TECHNICAL STAFF ANALYSIS REPORT

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ON

IODINE FILTER PERFORMANCE

TO

PRESIDENT'S COMMISSION ON THE ACCIDENT AT THREE MILE ISLAND

ADVANCE COPY NOT FOR PUBLIC RELEASE BEFORE AMS, WEDNESDAY, OCTOBER 31, 1979

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BY

William M. Bland Technical Assessment Task Force

OCTOBER 1979

WASHINGTON. D.C.

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I Summary

During the accident at Three Mile Island a quantity of Iodine 131 was detected in the gaseous effluent. This quantity was more than that which would be expected to pass through the filtering system if it performed as designed. Replacement charcoal in the Auxiliary Building ventilation system and in half of the fuel handling building ventilation system significantly reduced the iodine discharges suggesting that charcoal in the filter trains at the onset of the accident did not perform as expected.

Investigation determined that airflow is designed to normally bypass the filters for Control Room, Auxiliary Building and Fuel Handling Building exhaust and, if the level of radioactivity in the air stream reaches a predetermined level, airflow is diverted to pass through the filters.

Charcoal in use in the filters was purchased in 1975. It met the regulatory requirements in existence at that time but did not conform to the requirements in effect at the time che TML ? operating license was issued. The NRC approved use of the charcoal which w 3 installed and waived the surveillance requirements in the Operating License Technical Specifications for the Fuel Handling Building and Control Room air cleaning systems. Such surveillance was intended to verify correct system performance. There was no such surveillance for the Auxiliary Building ventilation system filter performance.

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The air filtering systems were designed to be used only when needed to remove airborne radioactivity, because of a limited filtering lifetime for charcoal. However, ventilation flow had been through the filters for about one year. This fact coupled with the lack of surveillance to verify system performance could explain apparently inadequate filter performance during the accident.

Samples of charcoal filters removed from the Auxiliary Building and Fuel Handling Building filter trains during the accident were tested for removal efficiency. These tests showed a degradation in removal efficiency for methyl iodide. Fuel Handling Building filter trains (A and B) showed a significant difference in efficiency removal (75.6% versus 49.1%) suggesting that in addition to the effect of degradation from one year's operation one train had been used much mode than the others. The Auxiliary Building filter trains both showed significant degradation.

These efficiency removal figures take into account the effect of the iodine-laden flow during the accident up to the point the filters were taken off-line for replacement. Tests are underway to determine the removal efficiency that existed at the start of the accident.

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II Analysis

A. Discussion

As noted in reference 1, which is a series of daily reports issued by NRC during the TMI-2 accident that began on March 28, 1979, a quantity of Iodine 131 was detected in the gaseous effluent from TMI-2. This quantity was more than anticipated to pass through the filtering system that was designed into the plant. It is noted in reference 1 and as shown in a partial summary of reference 1, reference 2, that when the iodine adsorptive filters, the activated charcoal, were replaced in the Auxiliary Building and in the Fuel Handling Building ventilation systems that the radioactive iodine effluent decreased to expected levels. This indicated that if there were no changes in venting paths or iodine supply, the new charcoal did the expected job and that the charcoal in the filter trains at the time of the accident had not performed as designed. No allowance has been made for the decay of Iodine 131, which has a half life of 9½ days; this will show a decrease in activity of the filtered air, also. This apparent poor performance prompted an investigation.

The improvement gained by replacing the charcoal filter elements is described in the April 25, 1979, report in reference 1, as follows:

"As a result of changing the charcoal filter on the A-Train of the Auxiliary and Fuel Handling Building Ventilation System, the iodine discharges have been reduced by approximately 80%." Note: Some of this apparent reduction could have been due to decay in activity over the four-day span of charcoal filter changeout.

A detailed history of tests and problems with the Gaseous Radwaste System is presented in reference 3. The most related items in this reference are probably the comments related to the history of the filters prior to the accident.

"The history of these filters prior to the accident may have had a significant impact on their performance during and after the accident." (ref 3).

"Since completion of acceptance testing, (approximately one year prior to the accident) all ventilation flow from the fuel handling and auxiliary buildings had been through the filter banks." (ref 3).

Design: By design, as described in the TMI-2 FSAR Section 9.4, item f, on page 9.4.1b, reference 4:

"Air flow at the atmosphere cleanup station in the Control Room, and the Auxiliary and Fuel Handling Buildings, normally bypasses the filters. If the level of radioactivity in the air upstream of the filters reaches a predetermined level, the monitoring device will automatically reposition the dampers to reroute flow through the filters"

This is confirmed on page 11-7 of the TMI-2 SER, reference 5.

