DECONTAMINATION STUDY OF THE YANKEE PLANT

By

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ABSTRACT

A Decontamination Study for the Yankee Nuclear Power Station, a 185 MWe facility situated on the Deerfield River in northwestern Massachusetts in the town of Rowe, was conducted to assess the economic impact of a major accident.

Because accidents at commercial nuclear generating facilities are extremely infrequent, the only realistic data base for the study is a utilization of data obtained from the incident at the Three Mile Island Unit-2 Station (TMI-2).

This study assumed that a similar accident was to occur at the Yankee plant and the steps taken to clean up the resulting damage were, for the most part, comparable to the plan for TMI-2. The economic costs associated with such an effort are predicted by the study to be approximately $360 million (1982 dollars) which includes the cost of decommissioning the plant.

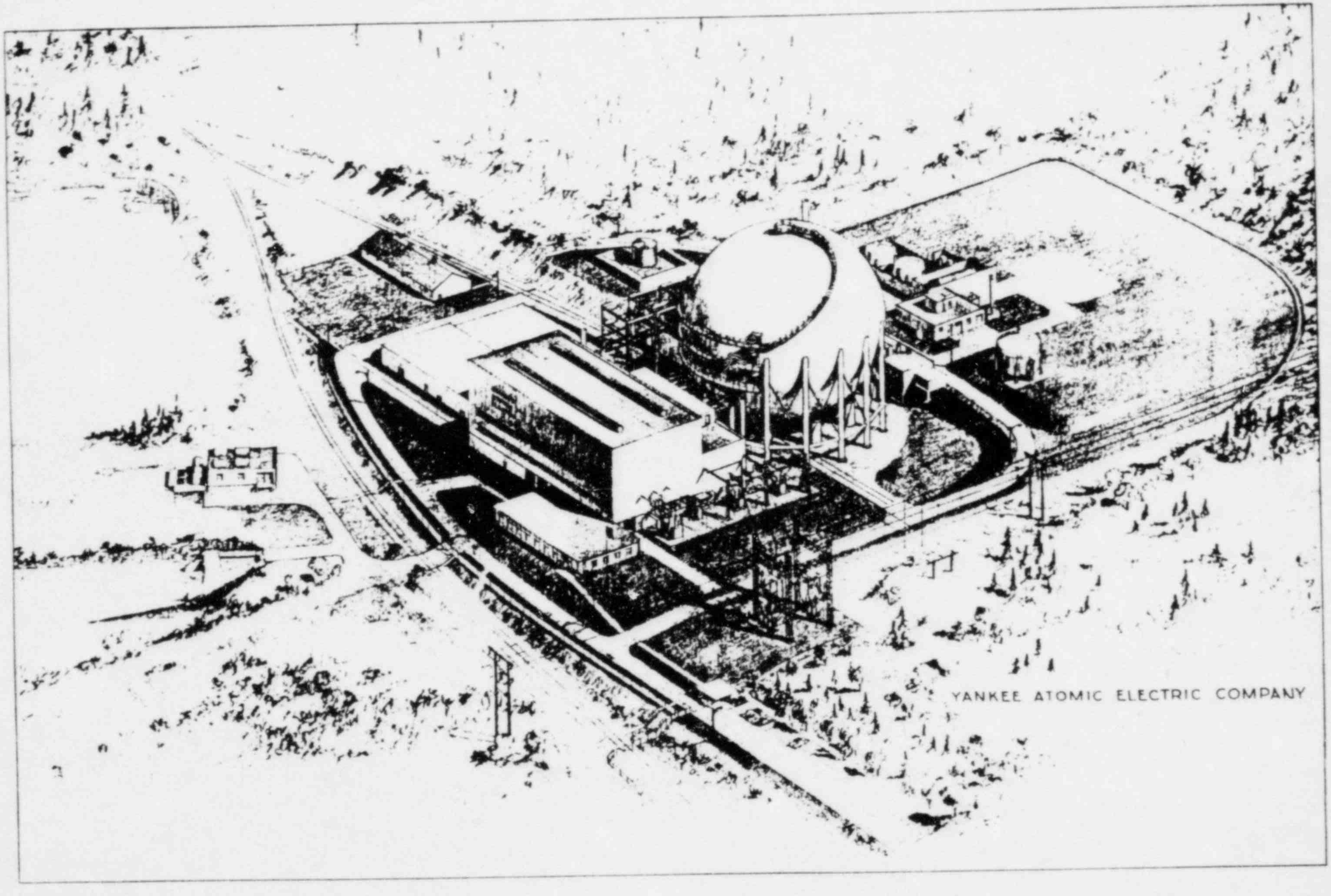

YANKEE ATOMIC ELECTRIC COMPANY

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

In August of 1980, General Public Utilities Corporation, which operates the Three Mile Island Nuclear Generating Station (TMI), published an estimate of the post-accident cleanup costs for the TMI Unit-2. The aggregate costs associated with decontamination and debris removal were estimated at just over $1 billion [2].

This report documents the decontamination and decommissioning tasks and their associated costs which would be encountered by Yankee Atomic Electric Company following an incident of the magnitude of the TMI Unit-2 accident at the Yankee Plant in Rowe, Massachusetts.

