June 29, 1982

Docket No. 50-213
LS05-82-06-120

Mr. W. G. Counsil, Vice President
Nuclear Engineering and Operations
Connecticut Yankee Atomic Power Company
Post Office Box 270
Hartford, Connecticut 06101

Dear Mr. Counsil:

SUBJECT: HADDAM NECK PLANT - DRAFT EVALUATION OF SEP TOPIC XV-12, RADIOLOGICAL CONSEQUENCES OF A ROD EJECTION ACCIDENT

Enclosed is our staff's draft review of SEP Topic XV-12, Radiological Consequences of a Rod Ejection Accident. The staffs conservative evaluation concludes the Haddam Neck Plant is not adequately designed to limit the dose at the exclusion area boundary to acceptable levels for the subject accident. Consequently, the significance of this difference will be addressed in the integrated assessment.

The contents of this safety evaluation report will be a basic input to the integrated assessment for the Haddam Neck Plant. This topic assessment may be revised in the future if your facility design is changed or if NRC criteria relating to this topic is modified before the integrated assessment is completed.

Sincerely,

Dennis M. Crutchfield, Chief
Operating Reactors Branch No. 5
Division of Licensing

Enclosure:
As stated

cc w/enclosure:
See next page

SE04
DSU USE EX(02)
Add: Stu Brown

*See previous yellow for additional concurrences.

OFFICE	SEPB:DL	SEPB:DL	SEPB:DL	SEPB:DL	ORB#5:PM	ORB#5:BC	AD:SA:DL
SURNAME	RFell:dk	SBrown*	CGrimes*	WRussell*	CTropf*	DCrutchfield	GLainas
DATE	6/ /82	6/10/82	6/16/82	6/16/82	6/16/82	6/ /82	6/ /82

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DATE	6/3/82	6/10/82	6/16/82	6/10/82	6/18/82	6/ /82	6/ /82

NRC FORM 318 (10-80) NRCM 0240 OFFICIAL RECORD COPY USGPO: 1981—335-960

Mr. W. G. Counsil

cc
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XV-12 SPECTRUM OF ROD EJECTION ACCIDENTS

I. INTRODUCTION

Ejection of a control element assembly from the core can occur if the control element drive mechanism housing or the nozzle on the reactor vessel head breaks off circumferentially. The ejection of a control element assembly by the reactor coolant system pressure can cause a severe reactivity excursion. This accident may result in radioactivity being released to the environment through the steam generator and containment leaks.

SEP Topic XV-12 is intended to evaluate the radiological consequences of this accident. The review will encompass those plant design features which limit the release including the plant technical specifications on primary to secondary system leakage.

II. REVIEW CRITERIA

Section 50.34 of 10 CFR Part 50 requires that each applicant for a construction permit or operating license provide an analysis and evaluation of the design and performance of structures, systems, and components of the facility with the objective of assessing the risk to public health and safety resulting from operation of the facility. The control rod ejection accident is one of the postulated accidents used to evaluate the adequacy of these structures, systems, and components with respect to the public health and safety.

General Design Criterion (GDC) 28, "Reactivity Limits," of Appendix A to 10 CFR Part 50, requires the reactivity control system to be designed with appropriate limits on the potential amount and rate of reactivity increase.

GDC 28 also requires that these postulated reactivity accidents include consideration of the rod ejection accident unless such an accident is prevented by positive means.

In addition, 10 CFR Part 100.11 provides dose guidelines for reactor siting against which calculated accident dose consequences may be compared.

III. RELATED SAFETY TOPICS

Topic II-2.C, "Atmospheric Transport and Diffusion Characteristics for Accident Analysis" provides estimates of the atmospheric transport and diffusion necessary to evaluate offsite doses. Various other SEP topics evaluate such items as containment isolation, containment leak testing, ESF systems, and steam generator integrity.

IV. REVIEW GUIDELINES

The review of the radiological consequences of a control rod ejection accident was conducted in accordance with the Appendix to Standard Review Plan 15.4.8, Rev. 1 (NUREG-0800) and Regulatory Guide 1.77. Existing plant technical specifications will be taken into account in calculating the radiological consequences. The plant is considered adequately designed against a control rod ejection accident if the resulting doses at the exclusion area (EAB) and low population zone (LPZ) boundaries are well within the guideline values of 10 CFR Part 100 (75 Rem thyroid and 6 Rem whole body for 2 hours at the EAB and the course of the accident at the LPZ).

