CPCC-324DP-26-00001
Revision 0

Fire Protection Functional and Operating Requirements for 324 Disposition Project

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
Hanford Field Office under Contract 89303320DEM000030

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Fire Protection Functional and Operating Requirements for 324 Disposition Project

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Richland, Washington

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Acronyms

DBF	Design Basis Fire
DFM	Deputy Fire Marshal
D4	deactivation, decommissioning, decontamination, and demolition
DOE	U.S. Department of Energy
F&OR	Functional and Operating Requirement
FHA	Fire Hazard Analysis
FPDA	Fire Protection Design Analysis
FPE	Fire Protection Engineer
HEPA	high-efficiency particulate air
HFO	U.S. Department of Energy, Hanford Field Office
HVAC	heating, ventilation, and air conditioning
IBC	International Building Code
MAQ	Maximum Allowable Quantity
MPFL	maximum possible fire loss
NFPA	National Fire Protection Association
PFHA	Preliminary Fire Hazard Analysis
QFPE	Qualified Fire Protection Engineer
REC	Radiochemical Engineering Complex
SMF	Shielded Materials Facility
TWRE	Temporary Waste Retrieval Enclosure

1.0 Scope

The *Fire Protection Functional and Operating Requirements for 324 Disposition Project*, CPCC-324DP-26-00001,is intended to support CPCC-324DP-26-00003, *Functional Design Requirements for the 324 Disposition Project*. The Fire Protection Functional and Operating Requirements (F&OR) document is an evolving document that is updated as more project details emerge and conflicts are resolved.

The Fire Protection F&OR document will expand in the conceptual design phase. This expansion will include a Fire Protection Design Analysis (FPDA) for the portion of this project that involves the placement of a structure(s) over the excavation and remediation site surrounding the remaining portion of the building. Since the project architect-engineering firm will include a Qualified Fire Protection Engineer (QFPE), the FPDA will be developed by the project Fire Protection Engineer (FPE), with review and approval by the CPCCo Deputy Fire Marshal (DFM), subject to the concurrence of the U.S. Department of Energy, Hanford Field Office (HFO) FPE, as necessary.

The *Fire Hazards Analysis for 324 Building*, CPCC-00015, will be updated by the CPCCo QFPE in three stages to reflect conditions, hazards, and controls for:

- Current arrangement and operations associated directly with the 324 Building.
- Grouting/stabilization processes associated with preparation of the 324 Building.
- New project processes introduced to the facility, and demolition activities prior to definitive design.

After the 324 Building Fire Hazards Analysis (FHA) has been updated, the FPDA will be merged into a Preliminary Fire Hazards Analysis (PFHA).

2.0 Purpose

The Fire Protection F&OR is intended to provide a conservative review of potential fire protection related requirements from codes, standards, recommended practices, and U.S. Department of Energy (DOE) Orders. It is anticipated that potentially conflicting requirements will be encountered from other disciplines that will require harmonization or further involvement by the stakeholders and the customer to resolve. The result should be a conceptual design that reduces project risk and better clarifies the design phase, extending through construction.

The purpose of this document is to provide:

- Preliminary guidance to the CPCCo 324 Building project team relative to potential fire protection and life safety impacts to the proposed project.
- The construction/demolition contractor with fire safety operational criteria and limitations
- The project architect-engineer and their responsible FPE an initial set of fire protection considerations and requirements from which to base conceptual designs and strategies.

- The HFO FPE the opportunity to consider potential risk mitigation approaches at a pre-conceptual design phase.

3.0 Background

The following sections provide a brief description of the existing 324 Building configuration and proposed project outline. Details of the present facility and its bounding fire protection conditions are contained in CPCC-00015. These conditions will be updated through a PFHA, which will be incorporated into the existing FHA CPCC-000015, during the conceptual design phase to reflect pre-project conditions, controls, and assumptions. A further update will be required during the definitive design phase to reflect project construction and later project deactivation, decommissioning, decontamination, and demolition (D4) activities and their additional or modified controls. Interim analysis of the project impacts to fire protection will be addressed through this F&OR in parallel with the Project's functional design requirements. Related details to the project are contained in CPCC-324DP-26-00003.

The following sections describe preliminary information at a pre-conceptual stage and will require additional input and definition from both the CPCCo project team and the architect-engineer to ensure sufficient data for the FHA. Table 1 provides a detailed breakdown of needed information and anticipated overall responsibilities for completion.

3.1 Location

The 300 Area is located in the southeast portion of the Hanford Site along the Columbia River and includes an approximately 400-acre industrial complex where fuel manufacturing operations took place during the plutonium production years of 1944 to 1989, and included experimental studies conducted in laboratory facilities. In compliance with the *Comprehensive Environmental Response, Compensation, and Liability Act,* removal actions and remedial actions were previously implemented in the 300 Area to demolish most of the facilities that supported the 300 Area's mission and clean up most of the waste sites resulting from historical operational releases or waste management practices.

3.2 Legacy Operations

The Chemical Materials Engineering Laboratory, more commonly known as the 324 Building, supported research on radioactive materials from 1966 to 1996. The building was designed to allow for performance of complex and varied experiments on highly radioactive materials. In 2009, workers discovered a visible breach in the stainless-steel liner at the floor of the B-Cell sump. Subsequent characterization of the soil underlying B-Cell confirmed high levels of ^{137}Cs and ^{90}Sr with dose rates up to 8,900 rad/hr directly below the B-Cell expansion joints.

3.3 Construction

The 324 Building is a concrete and steel structure constructed from 1964 to 1966 with a partial basement and first, second, and partial third floors surrounding an engineering hot cell complex. The phased PFHA is intended to provide more detailed information regarding current and projected conditions and end-states.

3.4 Preparations for Demolition

Prior to superstructure demolition, a Cold and Dark process will systematically isolate the 324 Building with the overriding purpose of providing a work environment safe from hazardous energy and materials. All existing process systems and utilities will be deactivated, removed, or isolated. These include electrical, water, and sewer utilities; compressed air and chillers; and heating, ventilation, and air conditioning (HVAC) systems. Deactivation of utilities and systems will include draining of free liquids; removal of bulk hazardous chemicals/materials, including oils, greases, hydraulic fluids, asbestos, and lead; removal or disconnection of manipulators on cell externals wall; deactivation of fire detection and alarm systems; and configuration for eventual demolition. Configuration may include a positive air gap, valves left open, handles removed, blanks installed, fuses removed, systems/tanks vented, etc., depending on the system type and or location of the isolation point. The baseline boundary for underground system isolation will be the building's fence.