The costs derived for the Yankee plant were arrived at by scaling the TMI-2 cost estimates based on an analysis of the tasks as differentiated by volumes, surface areas, core size, mass of material to be processed and radioactive concentrations. For the TMI-2 decontamination effort many of the tasks involve development of new technology or extensions of existing technology to new limits. Industry methods for decontamination and contaminated water processing, for example, have undergone several improvements as a direct result of the TMI-2 experience. The effect of this research-like development on the costs used in this study is to drive the costs higher than for normal production processing. The costs used in this study were not reduced to take advantage of the TMI experience.

2.0 DECONTAMINATION ANALYSIS

2.1 Cleanup Analysis of the TMI-2 Facility

On March 28, 1978 the TMI-2 facility underwent an accident of magnitude severe enough to damage a significant amount of equipment and contaminate a large portion of the plant with the highly radioactive by-products of the accident. Subsequent to the accident, several studies were performed to estimate the scope of the total cleanup effort and associated costs.

Perhaps the most exhaustive of these studies is the Environmental Impact Statement filed by the U. S. Nuclear Regulatory Commission in March 1981 [1]. This study evaluated the "activities necessary for decontamination of the facility, defueling, and disposition of the radioactive wastes". This report contains detailed cost estimates for various activities associated with the cleanup.

In addition to the NRC Study, General Public Utilities (GPU), which provides operational and technical support to the TMI-2 facility, also estimated the cost of a complete cleanup [2]. Both these studies form the basis for this Yankee decontamination analysis.

2.2 Cleanup Analysis for the Yankee Facility

2.2.1 Assumptions

The decontamination analysis for the Yankee plant has been developed using the estimations compiled for the TMI-2 facility. The underlying assumption in the Yankee Study is that the accident at the TMI-2 facility represents a severe reactor plant accident with reactor core damage and extensive radioactive contamination, involving most every structure and system associated with the operation of the reactor.

In an effort to estimate potential cleanup costs for Yankee, scaling techniques were used. The referenced TMI-2 cleanup studies provided the basis for scaling the various cleanup activities. In making comparisons between the two facilities, several factors were weighed before assigning a cost for the Yankee plant. A summary of the factors considered is given here.

1. Plant Physical Size - The Yankee plant occupies a much smaller area than does the TMI-2 unit. Where possible, actual dimensional comparisons were made between the two plants when scaling associated costs. The site building plan for the Yankee plant is shown on Figure 2.1.

2. Reactor Type and Capacity - The TMI-2 unit is a Babcock & Wilcox Pressurized Water Reactor (PWR) of 880 MWe capacity. The Yankee plant is a Westinghouse PWR of 185 MWe capacity. In certain cases, the costs associated with decontaminating structures and components can be scaled directly. This method must be used very cautiously, however, and some knowledge of physical size, as described above, must be available. The fact that both plants are PWR's makes comparisons at the system level easier as the auxiliary and support systems for each are quite similar.

2.2.2 Analysis

In an effort to break down the large costs of a decontamination effort into manageable, understandable quantities, Table 2.2 was constructed. The categories of activities listed are explained in detail below. Assumptions used in assigning costs to a postulated Yankee decontamination effort are documented in an effort to clarify the process by which the TMI-2 and the Yankee facilities were compared.

A. Fueled Plant Operations

This category captures the cost of maintaining the plant in a stable shutdown condition following an accident. This cost is mainly station service power required to run various electrical equipment required for post-accident core cooling. Equipment required would include one Safety Injection/Recirculation Train (500 kW), various auxiliary pumps and motors (600 kW), lighting and heating loads (400 kW), various instrumentation and control loads (500 kW), for a total power consumption of 2 megawatts at an annual cost of approximately $1,000,000. Manpower costs are specifically excluded from this category and appear in B and L below.

In the third year of the decontamination effort many of the large electrical loads are not necessary since the reactor core has been removed. The costs were held constant however to account for the power needs of the decontamination and waste processing systems.

B. Fueled Plant - Site Support Services

Site support services include the costs associated with the post-accident technical staff required to support the operation of the plant. During normal operations these costs would be associated with an engineering staff similar to the Nuclear Services Division for Yankee. For the Yankee analysis, the base cost of engineering support for the plant for the current year (1982) was evaluated. Tasks accounted for in this category range from post-accident licensing and analysis to engineering design of cleanup process systems.

C. Auxiliary Building Decontamination

This task covers the removal of surface contamination and/or contaminated water which entered the Auxiliary Building at TMI-2 during the accident. It is not expected that the Auxiliary Building at the Yankee plant would become contaminated during the course of an accident. Modifications and procedural changes designed to eliminate leakage outside of the primary containment were implemented at Yankee as part of the NRC's Post-TMI Action Plan requirements. The details of changes made by Yankee and acceptance of those changes by NRC are outlined in Appendix A. There exists, however, the potential, through equipment or piping failures, to have areas of this building become contaminated; therefore, the cost of a decontamination effort in this building was included in the study.

A comparison was made between the Yankee and the TMI-2 auxiliary buildings. The assumption was made that the piping and mechanical systems contained in the structures were basically the same with the exception of physical size and equipment accessibility. The structures were evaluated using actual dimensions, namely 100,000 ft^2 and 500,000 ft^2 for Yankee's and TMI's Auxiliary Buildings, respectively. Additionally, a significant difference exists between the two facilities in the area of equipment layout and accessibility. When the Yankee plant was designed and constructed (1956-1960), the designers were extremely liberal in allowing space between equipment (pumps, motors, switchgear, tanks, etc.) with the result being very good access to almost any piece of equipment in the building. This has proved valuable through the years from an ease of operation and maintainability standpoint. Following an accident, this ease of access would be extremely important in reducing manpower radiation exposures during decontamination.

