(9) ENCLOSURE 7

Battelle
Columbus Laboratories
505 King Avenue
Columbus, Ohio 43201
Telephone (614) 424-6424
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July 18, 1980

80-256-000 (M)
Docket 70X005
7-22-80

Mr. James G. Keppler, Director
Office of Inspection and Enforcement
Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, Illinois 60137

Dear Mr. Keppler:

Docket 70-8; 10 CFR Part 21 Report

This letter constitutes formal reporting of a defect as stipulated in 10 CFR Part 21. This formal submission follows up our initial telephone notification to your Mr. Charles Peck on the morning of July 17, 1980. Mr. Harley L. Toy, BCL Licensing Coordinator and my First Delegated Alternate, conducted the initial notification.

This formal notification is presented as outlined in Section 21.21(b)(3) of 10 CFR Part 21.

(i) Dr. Frederick J. Milford, Associate Director of Battelle's Columbus Laboratories and Designated Responsible Officer under provisions of 10 CFR Part 21, and Harley L. Toy, Licensing Coordinator and First Delegated Alternate.

(ii) The Battelle Columbus Hot Cell Laboratory operated under Byproduct License No. 34-6854-05 and Special Nuclear Materials License No. SNM-7.

(iii) Not applicable.

(iv) A release of airborne radioactive material and subsequent surface contamination occurred at the Battelle Columbus Hot Cell Laboratory on May 3, 1980, during unloading operations of a failed spent fuel assembly received from the Connecticut Yankee Atomic Power Company.

There was no release of radioactive material from the building. The data from bioassay procedures, including in-vivo counting, have established that resultant radiation exposures were well within prescribed

JUL 22 1980

standards as set forth in 10 CFR Part 20. Pulmonary depositions were a fraction of a percent of the permissible body burden.

An evaluation of this deviation in accordance with Part 21 procedures has determined that this incident is reportable to the NRC as a defect in that it could have created a substantial safety hazard. The determination that a substantial safety hazard could have resulted is based upon the following:

(a) Five staff members were in the immediate area of the pool when the release occurred,

(b) Established cask unloading procedures were followed which do not call for respiratory protection during that phase of the operation, and

(c) A significant radiological source term was present during the time they were unprotected.

(v) The results of the evaluation leading to the determination of a defect that could have constituted a substantial safety hazard were transmitted to the Designated Responsible Officer on July 16, 1980.

(vi) The exact kinetics and chemistry involved in this release are yet to be determined. Battelle-Columbus is in the process of proposing several research programs whose objectives are to provide a better understanding of the physical and chemical processes which occurred during the shipment of this failed spent fuel assembly. Pertinent to the release occurring during unloading operations at the BCL Hot Cell Laboratory are ongoing studies and investigations by Nuclear Assurance Corporation. Their spent fuel shipping cask NAC-1E was utilized in the shipment of the failed Connecticut Yankee fuel assembly to Columbus, Ohio. The shipment was accomplished with no adverse effects on the health and safety of the public during transport. Reference is made to a report filed by Connecticut Yankee Atomic Power Company to NRC's Region I on May 21, 1980. The letter report from Connecticut Yankee's W. G. Counsil stated that cask NAC-1E license decay heat limit had been violated during the shipment to Battelle-Columbus. The letter report was docketed in accordance with the provisions of 10 CFR Part 71 and DPR-61.

(vii) In order to preclude a reoccurrence of this type of incident, four corrective actions have been taken.

(1) The use of respiratory protection will be required during cask unloading procedures involving failed fuel assemblies until firm recommendations are made by the internal reviewers (see Item 2).

(2) A comprehensive review of all Hot Cell Laboratory Receiving Procedures will be conducted by D. G. Freas, Associate Section Manager, and the Radiological Materials Subcommittee. Recommendations regarding additional procedures needed, as well as modificaton of existing ones, will be submitted to the Radiological Safety Committee for approval. This review will be completed by July 31, 1980, and the recommendations implemented as soon as practical.