A weather-tight boundary will be installed on the Shielded Materials Facility's (SMF) South Cell and Airlock door; the Radiochemical Engineering Complex (REC) cells Airlock and A-Frame; the Low Level Vault; and the High Level Vault (i.e., a Line X or RHINO Liner) durable enough to withstand most impacts from demolition of a superstructure as well as provide weather-tight boundaries after demolition.

Activities to step out of the current nuclear facility Safety Basis by stabilizing the radiological material within and on the cells and vaults via fogging, painting, spraying fixatives, foaming, and/or placement of grout will be complete. Interior surfaces of the cells (including walls, ceilings, floors, air lock, and pipe trench) and the ductwork between the cells will have been coated with fixative to fix contamination in place.

Information regarding the demolition and stabilization phase is preliminary at this phases and requires a more detailed description for further analysis in the FHA.

3.5 Project Description

The anticipated process of dispositioning the Hanford Site 324 Building hot cells and vaults, and remediating the 300-296 Waste Site underlying the building includes the activities listed below:

1. Erect a containment enclosure(s) (i.e., Temporary Waste Retrieval Enclosure [TWRE]) over demolition/excavation areas.
2. Add grout to cells, if necessary.
3. Cut up or demolish above grade cells (REC and SMF).
4. Excavate soil and obstructions (micropiles, soil stabilization, and soil characterization casings) as necessary to facilitate below grade cells (REC) and removal of vaults.
5. Cut up or demolish below grade cells (REC) and vaults.
6. Excavate and remove 300-296 Waste Site (contaminated soil below and adjacent to B-Cell).

7. Loadout and package the waste (i.e., blocks, debris, and/or soil). Mix with consolidation material as necessary.
8. If required, add grout or other filler material for shielding and/or void fill of packages.
9. Perform radiation assay/survey of waste packages (CPCCo).
10. If necessary, remove excess high dose material from and/or add consolidation material to waste packages, then re-assay/survey.
11. Move waste packages to the Container Transfer Area outside of the TWRE.
12. Weigh waste packages to confirm they do not exceed allowed weight.
13. Load waste packages onto transporter.
14. Transport waste packages to the Environmental Restoration Disposal Facility in the Central Plateau area of the Hanford Site.
15. Collect soil samples to confirm 2013 record of decision action objectives have been met
16. Remove and dispose of the TWRE.
17. Backfill excavated areas with clean soil.
18. Contour site to match surrounding grade and minimize ponding over the remediated site.

4.0 General Project Requirements Assumptions

Enabling assumptions are made as a basis for the requirements delineated in this document.

Red text denotes fire protection related items that may impact design and schedule that require additional review and resolution by the project.

The following enabling assumptions are provided for consideration early in project design:

- A new Hazard Category 2 nuclear facility Safety Basis document covering the disposition of the 324 cell/vault and the 300-296 Waste Site remediation will be in place prior to the project's demolition activities.
- Administrative Controls established in the 324 Building FHA and associated Hanford Fire Marshal Permits will continue to apply, unless specifically analyzed by a QFPE and modified or replaced.
  - The 324 Building is not protected by an automatic fire sprinkler, detection, or alarm system. As a result, combustible materials have been removed to a limited combustible loading, in accordance with the National Fire Protection Association (NFPA) Standard 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*. Required Administrative Controls include a formal combustible control program, weekly self-inspections, and quarterly QFPE/ Fire Safety Officer audits.

  - Per NFPA 241, a formal fire prevention plan is required. The current program will need to be revised to include the scope for the current project and the new contractors, prior to project remediation implementation, in accordance with CPCC-PRO-FP-40422, *Fire Marshal Permit Interfaces*, and CPCC-PRO-FP-54134, *Fire Protection in D4 Facilities and Facilities Under Construction*.

- One or more large ventilated TWREs will need to be placed over the cells, vaults, and the 300-296 Waste Site footprint to prevent contamination spread to the environment during demolition, excavation, loadout, and packaging activities.
  - Proposed enclosure designs and specifications, and analyses related to fire protection shall be submitted to the CPCCo QFPE for review and approval, in accordance with DOE-STD-1066-2016, "Fire Protection"; CPCC-STD-FP-40404, *Fire Protection Program*; CPCC-STD-FP-54128, *Fire Protection Design*; and CPCC-PRO-FP-54134. Later in the construction phase, statements of work, plans, specifications, and associated work packages shall be submitted for review and approval.
- Due to the temporary nature of the confinement enclosure over the 300-296 Waste Site, "alternate" fire protection requirements for the TWRE is requested. The proposed construction would be to employ a fabric membrane structure.
  - The Project proposes to employ a membrane structure as an enclosure around the remaining 324 Building structure to provide a weather enclosure for excavation work and support functions. A membrane structure, erected in accordance with NFPA 1, *Fire Code*, and the International Building Code (IBC) would qualify as a Type II-B/Type II (0,0,0) structure. However, it would not suffice for the 2-hour fire rated barrier requirements for radiological confinement boundaries, per DOE-STD-1066-2016. If Nuclear Safety determines that the high-efficiency particulate air (HEPA) filter exhaust system is safety significant or greater, the confinement boundary requirements would increase overall building fire resistance as well.
  - If the structure is not a confinement (i.e., if the Documented Safety Analysis indicates that the structure is not required to confine the generation of radiological airborne particles), and the process could be performed in open air, then the structure might be classified as a weather enclosure.
  - Per IBC 3103, 180 days for a "temporary" structure can be extended to 1 year when approved by the building official. Otherwise, the membrane structure must meet IBC criteria for a new building or structure. If a permanent membrane structure is not possible or desired, then a modification or alternative (IBC 104.7) might be possible to be processed and formally approved by the HFO Authority Having Jurisdiction.