Examination of the TMI-2 Auxiliary Building, on the other hand, reveals some significant differences in complexity and accessibility. Although the two Auxiliary Buildings are not appreciably different in regards to equipment and systems housed, the number of internal walls, cubicles, and radiation protection barriers in the TMI-2 facility is large. The effect of this complexity increases the surface area requiring decontamination and reduces the access space between pieces of equipment structures. A conservative adjustment was made to the decontamination costs for the Yankee plant using only the quantitative dimensional comparison previously discussed. This method yielded a Yankee cost which was 20% of the projected TMI-2 cost for the work.

D. Containment Building Water Processing

The problem of contaminated water in the containment building following a major accident is primarily attributable to the operation of the Safety Injection System. The water which accumulates in the containment is a direct function of the capacity of the water sources available to the Safety Injection System. Radionuclide concentrations in this liquid would be a function of reactor power, system volumes, amounts of nuclear fuel and fission products in the reactor core and accident severity. The costs associated with the TMI-2 water processing involved approximately 700,000 gallons of contaminated water from the Reactor Building, 96,000 gallons from the Reactor Coolant System and 500,000 gallons to be used to decontaminate the surfaces of the Reactor Building and flush the Reactor Coolant System. For the Yankee plant, water sources available to the Safety Injection System could potentially put approximately 125,000 gallons of water into the containment. The Main Coolant System volume is 22,000 gallons for the Yankee plant. Decontamination and flushing procedures at Yankee are assumed to utilize the same technology as at TMI-2 and therefore, volumes of water used would be proportional to 1) containment surface area, and 2) Main Coolant System volume. Using these capacities, a volume-surface comparison was made between Yankee and TMI-2 which resulted in the Yankee volumes and surface areas being only 25% of those at TMI-2.

Comparisons between the TMI-2 and Yankee reactor cores are also made to determine the relative amounts of core radionuclides which could potentially be released into the water in the Main Coolant System and containment sump. Table 2.1 makes a comparison between the two cores. Dimensional and weight comparisons yielded that the Yankee core was approximately 60% as long, 60% of the diameter and contained only 20% of the fuel (UO_2) as in the TMI-2 core. The conclusion, therefore, is that the fission product release at Yankee for the same accident scenarios as TMI-2 would be approximately 20% of that released at TMI-2. To account for the possibilities of accidents more severe than the one studied at TMI-2, however, the fission product concentrations, and hence the costs, were not reduced for the Yankee study and were conservatively assumed to be the same as the TMI-2 case. Accordingly, a composite factor of .3 based only on the quantity of waste generated and treated was used to reduce the TMI-2 cost estimate for this work.

E. Additional Decontamination Support Facilities

The costs associated with the construction and operation of new contaminated waste processing and handling facilities are included here. Systems for analyzing and processing the accident quantities of liquid, solid and gaseous radioactive wastes are not part of an original plant design. In the case of the TMI-2 facility, special state-of-the-art processing systems were designed, constructed, and licensed following the accident. Systems and facilities necessary for a full decontamination effort would include:

- Evaporator/Solidification Facility
- Low-level Counting Facility
- Hot Chemistry Laboratory
- Containment Recovery Building
- Access Facility
- Laundry Facility
- Equipment Decon System Facility
- Security Access Facility
- Package Sewage Treatment Plant
- Warehouse Expansion

These same types of support facilities would be required for the Yankee site, however, the size of the facilities would be smaller. The decrease in size is proportional to a) the smaller volumes of liquid waste to be processed, b) the fewer surface areas involved in the decontamination effort, and the smaller labor and support force necessary. A factor of .25 was used in the Yankee calculation. This is based upon the handling and processing of approximately 25% of the waste as was projected for the TMI-2 case.

It is appropriate to note here that due to the absence of a containment building shield at the Yankee plant, many areas of the plant would be inaccessible for some time. For the purposes of this study, a waiting period of 6 months prior to initiating a massive cleanup effort is assumed. During this time, the plant would be maintained in a stable shutdown condition using existing plant equipment and operating staff. The impact of this waiting period on the final cleanup costs however was considered negligible and would typically be attributable to the cleanup licensing process in any case.

F. Gross Decontamination of the Containment Building

This task reflects the costs associated with a large manual decontamination effort to remove the bulk of the surface contamination on the containment building interior surfaces. This is necessary in order to permit fuel removal operations to proceed within acceptable radiological limits. As discussed in Task D, the radionuclide concentration in containment sump water and on interior surfaces is assumed to be the same as for the TMI-2 case. Radiation fields, being directly proportional to radionuclide concentrations are also assumed to be equivalent to those encountered at TMI-2. The costs of decontamination, therefore, can be calculated using surface areas and accessibility comparisons between the two facilities. A comparison between the containment surface areas can easily be made with the results indicating that the Yankee containment surface area is only 50% that of the TMI-2 containment. This is based on a calculated surface area of 150,000 ft^2 for the Yankee plant and a 300,000 ft^2 area for TMI-2 [1].

