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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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August 3, 1995

The Honorable Thomas P. Grumbly
Assistant Secretary for Environmental Management
Department of Energy
Washington, DC 20585

Dear Mr. Grumbly:

Enclosed for your consideration and action, where appropriate, are a number of observations concerning the structural integrity of Buildings 771 and 776/777 at the Rocky Flats Environmental Technology Site (RFETS). These observations were developed by the Defense Nuclear Facilities Safety Board's (Board) staff and an outside expert. The observations are based on a review of available documents, walkdowns of the buildings, and discussions with Department of Energy (DOE) staff and contractor personnel at RFETS June 21-22, 1995.

The staff has observed that the safety implications of the deteriorated floor slabs were not identified by DOE or the contractor, and that there has been no clear process of identification or mitigation of potential hazards. Thus, the guidance of DOE Order 5480.23, *Nuclear Safety Analysis Reports*, which requires the identification of hazards and the technical justification and bases for safe operation, was not followed in this case.

Therefore, pursuant to 42 U.S.C. § 2286b(d), the Board requests that DOE provide a report that will identify:

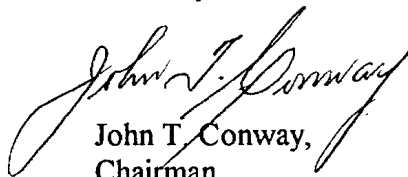
- Safety implications of the problem and its root cause, corrective actions to be taken to prevent a recurrence, and provisions for reviewing the safety implications of similar problems as they relate to all chemical processing facilities at RFETS.
- Corrective actions to be taken to ensure functional capability and operability of affected safety systems in the building.
- A plan that outlines the steps necessary to properly characterize the extent of the damage and safety ramifications of the degradation of the structural integrity of the floors and supported safety systems.

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The Board requests that the above report be submitted within 60 days of receiving this letter. If you need any further information in this connection, please let me know.

Sincerely,

A handwritten signature in cursive script that reads "John T. Conway". The signature is written in black ink and is positioned above the printed name and title.

John T. Conway,
Chairman

c: The Honorable Victor Reis, DP-1
Mr. Mark Whitaker, EH-9

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

July 10, 1995

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: J. Blackman

SUBJECT: Rocky Flats Environmental Technology Site (RFETS) -
Buildings 776/777 and 771 Structural Integrity Concerns

1. **Purpose:** This trip report documents the review conducted by the Defense Nuclear Facilities Safety Board's (Board) technical staff and outside expert of concerns regarding the structural integrity of Buildings 776/777 and 771. The review was performed on June 21 - 22, 1995 by the Board staff members J. Blackman and R. Kasdorf, and by outside expert J. Haltiwanger.
2. **Summary:**
 - a. The Board's staff reviewed the structural integrity concerns regarding Building 776/777 and has concluded that integrity of the floor slabs supporting portions of the ventilation system may be significantly degraded.
 1. The structural integrity of the floor slab in three areas of the building may have been compromised, posing an occupancy hazard. The chemically induced degradation of the floor slab may affect the integrity of the structural support of portions of the ventilation system. Since the problem has not been identified in the occurrence reporting system and/or as a Unreviewed Safety Question (USQ), the current effectiveness of the implementation of these systems must be reviewed. The Board's staff believes that the safety implications of this situation must be reviewed, a root cause analysis performed to determine why the problem was not properly identified, and the safety ramifications properly dispositioned. The potential for similar damage in other buildings must also be examined and dispositioned.
 2. The potential extent and mechanism of the concrete degradation by Kathene (lithium chloride in solution) and additives has not been characterized. The Board's staff believes that a properly conceived plan must be developed which includes: adequately characterizing the degradation mechanism; determining the affected areas in the building; and the development of appropriate repairs consistent with an understanding of the safety significance of the degraded regions.

- b. The Board's staff and outside expert reviewed the structural integrity concerns regarding Building 771. The Board's staff believes that the structural integrity of the building has not degraded due to chemical spills. However, three items were identified which warrant further consideration by DOE; namely:
1. The ends of two reinforced concrete roof beams framing into the reinforced concrete girder in the men's locker room have apparently delaminated. A steel column directly adjacent to the area is supporting the beams in question. The Board's staff suggests that the adequacy of the steel column in the men's locker room to transfer loads from the roof beam to the floor slab be confirmed.
 2. Cracking and rust stains were observed on a reinforced concrete floor beam near column D12 in room 149 directly below the ventilation system plenum area. The Board's staff believes that it would be prudent to sample the rust stains to determine if acids and/or plutonium residues are present.
 3. It was not apparent that DOE or EG&G had formally reviewed the Building 771 structural integrity concerns; the Board's staff believes that it would be prudent to do so.

3. Background:

- a. Building 776/777, a two story steel framed structure with non-composite reinforced concrete floor slabs, was designed and constructed in the mid 1950's and was used for plutonium casting and fabrication operations.

The concerns regarding Building 776/777 were contained in a letter to DOE, dated June 6, 1995, from the Environmental Information Network (EIN), which identified a "... structural collapse in one of the Pu buildings ..." at RFETS. The Board's staff contacted EIN who indicated that the area in question was located in B776/777, room 430.

The staff also spoke to other individuals familiar with the operations in the building, who confirmed that pieces of concrete had fallen from the ceiling in room 430. It was also indicated that the source of the problem may be related to spills of Kathene from the Kathabar System.

- b. Building 771 was designed and constructed in the early 1950's and was used as a plutonium recovery facility. It is a two story reinforced concrete structure with external shear walls and internal framing.

The concerns regarding Building 771 stem from a letter to the Board, from a concerned individual, dated April 5, 1995. The letter mentions three locations in the building where concentrated nitric acid had repeatedly leaked onto the reinforced concrete slab and may have affected the structural integrity of the building. Subsequent discussions with the individual, and with members of the staffs of DOE and EG&G, identified other locations in the building which might be also affected.

