FIRE HAZARDS ANALYSIS

FOR

BUILDING 9203 & 9203A COMPLEX

AT

Y-12 PLANT, OAK RIDGE, TENNESSEE

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PREPARED FOR

DEPARTMENT OF ENERGY

FIRE HAZARDS ANALYSIS

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EDITOR'S NOTE

This document was prepared under the requirements of DOE Order 5480.7A which was in effect during the preparation and review cycle. It is intended to represent a typical Fire Hazards Analysis for a moderate nuclear facility. DOE Order 5480.7A has subsequently been replaced by DOE Orders 420 and 440.1 as well as Implementation Guide G-420/440.1. These documents contain requirements and guidance for Fire Hazards Analyses similar to those in DOE Order 5480.7A.

TABLE OF CONTENTS

Page

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

PAGE

1.0 INTRODUCTION

1.1 Purpose

This analysis is intended to provide a comprehensive assessment of the risks from fire and fire related perils in the Building 9203 and 9203A Complex at the Oak Ridge Y-12 Plant. The analysis has been prepared in accordance with the criteria listed in DOE Order 5480.7A.

1.2 Approach and Assumptions

The approach taken to complete this evaluation involved identification of the fire risks present in the buildings, identification of the equipment present and its value to DOE, identification of the fire barriers and related materials used for the construction of the buildings, identification of the fire protection systems and equipment installed in the buildings, a determination of the adequacy of these systems, and a determination of the adequacy of the exit system in the buildings. After this data was collected, an analysis was performed to determine the relative nature of the fire risks present, whether the installed fire protection is adequate to effectively control these risks, and finally, a determination was made of the potential fire damage that could possibly occur in the building. Concerns such as the life safety of the building occupants and possible environmental damage from a fire incident were essential considerations in the evaluation.

The information presented in this report is based upon site documentation, construction plans and specifications, and a field inspection of the building. Waterflow test results were taken from the files of the site fire protection engineering group. No actual flow tests were conducted. Information regarding the HVAC systems and their operation was determined from construction documents and verified by the building mechanical supervisor.

Specific fire protection engineering data were obtained from the Y-12 Plant fire protection engineering group.

1.3 Limitations

This FHA has been prepared based upon the current occupancy, arrangement, and fire hazards in the building. This includes an evaluation of the equipment, chemicals, flammable and combustible materials, and hazards present. If occupancy changes occur, or the arrangement is modified, or different equipment, or significantly increased quantities or types of hazardous materials are introduced to the facility, the evaluation may be invalid.

1.4 Facility Use, Function, Occupancy

Buildings 9203 and 9203A were recently designated as the Manufacturing Technology Deployment Center for the Y-12 Plant. The facilities in these buildings are intended to be used for technology transfer between the Y-12 Plant and the commercial manufacturing community. Numerous complex

materials development and testing capabilities currently exist at the Y-12 Plant, that could be transferred to the commercial sector to allow competitiveness and more effective use of resources. The Center has therefore been established to provide this link to private industry. The equipment and facilities located in Building 9203 and 9203A Complex include various types of computer equipment that can be networked to mainframe computers. The buildings, originally constructed over 30 years ago, have 50,000 square feet of floor area, that include analytical laboratories, manufacturing demonstration laboratories, fabrication shops, chemical process pilot laboratories, ultrasonic testing laboratories, stress and fracture testing laboratories, electronics and instrumentation laboratories, and surface chemistry and physical properties laboratories which use several types of electron microscopes. A 274 person conference room and a large assembly area are provided for public presentations. The facility also includes office areas for resident specialists.

Due to the complex arrangement of these buildings, a single occupancy classification cannot be assigned. An area by area classification is therefore used. The classifications are based upon the Life Safety Code and the Uniform Building Code (UBC), current editions.

Building 9723-24 - This building is considered an Existing Business occupancy by NFPA 101, and is classified as a UBC B-2 occupancy. The building also includes an Existing Class "C" Assembly occupancy having 2,800 square feet, which is also classified as UBC A-3.

Building 9203A - The first floor is considered General Purpose Industrial occupancy, and the second floor is considered an Existing Business occupancy by NFPA 101. Both are classified as UBC B-2 occupancy.

Building 9203 - The majority of the building is considered a General Purpose Industrial occupancy by NFPA 101. The second floor conference room is an NFPA 101 Class "C" Assembly occupancy of 2,850 square feet. Several offices are located in building 9203, however, these offices are considered incidental to the laboratories, and are classified with the remainder of the building. The building is classified as UBC B-2 except for the Assembly occupancy, which is classified as UBC A-3.

Building 9752 - This building is classified as a General Purpose Industrial occupancy by NFPA 101, and classified as UBC B-2.

Building 9205 - This building is classified as a High Hazard Industrial occupancy by NFPA 101, and classified as UBC B-2. Note: The building contains less than the exempt amount of hazardous materials listed in the UBC for a fully sprinklered facility. Therefore, the building is not classified as a Group H occupancy.

1.5 General Site Fire Protection

The fire protection for the Y-12 Plant, which is pertinent to the 9203 and 9203A Complex, primarily

consists of a site-wide fire alarm system, a fire service main and water supply, and a site fire department. All are adequate for this building. Refer to Reference (a) for further details on plant's fire protection features.

2.0 CONSTRUCTION

2.1 Description of Facility

The Building 9203 and 9203A Complex consists of five different buildings that were constructed at different times using different types of construction. Some of the individual buildings were expanded during their lifetime, resulting in individual composite construction types. The buildings were constructed over 30 years ago. The buildings are all interconnected via corridors or stairways. Because of this, the complex is analyzed as a single facility. Building 9723-24 is the entrance to the complex on First Street. Building 9203A connects to the west side of building 9723-24. Building 9203 connects to the south side of building 9723-24. Building 9752 is located on the southeast side of building 9203, and building 9205 is located on the southwest side of Building 9203. Descriptions of the five building are as follows:

Building 9723-24 - This building is a one story, wood frame building with a sloped roof that fronts on First Street. The building construction classification per the Uniform Building Code (UBC) for this structure is Type V, non-rated combustible. The south side of this building adjoins building 9203, while the west side of this building connects to building 9203A. This building contains offices, and two large open areas that are used for public meetings. The gross floor area of this building is approximately 9,000 square feet. HVAC for this building is supplied by a single fan unit located in a mechanical room adjacent to the rest rooms in the center of the building. Supply Fan unit (SF) 108 is a 4,050 cfm unit that is arranged with a ducted supply to the various rooms in this building. The return is via a single vent grille located in the corridor outside the fan room. Fresh air make up is from air drawn in through the building door openings. The controls for the unit are located in the mechanical room. Air movement in this building is from the offices to the corridor in the rear of the building, and then to the center corridor to the return air grille.

Building 9203A - This building is an unprotected steel frame, and concrete block, two story structure. The roof is a flat gravel covered built-up membrane over a steel deck. This is considered to be non-rated, noncombustible UBC Type II-N construction. Building 9203A connects to building 9723-24, through a corridor adjacent to the south stairwell. Two hour rated concrete block walls and fire rated doors for Class B openings perform this separation. The south stairwell of Building 9203A is connected to building 9203 via the Vacuum Technology Laboratory on the first floor, and the large conference room on the second floor. The gross floor area of building 9203A is approximately 6,000 square feet per floor. An additional area of approximately 625 square feet exists only on the first floor of building 9203A. This area was added to the northeast wall on the front side of the building and is used to house the ultrasonic test equipment. The HVAC system for the first floor of this building is supplied by SF 101 located in room 106 in the southwest corner of the building. This recirculating system is arranged with a

ducted supply to the various rooms on the floor. The return is via a duct located in the corridor ceiling. Fresh air make up is from a duct extended to the building exterior. The controls for the unit are located in the mechanical room. Air movement in this part of the building is from the offices to the corridor via louvers in the office doors, and then from the corridor to the return duct in the ceiling. The return duct is separate from the air supply. The second floor of this building is supplied by SF 301 located in a mechanical room on the roof of the building. This recirculating system is arranged with a ducted supply to the various rooms on the floor. The return is via a duct located in the corridor ceiling. Fresh air make up is from an opening in the air handler enclosure. The controls for the unit are located in the mechanical room on the roof. Air movement in this building is from the offices to the corridor via louvers in the office doors, and then from the corridor to the return duct in the ceiling. The return is to the air handler which mixes the fresh air make up with the return air.