G. Head and Core Removal

This task represents the engineering, labor, and equipment costs of disassembling and dismantling the reactor vessel and internals proper. The components inside of the reactor vessel, including fuel, could be severely damaged and deformed following an accident of this type, requiring special disassembly and defueling procedures. Engineered tooling and equipment and large man-hour expenditures are involved in these tasks. The breakdown of this task and the contribution to the effort has been estimated [1] to be as follows:

1. Inspection	17%
2. Head and Internals removal	18%
3. Defueling	45%

4. Main Coolant System Decontamination 20%

Recent inspections of the TMI-2 reactor have shown that the reactor internals and fuel were severely damaged during the course of the accident. Fuel assemblies and control rods in the center of the core have been reduced to a rubble bed through oxidation of the zirconium clad material and melting of the control rod material. Prior to a cleanup o; ‹nis debris, detailed inspections of the inside of the entire reactor vessel must be performed. Most likely a full-scale mockup will be constructed to assist in designing the removal tools, refining the defueling procedures, and developing the work plan. The cost of the inspection subtask was assumed to be the same as at TMI-2 ($8,500,000).

The head removal task for the Yankee plant would be approximately the same as in the TMI-2 case. The head is smaller and is secured by fewer studs but the cost of the subtask was assumed to be the same as projected for TMI-2 ($9,000,000) because the methods and procedures would be so similar.

Once the inspection and head removal tasks have been done, the actual defueling (debris removal and packaging) will be a function of the amounts of the various materials (uranium oxide, zirconium oxide, stainless steel, etc.) which previously made up the core structure. For the Yankee comparison, therefore, the core inventory can be compared as was done in Task D. The Yankee and TMI-2 cores contain approximately 20 tons and 100 tons of uranium full, respectively. Other structural materials, control rods, and fuel assembly cladding add approximately 75 tons to the TMI-2 core and approximately 20 tons to the Yankee core. Material contained in the Yankee core, therefore, is only approximately 20% of that at TMI-2. By additional comparison, this Yankee material is contained in a core configuration which is 40% shorter and 40% smaller in diameter than the TMI-2 core. Therefore, although the methods and relative ease of disassembly of the two reactors would be similar, the quantities of material handled will be significantly different (80% less).

The TMI-2 case assumed that 50% of the defueling subtask was involved in preparation. These preparation costs are assumed to be the same for Yankee ($11,250,000). The remainder of the cost, the actual removal and disposal of material, would be proportional to the size of the core. As discussed above, the Yankee core is approximately 20% the size of TMI-2, therefore the actual defueling cost would be 20% of $11 million ($2,250,000).

Finally, the last subtask would be the decontamination of the Main Coolant System. As discussed in Task D, the volume comparison of the Yankee Main Coolant System to the TMI-2 system shows that Yankee is only 20% of the volume of TMI-2. For the same radionuclide concentration and similar decontamination methods, therefore the decontamination effort for Yankee would be 80% less than that required for TMI-2 ($2,000,000).

Adding these four subtasks would produce the following total cost for the Head and Core Removal Task:

Subtask	Yankee Cost
1. Inspection	$8,500,000
2. Head and Internals Removal	9,000,000
3. Defueling	13,500,000
4. Main Coolant System Decon.	2,000,000
	$33,000,000

H. Facilities to House Contaminated Equipment and Material Removed from the Containment Building

The costs associated with the storage of contaminated material (solid and liquid) and equipment removed from the containment during decontamination would necessarily be directly proportional to the physical size of the containment structure. Previous comparisons (Category D and G) have shown the Yankee containment and equipment to be the equivalent of 50 to 80 percent smaller than the TMI-2 unit. The Yankee cost for this task, therefore, was conservatively estimated to be 50% of the TMI-2 cost for similar work.

I. Additional Decontamination of Containment Building

The costs associated with this activity are somewhat dependent on activities G and H above. As soon as the highly radioactive reactor core components and fuel are removed, the remainder of the components in the containment building as well as the structure itself can be more thoroughly decontaminated.

At this point, the Yankee analysis departs somewhat from the TMI-2 case. For TMI-2, the analysis is based on a cleanup which would place the unit back in service at some future date. If Yankee, which is now 22 years old, were to have a TMI-2 type accident, the most likely scenario would be cleanup to a level suitable for decommissioning not restart.

The cost of additional containment building decontamination to allow for dismantling of equipment and structures can be scaled from the TMI-2 costs by applying the same volume factor (.5) as has been used to scale the other work related to the containment activities. Costs associated with dismantling and disposal of components and systems following this additional decontamination are included in the decommissioning costs presented in Task N.

J. Defueled Plant Operation

After the third year of the plant cleanup it is expected that the fuel has been removed from the reactor and the mode of operation changes. In general, all systems within the containment could be decontaminated and dismantled as they would no longer be required to be operable to support reactor core cooling.

Based on this, it has been assumed that defueled plant operations are zero, and the costs which would normally be associated with this category, electric power, operating personnel, support staff, and consumable supplies, are included in the decommissioning effort (Tasks A and N).

K. Defueled Plant Support Services

As in Task J above, the cost of plant support services are assumed to be related to decommissioning during the latter stages of a decontamination effort. These costs, therefore, are split between Tasks B and N for the Yankee Decontamination Study.