    Either an "Exemption" or "Equivalency" would be required to pursue the proposed use of a membrane structure under circumstances where nuclear safety significant confinement boundaries would be required, in accordance with CPCC-PRO-FP-40424, *Equivalencies, Exemptions, and*

Interpretation/Clarification Requests (ICR's). An exemption, per DOE O 420.1(c), Change 3, "Facility Safety," would require preparation of a formal request by a QFPE, review by the Hanford Fire Marshal, submittal to the HFO FPE for concurrence, and approval by DOE Headquarters. An equivalency would require preparation of a formal request by a QFPE, review by a Hanford DFM, and submittal to the HFO FPE for approval. The primary criteria for approval of an equivalency is that the proposed alternative be at least as effective as the prescriptive requirement it replaces (in this case IBC Type II-B construction).

- A Container Transfer Area(s) will accommodate receipt of waste packages/ containments after exposure rate characterization measurement. CPCCo will be responsible for all further handling pursuant to final waste disposition thereafter.
  - Any Container Transfer Area shall be reviewed and approved in advance by a QFPE.
- With the exception of fuel and combustible fluids carried in as part of permitted vehicles within the building, flammable and combustible liquids essential to operations, regardless of quantity, will be placed within an approved flammable liquids storage cabinet when not in use.
- Hazardous chemicals, regardless of quantity, will be placed in an approved hazardous chemical storage cabinet when not in use.
- According to earlier characterizations, containers selected for processing within this building will not contain free liquids or pyrophoric metals.

5.0 Exposures

This section focuses upon limiting adverse for exposure to/from the 324 Building and its appurtenances and is subject to preliminary, in-progress, and definitive review and approval of related site and general arrangement drawings and specification by the QFPE.

1. 35 ft clear space separation minimum from wildland.
2. 50 ft minimum clear space from nearest building, per NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*.
   a. No intervening combustible storage
   b. No parking within 30 ft of building
3. Fire Department access roads, per NFPA 1.
   a. Accessible on all sides of building
   b. 20 ft wide minimum
   c. Apparatus load bearing surface

6.0 Construction

The 324 Building is a concrete and steel structure constructed from 1964 to 1966 with a partial basement and first, second, and partial third floors surrounding an engineering hot cell complex. The degree to which the overall 324 Building remains intact before construction and operations within the membrane structure remains to be defined and analyzed in the PFHA.

This section focuses on codes and standards for permitted construction types, and a preferred damage limiting strategy. When "Preferred" is indicated, the item is advisory and not based upon a code minimum requirement. When "Minimum" is indicated, it relates to a specific criteria or requirement of applicable code or standard.

Under the preferred strategy, support features (i.e., mechanical rooms, electrical rooms, break rooms, rest rooms, offices, and storage areas) are restricted to the extent practicable, either by physically relocating to the outside a safe distance away from the structure or providing a fire rated enclosure or similar fire rated modular structure; thereby minimizing fire exposure to operations within the structure operations from these ignition and combustible sources in an otherwise non-fire protected structure.

Items in red indicate further considerations between prescriptive code and standard requirements and the project's preference for a membrane structure.

Because the document CPCC-324DP-26-00003 is in preliminary stages, a defined path for the exploration of fire protection alternative paths is not available at this time.

7.0 Building Shell

1. For Hazard Category 1, 2, or 3 nuclear facilities, per DOE-STD-1066-2016:
    a. IBC construction Type II-B, NFPA 220, *Standard on Types of Building Construction*, Type II (0,0.0) minimum
    b. Structural materials shall be noncombustible
    c. Special Industrial occupancy exception for height and area limits shall not be applied

Project proposed construction: membrane structure, based upon temporary nature of excavation/remediation activities to be conducted.

- DOE-STD-1066-2016 discourages the use of membrane structures as the primary construction for Hazard Category 2 nuclear facilities.
    - Hazard Category 2 nuclear facilities involve significant quantities of radioactive material, where a release could have serious consequences.
    - DOE-STD-1066-2016 requires noncombustible construction for safety-class and safety-significant structures in these facilities (Section 5.3.1.2 of DOE-STD-1066–2016).
    - Membrane structures (such as tents or fabric-covered buildings) are required to be NFPA 704, *Standard System for the Identification of the Hazards of Materials for*

Emergency Response, which meets the IBC standard for Type IIB construction. Relevant sections of DOE-STD-1066-2016:

- Section 5.3.1 – "Structural Materials and Types of Construction "

  Safety-class and safety-significant structures shall be of noncombustible construction.

- Section 5.3.2 – "Combustible Materials"

  Combustible materials shall be minimized in nuclear facilities, especially those with Hazard Category 1 or 2 classification.

- Section 5.3.3 – "Temporary Structures "

  Temporary structures (including tents and membrane structures) are generally prohibited in areas where their failure could impact nuclear safety functions.

- Such a deviation from DOE-STD-1066-2016 would require prior concurrence by the HFO AHJ for an equivalency or DOE Headquarters for an exemption.
  - It may be argued that since the HEPA filter exhaust system is considered to be "general service," per Nuclear Safety, any fire that would breach the membrane would result in a release of radioactive contamination under the threshold without additional confinement or containment.
  - The overall combustible load is, by design, maintained at an NFPA 241 limited combustible level with continuity between piles to be unlikely and of low intensity.
  - Since soil excavation is the primary function of this project and equipment, if the project is to utilize FM-Approved less hazardous hydraulic fluids and/or localized mobile equipment fire protection, the overall fire risk is physically less than assumed for a typical H-4 occupancy.
  - IBC Type IIB/NFPA 220 Type II (0,0,0) construction is non-fire rated, noncombustible. Membrane materials conforming to NFPA 701, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*, while not noncombustible, both have reduced heat release rates and delayed ignition properties, providing a degree of life safety. In practical terms, a fire involving contact with the membrane fabric would be assumed to perforate but not propagate rapidly.
  - A case could be made that a conforming membrane structure performs in a nearly identical manner to a noncombustible lighting-weight corrugated metal on steel frame structure in similar fire conditions for this project.
- The proposed term of use exceeds the statutory 180-day maximum limit for "temporary" per NFPA 1 and the IBC. Extended use will need to be considered in any equivalency or exemption request.
- Assuming that the HFO FPE, acting as the AHJ, concurs with membrane construction as an acceptable alternative, the following would apply:

- **NFPA 1 – *Fire Code***
  - **Chapter 25 – Tents and Membrane Structures**
    - Section 25.1.1: *Scope* – Applies to tents and membrane structures used for assembly, mercantile, or similar purposes.
    - Section 25.2: *General Requirements* – Includes provisions for location, structural stability, and fire safety.
    - Section 25.2.3: *Fire Resistance* – Membrane material must meet flame propagation performance criteria.
    - Section 25.2.4: *Separation Distances* – Specifies minimum distances from buildings, lot lines, and other tents.
    - Section 25.2.6: *Heating and Cooking Equipment* – Restrictions on open flames and heating devices inside or near membrane structures.
    - Section 25.2.7: *Means of Egress* – Requirements for exits, signage, and accessibility.
    - Section 25.2.9: *Maintenance and Inspection* – Mandates regular inspection and maintenance for safety compliance.