Building 9203 - This building is for the most part, a one story structure located south of building 9723-24. A three story tower is located on the south side of the building between column lines 9.5 and 12. The second and third floors of this tower area are unoccupied and are restricted contaminated radioactive areas. The east side of the building is constructed of heavy reinforced concrete columns and floor slabs. Walls between the columns are filled in with hollow clay tiles between column lines 7 and 12, and bricks between columns 4 and 7. A flat built-up membrane roof is provided. From column line 4 to the west end of the building, the construction is concrete block and unprotected steel frame. This is considered non-rated, noncombustible UBC Type II N construction. The gross floor area of this building is approximately 24,300 square feet. Building 9203 has several air handlers that are typically arranged as recirculating type systems. The supply is ducted to the area served and the return air is drawn to a return air duct usually located in the corridor. The return air is then mixed with a percentage of incoming fresh air taken from a fresh air source at the air handler enclosure. The fan units that serve this area are:

SF 103 - This unit is located above the ceiling in room 17. The system supplies only room 17, and the controls are located on the east wall of the room.

SF 104 - This unit is located in room 13A which acts as a return air plenum. This room is also used as a storage room for instrumentation and electronics repair materials. This system supplies rooms 10-13. The shut off for the system is located in room 33 on the east side of the building. A stop switch is also installed in the corridor between rooms 10E and 10F.

SF 105 - This unit is located in room 33A on the east side of the building. The system supplies the area including rooms 24-33. The system shut off controls are located in room 33.

SF 106 - This unit is located in a separate enclosure outside of the building at column lines I- 10. The rooms supplied by this unit include rooms 14 and 15 and the unoccupied areas on the second and third floor. The controls for the unit are located in the fan room.

SF 302 - This 6,000 cfm unit supplies the large conference room on the second floor. The unit and its controls are located on the roof of the building.

SF 303 - This unit is located in a separate mechanical room on the first floor outside the building at column line A-1. The controls are at this same location. The unit supplies 6,000 cfm to the Vacuum Technology Laboratory.

SF 304 - This system is located in an HVAC room on the roof of the building. It serves rooms 5, 6, 7, 8, 4, 20, 21, and 22. The fans provide a total air supply of 8,400 cfm. The controls are located in the HVAC enclosure on the roof.

SF 305 - This system supplies rooms 1-4. It is a 9,000 cfm unit located in the same roof top enclosure as SF 304. The system controls are located in the enclosure.

SF 306 - This unit supplies the newly renovated areas in room 19. The unit is located in a separate enclosure on the roof of the building. Also located in the enclosure are a HEPA filter and a laboratory hood exhaust (890 cfm) for room 19. Duct smoke detectors are installed in the ductwork affiliated with this unit. The system controls are located in the roof top enclosure.

SF 307 - This system is a one pass type system that serves room 41, 42 ,and 42A. The 13,400 cfm unit and its controls are located in a roof top enclosure. Four laboratory vent hood exhaust ducts also penetrate the roof at this location.

SF 308 - This unit is located on the roof of the building. It supplies rooms 45-50. The controls area located in the HVAC enclosure.

SF 401 - This unit supplies a portion of room 19. Unlike the other HVAC systems, this unit is arranged in a one pass configuration with a flow rate of 9,300 cfm. The unit is located in a fan room on the roof of the building. The controls are located in the roof top enclosure.

Building 9752 - This building is located in the southeast corner of building 9203, and is accessed from building 9203 through the small machine shop in room 30. The building includes three rooms. Room 33 is the machine equipment room, which is a separate room accessible only from the outside. Room 30, the small machine shop, and room 31, the electrical maintenance shop are the remainder of the building. The construction of this building is consistent with the adjacent section of building 9203. which consists of reinforced concrete frame and walls of hollow clay tile. This is considered non-rated, noncombustible construction UBC Type II-N. The gross floor area of this building is approximately 1,320 square feet. Building 9752 is supplied by a single fan unit located in the ceiling of the machine room, room 30. The fan unit is arranged with a ducted supply to room 31, the maintenance shop, in this building. The return is via a single vent grille located in the ceiling in room 31. Fresh air make up is from air drawn in through the building exterior on the east side. The controls for the unit are located in

room 30. Air movement in this building is from supply ducts to the work shop of the building, and then to the return duct located in the ceiling of the work shop.

Building 9205 - This building is located next to the southwest corner of building 9203 and can only be accessed from exterior doors. The west section of the building is a reinforced concrete frame building, with non-bearing walls constructed of hollow clay tiles. The west side of the building consists of a large central laboratory room, and the east side is a small connected workshop. The workshop section is constructed with concrete block walls. A flat built up roof is constructed of reinforced concrete. A noncombustible gas cylinder storage area is located on the exterior north side of the building. This is considered non-rated, noncombustible construction UBC Type II-N. The gross floor area of this building is approximately 2,700 square feet. HVAC for this building is supplied by a single fan unit located in the west room of the building. The fan unit is arranged with a ducted supply to the central room in the building. The return is via a single vent grille (2-ft x 4-ft) located in the west wall of the central room. Fresh air make up is from air drawn in through the building exterior on the west side. The controls for the unit are located in the supply fan room. Air movement in this building is from supply ducts to the central room of the building, and then to the single vent grille located on the west wall of the central room. In the central room, two full size cabinet hoods are provided for the Chemical Vapor Processing facility. The exhaust ducts from the cabinets extend to an exterior filter and stack on the north side of the building. The small work shop on the east side of the building has two wall mounted air conditioning units. One unit is positioned on the south wall and another on the west wall. A steam heat unit is provided in the ceiling area of the work shop.

2.2 Fire Boundaries

Fire separations are provided between buildings within the Building 9203 and 9203A Complex. A two hour fire rated concrete block wall with rated fire doors for Class B openings separates building 9203A and building 9723-24. The stairways on each end of the large conference room and in the northeast corner of building 9203A are also constructed of concrete block walls and Class B fire doors. The wall between building 9723-24 and building 9203, which is the north wall of the Vacuum Technology Laboratory is a two hour fire rated concrete block assembly. The south wall of the Vacuum Technology laboratory is also a two hour rated concrete block assembly. Finally, the wall between building 9203 and building 9752 is a two hour fire rated assembly. This wall is a hollow tile assembly.

The fire area boundaries in this facility are considered inadequate to meet the criteria of DOE Orders. Deficiencies were noted with all of these barriers during the field survey of the complex. Examples of these deficiencies include:

The south stairway of building 9203A has numerous penetrations through the protected exit enclosure. The penetrations include conduits, cable trays and a duct that is approximately 3 feet by 4 feet in dimension. NFPA 101 specifies that exit enclosures must not be penetrated except for sprinkler piping,

stair pressurization, or conduits for lighting within the exit.

The concrete block wall that separates building 9723-24 from building 9203 has numerous open penetrations for conduits and computer cables that have not been properly sealed.

The south wall of the Vacuum Technology Laboratory includes a section of approximately 300 square feet of glass block. The glass block has been painted to resemble the adjacent two hour rated concrete block wall. The glass blocks will not provide a two hour fire rating.

The wall between building 9203 and building 9752 is a hollow clay tile barrier. The door in this wall has an ordinary glass vision panel, approximately 10-in X 10-in. The ordinary glass will not provide a two hour fire rating.

The corridor doors to the computer rooms (Rooms 212 and 215) on the second floor of Building 9203A have large glass windows and ventilation louvers in their lower half. Per NFPA 75 and DOE/EP-0108, computer rooms should be separated from adjacent areas by at least one hour rated construction.

A building wide fire barrier inspection and maintenance program is needed to ensure the continued operability of the fire separations in this complex. The program should periodically evaluate the condition of all required fire barriers, and ensure that rated barriers are provided where required. Open penetrations caused by the routing of computer cables and other services should be routinely sealed with approved materials.

2.3 Interior Finish Materials

The interior finish in the complex includes painted drywall, painted brick, painted clay tiles, exposed clay tiles, painted concrete block, and exposed concrete block. The rear wall of the large conference room has textured fabric-covered gypsum board. Floor coverings are typically resilient tiles, with commercial grade carpeting in the offices and in the aisles of the large conference room. The interior finish materials for the complex provide a Class A rating with flame spread ratings of less than 25 as required by NFPA 101 for exits. The interior finish materials in this facility are, therefore, considered adequate to meet the criteria of DOE Order 5480.7A.

3.0 LIFE SAFETY

3.1 Means of Egress

Each of the sections of the Building 9203 and 9203A Complex have slightly different exit arrangements. To simplify the analysis of the exit system, each building is discussed separately.