(3) Prior to submittal of case reviews to the Radiological Safety Committee (RSC), the 585 Section Manager will require review and approval of all cases by the Hot Cell Laboratory Operations Manager and his staff. This review will be oriented to the "hands-on" aspects of the proposed experiment. This procedure is to be in place by July 15, 1980.

(4) Communication with the shipper regarding potential hazards during unloading will be enhanced. Such communications are presently included in cask unloading procedures. Effective immediately, communication procedures will be initiated at the time of loading by the shipper and continued throughout the unloading operations.

(viii) It is anticipated that the results of our ongoing investigations into the cause of the release during cask unloading operations will be available for distribution to all shippers and processors of irradiated spent fuel. The information and conclusions drawn during our evaluation have been shared with Connecticut Yankee and it is our intention to continue this joint participation to a satisfactory conclusion.

We are confident that our corrective actions will preclude a reoccurrence of such an incident. Our total file pertaining to the investigation of the deviation and subsequent determination of a defect reportable under 10 CFR Part 21 is available for your inspection. We shall provide whatever additional information you may require.

Very truly yours,

Frederick J. Miford

Frederick J. Miford
Associate Director

FJM:lba

Enc. (3)

cc: Connecticut Yankee Atomic Power Company, Mr. Ralph Brisco

Registered Mail

Battelle's Columbus Laboratories
Form D-21

Date: MAY 5, 1950

cc: [illegible]

PART 21 INITIAL DEVIATION REPORT

To: D. A. McKown/H. L. Toy
From: G. E. KIRSCH
Subject: Initial Report of Deviation that Could Constitute a Substantial Radiological Safety Hazard N1-2-5/5/50

NATURE OF DEVIATION (check one):

☐ Departure from technical requirements as specified in the BCL Research Agreement.

☒ Improper departure from NRC regulations, license conditions, or approved procedures.

☐ A faulty component or procedure utilized in BCL nuclear operations.

DATE DEVIATION DISCOVERED: MAY 3, 1950 TIME: 1:30 AM

LOCATION OF DEVIATION (facility or area): JN-1B HOT LAB. POOL AREA

BRIEF DESCRIPTION OF DEVIATION: RELEASE OF RADIOACTIVE MATERIAL FROM A SHIPPING CASK DURING AN UNLOADING OPERATION.

INJURY OR PROPERTY DAMAGE: JN-1B HIGH BAY AREA WAS CONTAMINATED WITH RADIOACTIVE MATERIAL.

IMMEDIATE ACTION TAKEN: POOL AREA/HANDLING EQUIPMENT SECURED, AREA EVACUATED AND MANAGEMENT/SAFETY DEPARTMENT NOTIFIED.

DATE EVALUATION INITIATED: MAY 3, 1950

NOTE: Evaluation must be resolved within seven (7) working days subsequent to discovery of the deviation.

Has approved by WJ Media

Distribution:
K Drog
W Media
V Pasupathi
H Toy
D McKown
R Klingensmith
D Hackney

May 21, 1980

Mr. Ralph Brisco
Northeast Utilities
Service Company
P. O. Box 270
Hartford, CT 06101

Dear Mr. Brisco:

As our Mr. Harley Toy discussed with you over the phone recently, Battelle is proceeding to conduct an evaluation of the contamination release experienced in our hot cell laboratory upon unloading of Connecticut Yankee Fuel Assembly HB? from the RAC-1-B shipping cask. It is the purpose of this evaluation to determine whether or not this event need be reported to the NRC as required by 10CFR21.

As a first step in our evaluation, a review of the event was conducted by an internal Battelle Ad Hoc committee. The initial report of this committee was submitted on May 19, 1980. A copy is enclosed for your information. Further information will be made available to you as it is obtained.

We invite NUSCO participation in this evaluation and suggest that, if appropriate, the report to NRC be a joint submission.

Our interaction with the regulatory agencies in matters such as this is handled by Mr. Toy. Please feel free to contact him at any time at 614-424-7791.