L. Base Operations and Maintenance

The figure of $13,400,000 used in the Yankee study is the projected plant's direct cost of on-site Operations and Maintenance for 1982 which is the base year for this study. Included in this cost are on-site staff salaries, materials required for normal maintenance and consumables not associated with the accident cleanup. A conservative assumption was made that this cost would be affected only by escalation throughout the 5-year decontamination/decommissioning effort and that no significant site staff reductions would be made until the effort was essentially complete.

M. Escalation

An attempt was made to quantify an escalation factor to be applied to the totals to account for the fact that the TMI study was performed in 1980. It was felt that 10 percent per year would be a reasonable average.

N. Decommissioning

As previously mentioned, the endpoint of a large post-accident cleanup effort for the Yankee plant would be the decommissioning of the unit. Studies performed [3] indicate that the most feasible and cost-effective form of decommissioning for the Yankee plant would be complete dismantling and removal. This form of decommissioning has a high initial cost, however, after the work is complete there are no post-decommissioning costs and the site becomes available for any future use. Cost of the decommissioning is estimated at $34 million (Reference 3) (1982 dollars). These costs include engineering, facilities, supplies and equipment, and insurance. Approximately $10 million of these costs were included in Category B to account for tasks and manpower common to both cleanup and decommissioning.

Although a special decommissioning fund has been established, it will be 1991 before the fund will have accumulated the $34 million. For the purpose of this study we have assumed decommissioning costs as part of the total decontamination effort since Yankee will not be restarted if it were to have a TMI-type accident.

3.0 CONCLUSIONS

The comparisons made between the Yankee and TMI-2 facilities for the large post-accident decontamination effort previously described lead to the conclusion that such an effort would cost approximately 360 million in 1982 dollars. If the inflation were projected at 10% per year, during the course of a cleanup and decommissioning, the total costs would still be less than $500 million. This cost has been further evaluated leading up to the following observations and conclusions:

1. The costs derived for the Yankee plant, some of which were arrived at by scaling TMI-2 estimates, were in all cases conservative. For example, when a scaling factor was derived by calculation it was rounded off high in an attempt to account for uncertainties.

2. For the TMI-2 decontamination effort many of the tasks involve development of new technology or extensions of existing technology to new limits. Industry methods for decontamination and contaminated water processing, for example, have undergone several improvements as a direct result of the TMI-2 experience. The effect of this research-like development on the costs used in this study is to drive the costs higher than for normal production processing. The costs used in this study were not reduced to take advantage of the TMI experience. The implementation of the philosophy has the effect of maintaining the conservative approach to the Yankee plant estimate.

Even with these conservatisms, the cleanup and decommissioning costs for a large accident at the Yankee plant would amount to approximately 360 million in 1982 dollars. This cost study provides a comprehensive estimate of costs of manpower, services, money, equipment, new technology development, transportation and waste burial using existing experience and most recent estimates.

REFERENCES

1. NUREG-0683, Final Programmatic Environmental Impact Statement Related to Decontamination and Disposal of Radioactive Wastes Resulting from the March 28, 1978 Accident at Three Mile Island Nuclear Station, Unit 2, U.S. Nuclear Regulatory Commission, March 1981.

2. TMI-2 Recovery Program Estimate, GPU Nuclear Corp., August, 1980.

3. Decommissioning Study for Yankee Nuclear Power Station, Yankee Atomic Electric Company, May, 1980.

4. Revised Cost Estimates for Decontamination and Cleanup of the Big Rock Point Plant after a Worst Case Accident, Consumers Power Company, June 2, 1982.

TABLE 2.1

	TMI-2 Reactor	Yankee Reactor
Control Rods	69	22
Fuel Assemblies	177	76
Fuel Rods	36,816	23,142
Reactor Thermal Power	2770 MWt	600 MWt
Size of Reactor Core		
Height of Fuel	144"	90"
Equivalent Core Diameter	128"	76"
Weight of Fuel - (As UO_2)	207,000 lb.	40,000 lb.
Total Weight of Fuel Assemblies	275,000 lb.	65,000 lb.

TABLE 2.2

Summary of Decontamination Costs for Yankee Plant By Category, By Year
(5 year effort)
(1982 Dollars in Thousands)