Building 9723-24 - This building is currently served by five direct exit doors. Two exit doors are located on the north side of the building. Both of these exits have double doors. A single door is located on the south side, and another single door is on the east side of the building. In addition to these direct exit doors, the rear corridor of Building 9723-24 interconnects to the Building 9203 corridor on the east side of the Vacuum Technology Laboratory. A direct exit door is located in this corridor about fifteen feet from building 9723-24. The rear corridor of Building 9723-24 also provides access to Building 9203A through the rear exit lobby from that building. Both of these openings to the other building are made via short ramps to match the different floor elevations. The maximum slope is 1 in 9 for a ramp 9 feet in length. The exit capacity of the five direct exits is 1,140 persons. The calculated occupant load for the building is 113 persons, based upon an allowance of 100 square feet per person as specified by the Life Safety Code for a Business Occupancy. In the Business Occupancy sections of the building, the number of occupants is normally less than 10. During special events, the large room in the front of the first floor of the building is used as a public meeting room, which is considered a Class "C" Assembly Occupancy. The meeting room is a large open room that is filled with folding chairs during an event. The area of this room is approximately 2,800 square feet. Using an occupant load factor of 15 net square feet per person for this area will add an additional 187 persons to the overall calculated load for the building, for a total of 300 persons. The exit capacity of 1,140 persons is well in excess of that required. The remote exits are separated by a straight line distance of 73 feet. The overall diagonal of building 9723-24 is 158 feet. The exit remoteness therefore satisfies the 1/3 diagonal criteria for a sprinkler protected building in accordance with NFPA 101 for new construction. The means of egress for this building provide multiple, remotely located exit paths that have adequate capacity and remoteness to satisfy NFPA 101, meets the UBC exit requirements, and are adequate for the protection of the building occupants. One minor deficiency was noted in the last assessment for building 9723-24, regarding the reversed direction of door swing for the rear exit from the first floor Assembly Occupancy.

Building 9203A - This building is served by two concrete block stairway enclosures located on the northwest and southeast sides of the building. The stairway doors are self closing fire rated assemblies for the Class B openings. The stairways both have a clear width of 46 inches, providing an exit capacity for 306 persons. The calculated occupant load for this building is 77 persons, based upon an occupant load factor of 100 persons per square feet for a Business or Industrial occupancy. The capacity of the two stairways is more than adequate. The normal number of occupants in the building is approximately 25 people. The stairways are separated by a straight line distance of 85 feet. The overall building diagonal is 125 feet, therefore the exit remoteness satisfies the NFPA 101 1/3 diagonal criteria for a sprinkler protected building. Both stairways discharge directly to the outside. The first floor occupants also have the option of using two direct exit doors located next to the stairway enclosures. There were no concerns identified with the exit provisions of this building. A dead end corridor was noted on the second floor along column line 15 by the copy machine. The measured length of the corridor is approximately 40 feet, which is acceptable per NFPA 101. The means of egress for this building provide multiple, remotely located exit paths that have adequate capacity and remoteness to satisfy NFPA 101, meets the UBC exit requirements, and are adequate for the protection of the building

occupants.

Building 9203 - This building has six direct exit doors. The north exit door is a double door that opens to the corridor between building 9723-24 east of the Vacuum Technology Laboratory. This corridor has a set of double doors to the outside approximately fifteen feet from building 9203. The west side exit door is a single door, accessed through laboratory room 49 (X-ray lab at Col. G). The east side door is a double door accessed through a general area designated as room 26 (between Cols. E & F). The central corridor at Column line C connects to three north-south corridors (at Cols 4, 7, & 9.5) that provide a means of egress to the south loading dock. Each of these corridors has a set of double doors to the exterior. The capacity of the exit doors is 1,600 persons. The calculated occupant load of the building is 243 persons, based on an occupant load factor of 100 square feet per person. The capacity of the exits is therefore considered acceptable. The normal number of occupants in the industrial sections of the building is approximately 25. The remote exits are separated by a straight line distance of 150 feet. The overall building diagonal is 212 feet. The exit remoteness is therefore considered acceptable. There were no concerns identified with the exit provisions of this building. The second and third floor areas on the east side of the building are accessed via a single stairway at column line H-7. Because these restricted areas are vacant, the single exit is considered acceptable. The means of egress for this building provide multiple, remotely located exit paths that have adequate capacity and remoteness to satisfy NFPA 101, meets the UBC exit requirements, and are adequate for the protection of the building occupants.

The Vacuum Technology Laboratory and the second floor large conference room are part of this building, however, due to their semi-detached location, the exit provisions for these areas are considered separately. The Vacuum Technology Laboratory primary exit is through a set of double doors on the east side that open into the corridor between buildings 9203 and 9723-24. A direct exit door is provided in the corridor, directly across from the doors to the Vacuum Technology Laboratory. The second means of egress is provided by a direct exit door to the outside on the west side of the laboratory. A third door is provided that opens to the first floor landing of the south stairway of building 9203A. The large conference room on the second floor uses the south stairway of building 9203A as the primary exit path. A second stairway is located at the rear of the conference room. The rear stairway discharges to the first floor corridor by the main entrance to the Vacuum Technology Laboratory. Per NFPA 101, up to 50% of the required means of egress do not have to discharge to the outside, but are permitted to discharge on the level of exit discharge in a sprinklered building. The conference room is approximately 2,850 square feet. Using an occupant load factor of one person per 15 net square feet provides a calculated occupant load for this area of 190 persons. The south stair of building 9203A has a capacity of 153 persons. The rear stair in the conference room has a minimum capacity of 146 persons. The available exit capacity is therefore 299 persons. Because this must be shared with building 9203A, a percentage of the occupants from building 9203A must be assumed to use the south stair. For conservatism, the entire calculated occupant load (77 persons) is assumed to use this stairway. This would still allow an exit capacity of 222 persons, which exceeds the calculated load for the conference room. The means of egress for this building provide multiple, remotely located

exit paths that have adequate capacity and remoteness to satisfy NFPA 101, meets the UBC exit requirements, and are adequate for the protection of the building occupants.

Building 9752 - This building has three exits doors. The machine equipment room has a single exit door located on the east side of the building. This exit serves only this room. The electrical maintenance shop, room 31, has a set of double doors to the loading dock on the south side of the building. Room 31 also has a single exit door that leads to the small machine shop. A west exit door serves the small machine shop, room 30. The calculated occupant load for this building is twelve persons, based upon an occupant load factor of 100 square feet per person. The number of persons normally in the building is less than 10 persons. The exit doors have a capacity of 775 persons, therefore the exit capacity is considered adequate. There were no concerns identified with the exit provisions of this building. The Life Safety Code permits a single exit for areas having common path of travel of 50 feet. Travel distance in all the rooms in this building is 35 feet or less. The means of egress for this building provide exit paths that have adequate capacity to satisfy NFPA 101, meets the UBC exit requirements, and are adequate for the protection of the building occupants.

Building 9205 - This building is served by four direct exit doors. One is located on the east side of the building near the acid storage shed, two are located on the north side of the building, and the last door is located on the south side of the building. The capacity of the exit doors is 700 persons. The calculated occupant load for the building is 27 persons, based upon an occupant load factor of 100 square feet per person. The normal number of occupants in the building is less than 15 persons. Therefore, the exit capacity is adequate. The remote exits are separated by a straight line distance of 75 feet. The overall building diagonal is 90 feet. Therefore, the exit remoteness is satisfactory for a sprinkler protected building. The means of egress for this building provide multiple, remotely located exit paths that have adequate capacity and remoteness to satisfy NFPA 101, meets the UBC exit requirements, and are adequate for the protection of the building occupants.

The exit provisions in this facility are, therefore, considered adequate to meet the criteria of DOE Order 5480.7A ¶ 9. b (2).

3.2 Emergency Lighting and Exit Signs

All of the buildings in the complex use battery pack emergency lighting units for the illumination of the primary exit paths. In addition, there is a gasoline powered generator that will come on-line if main power is lost. There is at least one lighting fixture in each room that is connected to the emergency circuits, except for the second floor of building 9203A. Illuminated exit signs are installed above the exit doors and in the exit corridors. The exit signs are connected to the emergency generator as well. To supplement this, all exit doors and doors leading to an exit are painted red. The provisions for emergency lighting and the locations of the exit signs are adequate and provide a level of protection consistent with the criteria of NFPA 101, and therefore comply with DOE Orders.

3.3 Security Interface

There are no impediments created by the security system that would prevent the timely evacuation or prompt rescue of personnel in the Building 9203 & 9203A complex.