V. EVALUATION

The licensee provided a discussion of the radiological consequences, dated September 30, 1981. No detailed calculation was performed, since the licensee concluded that no clad damage would occur as a result of the accident. Therefore, the activity available for release would be a very small fraction of the LOCA activity, and dose consequences would be well below 10 CFR 100 limits. The staff has evaluated the CEA ejection under the assumption of no fuel failure using the plant's technical specification on coolant activity and concludes that the consequences would be small fractions of 10 CFR 100 guidelines. The activity released in this case is limited to that contained in the primary coolant. The plant's limiting condition for operation on primary coolant activity is 68/E μCi/ml (where E is defined as the average gamma energy of the activity in MeV for nuclides with half lines greater than 30 minutes). No specific limit for radioiodines is given. Therefore, the staff assumed that the activity was all ^{131}I, that is 174 μCi/ml. The calculated doses at the exclusion area boundary (EAB) for 0-2 hours after the accident for leakage through the containment at the technical specification limit (0.25%/24 hours) and for release through the secondary side due to technical specification primary-secondary leakage (0.4 gal/min) are given in Table XV-12-1. (Whole body and LPZ doses are not limiting.)

A decontamination factor of 10 for radioiodines was allowed for the primary-secondary leakage release path. Although there is no technical specification on secondary water chemistry (specifically no requirement on additives which would raise the pH), this value is considered justified because the release would be through small leakage paths and, since the steam generator would not be blown dry, underwater.

The NRC staff has not agreed with the licensee's criteria of no fuel failures since an evaluation of final bundles which may experience DNB was not performed. Therefore, the staff has conservatively specified 10% fuel clad failures should be assumed after a control rod ejection (CEA) accident. Based on this assumption, the 0-2 hr. exclusion area boundary doses are estimated to be less than 99 rem and the duration of the accident dose at the low population zone is estimated to be 66 rem. Parameters used in this evaluation are included in Table XV-12-2.

VI. CONCLUSIONS

The estimated low population zone thyroid doses are acceptable to licensing criteria. The estimated 2 hr. EAB dose exceeds the criteria by 33% or 24 rem. However, because the percentage (10%) of failed fuel clad is conservative and because the dose model yields conservative estimates, it is the staff's judgment that an analysis using a DNB criteria would result in significantly lower estimations of failed fuel which would lead to lower doses. The need to perform a rod ejection accident evaluation to determine the number of fuel assemblies experiencing DNB will be determined during the integrated assessment.

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Table XV-12-1

Radiological Consequences of the Control Rod Ejection Accident
all Doses in Rem

Case 1 - Primary and Secondary Coolant Activity Release Only

Pathway	EAB Thyroid Dose
Containment leakage	1.2
Primary-Secondary leakage	.2

Case 2 - 10% Clad Damage Only

Pathway	2hr. EAB Thyroid Dose	EAB Whole Body Dose	30 day LPZ Thyroid	LPZ Whole Body
Containment leakage	77	<.1	64	<.1
Primary-Secondary leakage	22	.7	2.0	<.1

Table XV-12-2

Assumptions Made in Analysis of
Control Rod Ejection Accident

1. Power level 1880 MWt
2. Loss of condenser following the accident
3. Primary system volume 20900 gal
4. Primary system activity prior to the accident 174 $\mu Ci/ml$ ^{131}I
5. Iodine decontamination factor of 10 between water and steam
6. Primary to secondary leak rate 0.4 gal/min
7. Containment leak rate 0.25%/24 hours, reduced by factor of 2 after 1 day
8. Release of 10% of radioiodine and all noble gases in gaps of rods with clad damage
9. Meteorological conditions X/Q sec/m^3

EAB	0-2 hr	8.4×10^{-4}
LPZ	0-8 hr	1.5×10^{-5}
	8-24 hr	1.0×10^{-5}
	24-96 hr	4.4×10^{-6}
	96-720 hr	1.3×10^{-6}

10. Flux peaking factor 1.0
11. Time to stop secondary side releases 0.5 hr.