International Building Code (IBC)

- **Chapter 31 – Special Construction**
  - Section 3102 – Membrane Structures
  - 3102.1: General – Defines membrane structures and scope of application.
  - 3102.2: Construction Documents – Requires detailed plans for design, anchorage, and fire safety.
  - 3102.3: Permits – Specifies when permits are required for temporary or permanent membrane structures.
  - 3102.4: Location and Access – Addresses placement and emergency access.
  - 3102.5: Fire Safety – Requires compliance with flame propagation performance standards.
  - 3102.6: Structural Design – Must meet wind, snow, and load requirements per Chapter 16.
  - 3102.7: Means of Egress – Specifies exit requirements similar to other assembly occupancies.

2. Assuming DOE-STD-1066-2016 applies Hazard Category 2 for this nuclear facility and a membrane assembly is not approved:
   a. Foundation: primarily concrete slab-on-grade, surrounded by a combination of compacted, previously excavated, and undisturbed soil.

b. Exterior walls:

    i. Preferred – FM-Approved insulated wall panels tested to Approval Standard 4880 and 4882.

    ii. Minimum - Corrugated metal panels with interior-mounted, non-combustible vinyl-faced fiberglass.

c. Roof:

    i. Preferred – FM-Approved Class I Steel Deck tested to Approval Standard 4450, installed per FM Loss Prevention Data Sheets 1-28R, "Roof Systems," and 1-31, "Metal Roofs," per DOE-STD-1066-2016.

    ii. Minimum – Class A (ASTM E108-11, *Standard Test Methods for Fire Tests of Roof Coverings*, or UL-790) Corrugated metal Interior-mounted, noncombustible vinyl-faced fiberglass.

d. Frame:

    i. Preferred – 2-hour fire rated

    ii. Minimum – Unprotected noncombustible

e. Interior Finish: Class A with flame spread index of 25 or less and smoke development index of 450 or less (ASTM E84-23b, *Standard Test Method for Surface Burning Characteristics of Building Materials*), per DOE-STD-1066-2016 for Hazard Class 1, 2, and 3 nuclear facilities.

f. HVAC (If provided – at this time, the membrane structure is non-heated:

    i. Preferred - None or Heating to minimum 40°F, maximum 120°F (electric powered)

    ii. NFPA 90A, *Standard for the Installation of Air-Conditioning and Ventilation Systems*

    iii. NFPA 90B, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*

    iv. NFPA 91, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids*

    v. Once-through ventilation systems do not require in-duct smoke detection unless required by the FHA for fire control.

g. Lighting: NFPA 70, *National Electrical Code*®/ 29 CFR 1910, "Occupational Safety and Health Administration," General Industry, industrial lighting levels, utilizing LED luminaires.

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h. Lightning Protection: NFPA 780, *Standard for the Installation of Lightning Protection Systems*, and DOE-STD-1020-2016, "Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities."

7.1 Interior Support and Processing

1. Modular support or processing enclosures.

   The anticipated structures are intended to provide fire rated separation from the remainder of the enclosure during excavation, such that a fire within any single enclosure will be confined to that structure and its contents. This may be achieved either through physical clear space separation of the proposed occupancy or operation outside of the membrane enclosure or through fire rated assemblies arranged as cubicles within. Typical occupancies or operations that would be considered for this subdivision include, but are not limited to electrical switchgear rooms, hydraulic or pneumatic equipment rooms, mechanical or exhaust fan rooms, storage or maintenance rooms.

   a. Prefer – 2-hour fire rated for confinement enclosure within the membrane structure or relocation outside of the membrane enclosure with an intervening minimum 50 ft clear space free of combustibles (for reduced spatial separation, provide rated construction in accordance with NFPA 80A). Such rated or spatial separations are intended to maintain a fire loss under the DOE maximum possible fire loss (MPFL) criteria to the smallest area. Further, such separations reduce the involvement and release of radiological material at risk. The use of partitioning or enclosure for other types of processing areas should be based upon review within the FHA, depending upon concentration of combustibles, ignition sources, exposures, etc. This also improves life safety personal evacuation by protecting the established means of egress and exiting.

   b. Interior Finish:

      i. Prefer – FM-Approved Class I, tested to Approval Standard 4880

      ii. Minimum - Class A with flame spread index of 25 or less, and smoke development index of 450 or less (ASTM E84b), per DOE-STD-1066-2016 for Hazard Category 1, 2, and 3 nuclear facilities.

   c. Floor (The degree of liquid containment or drainage to a safe location is dependent upon Environmental and Nuclear Safety characterization) containment and drainage is limited to areas or operations analyzed to have hazardous materials in excess of the Maximum Allowable Quantity Limit (MAQ), per NFPA 1; NFPA 30, *Flammable and Combustible Liquids Code*; and NFPA 400, *Hazardous Materials Code (2025)*, based upon review in the FHA. Physical and administrative controls which reduce the amount of hazardous material at risk can also be credited as mitigating factors to reduce the need for confinement or containment (e.g.,

restriction or elimination of ignitable fluids, including diesel fuel, lubricating fluids; or replacement of hydraulic fluids with FM-Approved less hazardous liquids, or use of electric vehicles). If containment is required:

i. Concrete slab-on-grade, liquid-tight, with provision for floor drain to safe location.

ii. FM-Approved noncombustible raised floor with secondary containment.

d. Lighting: NFPA 70 / 29 CFR 1910 industrial lighting levels, utilizing LED luminaires

e. Exhaust Ventilation: presume once-through laminar flow exhaust HEPA filtration system and stack release.

i. Duct from the processing room to the HEPA filter shall be metal with 2-hour rated fire wrap or other approved fire-resistance enclosure.

ii. No intervening dampers from point of ventilation to the HEPA filter, except for heat detector actuated bubble-tight dampers upstream and downstream of the HEPA filter bank, per DOE-STD-1066-2016.

iii. May require flammable gas detection or continuous air monitor arranged for personnel alarm and high-high ventilation exhaust depending upon Nuclear Safety characterization.