4.0 FIRE HAZARDS

4.1 Identification of Significant Fire Hazards

The potential fire hazards in the complex are outlined in the following sections. The hazards are addressed on a building by building basis. In general, the occupancies consist of office space, laboratories, and General Industrial occupancy. With the exception of building 9205, all of these are considered to be Ordinary hazard in terms of the fire risk present. Quantities of combustibles in these areas are moderate with no stockpiling of combustibles over 8 ft. high. Anticipated rates of heat release are expected to be moderate and in the range of 1 MW to 10 MW, except in a few isolated areas. Laboratory usage of compressed gas cylinders of hydrogen and methane in building 9205 presents a potential risk of explosion, thus causing this portion of the complex to be classified as a High Hazard Occupancy. The laboratories use limited amounts of flammables (typically 10 to 20 gallons per laboratory mostly in approved cabinets), which categorizes them as Class C Laboratories.

Building 9723-24 - This building is primarily office space. There is currently a clean room located on the east side of the building. The clean room is no longer in use and is to be removed. A small boiler room is located on the southeast side of the building. The area contains steam pressure equipment and an electric boiler. Other than the electric boiler, there are no significant fire hazards in this building.

Building 9203A, first floor - The ground floor of this building contains an electrical switchgear and HVAC room, an X-ray laboratory in room 104, several electrical testing laboratories in rooms 113, 100, and 102, and an ultrasonic testing laboratory in room 105. The rooms typically have entrance doors with a large glass window and a 2-ft X 2-ft louver in their lower half. The X-ray lab has several oil filled dielectric power supplies (less than 25 gallons of oil) and several cable trays. Thorium is stored in a safe in room 113. The quantity of thorium stored is less than 25 grams. Radioactive sources are stored in a closet in the rear of room 102. A 12 gallon approved flammable liquids cabinet is located in room 103.

Building 9203A, second floor - The second floor of this building is office space. Rooms 212 and 215 are raised floor computer rooms. There are no significant fire hazards in these areas.

Building 9203 - A section of the stress fracture testing lab in room 1 is designated as a radiation controlled area. This is because radioactive samples are sometimes tested in two large hydraulic testing stands located in this area. The hydraulic pump and oil tank that supplies the test stands is located in an

exterior mechanical room. The hydraulic system uses approximately 200 gallons of Mobil DTE 25 hydraulic fluid at 2,000 to 3,000 psi with a flow rate of 40 gpm. The high pressure hoses for the hydraulic rams are routed through an opening in the exterior wall. Rooms 7 and 8 are used for surface analysis. Lithium hydride is stored in three glove boxes in room 8. The maximum quantity of hydride is less than a quart of material. The thermally sensitive material in a gray-white crystal form is contained in an Argon atmosphere within the glove boxes. Rooms 13A and 33 are HVAC rooms which contain air handlers and some electrical gear. Room 15 is an air monitoring lab with a radiation control area. Lab quantities of depleted uranium and thorium are stored in this room. Room 17 is an X-ray diffraction laboratory with small amounts of chemicals.
Room 19 is a laser laboratory that has a Class IIIB and a Class IV laser. Room 42 is a laboratory that is presently vacant. Rooms 45 through 50 are micro-analysis laboratories with a scanning electron microscope and a transmission electron microscope. Rooms 47 and 49 contain small quantities of various laboratory chemicals, while room 47 has small quantity of Lithium Hydride in a glove box. Room 49 also has a 12 gallon approved flammable liquids cabinet. The Vacuum Technology Laboratory located in room 150 has various precision machining tools, heavy duty electrical service outlets, and an approved flammable liquids storage cabinet.

The second and third floor are vacant areas that have been roped off as restricted contaminated areas. Compressed gas cylinders are stored in 4 concrete bins on the rear loading dock. The gasses include hydrogen, argon and oxygen. Approximately 6 standard cylinders of each are stored at this location. An acid storage building (building 9959-3) is located adjacent to the loading dock. The acid storage building is a freestanding metal 8-ft X 8-ft building. A gasoline powered generator and the primary building electrical feeder station are located in a detached concrete building (building 9767-9) southeast of the loading dock.
An oil filled transformer is located south of the electrical substation.

Natural gas, argon, and nitrogen are piped into the laboratories from a pipe rack south of building 9203. The manual shut off valves are located outside the building's southwest corner. The natural gas system is not in-service and the system's valves are in the closed position.

Building 9752 - This small building is an electrical maintenance shop that contains testing equipment and soldering instruments, in addition to a machine equipment room and work shop. The primary fire hazards here are small containers of lubricants and cutting oils, shop manuals on open book shelves, and the electrical soldering guns.

Building 9205 - This building is used as the Chemical Vapor Processing Laboratory. A small area in the front is used as a workshop by building maintenance personnel. The laboratory has two vented test chambers, which use hydrogen gas. The excess gas is vented to the outside. The laboratory area contains cylinders of hydrogen, chlorine, methane, and ammonia. The electrical equipment in this building is not Classified equipment. Because of the presence of cylinders of compressed gases inside the building, this is considered a high hazard area.

4.2 Natural Hazards Impact on Fire Safety

In the event of an earthquake, the sprinkler systems in the Building 9203 complex may be damaged. The systems, designed and installed years ago, have not been constructed to withstand seismic loading. NFPA 13, the automatic sprinkler design standard used during the design, did not require earthquake protection for sprinkler systems at the plant, since the plant area is not in an earthquake zone. The plant fire main may be ruptured by a seismic event. Isolation valves are installed in the piping to allow re-directing flow through the yard mains. Currently, the natural gas piping is locked and tagged off at the gas meter on the southwest side of the building, and therefore was not analyzed. If gas service is restored, this FHA will require updating. Electrical wiring and switchgear have also not been designed for a seismic event. These devices could be shaken loose from their mountings, causing sparking and the ignition of surrounding combustibles. The small containers of flammable chemicals in the laboratories, typically containing a few ounces each, could also be shaken from their cabinets causing the breakage of glass containers. A small amount of the 10-20 gallons per laboratory could be released and find ignition sources. Similar events can be postulated for other types of natural disasters. These scenarios are not expected to cause the occurrence of a fire that could not be controlled by a functional sprinkler system or extinguished by the site fire department if available in the natural disaster scenario. Availability during multiple accidents should be evaluated in the safety analysis.

The Building 9203 Complex is located above the area flood plains. The potential for flood damage to the building fire protection systems is, therefore, considered negligible.

The potential for wind storm damage to the fire protection features of Building 9203 and 9203A Complex is possible. A tornado would cause severe damage to the building if it is directly hit. The building has no specialized design features to enable it to withstand tornado force winds.

4.3 Analysis of Potential Fire Scenarios.

Based upon the fire hazards noted in Section 4.1, a variety of potential fire scenarios can be postulated. The events analyzed below are considered to represent the most severe hazards based on the present occupancy and use of the building.

Building 9723-24 - This building is primarily office space, in addition, an electric boiler is located in the southeast corner. The boiler room is not separated from the adjacent areas by fire rated construction. However, automatic sprinklers are installed in the boiler room. Two worst case fire scenarios are postulated for this building. An electrical fault occurs in the boiler causing ignition of the surrounding combustible framing, or an employee leaves a portable heater turned on after hours causing ignition of office furniture. For either case, the installed automatic sprinklers will operate and control or possibly extinguish the fire. Because of the combustible construction of this building, it is possible that the fire may not be confined to the room of origin. Either of the postulated fire scenarios will create smoke and

products of combustion that will be drawn to the center of the building where the solitary air return opening is situated. Because of the sprinklers, damage to the building will be limited. However, smoke and products of combustion from the fire will be drawn through the building exit corridors due to the HVAC system not being de energized by duct mounted smoke detection devices.

Building 9203A, first floor - This area primarily contains individual rooms housing electrical testing and calibration equipment. There are also a mechanical room and two X-ray machines. Radioactive sources are stored in the rear of room 102. Thorium is stored in a steel vault in room 113. The quantity of thorium in the 30 cubic feet vault is less than 25 grams. The postulated fire scenario for this area is a fault in an electrically powered device causing ignition of the electrical device and its interconnected cabling. Since the relative hazard in all of the rooms is approximately equal, the worst case scenario would be a fire event that would also involve the stored thorium. The automatic sprinklers would not be expected to extinguish a fire involving a combustible metal such as thorium. For the thorium to be involved, the fire would first have to breach the steel vault, which is considered unlikely because of the heavy steel construction of the vault and the limited fuel load in the room. The automatic sprinkler system will prevent exposure fires from adversely impacting the stored thorium in the vault. Because of the design of the building HVAC system, contaminated air will be drawn into the corridors, resulting in a health hazard to the building occupants and responding fire fighters. The corridors in this building are used as return air plenums. In a fire situation, smoke and fire gases produced will be drawn into the corridors, making it hazardous for the building occupants to evacuate. The noncombustible construction of the building in conjunction with the sprinkler system will limit any postulated fire to the room of origin.