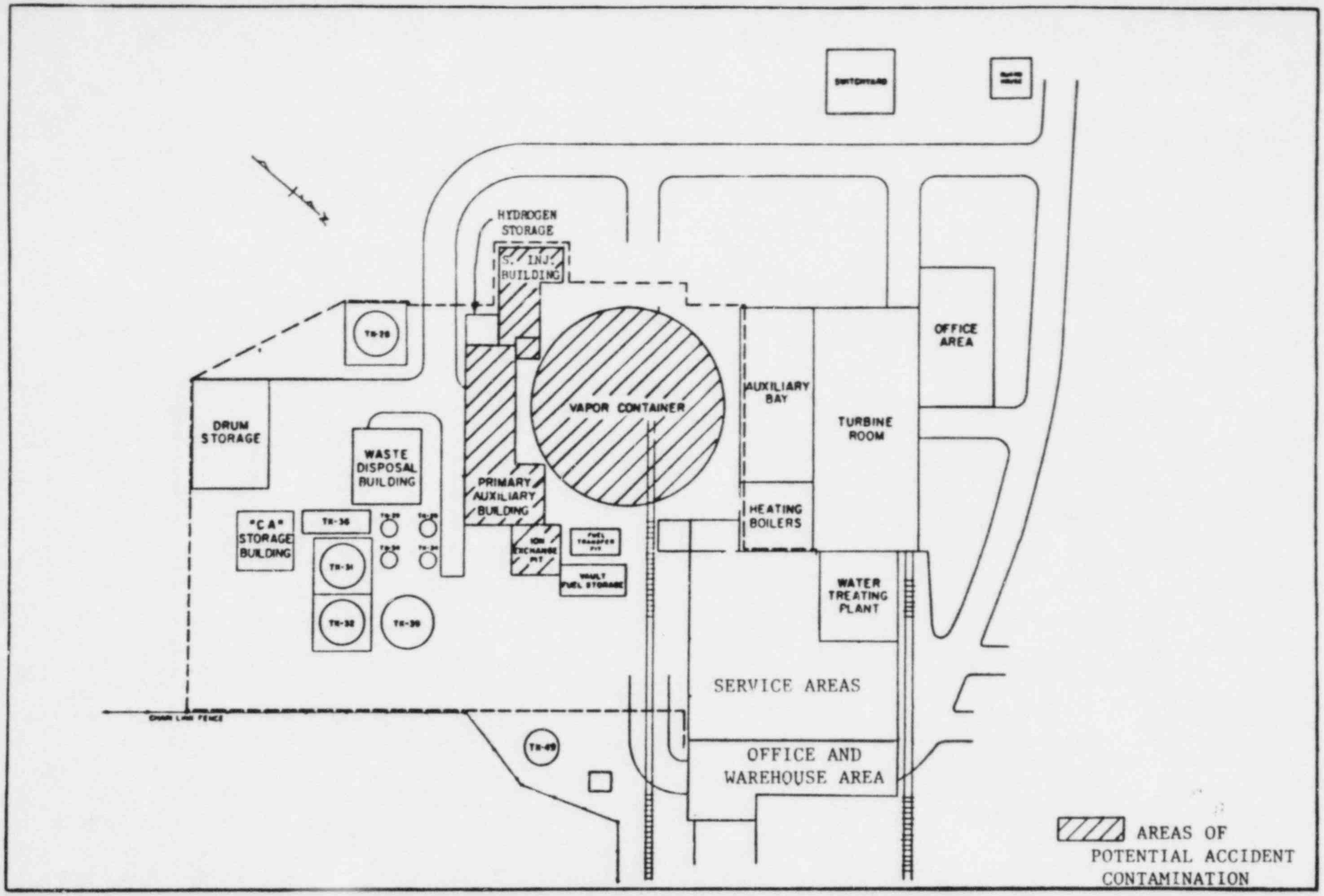
Category	Base Year (1982)	Year 2	Year 3	Year 4	Year 5	TOTAL
A. Fueled Plant Operations	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 5,000
B. Fueled Plant - Site Support Services	6,200	6,200	6,200	6,200	6,200	31,000
C. Auxiliary Building Decontamination	2,000	700	400	100	-	3,200
D. Containment Building Water Processing	6,500	1,100	-	-	-	7,600
Subtotal (A-D)	$15,700	$ 9,000	$ 7,600	$ 7,300	$ 7,200	$ 46,800
E. Additional Decontamination Support Facilities	5,300	10,700	3,800	900	400	21,000
F. Gross Decontamination of Containment Building	2,000	11,700	12,800	4,000	900	31,400
G. Head and Core Removal	5,000	13,000	11,000	3,000	1,000	33,000
H. Facilities to House Containment Equip. and Mat'l	1,700	2,700	0	0	0	4,400
I. Add'l Decontamination of Containment Building	3,200	6,700	4,600	27,400	12,400	54,200
J. Defueled Plant Operations	0	0	0	0	0	0
K. Defueled Plant Site Support Services	0	0	0	0	0	0
Subtotal (E-K)	$17,200	$44,700	$32,200	$35,300	$14,700	$144,100
Subtotal (A-K)	$32,900	$53,700	$39,800	$42,600	$21,900	$190,900
L. Base Operations and Maintenance	13,400	13,400	13,400	13,400	13,400	67,000
M. Escalation (1980 Dollars to 1982 Dollars)	5,100	9,300	6,500	7,000	2,900	30,800
N. Decommissioning	0	0	0	10,000	10,000	20,000
TOTAL	$51,400	$76,400	$59,700	$73,000	$48,200	$308,700
Adjustment to account for early decontamination work done at TMI-2 during 1979-80 prior to this study (1981).						50,000
					TOTAL	$358,700

TABLE 2.3

Decontamination Study
Cost Comparison TMI-2 vs. Yankee

(1982 Dollars in Thousands)

Category		TMI-2	Yankee	Scaling Factor
A.	Fueled Plant Operations	$ 41,101	$ 5,000	Actual Yankee
B.	Fueled Plant - Site Support Services	21,015	31,000	Actual Yankee
C.	Auxiliary Building Decontamination	15,766	3,200	.2
D.	Containment Building Water Processing	25,203	7,600	.3
	Subtotal (A-D)	$ 103,085	$ 46,800	--
E.	Additional Decontamination Support Facilities	83,985	21,000	.25
F.	Gross Decontamination of Containment Building	62,712	31,400	.5
G.	Head and Core Removal	63,147	33,000	Composite
H.	Facilities to House Containment Equip. and Mat'l	8,816	4,400	.5
I.	Add'l Decontamination of Containment Building	110,451	54,200	.5
J.	Defueled Plant Operations	30,166	0	--
K.	Defueled Plant Site Support Services	12,535	0	--
	Subtotal (E-K)	$ 371,812	$144,100	--
	Subtotal (A-K)	$ 474,897	$190,900	--
L.	Base Operations & Maintenance	75,000	67,000	Actual Yankee
M.	Escalation	209,325	30,800	--
N.	Decommissioning	--	20,000	Actual Yankee
	TOTAL	$ 759,222	$308,700	--
	Expended Through 1981	275,104	50,000	--
	TOTAL	$1,034,326	$358,700	--