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Filter History: According to information contained in reference 6, the charcoal in use in the subject filters at the time of the accident was purchased in 1975 and conformed at that time to the Regulatory Guide that was in force at that time (Reg. Guide 1.52). This charcoal, however, did not meet the requirements of the Regulatory Guide in force at the time TMI-2 operating license was issued (Reg. Guide 1.52, Rev. 1, July 1976). According to reference 3 and to reference 6, the NRC in consideration of the earlier purchase of the charcoal by the utility issued item F.2 of Attachment 2 to Operating license DPR-73, reference 7, which permitted the use of this charcoal by deferring surveillance requirements for the Fuel Handling Building Air Cleanup paragraphs 4.9.12.b.2 and 4.9.12.c (ref 8a) and for the Control Room Emergency Air Cleanup System, paragraphs 4.7.7.1.c.2 and 4.7.7.1.d, (ref 8b) specification wbich are reproduced below. References 8a and 3b are taken from the TMI-2 Technical Specification.

Excerpts from Fuel Handling Building Air Cleanup - Surveillance Requirements

4.9.12.b.2. Verifying within 31 days after removal that a laboratory analysis of a representative carbon sample obtained in accordance with Regulatory Position C.6.b. of Regulatory Guide 1.52, Revision 1, July 1976, meets the laboratory testing criteria of Regulatory Position C.6.a. of Regulatory Guide 1.52, Revision 1, July 1976.

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4.9.12.c. After every 720 hours of charcoal adsorber operation by verifying within 31 days after removal that a laboratory analysis of a representative carbon sample obtained in accordance with Regulatory Position C.6.b of Regulatory Guide 1.52, Revision 1, July 1976, meets the laboratory testing criteria of Regulatory Position C.6.a of Regulatory Guide 1.52, Revision 1, July 1976.

Excerpts from Control Room Emergency Air Cleanup Surveillance Requirements:

4.7.7.1.c.2 Verifying within 31 days after removal that a laboratory analysis of a representative carbon sample obtained in accordance with Regulatory Position C.6.b. of Regulatory Guide 1.52, Revision 1, July 1976, meets the laboratory testing criteria of Regulatory Position C.6.a. of Regulatory Guide 1.52, Revision 1, July 1976.

4.7.7.1.d After every 720 hours of charcoal absorber operation by verifying within 31 days after removal that a laboratory analysis of a representative carbon sample obtained in accordance with Regulatory Position C.6.b. of Regulatory Guide 1.52, Revision

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1, July 1976, meets the laboratory testing criteria of Regulatory Position C.6.a. of the Regulatory Guide 1.52, Revision 1, July 1976.

For both cases the significant one waived is the one that requires laboratory analysis after every 720 hours of charcoal adsorber operation to verify criteria in Regulatory Guide 1.52, Revision 1, July 1976.

It is noted that the Technical Specification at the time of the TMI-2 accident did not require surveillance testing of the charcoal filters in the Auxiliary Building Air Ventilation System.

B. Evaluation

From the foregoing discussion on the facts that

(1) though the air filtering systems were designed to be used only when needed by radioactive conditions, the filters had been in continuous use for about a year prior to the initiation of the accident, and

(2) through the issuance of item F.2 of attachment 2 to the license, the surveillance requirements were waived that would have verified on a monthly basis the adequacy of the charcoal in the Fuel Handling Building and Control Room Emergency Air Cleanup system.

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These two occurrences could explain why the filter performance was not as expected during the accident and not as good as the performance achieved by the charcoal that was used for replacement during the accident.

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The Auxiliary Building Ventilation System charcoal filters had apparently also been used continuously. There was no Technical Specification requirement for them to undergo surveillance tests. This lack of surveillance testing is borne out by a review of the Auxiliary Building Ventilation System Filters Maintenance History that was examined from Nov.1978 through July 1979. The first sampling for 720 hours surveillance testing is noted on June 12, 1979, ref. 10. Also as noted in ref 11, a GPUSC man working specifically in this area had not been able to find records, as of Sept. 14, 1979, of any surveillance tests run on these charcoal filters prior to the accident.

It is noted that Removal Efficiency tests conducted by Nucon* on the samples of the charcoal filters that were removed from the Auxiliary Building and Fuel Handling Building Filter trains during the March 28, 1979, accident, ref 11 and 12, show degradation in removal efficiency of methyl iodide. The B filter train in the Fuel Handling Building System shows significant degradation, 49.1% compared to 75.6% on Train A. This indicates that possibly, in addition to having been subjected to flow for almost a year, that the Fuel Handling Building duct system may have had a more unbalanced flow through the filter trains or much more exposure to iodine in B Train than the duct system in the Auxiliary Building where the filter trains showed more comparable degradation, as shown below.