Building 9203A, second floor - This area is primarily office space with two raised floor computer rooms. The fire hazard here is that expected of a typical business occupancy. Potential fire scenarios could include space heaters, coffee pots, or overloaded electrical circuits. The postulated fires will be controlled or extinguished by the sprinklers. Because of the building's noncombustible construction and area wide sprinklers, the fires are expected to be confined to the room of origin. The corridors in this building are used as return air plenums. In a fire situation, smoke and fire gases produced will be drawn into the corridors, making it hazardous for the building occupants to evacuate.

Building 9203 - Several possible fire scenarios can be postulated for this area. Most of the building consists of laboratories containing limited amounts of flammable chemicals. The hazard in these areas is about equal. The most severe fire exposure would occur in the Stress Fracture testing laboratory if a high pressure hydraulic hose were to rupture and cause ignition of atomized combustible hydraulic fluid. The Laboratory Supervisor indicated that the testing stands are computer controlled and will automatically trip the hydraulic pump upon a loss of pressure. The possibility of a severe fire event occurring is considered low because of this interlock, however, if the assumption is made that the hydraulic pump does not shut down, a significant fire scenario can be postulated. The spraying hydraulic fluid will be discharged as a finely atomized mist. When the hydraulic fluid reaches an ignition source, a sudden ignition along with a rapid flame front would be expected. It is doubtful that the

sprinkler system can control a fire of this nature. While the duration of an oil fire would be limited because the oil reservoir contains only 200 gallons of fluid, this intense initiation source would result in a large self-sustained fire. Fire extension will likely occur to the adjacent office as the interconnecting door is usually kept open. The north wall of the room contains a 300 square foot section of glass block. This could permit the extension of the fire to the Vacuum Technology Laboratory. Smoke, fire gas, and soot damage can be anticipated to spread through the remainder of Building 9203 because the corridors are used as return air plenums and the HVAC systems lack a means to de energize the system during fire conditions. This scenario should be considered by the safety analysis.

The second type of scenario that can be postulated is a laboratory fire similar to that postulated for the first floor of building 9203A. Small quantities of radioactive materials are located in room 15, and lithium hydride is located in glove boxes in rooms 8 and 47. A fire involving these areas would expose the building occupants and the emergency services personnel to potentially contaminated or toxic materials. Lithium hydride is a slightly toxic material that is water reactive and evolves hydrogen on contact with water. The design of the HVAC system in this building uses the corridors as return plenums in the occupied areas. The quantities of hazardous materials stored in the laboratories is small. In most cases, only several liters of flammable liquids were noted. The magnitude of fires in this building is expected to be small. The installed automatic sprinklers will control any fires and limit their spread to the room of origin. As before, the most significant hazard is the design of the building HVAC systems.

A third scenario that is considered is a fire occurring on the second or third floor of this building. These areas are currently vacant, but they are restricted radioactive material contaminated areas. The HVAC system for this area also serves other floors of the building. The spread of smoke and contaminated materials to other areas by the HVAC system is possible. Damage to the first floor of building 9203 from a fire in these areas is expected to be minimal because of the installed automatic sprinkler protection.

Several exterior fire scenarios can be postulated for building 9203. Compressed gas cylinders are stored on the south loading dock. The cylinders are secured with their protective valve caps in place. The storage area has four bays separated by nominal 7 inch concrete block walls and on overhead covering of concrete plank approximately 2 inches thick. The cylinders are placed against the rear wall of the building, allowing open ventilation on one side of the bays. The entire storage area is approximately 3 feet deep by 10 feet in length. About 25 cylinders are stored at this location. The cylinder storage area is on the south loading dock between two rear exit doors. The distance from the cylinders to the doors is about 15 feet. It is not likely that a fire inside the building would involve the compressed gas cylinders because of the concrete separations and sprinklers. A dry pipe sprinkler system is installed for the protection of the loading dock. A fire on the loading dock is not expected to significantly damage building 9203.

The main electrical substation feed and its transformer are located at the southeast corner of the building. The transformer is shielded from the building by the concrete block switchgear building. The

transformer is about 35 feet from building 9203. If the transformer were to be involved in a fire, the slope of the parking area would cause any leaking transformer oil to flow away from the building. In addition to this equipment, a small generator is located on the east side of the switchgear building. The generator is powered by a gasoline driven engine with an internal fuel tank. The capacity of the tank is 15 gallons. Neither of these hazards is expected to impact building 9203 because of the separation distance and the shielding of the intervening concrete block building.

An 8-ft X 8-ft sheet metal acid storage shed is located outside the southwest corner of the building. Acids of themselves are not typically a fire source, but are oxidizers. The acid storage shed is located about one foot from the outside wall of the building. There are no windows or openings into building 9203 at this point. The existing protection for the acid shed is considered adequate. If a fire were to occur in the acid shed, its impact on building 9203 would not be significant due to the concrete block walls and the installed sprinklers.

Building 9752 - The fire hazard in this building is considered minimal. The building is a four room structure that is used by the building electricians as a workshop area and contains a machine equipment room. Limited amounts of combustible materials, consisting primarily of books and shop manuals, are located in this building. The postulated worst case fire event in this building is the potential ignition of the workbench or surrounding combustibles by unattended soldering instrument. The installed sprinkler system should control or extinguish the fire without spread to adjacent buildings.

Building 9205 - The principle fire hazard in this building is the flammable and toxic gasses used in the chemical vapor process equipment. Cylinders of hydrogen, methane, ammonia, and chlorine are used in the processes being investigated. There are one or two cylinders of each material present. Other combustible materials are limited. The postulated worst case fire scenario in this building is caused by a leak of one of the flammable gasses that eventually reaches the lower flammable limit in the presence of an ignition source. Classified electrical equipment is not installed in this area. An explosion will result that could cause damage to the installed sprinkler piping and render the system ineffective. Because of the limited amounts of fixed combustibles in the building, a severe fire exposure is not expected to follow. The ammonia and chlorine gas cylinders may vent their contents during the incident. This will create an atmosphere that is toxic and irritating to the responding emergency service personnel. Other than potential physical damage from flying debris, the postulated incident should not result in fire reaching 9203 or building 9203A, because these masonry buildings are physically separate from building 9205.

4.4 Exposure Fire Potential

Building 9720-20 is approximately 25 feet west of the Building 9203 & 9203A complex. The exterior wall at this location is a masonry wall and does not have any windows or openings. The potential for fire spread to this building from building 9203 and vice versa is considered negligible. The north, east, and west sides of the building are adjacent to streets. The surrounding facilities across the streets from the

complex are provided with automatic sprinkler protection.

There is no potential fire exposure threat to the Building 9203 and 9203A Complex.

4.5 Potential for a Toxic, Biological, or Radiation Incident

4.5.1 Criticality, radioactive materials, and contamination

There are no criticality issues in this building. There are currently no materials capable of causing a criticality accident. The existing criticality alarms have been deactivated. Very small amounts of low level radioactive materials and designated Radioactive Contaminated Areas (RCA) are located as follows:

Building 9203A -

Radioactive sources stored in room 102A
RCA area in room 104
Thorium storage in room 113

Building 9203 -

RCA area in room 1
RCA area in room 15, includes storage of Thorium and depleted Uranium.
RCA area in room 49
RCA second floor tower area

A fire in any of these areas is expected to cause contaminated smoke to be spread to adjacent rooms and corridors.

4.5.2 Chemical, Corrosive Agents, and Other Special Hazards

The chemicals used in the laboratories are typical laboratory chemicals. No extremely hazardous or toxic materials were noted in the laboratory areas. In some of the other areas, special hazards were identified. Building 9205 contains cylinders of chlorine and ammonia. Both of these vapors are harmful to personnel who are exposed to them. Their involvement in a fire situation would impact the people exposed, however, there would be no additional fire damage as a result. Lithium hydride is used in two areas, rooms 8 and 47. The quantity of the material is estimated to be only several ounces, and the material is used inside of glove boxes. The glove boxes containing lithium hydride are under an inert Argon gas blanket. Lithium hydride when exposed to water will react violently by forming hydrogen and igniting upon contact. This material is slightly toxic.