Very truly yours,

R. W. Klingensmith
Project Manager
Nuclear Materials Technology

RWK:jt

Encl.

cc: Mr. J. T. Patch, NUSCO

Battelle
Columbus Laboratories

Project Number 7-0342 (5557)

Internal Distribution
RS Denning
AN Plummer
ML Toy
NE Miller
RJ Burian
M. Pobereskin
Chrono/erc

Date May 19, 1980

To D. A. McKown

From Ad Hoc Committee

Subject

NI-2-5/5/80

Following the incident involving contamination of the area around the pool of the Hot Laboratory in the unloading of a Connecticut Yankee fuel assembly, an Ad Hoc Committee was formed to review the phenomena associated with the release. It was not the objective of the Committee to review procedures for the receipt and handling of shipping casks or to make recommendations that would prevent a similar incident in the future. The objective was to define the potential source of the contamination and to evaluate possible explanations for the physical processes which led to release.

The evidence available to the Committee was:

(1) After the head was removed from the submerged cask, a blackish cloud emanated from the cask, spreading throughout the pool and obscuring visibility.

(2) The radiation level increased almost immediately in the area.

(3) An aerosol was apparently released from the pool surface which deposited in patterns consistent with the direction of air flow.

(4) The proportion of fission products to actinides measured in the aerosol implies that the released material was composed of fuel.

Possible contributing factors to the generation of the contaminating material and the release are:

(1) The maximum temperature and time at temperature during shipment.

(2) The preexisting extent of cladding failure.

(3) The cladding material (stainless steel).

(4) The quenching of exposed heated fuel.

Consideration was given to the possibility that the cask had been contaminated prior to the loading of the assembly at the site of the utility. However, after the water in the cask was drained back into the fuel storage pool at Connecticut Yankee subsequent to loading, there was no indication of increased contamination of the pool. It, therefore, seems quite unlikely that the contamination was the result of prior shipments.

Calculations were performed using the Wooton-Epstein correlation[1] to predict the peak cladding temperature during shipment. The results are shown in Figure 1 as a function of decay heat load. It should be recognized that the uncertainties in this calculation are large and not well characterized. A flat axial power profile was assumed. More typically, a peaking factor of approximately 1.2 would be expected for spent fuel. This factor can be applied directly to the cask heat load.

Without a detailed operating history for the assembly, the decay heat load for the cask could not be determined accurately. The heat load could be estimated, however, using the following assumptions:

(1) During the operation, the assembly had the average power in the core.

(2) The heat load is based on "draft" ANS5.1.

(3) The assembly was irradiated for three years and decayed for 430 days.

The estimated decay heat for the assembly is 3.1 kW. With a peaking factor of 1.2, the predicted peak fuel temperature would be 550°F. A review of UO_2 oxidation data indicates that at temperatures below approximately 480°F, UO_2 oxidizes in air to a complex mixture of oxides approaching an oxygen-uranium ratio of 2.33. At higher temperatures, UO_2 oxidizes to U_3O_8 which has significantly lower density with the potential for flaking from the surface.[2] Considering the maximum predicted temperature of the fuel, circumstantial evidence indicates that this may have been a major contributing factor to the generation of a fine fuel powder which was apparently released.

Alternative explanations for the release of uranium oxide powder from the pins are that it fell out of breaches in the cladding as the result of vibrations during shipment or was spalled off the fuel surface as the result of quenching with water during cooldown prior to unloading the cask.

The release of aerosol from the surface of the pool suggests that, during filling of the cask with water prior to placement in the pool, some of the fine uranium oxide powder was not wetted. After the head was removed, the powder either floated to the surface in an adhered layer of gas or escaped within bubbles.

It should be recognized that the scenarios for release which are described above are speculative and that definitive statements about the causes of the release cannot be made without supporting research. The nature of the incident could have widespread implications about dry shipments of fuel, maximum permissible fuel temperatures, inert shipments, and uncontained shipment of failed fuel. Further research should be undertaken to determine the cause of the release and this information disseminated widely to assure that a more serious incident does not occur in the future.

RSD:erc

MEMORANDUM
TO: D. A. McKown
FROM: Ad Hoc Committee

May 19, 1980

References

(1) R. O. Wooton and H. Epstein, "Heat Transfer From a Parallel Rod Fuel Element in a Shipping Container", unpublished.

(2) Uranium Dioxide: Properties and Nuclear Applications, Ed. by J. Belle, U.S. Government Printing Office (1961).