*/ Nuclear Consulting Services, Inc., Columbia, Ohio performs the testing for Metropolitan Edison Company.

The results of the removal efficiency test conducted to date on the charcoal removed from TMI-2 during the accident, reference 11 and 12 are as follows

Removal Efficiency @ 95% Relative Humidity

Auxiliary	Building,	A-Train	69.5%
Auxiliary	Building,	B-Train	56.0%
Fuel Hand	ling Build	ing A-Train	75.6%
Fuel Hand	ling Build	ing B-Train	49.1%

Location

New charcoal, by reference 9, should have a Methyl Iodine removal efficiency of 99%. The removal efficiency requirement has been increased in subsequent issues of the Regulatory Guide.

Replacement of the charcoal during the accident was done in the following sequence, ref 2.

Auxiliary Building, A Train		April	20,	1979
Fuel Handling Building, A Train		April	24,	1979
Auxiliary Building, B Train		April	25,	1979
Fuel Handling Building, B Train	Approximately	May 2	3-24	, 1979

Change out of the charcoal in the Fuel Handling Building B Train, which has the lowest tested removal efficiency of the samples removed during the accident, as noted above, was accomplished. The reason for the change out sequence according to telecon with Mr. Montgomery GPUSC, on September 28, was that when change out of the charcoal filter in the B Train was first attempted, on about April 20, it was found to be radioactively too "hot" to handle. He noted a radiation level of at least 1 R/hour was measured on April 21. Change out of Train B is reported to have been accomplished about May 23-24 after sufficient decay had occurred. These dates and the radiation level are subject to commation. Radiation level readings made on the other three charcoal trains at change out of the charcoal during the accident have been requested. Response to date reports that the radiation level on the charcoal in the Fuel Handling Building A Train ranged 150-350 mR/hour when charcoal changeout was begun on April 21.

It is understood that further testing, underway by Nucon* at this time (October 12, 1979), may better define the removal efficiency of these charcoal filter trains at the time of the beginning of the TMI-2 March 28, 1979, accident. This additional information may give more understanding as to the reason why the filters in place at the time of the accident performed so poorly.

*/ See * on page 9.

C. Finding

It is probable that the ventilation flow through the filter trains in the Auxiliary Building and the Fuel Handling Building Ventilation Systems in the year prior to the accident significantly decreased the removal efficiency of the charcoal filtering elements. The waiver, granted by NRC, of the periodic surveillance testing requirement for the Fuel Handling Building Charcoal filters, the omission of a periodic surveillance requirement for the Auxiliary Building charcoal filter, and the use of charcoal that didn't meet the minimum requirements at the time of TMI-2 licensing contributed to the use of charcoal filter elements that didn't accomplish the required filtering at the beginning of the accident at TMI-2.

REFERENCES

III

- Preliminary Notification of Event on Unusual Occurrences issued relative to the TMI-2, March 28, 1979 Accident. 9290000
- 2. Summary of TMI-2 Iodine Filter activity from reference 1. 9290001
- NUREG 0600 Investigation Into the March 28, 1979 Three Mile Island Accident by Office of Inspection and Enforcement August 1979. 9290012
- 4. TMI-2 FSAR Section 9.4 920002
- 5. TMI-2 SER, NUREG 0107. 6290170
- Memorandum for Record, "Status Report on Filter Elements from TMI-2" Wm. Bland, Sept 20, 1979. 9290003
- 7. Item F.2 of Attachment 2 to Operating License OPR-73 9290004
- 8a. TMI-2 Technical Specification Surveillance requirements 4.9.12. 9290005
- 8b. TMI-2 Technical Specification Surveillance requirement 4.7.7.1. 9290006

- 9. Regulatory Guide 1.52, July 1976 Design, Testing, and Maintenance Criteria for Post Accident Engineered-Safety Featuring Atmosphere Cleanup System Air Filtration and Absorption Units of Light-Water-Cooled Nuclear Power Plants. 9290007
- Memo for Record "Auxiliary Building Exhaust Filter Maintenance History 10/1/79 - 7/31/79" Art Carr Sept. 10, 1979. 9290008
- Memo for Len Jaffe "Update on Iodine Filter Data" Wm. Bland, October 11, 1979. 9290009
- Letter, Shaw, Pittman, Potts, and Trowbridge, transmitting "Analysis of the Adsorbers and Adsorbents from Three Mile Island Unit No. 2," June 11, 1979. 9290011

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