4.5.3 Off-site Impact

The types and quantities of radioactive materials in the Building 9203 and 9203A Complex are not significant. Typically these materials are used only in small quantities for research. During an extensive fire, local contamination could occur in the vicinity of building 9203. Potential off-site contamination from a fire plume is doubtful, due to the location of the complex to the plant boundary, very limited quantities of radioactive material in the buildings, the installed automatic sprinkler protection, and the on-site response of the Y-12 Plant Fire Department.

4.6 Containment of Fluids

Runoff from sprinkler flow or from fire fighting operations would likely drain out of the building and towards the south, due to the existing slope at this location. A system of storm drains is installed at the plant site. In the unlikely event that the sprinkler system were to operate for an extended period, or if fire fighting operations continued for an extended duration, the runoff would enter the storm drain system. Emergency response personnel would initiate procedures to minimize potential fluid run-off during fire emergencies.

5.0 FIRE PROTECTION

5.1 Water Supply and Distribution System

The complex is supplied by the plant combined domestic, industrial, and fire service water supply and distribution system. Two water supply gravity reservoirs having a 7 million gallon water reserve and treatment system are located on the north side of the plant. This system provides water to the Y-12 Plant, Oak Ridge National Laboratory, and the City of Oak Ridge. An additional 6 million gallon reserve supply is provided by three storage tanks (each tank has 2 million gallon capacity) on the south ridge of the plant. This 6 million gallon gravity reserve is dedicated solely to fire protection for the Y-12 Plant. Several feed mains (twenty four inch and sixteen inch diameter) from the water treatment plant to the grid distribution system are provided. In the section of the plant where the 9203 building complex is located, the feeds consist of two 16 inch lines and two ten inch lines. The main feeds connect to an eight inch diameter loop around Building 9203. Three hydrants serve the Building 9203 complex. Hydrant 213 is on the eight inch line in front of the building along First Street. Hydrant 212 is also on the eight inch loop on the east side of the building. Hydrant 205 is supplied from an eight inch line and is located southwest of the building, inside the security fence. The main sprinkler feed to building 9723-24 and building 9203 are six inch diameter lines taken from the eight inch loop. The sprinkler systems are all connected through PIVs located in the yard. The sprinkler feed to building 9205 is supplied by a three inch diameter cross main extended from building 9203.

Flow tests performed on the water distribution system in the vicinity of building 9203 in September 1992 showed excellent flows and pressures. Hydrant 214, located along First Street, north of building

9202 provided a static pressure of 76 psi. With a flow of 3770 gpm, a residual pressure of 62 psi was observed at Hydrant 214. Hydrant 208, located northeast of building 9201-3, provided a static pressure of 90 psi. With a flow of 3912 gpm, a residual pressure of 78 psi was observed at Hydrant 208.

The current yard main system to building 9203 is considered to provide an adequate and reliable water supply and distribution system for any potential fire protection needs, and satisfies the criteria of DOE Order 5480.7A ¶ 9. b. (8).

5.2 Fire Suppression

5.2.1 Sprinkler System

The Building 9203 and 9203A Complex is completely sprinkler protected. The coverage of the building is split into two systems: building 9203A and building 9723-24 are protected by one system, and building 9203, building 9752, and building 9205 are protected by the second system. The rear loading dock is protected by a two inch dry pipe valve, manufactured by Grinnell. This system is connected to the sprinkler system for building 9203, while the front walkway areas of building 9723-24 and building 9752 are protected by anti- freeze loops. The sprinkler systems were installed at different times and with differing types of valve trim and sprinklers.

The wet pipe sprinkler system protecting building 9723-24 and building 9203A is fed from a six inch connection to the yard main on First Street. The sprinkler riser is located in the lunch room area in the north section of building 9723-24. A Tyden six inch alarm check valve is installed on the riser above the system OS&Y valve. A PIV, locked in the open position and supervised with a tamper switch, is also provided in the yard outside the building. Waterflow is indicated by a water motor gong and a pressure switch located above the retard chamber. The water flow alarm is electrically connected to the Gamewell fire alarm system. Tamper indication is provided by stem mounted tamper switches on the control valves. A fire department siamese connection is located on the north wall of the building at this location. Spare sprinklers for building 9723-24 are marked Viking Model C 1953, 165 ^{o}F. Observation of exposed sprinkler piping showed that the system is a pipe schedule system designed for Ordinary hazard. Spacing is approximately 115 square feet per sprinkler. Where suspended ceilings are installed, there are sprinklers both above and below the ceiling. The system installed in building 9203A is similar, however, newer style sprinklers are installed. There are two raised floor computer rooms in building 9203A. These areas are in rooms 212 and 215 on the second floor. Additional branch lines are located beneath the raised floor areas in these rooms. A shutoff valve for room 212 is located at the ceiling level in the corridor just outside the room.

The wet pipe sprinkler system protecting building 9203, building 9752 and building 9205 is fed from a six inch connection to the yard main on the east side of the building. The sprinkler riser is located in room 26 on the east side of building 9203. An Automatic Sprinkler Company six inch alarm check

valve is installed on the riser. A PIV, locked in the open position and provided with a tamper switch, is provided in the yard outside the building to isolate the system. Waterflow is indicated by a water motor gong and a pressure switch. The water flow alarm is connected to the Gamewell fire alarm system. A fire department siamese connection is located on the east wall of the building at this location. The sprinkler system is designed and installed to Ordinary hazard requirements. Where suspended ceilings are installed, there are sprinklers both above and below the ceiling.

The automatic sprinkler systems in Building 9203 and 9203A Complex, in general, conform to NFPA 13, Standard for the Installation of Automatic Sprinkler Systems, and are considered adequate for the hazards present in these buildings. Some minor concerns were identified in the most recent assessment, that have a limited impact on the overall effectiveness of the systems. The installed automatic sprinkler protection conforms to the fire protection criteria in DOE Order 5480.7A.

5.2.2 Standpipe Systems

No standpipe systems are installed in any buildings in this complex. Interior fire attack will be performed by fire department hose evolutions. The multiple exterior doors allow the fire department to attack a fire from different directions in the event one of the doors is obstructed by the fire. A 200 foot hose lay is capable of reaching all areas in these buildings. NFPA 101 does not specify a standpipe system for a two story Business / Industrial Occupancy. The present arrangement is considered to provide a level of protection adequate for the occupants of the building, and complies with DOE Orders.

5.2.3 Portable Fire Extinguishers

Multipurpose dry chemical fire extinguishers, having 2A-10BC ratings, are installed throughout the corridor areas of the Building 9203 and 9203A Complex. The extinguishers are spaced at about 75 foot intervals. Additional units are located in some of the various laboratories and shop areas. CO_2 units, having 20 lbs. of agent, and 2-1/2 gallon pump type water units are provided in each computer room in accordance with DOE/EP-0108. Larger multipurpose dry chemical fire extinguishers, having 20A-120BC ratings, are located in areas where pressurized hydraulic lines or other combustible liquids could be encountered. These areas include the Vacuum Technology laboratory and the Stress Fracture Testing laboratory. A container of Class D (Coke) extinguishing agent is located in room 8 for use on combustible metal fires. Building 9205 is provided with 20 lb CO_2 units and cartridge operated dry chemical extinguishers.

The portable fire extinguishers in the Building 9203 and 9203A Complex have current inspection tags, are spaced within the 75 foot travel distance limitation of NFPA 10, and provide the area coverage specified in Table 3-2.1 of NFPA 10. Specialized extinguishers are located in areas requiring protection of particular hazards. The fire extinguishers are adequate for the first aid fire fighting needs of the occupants of the buildings, and conform to the requirements listed in NFPA 10, Portable Fire

Extinguishers.

5.3 Protective Signaling System

5.3.1 Fire Detection System

Limited fire detection capability is provided in this complex. Two local control panels are installed. A Pyrotronics System 3 control panel is mounted in the second floor corridor of building 9203A. This panel is used to monitor the smoke detectors in computer rooms 212 and 215. The smoke detectors in these rooms are located below the raised floor and on the ceiling. The other control panel is mounted in the middle corridor of building 9203. This panel is a Gamewell Zans 400 model that is used to monitor the duct detectors installed in room 19. The local control panels are connected to the plant-wide fire alarm system. The above mentioned detectors are the only detection devices in this complex.