2. HEPA Filter structure shall be arranged from a fire protection standpoint, in accordance with DOE-STD-1066-2016.

a. Two-hour fire rated enclosure or located outside at least 50 ft from membrane structure (for reduced spatial separation, provide rated construction in accordance with NFPA 80A).

b. Heat detector actuated bubble-tight dampers upstream and downstream of the assembly.

c. Class A rated HEPA media.

d. Noncombustible duct and stack.

3. Support offices, break room, rest room, change room, storage areas.

a. Fire Rated separation:

i. Prefer 1-hour room if interior to membrane structure or located outside at least 50 ft from membrane structure (for reduced spatial separation, provide rated construction in accordance with NFPA 80A).

4. Electrical Room, Mechanical Room.
    a. Fire Rated separation:
        ii. Prefer 2-hour room if interior to membrane structure or located outside at least 50 ft from membrane structure (for reduced spatial separation, provide rated construction in accordance with NFPA 80A).
        i. Minimum 1-hour.
5. Fuel-fired Generator (if provided) and Switchgear.
    a. Fire Rated separation:
        i. Prefer 2-hour.
        ii. Minimum 1-hour or 50 ft clear space separation (for reduced spatial separation, provide rated construction in accordance with NFPA 80A).

8.0 Occupancy

This section establishes the IBC/NFPA occupancy group and identified prescriptive requirements for fire protection.

Regardless of the construction and protection strategy selected for this project, fire loss scenarios will be required for the Design Basis Fire (DBF) and MPFL conditions specific to the operations and combustible loads posed within the proposed new excavation structure. The DBF and MPFL scenarios specific to this project shall be developed by a QFPE and reviewed for approval by a CPCCo DFM, per DOE-STD-1066-2016 and the Hanford Fire Marshal's Charter.

Quantitative fire modeling may be required to support assertions of limited fire propagation (i.e., where results are at or below both nuclear and fire protection program monetary limits) where automatic fire protection is proposed to be omitted. While no longer required by DOE-STD-1066-2016, the maximum credible fire loss and normal loss expectancy should also be developed to demonstrate the impact of any automatic fire protection or combination of physical protection and administrative controls upon the fire incident. Further guidance relative to content and format of loss scenarios is provided in CPCC-PRO-FP-40420, *Fire Protection Analyses*.

The practicality of quantitative combustible control limits must be supported by a combination of fire modelling and examination of project operational limitations.

It is anticipated that the QFPE will need to revise the loss scenarios as the project design progresses. Therefore, the combined loss scenario effort should be a standalone PFHA document for at least the conceptual phase with milestone updates at 30 percent, 60 percent, and 90 percent. Incorporation into the FHA should be between the 90 percent and 100 percent design phases.

The following is based upon preliminary project information. Preferred and minimum criteria are presented, as in prior sections:

1. Per DOE-STD-1066-2016, the occupancy is considered to be IBC High Hazard Group H-4; NFPA 101, *Life Safety Code*®, "General-Purpose Industrial" classification for the main common area of the building.
    a. Mixed Occupancy –
    b. Support functions, such as battery/UPS rooms, electrical rooms, HVAC/HEPA Filter Rooms are considered to be separated use.
    c. Restroom/change rooms; lunchrooms; and meeting rooms, if any, are considered to be incidental non-separated uses.

    Preferred: From a fire and contamination spread standpoint, such uses should be either relocated to the outside of the structure and separated by fire rated construction or relocated to other facilities.
2. Equipment Hazards

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a. Remotely operated equipment, if used, should be equipped with FM-Approved less hazardous industrial fluids as a substitute for mineral oil hydraulics, unless the associated impacts from mineral oil have been analyzed in the FPDA and approved.

3. Vehicular Hazards

a. Tractor-trailer: The tractor-trailer represents a consistent credible fire exposure. The combustible package includes up to ___ gal. (to be determined) of diesel fuel; ___ gal (to be determined) hydraulic and brake fluid; 18 tractor/truck tires, as well as plastic truck cowling, seats, hoses, and wiring. (Since this F&OR precedes conceptual design, specific equipment and vehicle selection has not yet been made. The foregoing includes blanks which will be addressed at conclusion of the conceptual design phase.)

A combustible liquid pool fire has been analyzed in other SWOC FHA's and determined to completely involve the tractor-trailer assembly and contents directly on the trailer, as well as spread to adjoining storage. The degree of fire damage to containers in the immediate vicinity has been evaluated, per DOE-STD-5506-2021, "Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities."

Preferred: Rated construction of modular buildings could potentially provide passive protection from fire extending into the project areas. Fire-rated construction would prevent fire extension into separate use areas.

Note: Currently, administrative controls are used at CWC facilities, wherein the trailer is backed into the building, immediately detached from the tractor, which is in turn driven away from the facility. While this reduces the amount of time that the vehicle fire exposure may be present, it does not eliminate the threat.

b. Lift-trucks: Other CPCCo facilities utilize propane-fired lift trucks. They represent a second credible fire exposure from fire and explosive missile debris of the pressurized fuel tank and hydraulic fluids and plastic or rubber hoses, wiring, and operator seats. Though individually a lessor hazard than the tractor-trailer assembly, similar involvement to surrounding operations must be considered in accordance with DOE-STD-5506-2021.

Preferred: A means of reducing the hazard from industrial lift trucks would be the use of electrically powered units having FM-Approved less hazardous industrial fluids substituting for mineral oil hydraulics.

Consideration should also be given to the feasibility of installed automatic mobile equipment fire suppression on individual units with larger volumes of ignitable fuels, hydraulics, and lubricating systems.

c. Parked vehicles:

Minimum: No other vehicle parking is permitted with the buildings. The 30-ft spatial separation of parking from the building prevents damage from a fully involved vehicle fire.

4. Prohibited Materials (Minimum)

a. Flammable and combustible liquids; hazardous chemicals; and flammable and compressed gases above the NFPA 1, NFPA 30, and NFPA 400 MAQ will not be permitted.

b. Compressed gases should be stored outside the building and equipped with fixed piping to the point of use. Hot work will not be permitted, unless reviewed and approved by the CPCCo DFM through a fire permit.