YANKEE NUCLEAR POWER STATION	SITE BUILDING ARRANGEMENT	FIGURE 2.1

APPENDIX A

Telephone 617 366-9011
TWX
710-390-0739

B.3.2.1
WYR 79-163

YANKEE ATOMIC ELECTRIC COMPANY

20 Turnpike Road Westborough, Massachusetts 01581

December 31, 1979

United States Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Office of Nuclear Reactor Regulation
Mr. Harold Denton, Director

References: (a) License No. DPR-3 (Docket No. 50-29)
(b) USNRC Letter to YAEC, dated October 30, 1979
(c) YAEC Letter to USNRC, dated November 19, 1979 (79-141)
(d) YAEC Letter to USNRC, dated November 7, 1979 (79-131)
(e) USNRC Letter to YAEC, dated October 17, 1979

Dear Sir:

Subject: Lessons Learned Short-Term Requirements

This letter forwards information requested by your letter, Reference (b), and/or committed to by us in our letter, Reference (c). This information is attached as follows:

Item	Description
2.1.2	Relief and Safety Valve Test Program and Schedule
2.1.3b	Instrumentation for Detection of Inadequate Core Cooling
2.1.4	Identification of Essential and Non-Essential Systems
2.1.5a	Dedicated H_2 Control Penetrations
attached → 2.1.6a	Systems Integrity for Containing Radioactive Materials Outside of Containment
2.1.6b	Design Review of Plant Shielding
2.1.7a	Automatic Initiation of Auxiliary Feedwater

Item	Description
2.1.8a	Post Accident Sampling
2.1.9a	Reactor Coolant System Venting
2.2.2b	On-Site Technical Support Center (TSC)

We trust you will find this information satisfactory; however if you have any questions please contact us.

Very truly yours,

YANKEE ATOMIC ELECTRIC COMPANY

J. A. Kay

J. A. Kay
Senior Engineer - Licensing

JAK/kaf

ATTACHMENT

Section 2.1.6.a Systems Integrity For Containing Radioactive Materials Outside Of Containment

Yankee has implemented a program to reduce leakage from systems outside containment that would or could contain highly radioactive fluids during a serious transient or accident to as-low-as-practical levels. In general, the program consists of periodic leak tests on specified systems to verify system integrity and identify component leakage. During the leak test the system will be visually inspected to identify leaking components. This identified leakage will be properly recorded and reported to the Program Administrator for corrective action.

The Leak Reduction Program consists of two parts:

A - Continuing leakage Identification Program normally performed quarterly on operating systems and
B - Integrated Leakage Identification Program normally performed at refueling intervals.

Continuing Leakage Identification Program

Specified systems in the program will be visually inspected while in service on a periodic basis, usually quarterly. The inspection will be conducted in accordance with the specific system surveillance or inspection procedures. Any leakage identified will be recorded in the specific procedure and reported to the Program Administrator. The Program Administrator will determine the action required and ensure that action is taken. If the action required involves maintenance, the system/component will be reinspected following the maintenance to establish the leakage rate for the system/component. The leakage rate determined will be recorded on a Master List.

Integrated Leakage Identification Program

Specified systems in the program will be subjected to an Integrated Leak Rate Test on at least a refueling interval to establish their Integrated Leakage Rates. During the performance of the leak test an integrated leak rate will be determined, where system configuration permits. Where an integrated leak rate cannot be determined, an attempt will be made to quantify the leakage by component where leakage is found.

The results of the Integrated Leakage Rate Test (ILRT) will be evaluated by the Program Administrator. Corrective action will be taken where necessary to reduce the leakage to as-low-as-practical and repeat the ILRT where necessary. The results of the ILRT will be recorded on the Master List.

Systems which are exempted from the Integrated Leak Rate Test are delineated in Table "A". The reason for this exemption is also stated in Table "A".

Systems Excluded From The Leak Reduction Program

Systems listed in Table "B" are excluded from the Leak Reduction Program. The reason for this exclusion is also stated in Table "B". In most cases the exclusion is based on the requirement that two pressure boundaries must fail, i.e. a double failure, before leakage to the environment would ensue.

Leakage Rate Measurements

Leakage rate measurements for all systems in the program are delineated in Table "C". In many cases no leakage was found. Those systems which were not able to be placed in operation due to the plant's operating status are so designated. Table "C" represents an initial attempt at quantifying system leak rates. As more experience is acquired, the leak rate monitoring program may be modified to provide a more workable tool for evaluation of system performances. As leak rate measuring procedures are improved through experience, the leak rates delineated in table "C" may change. It is Yankee's intention, through this Leak Rate Reduction Program, to keep leak rates as-low-as practical.

We have reviewed the North Anna Unit 1 incident, as it applies to our facility. To date no design or operator deficiencies have been identified. No modifications are deemed necessary as a result of this review.