A significant concern was identified with the fire alarm system as it relates to the HVAC systems. Fifteen separate HVAC systems are installed in the complex. The HVAC fans can only be stopped by deactivating the circuit breaker for the power supply. The breakers are typically located in the fan rooms which are located at several different stations, mainly on the roof. The majority of the systems are recirculating type systems that use the corridors for a return plenum. In a laboratory fire situation, the exit corridors will be subject to smoke and possibly toxic or contaminated products of combustion. Duct mounted smoke detectors should, therefore, be installed in all of the recirculating systems in accordance with NFPA 90A to automatically stop the fans upon detection of smoke. The present condition of the fire alarm system does not satisfy the requirements of DOE Orders.

5.3.2 Manual Alarm Systems

The Building 9203 and 9203A Complex is connected to the plant Gamewell fire alarm system. The plant wide system connects all of the facilities to a central monitoring station located in building 9710-2 and to the Plant Shift Superintendent's office in building 9706-2. Any actuated manual pull station or water flow alarm will automatically be transmitted to the site fire department. The fire department will respond with a full assignment consisting of an incident command vehicle, ambulance, an aerial ladder/pumper combination, and rescue vehicle. Standard operating procedures are to respond to the master box that is in alarm and then determine the location of the event from the annunciator panels located by each master box. The building is connected to master box #215 located at C Road and First Street just west of Building 9202. The alarm system includes eight manual pull stations, waterflow and tamper alarms, and duct smoke detectors for the Laser Lab in Room 19. The existing manual alarm system has been designed in accordance with NFPA standards, and is considered marginally adequate for the protection of this building complex.

5.3.3 Notification System

The building evacuation signals are announced over PA system speakers installed throughout the corridors. All personnel alerting signals are announced over the plant PA system from the Plant Shift Superintendent's control center. This includes all site emergencies such as severe weather, weather, radiation incidents, fires, etc. The PA system is installed in each building, as well as in the yard areas, and is routinely tested. Although the PA system is not a UL listed fire alarm audible indicating system, it is tested and used daily. This is considered to provide an acceptable level of reliability as compared to UL listed appliances that are only periodically tested. This system has a UPS secondary power supply with diesel driven generator back-up. The PA system has been evaluated by Factory Mutual at the plant and found to be acceptable to FM. The notification system, while not designed in accordance with NFPA standards, is considered adequate for the protection of this complex, based on Factory Mutual's acceptance.

5.4 Fire Department/Fire Brigade Response

Reference (a) verifies that the Y-12 Plant Fire Department is trained and equipped to handle any fire that could occur in a building the size of the Building 9203 & 9203A complex.

The Y-12 Plant Fire Department has prepared pre-fire plans for building 9203 and building 9203A. The incident command vehicle of the fire department carries a set of pre-fire plans for the plant, including the above mentioned plans. Additional sets of pre-fire plans are located at the fire department, building 9710-2, and the PSS office, building 9706-2.
The most recent assessment of this building identified deficiencies with the pre plans because they lack sufficient information on high dollar value equipment, critical process equipment, locations of HVAC system controls and shut-offs, and potential salvage operations.

Based upon a review of the Y-12 Plant Fire Department response records over the last 12 months, the response time for the Y-12 Plant Fire Department to respond to the Building 9203 and 9230A Complex is less than 2 minutes from receipt of the alarm or call. The distance from the fire station to the complex is less than 1/2 mile. The Building 9203 and 9203A Complex is accessible by the fire department on the north, east, and south sides of the complex. The west side of the complex has a 7 ft. high security fence, which separates the complex from the limited area of the plant. This security fence has a vehicle access gate, which is normally locked. This fence could hinder fire department access to the buildings from the west side. Three hydrants serve the Building 9203 complex. Hydrant 213 is on the eight inch line in front of the building along First Street. Hydrant 212 is also on the eight inch loop on the east side of the building. Hydrant 205 is supplied from an eight inch line and is located southwest of the building, inside the security fence. The main sprinkler feed to building 9723-24 and building 9203 are six inch diameter lines taken from the eight inch loop. Isolation valves are provided, and adequately spaced on the fire water distribution system.

There is no fire brigade for this building, nor is one needed.

6.0 FACILITY EQUIPMENT AND PROGRAM PRESERVATION

6.1 Protection of Essential Safety Class Systems

No essential class safety systems are contained in these buildings. The nature of the experiments conducted may involve small quantities of fissile materials; however, there are no systems in the buildings that require management during a fire event to preclude reaching an unrecoverable condition.

6.2 Critical and Vital Programs

6.2.1 Identification of Vital Programs Impacted and Recovery Potential

In the event of a fire in this complex, the amount of fire damage and resultant downtime will depend on the fire source and the extent of fire spread after activation of the sprinklers. Because of the building's automatic sprinkler protection, it is anticipated that the postulated credible fires will cause the facility to be down for a period of 6 to 12 months, with the loss of precision scientific testing and calibration equipment, non-critical records, and software that is not duplicated elsewhere. The operations in this building are unique and cannot be performed by another facility. The critical process equipment located in this building is precision scientific testing and calibration equipment. A fire occurring near this equipment is expected to damage the sensitive equipment from the adverse effects of smoke, fire gases, and heat. For equipment not directly involved in the fire, activation of the wet pipe sprinkler system adjacent to the equipment and manual fire fighting actions will likely cause damage to the equipment. In fires where there is either considerable quantities of smoke and extensive use of water from fire hose application, considerable damage is anticipated, unless prompt salvage operations aid the restoration of operations and limit potential damage. A deficiency was identified in the latest Assessment for the Building 9203 and 9203A Complex pre-fire plans, because they do not contain any information about the need for prompt salvage actions, nor is the location of the high dollar equipment that needs to be protected identified. The personnel in these areas indicated that all of this equipment is 20 years old or older, and would most likely be replaced rather than be repaired.

6.2.2 Identification and Protection of Critical Process Equipment.

The following equipment has been identified as being critical to the mission of this building complex:

<u>Building 9203 -</u>

1) Stress fracture test stands in room 1
2) X-ray equipment in room 17

3) Two laser units in room 19
4) Transmission electron microscopes in rooms 45 and 46.
5) Scanning electron microscope in room 48
6) Scanning auger microscope and secondary ion microscope in the SIMS laboratory

All of this equipment is located in areas having area wide automatic sprinkler protection. Room 19 also has duct smoke detectors to stop the HVAC supply fans upon the detection of smoke.

Building 9203A -

1) Non destructive X-ray test equipment in room 104 and its control equipment in room 102.
2) Ultrasonic test equipment in room 105.

All of this equipment is located in areas having area wide automatic sprinkler protection.

Building 9205 -

No critical process equipment

Building 9723-24 -

No critical process equipment

Building 9752 -

No critical process equipment

6.3 Identification and Protection of High Dollar Value Equipment

The following equipment has been identified as having a replacement cost over $ 250,000.

Building 9203 -

1) Stress fracture test stands in room 1 $500,000
2) X-Ray equipment in room 17 $600,000
3) Two laser units in room 19 $400,000
4) Transmission electron microscope in room 45 $500,000
5) Scanning electron microscope in room 48 $350,000
6) Scanning auger microscope (cols. 8-9 & A-B) in the SIMS Laboratory $600,000
7) Secondary ion microscopes (cols. 9-11 & A-B) in the SIMS Laboratory $1,000,000

All of this equipment is located in areas having area wide automatic sprinkler protection. Room 19 also has duct smoke detectors to stop the HVAC supply fans upon the detection of smoke.

Building 9203A -

1) Non destructive X-ray test equipment in room 104 and its control equipment in room 102. $600,000
2) Ultrasonic test equipment in room 105. $1,000,000
3) Computer equipment in rooms 212 and 215. $300,000

All of this equipment is located in areas having area wide automatic sprinkler protection. Computer rooms 212 and 215 are also protected by area wide smoke detectors located on the ceiling and below the raised floor.

Building 9205 -

No high dollar equipment

Building 9723-24 -

No high dollar equipment.

Building 9752 -

No high dollar equipment

6.4 Facility Damage Potential

6.4.1 Maximum Credible Fire Loss

The MCFL for this complex is predicted for a fire in the ultrasonic testing area, room 105 in building 9203A. The estimated value of the equipment in this room is in excess of $1,000,000. The downtime for the facility and potential loss of proprietary computer software related to the test facility could increase this estimate. High dollar value equipment is located in several areas of the complex, however, in all other cases the highest dollar loss in a single room is under $750,000. Because of the non-combustible construction of the facility and the installed automatic sprinklers, fire is not expected to extend beyond the room of origin in any area containing high dollar value equipment. With the present

HVAC system, the spread of smoke and products of combustion will occur in the corridors and adjacent rooms. This will increase the total fire loss. The MCFL considering this is estimated to be $1,500,000.