5. Life Safety

a. Minimum: Means of egress – Per NFPA 101:

i. For a General-Purpose Industrial Facility representing the remainder of the building, the maximum travel distance in a building with an approved automatic sprinkler system throughout is 250 ft, with maximum 50 ft dead-end corridors and 100 ft maximum common path of travel.

b. Minimum: Emergency Lighting – Emergency lighting and illuminated wayfinding shall be provided in accordance with NFPA 101 throughout the entire building, processing modules, and support rooms. The building is considered to be a windowless structure.

c. Preferred: Provide wireless modular manual pull stations and audible visual alarm devices strategically throughout the facility.

d. Life safety features and supporting specifications shall be prepared by a qualified fire protection engineer and submitted for DFM review and approval, per CPCC-PRO-FP-54130, *Life Safety Features and Emergency Lighting*.

9.0 Protection

This section focuses upon code required fire protection features, based upon prescriptive requirements based upon occupancy group. The project would prefer to forego the expense of an approved automatic sprinkler system throughout. As an alternative, a combination of remotely controlled monitor stations connected to fire detection and Artificial Intelligence (AI) supervised video fire surveillance is proposed as an approved alternate. Such a system could provide pin-point early detection and response with smaller water discharge. Installation of mobile package fire protection equipment could further reduce fire loss expectancy. Examination of the suitability of these alternative systems for their intended life safety and property protection purpose is beyond the scope of this F&OR and should be evaluated by the architect-engineer

FPE in an FPDA. A PFHA and a fire protection equivalency or exemption request are required to resolve these issues.

9.1 Water Supply

1. Must be reliable and adequate, per DOE-STD-1066-2016.

A water supply test and analysis needs to be coordinated and conducted with Pacific Northwest Laboratories (owner of the 300 Area fire pump, City of Richland Fire Department, and CPCCo Fire Protection Engineering to establish current flow and pressure available at 324 Building from the 300 Area fire pump and City of Richland water supply.

2. Based upon the assessment of Nuclear Safety, per DOE-STD-1066-2016, the water supply is not safety significant.
3. An adequate water supply for the combination of maximum sprinkler system demand plus hose streams and separate maximum fire department flow, per NFPA 1, at 20 psi is required.
4. Water supply and distribution system designed to prevent a single failure from causing the system to fail to meet demand. For nuclear facilities, the water distribution system shall be looped.
5. Water supply arranged in accordance with NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*.
6. Fire Hydrants: hydrants shall be no closer than 40 ft from building walls. Hoses running from hydrants shall not exceed 300 ft to all exterior portions of the building. A minimum of two hydrants shall be provided.
7. The existing water supply system, fire pump, and tank shall be reviewed by a QFPE, as part of the FPDA.

9.2 Automatic Sprinklers

If it is determined that the project design and operations warrant an approved automatic sprinkler system throughout, the following guidance is presented (any passive or active fire protection proposed will require development of a supporting FPDA prepared by the architect-engineer FPA and review and approved by the CPCCo DFM):

1. Hazards vs. Protection: For the fire exposures posed by the tractor-trailer assembly, using NFPA 13, *Standard for the Installation of Sprinkler Systems*, Annex A, A.4.3.3.2 Examples of Ordinary Hazard Group 2 occupancies are Automobile Parking Garages, and Vehicle Repair Garages, which best fit the fire hazard characteristics of the tractor-trailer rig and fuel-fired forklift vehicles.

   An alternative comparison is the dump floor of a refuse processing facility. However, the combustible loading and commodity hazards should be distinctly lower for the proposed D4 activities in this project.

2. Commodity classification for the waste is considered to range from NFPA 13 Class I to Class IV.
3. Control Mode Density Area sprinkler protection at a minimum density of 0.25 gpm/ft^2 over the most remote 2,000 ft^2 (wet system) or 2,600 ft^2 (dry system):
    a. Will permit Class I – IV commodity between 12 – 15 ft in high pile arrays.
    b. Plastics A Commodity without metal overpack or fire resistive thermal barrier may be stored up to 8 ft in piles.
4. Riser: locate riser inside a room with exterior personnel access.
5. Hose stream demand: 500 gpm.
6. Hydraulic Pressure Margin: Hydraulically design sprinkler system for a supply pressure of at least 10 percent, but not less than 10 psi below the supply curve.
7. Duration: 120 minutes
8. A potential pathway to an approved exception to the requirement for an approved automatic sprinkler throughout the membrane structure (such a determination would need to be developed and supported in the architect-engineer's FPDA, reviewed and by the CPCCo DFM, and incorporated in the PFHA).

    DOE-STD-1066-2016 is intended for use in new facilities. However, the 324 Building is an existing Hazard Category 2 nuclear facility with an H-4 occupancy that is currently non-sprinklered. It may be argued that:

    a. The current FHA permits existing D4 activities in a building no longer having automatic sprinkler protection or alarm system throughout.
    b. The overall occupancy, operations, and function have not changed with the proposed project.
    c. Therefore, new automatic sprinkler protection for the existing premises and operations is not required.
    d. Alternate Protection:
        i. An FM-Approved remote-operated fire detection and suppression system (e.g., Fire Rover or equivalent, consisting of integrated water monitors, fire detection and AI-enhanced closed-circuit monitoring may be considered a means of early detection and suppression that may reduce contamination spread from a fire event.
        ii. Similarly, any fuel-fired vehicles or equipment should be equipped with an engineered fire suppression system to confine equipment fires to a single unit.
        iii. Neither items a nor b are considered by FM to be replacements for building automatic sprinkler protection because:

iv. The proposed detection and suppression system is FM-Approved. It's manually or remotely operated, not automatic. It is designed for targeted suppression rather than full-area coverage.

9.3 Fire Alarms and Detection

1. Provide a fire alarm system in accordance with the Hanford fire protection standard HNF-36174, *Hanford Fire Protection Design Requirements*, and NFPA 72, *National Fire Alarm and Signaling Code*®, (such a determination would need to be developed and supported in the architect-engineer's FPDA, reviewed and by the CPCCo DFM, and incorporated in the PFHA).
2. Provide Radio Fire Alarm Repeater in accordance with HNF-36174.
3. Alternatively:
    a. Provide a modular wireless fire alarm and pull station arrangement with remote monitoring capability.
    b. Requires both an FPDA and approval by the Hanford Fire Marshal and the Hanford Mission Integration Solutions, LLC.
    c. Must also meet the cyber security requirements for this DOE O 205.1C, "Department of Energy Cyber Security Program," per the governing Statement of Work.