RS Denning _____

AM Plummer _____

M. Pobereskin _____

HL Toy _____

NE Miller _____

RJ Burian _____

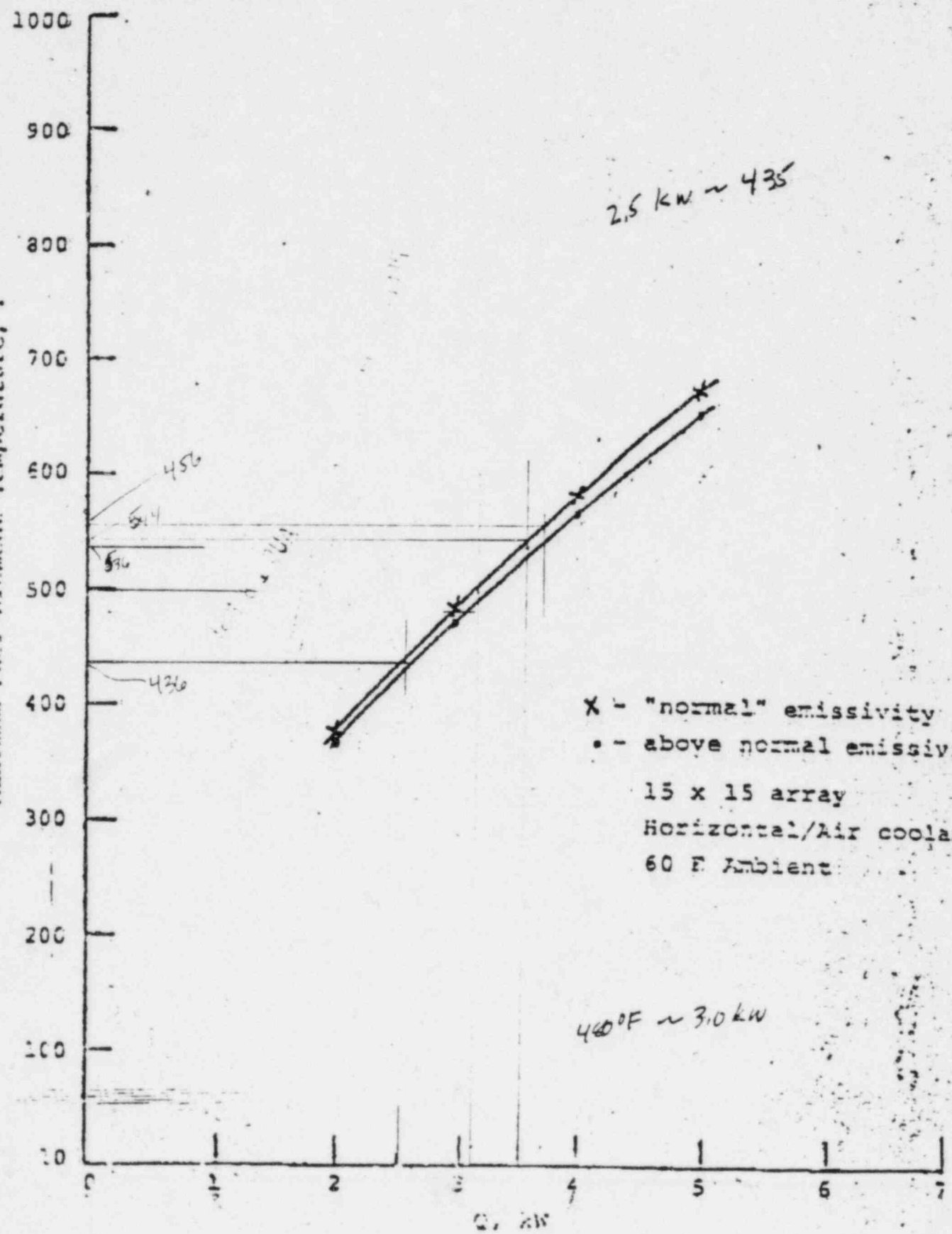

Figure 1. Connecticut Yankee in NFS-4