6.4.2 Maximum Possible Fire Loss

The MPFL for this building complex is predicted to be an uncontrolled fire occurring in the southwest corner of building 9203. The equipment in the micro analysis lab and the X-ray diffraction lab is valued at a total of $850,000. The uncontrolled fire is predicted to generate sufficient amounts of smoke and products of combustion to damage all of this equipment, the contents of the building, and to cause localized structural damage. Due to the design of the HVAC system, surrounding areas will also be subject to this damage. Because of the lack of qualified penetration seals and other issues identified with the fire barriers in this complex, the fire damage will not be contained to just this building. Considering this possible extent of damage, the MPFL is estimated to be $7,000,000. The limited amount of hazardous and radioactive material is not likely to cause measurable contamination beyond the building boundaries.

6.5 Emergency Planning

Emergency planning at the Y-12 Plant is carried out be the site Emergency Preparedness Department. This group has responsibilities in alarm notification and building evacuation, spill prevention and control, security planning, and other emergency operations.

During any emergency at the Y-12 Plant, the Plant Shift Superintendent (PSS) is in-charge of the emergency operations. During fire conditions, the senior fire department officer is the incident commander at the fire scene. If additional resources are needed during emergency conditions, the PSS can activate the Emergency Operations Center (EOC), which is located in building 9706-2. Designated personnel from support groups, such as utilities, health and safety, security, maintenance, and other needed plant groups, respond to the EOC. The operations of the EOC are proceduralized, and the designated personnel receive training on their roles and responsibilities during emergencies. Reference (c) provides additional details on Emergency Planning.

6.6 Security Coordination

The fire department responds to fire emergencies at the Building 9203 & 9203A complex from the protected area of the plant. Standard operating procedures are in place to assure that the emergency response through security gates is not delayed exiting the protected area. The security provisions for this building would have no adverse impact on the fire fighting operations.

With regard to fire fighting evolutions for building 9203, Hydrant 205, which is located southwest of the complex, is inside of the limited zone fence. Hydrants 212 and 213 are available to the fire department

from locations outside of the fence. If these two hydrants could not supply sufficient fire flow and Hydrant 205 was needed, security will need to open the normally locked security gate adjacent to the hydrant. It is not expected that this situation would ever occur. Recent tests show that both of the hydrants outside the fence are capable of flowing in excess of 3,000 gpm. The fire department siamese connections for the two sprinkler zones in the building are located convenient to these two hydrants.

7.0 CONCLUSION

The overall assessment of the fire hazards analysis for the Building 9203 and 9203A Complex is that the complex meets the intent of the applicable DOE fire protection orders, with the exception of the three identified major deficiencies. Until these three items are corrected, the level of fire protection provided is not considered acceptable.

8.0 RECOMMENDATIONS

There are three major fire protection concerns in the Building 9203 and 9203A Complex requiring correction.

Recommendations to correct minor deficiencies are found in the Fire Protection Assessment for the Building 9203& 9203A complex.

The major deficiencies are:

1) The Building 9203 and 9203A Complex lacks a comprehensive fire barrier maintenance program, as required by DOE Order 5480.7A ¶ 9.b. (2) and (5)

Deficiencies were noted with all of the fire barriers during the field survey of the complex. The rear stairway of building 9203A has numerous penetrations through the protected exit enclosure. The penetrations include conduits, cable trays and a duct that is approximately 3 feet by 4 feet in dimension. NFPA 101 specifies that exit enclosures must not be penetrated except for sprinkler piping, stair pressurization, or conduits for lighting within the exit.

The concrete block wall that separates building 9723-24 from building 9203 has numerous open penetrations for conduits and computer cables that have not been properly sealed.

The south wall of the Vacuum Technology Laboratory includes a section of approximately 300 square feet of glass block. The glass block has been painted to resemble the adjacent concrete blocks. The glass wall will not provide a two hour fire rating.

The wall between building 9203 and building 9752 is a hollow clay tile barrier. The door in this wall has an ordinary glass vision panel, approximately 10-in X 10-in. The ordinary glass will not provide the

required fire rating.

The corridor doors to the computer rooms (212 and 215) on the second floor of Building 9203A have large vision panels and ventilation louvers in their lower half. Per NFPA 75, computer rooms should be separated from adjacent areas by one hour rated construction.

2) The HVAC systems lack duct mounted smoke detectors to de-energize the supply fans to prevent recirculation of fire by-products. This special hazard protection is required by DOE Order 5480.7A ¶ 9.b. (12) and (13)

At least, fifteen separate HVAC systems are installed in the complex. The HVAC fans can only be stopped by deactivating the circuit breaker for the power supply. The breakers are typically located in the fan rooms which are mainly on the roof. The majority of the systems are recirculating type systems that use the corridors for a return plenum. In a laboratory fire situation, the exit corridors will be subject to smoke and possibly toxic or contaminated products of combustion. Duct mounted smoke detectors should, therefore, be installed in all of the recirculating systems in accordance with NFPA 90A to automatically stop the fans upon detection of smoke.

3) In building 9205, leakage of flammable gases from the hydrogen, methane, and ammonia gas cylinders used in the chemical vapor process presents a potential hazardous fire situation. This special hazard protection is required by DOE Order 5480.7A ¶ 9.b. (13)

The flammable gas cylinders should be relocated external to the building or flammable gas detection provided in the building and connected to the plant fire alarm system.

9.0 REFERENCES

(a) "Site-Wide Fire Protection Features", Y-12 Plant, Y/XP-198, dated February 10, 1992.
(b) Fire Protection Assessment for Building 9203, dated March, 1993

(c) Y-12 Plant Emergency Plan, dated July, 1992

APPENDIX A

BUILDING 9203/9203A FLOOR PLANS AND SITE PLAN

APPENDIX B

QUALIFICATIONS OF AUTHORS

Randall Eberly: B.S. degree in Fire Protection Engineering from the University of Maryland; Registered Professional Fire Protection Engineer; 21 years experience in fire protection engineering as a private consultant and as an employee of the Nuclear Regulatory Commission, U.S. Coast Guard, Tenera, and Events Analysis, Inc.

Robert O'Laughlin: B.S. degree in Fire Protection Engineering from the University of Maryland; Registered Professional Fire Protection Engineer; Certified Safety Professional; 32 years experience in fire protection engineering as a private expert and as an employee of the National Institute of Standards and Technology, Professional Loss Control, Union Carbide, and the Tennessee Valley Authority.

ANNEX #1 AUGUST 2, 1995

A re-assessment of the Building 9203 and 9203A Complex was conducted in July and August 1995. Generally, the construction, occupancy, and use of the building have not changed except for the items listed below.

The conditions identified in this assessment that vary from the Fire Hazards Analysis are the following:

Construction:

In building 9203, a noncombustible suspended ceiling was installed below the piping and ventilation ducts in the corridors. Sprinklers have been installed below the new ceiling.

In building 9723-24, a new partition was added in the Class "C" place of assembly with double leaf swinging doors that open in the direction of exit travel.

Fire Hazards:

In building 9203, the glove boxes containing the lithium hydride have been re-located from rooms 7 and 8 to room 42.

In room 13 in building 9203, an Adept robotics machine has been installed in the northwest corner of the room to be used as a de-burring tool machine for Sandia Lab. The value of the machine and computer equipment is approximately $500,000. Currently, the machine is not operational.

In building 9205, the hydrogen gas cylinders and the ammonium gas cylinders have been removed from the building. This eliminates a significant fire hazard identified in the FHA and re-classifies this occupancy from "High Hazard" to "Ordinary Hazard".

Life Safety:

New exit signs and directional exit signs have been installed in the 9203 and 9203A Complex.

In building 9723-24, the double leaf door from the Class "C" place of assembly has been reversed. Reversing the door swing for the place of assembly in building 9723-24, corrects a deficiency identified in the March 1993 analysis.

Status of FHA Recommendations:

The status of the deficiencies listed in the March 1993 Fire Hazards Analysis for Buildings 9203 and

9203A Complex is as follows:

Recommendation #3: In building 9205, leakage of flammable gases from the hydrogen, methane, and ammonia gas cylinders used in the chemical vapor process presents a potential hazardous fire situation. This special hazard protection is required by DOE Order 5480.7A, ¶9.b. (13).

> Status: CLOSED - The flammable gases have been removed from this building. The chemical vapor process which used flammable gas cylinders in building 9205 is not operational.

All other recommendations from the March, 1993 FHA remain OPEN.