Supplement to Safety Analysis Report - 306W Building Clean Room and Assembly Area

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November 1980

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SUPPLEMENT TO
SAFETY ANALYSIS REPORT - 306W BUILDING
CLEAN ROOM AND ASSEMBLY AREA

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SUPPLEMENT TO SAFETY ANALYSIS REPORT - 306W BUILDING
CLEAN ROOM AND ASSEMBLY AREA

I. INTRODUCTION

The 306W Building contains 1) a diversified metalworking facility, 2) a specialty shop that provides machining services for uranium, thorium, and other materials of low specific radioactivity, 3) a nuclear fuels laboratory, 4) a SNM storage area, and 5) support laboratories. The facility, safety analysis, and operating limits are described in the Safety Analysis Report⁽¹⁾ and supplement to Safety Analysis Report - Operations Safety Requirements.⁽²⁾ Current and projected programs conducted for the Fuel Behavior Research Branch, Division of Reactor Safety Research, U.S. NRC include the design and assembly fabrication of complex, instrumented unirradiated LWR fuel test assemblies. These programs require modifications in an area of the building to provide improved cleanliness, temperature, and humidity control for component inspection, instrument check-out, and test assembly. The modified space will be at a positive differential pressure relative to atmospheric pressure to prevent intrusion of outside dust, preserving cleanliness requirements for that space. However, the 306W Building SAR requires that laboratory and highbay areas in the building be at a negative differential pressure. This supplement to the SAR presents a safety analysis demonstrating the positive differential pressure in the modified space does not increase the risks for operations within the facility.

II. MODIFICATIONS TO ROOM 120

Room 120, shown in relationship to the rest of 306 Building in Figure 1, was modified as shown in Figure 2. The changes that were made included the installation of a prefabricated clean room and its required services, installation of laboratory case work and services, sealing of exhaust ducts at the east wall, removal of the existing supply air unit and installation of a roof-mounted HVAC unit and its distribution system, installation of an exterior exit door on the south wall, leveling and surfacing the floor with vinyl, and sealing and painting the interior and exterior areas where required. These modifications are detailed on Drawings H-3-41687, 41688, 41772, 41779, and 41782. The simplified ventilation system revision is shown in Figure 3.

III. DISCUSSION OF MODIFICATIONS TO THE FACILITY

- Ventilation System

The Room 120 configuration consists of a clean room approximately 20' x 22' x 10' high located within a 40' x 40' x 22' high room. The clean room has its own recirculating HVAC system including HEPA filters and temperature control devices to provide the required conditions for the meterology equipment.

The large room is served by a roof-mounted HVAC system consisting of an air handler, medium and high efficiency filters, temperature control devices, and a HEPA filtered outside air supply source.

The main room system operates in a recirculating air mode with outside make-up air proportioned to maintain Room 120 slightly positive to its surroundings to provide the required cleanliness and temperature conditions for the instrumentation and test assembly work to be performed. The proposed positive differential to be maintained is in the range of 0.05 to 0.08 inches water gage. The main system is designed to handle 5000 to 6000 cfm. Outside make-up air will be in the range of 10%, or approximately 500 cfm depending on the configuration leakage rate.

- Inspection Clean Room

The clean room is a prefabricated Class 10000 structure built by Moore and Hanks Company. The area is used for component inspection involving the measurement of very close tolerances. The structure walls and ceiling are constructed of CPR Upjohn 493 urethane foam (Class A-1 foam with flame spread of 25) sandwiched between 20 gauge galvanized steel. Although the clean room constitutes a concealed combustible space within the 306-W Building, there are no exposed combustibles associated with the structure. Four Fenwal heat detectors are provided within the clean room and are tied into the building alarm system. As a result of fire protection review of 306-W Building it was concluded that the clean room should be additionally protected by a sprinkler system, integrated with the 306W Building system. Final design of the clean room sprinkler system is expected to be completed by December, 1980 and the installation completed by March, 1981. A recirculating HVAC system maintains the clean room pressure approximately 0.05 inches water above the pressure of the main room.

IV. SAFETY ANALYSIS

As a clean room, the modified Room 120 will operate at a positive pressure with respect to the environment. As designed, this will result in approximately 500 cfm leakage from Room 120. Because the remainder of 306 Building is maintained at a negative pressure with respect to atmosphere, much of the Room 120 leakage will flow into 306 Building via a connecting door. There will be no significant movement of air from 306 Building into Room 120.

In addition to leakage from Room 120 into 306 Building, a portion of the 500 cfm will reach the environment directly via an outside door and other uncontrolled leak points. This leakage is unfiltered and therefore represents a potential pathway for release of suspended particulate and gaseous radioactive material to the environment and has been considered in the following discussion.

Because the sintered UO_2 fuel pellets handled in the modified Room 120 are completely encapsulated in sealed zircaloy tubes, there will be no routine releases of this material into the facility or environment. In addition, the nature of handling operations precludes the application of stresses sufficient to cause failure of the zircaloy cladding and significant release of radioactive material.

In an analysis of releases from spent fuel during transportation accidents,⁽³⁾ it was determined that a severe accident that breached the canister and all spent fuel elements would release only 10^{-6} of the fuel material. This would represent approximately 4×10^{-3} μCi from a typical fuel pin handled in this facility. Any accident that could be postulated for the fuel handling operations to be conducted in Room 120 would result in a much lower total release than this, and would result in exposures well below the 10% of an allowable maximum annual dose to a radiation worker (500 mrem) or a member of the public (50 mrem) as provided for in the General Safety Assessment Document for PNL-Managed Nonreactor Nuclear Facilities.⁽⁴⁾

Nuclear safety limits for Room 120 will be identical to the nuclear safety limits given in the building SAR. In particular, since moderator will not normally be present, the rod batch will be set at 45%, or less, of the critical number and

(3) "An Assessment of the Risk of Transporting Spent Nuclear Fuel by Truck," PNL-2588, November 1978.

