rem
SDE	12 rem	30 rem

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[1] Regulatory Guide 1.4, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors," Revision 2, USNRC, 1974.

[2] Regulatory Guide 1.109, Revision 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," USNRC, 1977.

[3] Shleien, B. (ed.) "The Health Physics and Radiological Health Handbook," Revised Edition, Scinta, Inc., Silver Spring MD, 1992.

[4] ICRP Publication 30, "Limits for intakes of Radionuclides by Workers," International Commission on Radiological Protection, Oxford Publication Press, 1980.