Table "A"

Systems exempted from Integrated Leak Test

1.	Shutdown Cooling	Reason: Closed System - Impossible to perform ILT
2.	Main Coolant Bleed	Reason: Undergoes constant LRT's
3.	Charging & Volume Control	Reason: Undergoes constant LRT's
4.	Waste Gas	Reason: Cannot Isolate

Table "B"

Systems Exempted from Program

1.	Component Cooling	Reason: Double Failure
2.	VC Heating/Cooling	Reason: Double Failure
3.	Feedwater/Steam/Blowdown	Reason: Previously established Technical Specification leak rate limit
4.	Cavity Fill	Reason: Double Failure
5.	VC Air Charging	Reason: Double Failure
6.	Cavity Purification	Reason: Double Failure
7.	NST Sample	Reason: Double Failure
8.	VC Ventilation & Purge	Reason: Double Failure
9.	Demineralized Water to Vapor Container	Reason: Double Failure
10.	Low Pressure Vent Header	Reason: Double Failure

Table "C"

Leakage Rate Measurements

	SYSTEM	LEAK RATE (GAL/DAY)
1.	Safety Injection (ECCS) System	10
2.	Vapor container Recirculation System	0
3.	Shutdown Cooling System	*
4.	Main Coolant Bleed	0
5.	Charging and Volume Control System	400**
6.	Safety Valve Discharge	*
7.	Low Pressure Surge Tank (LPSI) Cooling System	0
8.	Purification System	0
9.	Low Pressure Surge Tank and Appurtenances	0
10.	Waste Gas System	0
11.	Waste Liquid System	0
12.	Vapor container Drain Tank and Line	0
13.	Post Accident H^2 Vent System	0
14.	Neutron Shield Tank Tell Tales	0
15.	Main Coolant/Heise Pressure Line	0
16.	Main Coolant Drain Line	*
17.	Main Coolant Sample System	0
18.	Vapor Container Air Particulate Detector	0
19.	Fuel Handling System	0
20.	V.C. Pressure Monitoring System	0
21.	Valve Stem Leak Off System	0

*No data available due to inability to place system in operation because of plant status.

**This system leakage varies primarily due to leakage from the positive displacement charging pumps. This leakage is controlled and directed to the Gravity Drain Tank.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

April 18, 1980

Docket No. 50-29

Mr. James A. Kay
Senior Engineer-Licensing
Yankee Atomic Electric Company
25 Research Drive
Westborough, Massachusetts 01581

Dear Mr. Kay:

Enclosed is the staff's evaluation of the implementation of Category "A" Lessons Learned requirements (excluding 2.1.7a) at Yankee-Rowe. This evaluation is based on your submitted documentation and the discussions between our staffs at a site visit on April 2, 1980.

Based on our evaluation, we conclude that the implementation of the Category "A" requirements at Yankee-Rowe, is acceptable. Certain items, identified in the evaluation, will be verified by the Office of Inspection and Enforcement.

This evaluation does not address the Technical Specifications necessary to ensure the limiting conditions for operation and the long-term operability surveillance requirements for the systems modified during the Category "A" review. You should be considering the proposal of such Technical Specifications. We will be in communication with you on this item in the near future.

Sincerely,

Thomas V. Wambach for
Dennis L. Ziemann, Chief
Operating Reactors Branch #2
Division of Operating Reactors

Enclosure:
Evaluation

cc w/enclosure:
See next page

The licensee utilizes a hydrogen vent system for post accident hydrogen control. This system and its use for hydrogen control is described in their December 31, 1979 and April 9, 1980 submittals. The April 9, 1980 submittal includes a single failure analysis of the system for the containment integrity and the hydrogen control function. As discussed in the submittal, several purge system modifications are being considered to insure that the system meets the single failure. These modifications are to be completed by January 1, 1981. (3)

Based on our review of the above information, we have concluded that the licensee's hydrogen control system meets the NUREG-0578 Section 2.1.5.a. requirements for dedicated penetrations and is therefore acceptable.

2.1.5.c Hydrogen Control Procedures

The NRC's position is that the procedures for use of the hydrogen control system be reviewed considering shielding requirements and personnel exposure limitations.

During the site visit we discussed the licensee's review of the hydrogen vent system operating procedures OP-2658, Rev. 6, and agreed that no modifications are required.

We have concluded that the licensee has met the NUREG-0578 requirements for review of the hydrogen control system procedures, Section 2.1.5.c.

2.1.6.a Systems Integrity

The licensee has provided a list of those systems which he has determined may contain radioactivity following an accident. These systems include the safety injection, shutdown cooling, charging and volume control, main coolant bleed, purification, liquid waste, H_2 vent, waste gas, vapor container recirculation, and main coolant sampling systems. He has also provided a description of the leak reduction program which include visual inspections to identify leakage and appropriate corrective actions.

The licensee has measured final system leak rates and reported the results.

The licensee has established a leak reduction program for systems which may contain activity following an accident which includes testing once per refueling cycle to ensure the potential for release is minimized.

Our October 30, 1979 clarification letter requested the licensee to include a review of potential release paths due to design and operator deficiencies as discussed in the October 17, 1979 letter regarding North Anna. The licensee has analyzed their plant with regard to the North Anna Incident and found that corrective action is not necessary.

Based on the above information, we conclude that the licensee has met the Category "A" requirements for this item.

Yankee Atomic Electric Company