(4) "General Safety Assessment Document for PNL-Managed Nonreactor Nuclear Facilities," PNL-3280, March 1980.

not exceeding 90% of the minimum (water moderated and reflected) critical number. In this way, accidental water moderation could not cause criticality. When rods are fixed in an assembly, the geometry of the assembly precludes criticality with one unit, even with accidental water moderation, in accordance with the nuclear safety limits in the SAR.

In the highly unlikely event of a nuclear criticality in this area, potential releases of radioactive material to the environment would be no worse than environmental releases from the criticality described in Safety Analysis Report, 306-W Bldg., PNL-2549. This is due to the fact that a criticality involving the encapsulated pellets would not result in particulate releases. Gaseous fission product release are assumed to be the same as described in PNL-2549.

Based on the above discussion, there would appear to be no adverse radiological impact due to this use of the modified Room 120.

V. MODIFICATIONS TO OPERATIONS SAFETY REQUIREMENTS

The operation of Room 120 at a positive differential pressure requires corresponding modifications to the Operations Safety Requirements (OSRs) for the 306W Building.⁽²⁾ These changes have been incorporated in Item 1.1 RADIOACTIVE MATERIALS of the SAFETY LIMITS SECTION of the OSR's. Section 1.1 with the required changes is as follows:^(a)

^(a) Changes (additions) to the OSRs are indicated by information in [brackets].

1.1 RADIOACTIVE MATERIALS

Applicability

This requirement applies to the radioactive material that may be processed in the 306W Building.

Objective

The objective of this requirement is to preclude any receipt, storage and processing of radioactive material that could reduce the safety margin from that described in the safety analysis report.

Requirements

1.1.1 Radioactive materials processed shall be unirradiated uranium, thorium, or other materials equivalent in radiological hazard to unirradiated uranium and thorium.

1.1.2 Operations involving plutonium are prohibited unless the plutonium is in the form of sealed sources. Plutonium sources are limited to 230 g plutonium per source.

1.1.3 Fissionable material in the SNM storage area will be in sealed metal containers, except that uncontained solid metal pieces may be stored in the low-enriched racks or in the natural and depleted uranium storage cage.

1.1.4 Fissionable material in the specialty shop is limited to uranium-bearing material in the form of ingots, bars, pellets, and other similar solid pieces.

1.1.5 [Nuclear material in Room 120 is limited to material in the form of sintered pellets or other similar solid material that is fully encapsulated, such as in sealed fuel pins.]

Corrective Action

If radioactive material delivered to the 306W Building does not meet requirements 1.1.1 and 1.1.2, it shall be returned to the shipper. [Material delivered to Room 120 shall be returned to the supplier if it does not meet requirements 1.1.1, 1.1.2 and 1.1.5]. Material delivered to either the SNM storage area or the Specialty Shop shall be returned to the supplier if it does not meet requirements 1.1.3 and 1.1.4, respectively. If returning material to a shipper or supplier constitutes a safety hazard, movement of the material shall be halted and the situation shall be reported to appropriate Occupational and Environmental Protection (O&EP) personnel. If the situation constitutes an "abnormal occurrence," administrative action defined by Section 5.6 (a), (b), (c) [of the original ORRs] shall be taken.

Basis

The safety analyses presented in the SAR were based upon processing unirradiated enriched uranium. Therefore, material equivalent in radiological hazards to unirradiated uranium is no greater risk than the material described in hypothetical accidents in the SAR.

The 306W Building does not meet the "Criteria for Plutonium Processing Facilities" or the "Criteria for Plutonium Storage Facility." Therefore, to preclude an accidental release of plutonium, any plutonium material in the facility is restricted to a form at least equivalent to double-metal encapsulation. A 230-g limit on a plutonium source is well within the two-contingency policy for criticality safety.

Low-enriched (<5.1 wt% ^{235}U) uranium in solid form causes minimal radiological risk to the public or building occupants. A criticality (analysis presented in the SAR) is the most likely scenario for a release

of radioactive material and is precluded by the geometry of the low-enrichment storage racks. Natural and depleted uranium do not present a criticality hazard.

Machining operations in the Specialty Shop on solid pieces of uranium bearing materials have a low release potential. However, the ventilation system and equipment in the Specialty Shop were not designed for work with other forms, such as powders.

[The condition of positive pressure in Room 120 with respect to outside the 306W Building precludes handling of non-encapsulated fissionable material].

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2. C. R. Richey, "Supplement to Safety Analysis Report - 306W Building, Operations Safety Requirements", PNL-2549 Supp., August 1979.
3. "An Assesment of the Risk of Transporting Spent Nuclear Fuel by Truck," PNL-2588, November 1978.
4. "General Safety Assessment Document for PNL-Managed Nonreactor Nuclear Facilities," PNL-3280, March 1980.

SECOND FLOOR PLAN

FIRST FLOOR PLAN

- △ AIR SAMPLE STATIONS
- PASSIVE NEUTRON DETECTOR
- CRITICALITY DETECTOR

Figure 1. Simplified Floor Plan of 306W Building

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Figure 2. Room 120 - Clean Room
Inspection and Assembly
Floor Plan

Figure 3. Simplified Ventilation System
For the First Floor of the
306W Building

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