4. Discussion:

- a. On June 22, 1995, members of the Board's staff met with representatives of DOE and EG&G to determine the nature of the reported degradation of portions of the concrete floor slab in Building 776/777.

Staff members of EG&G indicated that deterioration of the roof in room 430 was first noticed in September 1994. The damage was described as rusting of the galvanized decking that forms the underside of the reinforced concrete floor slab. NDT examination in December 1994¹ (impact echo and spectral analysis of surface waves test method) of the concrete floor above revealed the extent of the delamination and cracking (approximately 9' x 11'). It was reported that the most degraded areas showed ". . . signs of severe cracking /delamination of the concrete from the rebar, which suggests that rebar corrosion has occurred . . ." Areas directly adjacent to the delamination were also reported to be of questionable integrity. The affected areas may, in fact, be greater than stated in the NDT report as testing was constrained by interference from equipment on the floor slab. Another area, in room 127, was also examined and showed similar deterioration (tested area was only 3' x 3' due to contract limitations).

The NDT test and the staff's examination of room 154 show that the structural integrity of the floor slab in the three areas of the building may have been compromised, posing an occupancy hazard. This degradation may also affect the integrity and functioning of the ventilation system.

NDT examination has not been conducted in other areas of the building. The principal means of identification of suspected areas has been examination of the underside of the floor areas for signs of corrosion. A third area, in room 127, was identified in this way and a fourth area, in room 134, is currently being examined and may potentially be affected.

EG&G attributed the source of the problem to Kathene spills from the Kathabar system. DOE reported that the Kathabar System was used to reduce humidity in the intake air of

¹ "Nondestructive Testing Investigation, Floor Slab Integrity Evaluation, Second Floor, Building 776, Golden, Colorado", Olson Engineering, Inc., Job No. 329, dated January 6, 1995.

the ventilation system and was in use from the initial operation of the building until 1990. The operation was subsequently discontinued due to corrosion and handling problems associated with Kathene.

The Board's staff understands that the repair of the roof areas in room 154 and 430 was begun in April, 1995. The repair was developed to prevent corrosion products from falling on hazardous waste stored in the rooms and not to restore the structural capacity of the floor slab to its original level. When workers attempted to scrape corrosion products from the steel decking, "golf ball" size pieces of concrete fell from the slab. DOE and EG&G reported that the deteriorated concrete was in an area of the floor that had not previously been thought to have been affected.

The staff also reviewed the structural adequacy of the proposed repair. It was reported that the slab was originally designed to withstand dead load plus a 200 psf live load. The repair did not appear to be adequate to support this load. While it was reported that a structural engineer had looked at the calculations, it was not obvious that the purpose of the repair was to return the deck to its original structural capacity.

DOE reported that the problem had not been identified in the occurrence reporting system and/or as a Unreviewed Safety Question even though the safety implications are readily apparent. DOE and EG&G stated that the concrete degradation problem was considered as a maintenance item and not a safety issue. After extensive discussion with DOE and EG&G, they stated that no technical review process was used to screen the safety significance of the issue. The repairs were being tracked by the Plant Action Tracking System (#95-0002946).

The extent and mechanism of the concrete degradation by Kathene (lithium chloride solution) have not been characterized by the contractor. In addition to the corrosion of the reinforcing steel, Kathene may directly affect the strength of concrete (sand-cement-aggregate bond). Therefore, the load capacity of affected areas of the building may be reduced even though corrosion of the underside and/or delamination of the slab is not evident. The Board's staff believes that these potential effects must be confirmed or ruled out.

Kathabar units are located in other areas of the building not currently identified as affected. The Board's staff believes that once the degradation mechanism of Kathene on concrete is adequately characterized, the entire building should be surveyed and affected areas identified and properly characterized. Since the Kathabar system was used in Buildings 707 and 779, these buildings must also be surveyed to determine possible effects.

- b. On June 21, 1995, DOE and EG&G briefed members of the Board's staff and an outside expert on the history of chemical spills in Building 771. At the request of the Board's staff, locations of all acid and alkaline spills, as well as all potential areas of structural distress, were identified on layout drawings of the building. A tour of the building to examine these areas was conducted. The Board's staff and its outside expert identified the following concerns in Building 771:
1. The connection of the reinforced concrete roof beam framing into the reinforced concrete girder at columns S2 and T2 in the men's locker room may have delaminated. Soundings of the crack pattern by the Board's staff indicate the presence of a drummy (hollow zone) at the beam-to-column connection which suggests degradation of the integrity of the connection. While a steel column (TS 8 x 8 x 1/4) was installed directly adjacent to the beam in question and is supporting the beam, this addition was developed as part of the installation of the Indirect & Direct Evaporative Cooling System, and not as a fix of the delamination. Since calculations could not be supplied by EG&G to confirm that the steel column is capable of safely transferring loads from the roof beam to the men's locker room floor slab, the Board's staff believes that it would be prudent to confirm that the steel column is adequate to transfer design loads.
 2. Cracking and rust stains as well as the appearance of some substance that glistens when exposed to light were observed on the end of a beam near column D12 in room 149. This area is located directly beneath the ventilation plenum where it was reported that acid fumes repeatedly condensed during facility operations. It is possible that acid may have penetrated and degraded the reinforced concrete floor beam. The Board's staff believes that since the plenum area is contaminated, it would be prudent to sample any residues on the beam in question to determine if acids and/or plutonium residues have penetrated from the plenum area.
5. **Future Planned Activities:** The Board's staff intends to follow the progress of the resolution of these problems and has tentatively planned a site visit in late July, 1995.