® National Fire alarm and Signaling Code is a registered trademark of the National Fire Protection Association, Quincy, Massachusetts.

10.0 Project Deliverable Milestones

The following is a general summary of deliverables relating to this project, intended to identify critical information for fire risk control. This table is for general guidance. Refer to the governing Statement of Work for required design deliverables.

Table 1. Project Deliverable Milestones

Item	Purpose	Prepared By	Milestone Phase
Narrative Descriptions			
Project Description • General – Phases – Schedule and Milestones	Support F&OR, FHA	CPCCo Project Team	CDR (Rev @ 30%, 60%, 90%
• Pre-Project Phase – Present configuration – Operations and activities – Timeframe – Phase end states	Support F&OR, FHA	CPCCo Project Team	CDR (Rev @ 30%, 60%, 90%
• Construction Preparation Phase – Objectives – Work prepared by CPCCo – Work Prepared by A&E – Work prepared by Contractor – Roles and responsibilities – Timeframe – Phase end states	Support F&OR, FHA	CPCCo Project Team	CDR (Rev @ 30%, 60%, 90%
• D4 Activities Phase – Objectives – Work conducted by CPCCo – Work conducted by Contractor – Process description – Timeframe – Phase end states	Support F&OR, FHA	CPCCo Project Team	CDR (Rev @ 30%, 60%, 90%
Drawings and Specification Submittals			
• Statement of Work (A&E, D4 Contractor – Specifications – Drawings – Terms and Conditions	F.P. Plan Review	CPCCo Project Team	CDR
• Request for Qualifications/Request for Proposal	F.P. Plan Review		A&E selection

Table 1. Project Deliverable Milestones

Item	Purpose	Prepared By	Milestone Phase
• Membrane Enclosure – General Description – Arrangement Drawings – Manufacturer's Data – NRTL Approvals and Listings – NFPA 1 required submittals – Contractor's Mobilization and erection plans	F.P. Plan Review	A&E Contractor	60% Design Prior to mobilization on site
• Support Structures – General Description of each – Site plan – Location – Construction – Dimensions – Fire rating – Exposure separations/clear space – NRTL Approvals and Listings	F.P. Plan Review	A&E	60% Design, (Rev 90%)
• Parking, Equipment Staging, Waste Handling, Areas	Support F&OR, FHA F.P. Plan Review	A&E and D4 Contractor	CDR (Rev @ 30%, 60%, 90%, and Contractor site preparation)
• Fixed and Mobile Equipment – Area of use – Number of units – Manufacturer's data sheets – Size – Power source (hydraulic, battery, etc.) – Lubricating & hydraulic fluid type and quantity	Support F&OR, FHA F.P. Plan Review	A&E and D4 Contractor	CDR (Rev @ 30%, 60%, 90%
• Hazardous Chemicals – Type – Quantity – Use – Storage – SDS – Permit Request	Support FHA & Permitting	CPCCo D4 Contractor D4 Contractor	Pre-project phase Construction Phase D4 Phase
Fire Protection Submittals			
• A&E Fire Protection Engineer Statement of Qualifications	Supports FPDA, F.P. development and approvals	A&E	30 days after bid award

Table 1. Project Deliverable Milestones

Item	Purpose	Prepared By	Milestone Phase
• Contractor Fire Prevention Officer Statement of Qualifications	Provides contractor oversight of NFPA 241 fire safety program and self-inspections	Contractor	30 days after bid award
• Fire Protection Design Analysis	DOE STD 1066 and FHA	A&E QFPE	At 30% design (rev @ 60% and 90%)
• Life Safety Analysis	DOE STD 1066 and FHA	A&E QFPE	At 30% design (rev @ 60% and 90%)
• Passive fire protection	F.P. Plan Review	A&E and Construction Contractor	Prior to installation on site
• Alarm and signaling system	F.P. Plan Review	A&E and Construction Contractor	Prior to installation on site
• Manual fire protection	F.P. Plan Review	A&E and Construction Contractor	Prior to installation on site
• Automatic fire protection	F.P. Plan Review	A&E and Construction Contractor	Prior to installation on site
• Loss Analyses – MPFL scenarios specific to pre-enclosure site preparation, enclosure construction and subsequent D4 activities relating to the project – MCFL scenarios specific to pre-enclosure site preparation, enclosure construction and subsequent D4 activities relating to the project	Support FHA	A&E FPE prepares CPCCo DFM reviews and approves	At 30% design (rev @ 60%
• Fire Hazards Analysis Update	Support FHA	CPCCo DFM prepare project FHA update	At 30% design (rev @ 60%, final at 90%)
Construction Site Fire Prevention			
• Contractor commitment to CPCCo Fire Protection Program (see references below) – Commitment to 324 Building combustible control program – Commitment to 324 Building personnel accountability program – Commitment to FHA assumptions and administrative controls	Support FHA & Permitting	CPCCo BTR, Enclosure Contractor, D4 Contractor	At bid award

Table 1. Project Deliverable Milestones

Item	Purpose	Prepared By	Milestone Phase
• NFPA 241 Fire Safety Plan	Support FHA & Permitting	CPCCo BTR, Enclosure Contractor, D4 Contractor	30 days after bid award
• NFPA 1 Hazardous Materials Management Plan	Support FHA & Permitting	CPCCo BTR, Enclosure Contractor, D4 Contractor	30 days after bid award
• Work Management Plans – CPCCo FPE involvement in work planning meetings, and plan of the day meetings – CPCCo FPE approval of formal work plans – Periodic fire prevention inspections with CPCCo FPE, contractor fire prevention officer, and BTR	Support FHA & Permitting	CPCCo BTR, Enclosure Contractor, D4 Contractor	Continuous

11.0 References

29 CFR 1910, "Occupational Safety and Health Standards," *Code of Federal Regulations*, as amended.

ASTM E84, 2023, *Standard Test Method for Surface Burning Characteristics of Building Materials*, Advancing Standards Transforming Markets International, West Conshohocken, Pennsylvania.

ASTM E108, 2024, *Standard Test Methods for Fire Tests of Roof Coverings*, Advancing Standards Transforming Markets International, West Conshohocken, Pennsylvania.

CPCC-324DP-26-00003, 2026, *Functional Design Requirements for 324 Disposition Project*, Rev. 0, Central Plateau Cleanup Company, Richland, Washington.

CPCC-00015, 2023, *Fire Hazards Analysis for 324 Building*, Rev. 1, Central Plateau Cleanup Company, Richland, Washington.

CPCC-STD-FP-40404, 2024, *Fire Protection Program*, Rev. 1, Chg. 0, Central Plateau Cleanup Company, Richland, Washington.

CPCC-PRO-FP-40420, 2026, *Fire Protection Analyses*, Rev. 2, Chg. 0, Central Plateau Cleanup Company, Richland, Washington.

CPCC-PRO-FP-40422, 2025, *Fire Marshal Permit Interfaces*, Rev. 1, Chg. 5, Central Plateau Cleanup Company, Richland, Washington.

CPCC-PRO-FP-40424, 2023, *Equivalencies, Exemptions, and Interpretation/Clarification Requests (ICRs)*, Rev. 1, Chg. 0, Central Plateau Cleanup Company, Richland, Washington.

CPCC-PRO-FP-54130, 2024, *Life Safety Features and Emergency Lighting*, Rev. 1, Chg. 1, Central Plateau Cleanup Company, Richland, Washington.

CPCC-STD-FP-54128, 2023, *Fire Protection System Design*, Rev. 1, Chg. 1, Central Plateau Cleanup Company, Richland, Washington.

CPCC-STD-FP-54134, 2025, *Fire Protection in D4 Facilities and Facilities Under Construction*, Rev. 2, Chg. 1, Central Plateau Cleanup Company, Richland, Washington.

DOE O 205.1C, "Department of Energy Cyber Security Program, U.S. Department of Energy, Washington, D.C.

DOE-STD-1020-2016, 2016, "Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities," U.S. Department of Energy, Washington, D.C.

DOE-STD-1066-2016, 2016, "Fire Protection," U.S. Department of Energy, Washington, D.C.

DOE-STD-5506-2021, 2021, "Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities," U.S. Department of Energy, Washington, D.C.

HNF-36174, 2023, *Hanford Fire Protection Design Requirements*, Rev. 8, Central Plateau Cleanup Company, Richland, Washington.

NFPA 1, 2024, *Fire Code*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 13, 2025, *Standard for the Installation of Sprinkler Systems*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 24, 2025, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 30, 2024, *Flammable and Combustible Liquids Code*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 70, 2026, *National Electrical Code®*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 72, 2025, *National Fire Alarm and Signaling Code®*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 80A, 2022, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 90A, 2024, *Standard for the Installation of Air-Conditioning and Ventilating Systems*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 90B, 2024, *Standard for the Installation of Warm Air Heating and Air-Conditioning Systems*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 91, 2026, *Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 101, 2024, *Life Safety Code*®, National Fire Protection Association, Quincy, Massachusetts.

NFPA 220, 2024, *Standard on Types of Building Construction*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 241, 2022, *Standard for Safeguarding Construction, Alteration, and Demolition Operations*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 400, 2025, *Hazardous Materials Code*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 701, 2023, *Standard Methods of Fire Tests for Flame Propagation of Textiles and Films*, National Fire Protection Association, Quincy, Massachusetts.

NFPA 704, 2022, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, National Fire Protection Association, Quincy, Massachusetts

NFPA 780, 2026, *Standard for the Installation of Lightning Protection Systems*, National Fire Protection Association, Quincy, Massachusetts.

12.0 Conclusion

The project is at a pre-conceptual design phase, requiring further consideration of resolution to conflicts and the pursuit of foreseeable alternatives. This F&OR provides an early insight into potential code-related issues, as well as some potential avenues for exploration of alternatives. Deeper examination will be required in which informal involvement in discussions with stakeholders and the HFO FPE is encouraged.

Appendix A

Peer Review

Appendix A
Peer Review

CPCCo ENGINEERING REVIEW CHECKLIST

Document Reviewed:

CPCC-324DP-26-00001, Rev. 0
Fire Protection Functional and Operating Requirements for 324 Disposition Project

Scope of Review:

Whole Document

Yes	No	N/A		
☐	☐	☒	*	Previous reviews completed and analysis, up to scope of this review, with no gaps.
☒	☐	☐		Problem completely defined.
☐	☐	☒		Accident scenarios developed in a clear and logical manner.
☒	☐	☐		Necessary assumptions explicitly stated and supported.
☐	☐	☒		Computer codes and data files documented.
☐	☐	☒		Data used in calculations explicitly stated in document.
☒	☐	☐		Data checked for consistency with original source information as applicable.
☐	☐	☒		Mathematical derivation checked including dimensional consistency of results.
☐	☐	☒		Models appropriate and used within range of validity or use outside range of established validity justified.
☐	☐	☒		Hand calculations checked for errors.
☐	☐	☒		Software input correct and consistent with document reviewed.
☐	☐	☒		Software output consistent with input and with results reported in document reviewed.
☒	☐	☐		Limits/criteria/guidelines applied to analysis results and appropriate and referenced. Limits/criteria/guidelines checked against references.
☒	☐	☐		Safety margins consistent with good engineering practices.
☒	☐	☐		Conclusions consistent with analytical results and applicable limits.
☒	☐	☐		Results and conclusions address all points required in the problem statement.
☒	☐	☐	*	Format consistent with appropriate NRC Regulatory Guide or other standards.
☐	☐	☒		Review calculations, comments, and/or notes are attached.
☐	☐	☒		For calculations in which codes/spreadsheets *(e.g., RADIDOSE, GENII, etc)* are used, is the latest revision used? Is the User Authorized?
☐	☐	☒		Hazard controls established are appropriate for the hazards including selection using the appropriate hierarchy *(e.g., engineered over administrative)*.
☐	☐	☒		The preventive or mitigative credit assigned to hazard controls are appropriate, and the basis is documented.
☒	☐	☐		**Document approved.**

Reviewer:

James Skyler Gabriel
Print First and Last Name

Gabriel, James S Digitally signed by Gabriel, James S Date: 2026.03.05 13:54:11 -08'00'
Signature / Date

*** Any calculations, comments, or notes generated as part of this review should be signed, dated and attached to this checklist. Such material should be labeled and recorded in such a manner as to be intelligible to a technically qualified third party.**

A-6004-797 (REV 6)