11.1 CIVIL STRUCTURAL SYSTEMS

11.1.1 Function

The safety functions of the principal SSCs associated with the civil structural systems are discussed in Chapter 5. Civil structural systems provide the following functions:

- Support principal structures, systems, and components (SSCs) and other SSCs during normal, severe, and extreme loading conditions
- Provide confinement functions as part of secondary and tertiary confinement systems
- Protect principal SSCs from the effects of normal, severe, and extreme environmental loads
- Protect principal SSCs from the effects of design basis internal and external fires by providing fire barriers.

11.1.2 Description

The civil structural systems for the Mixed Oxide (MOX) Fuel Fabrication Facility (MFFF) include the buildings, support structures, and facilities that house, support, confine, or contain various plant systems, components, and equipment associated with licensed nuclear materials, or hazardous chemicals associated with licensed nuclear materials, as well as support buildings.

The buildings and structures of the MFFF are arranged as shown in Figure 11.1-1. They provide for safe, secure, and efficient performance of all MFFF functions. In particular, the site layout and facility features satisfy stringent security criteria for safeguarding the special nuclear material utilized at the MFFF.

The entire MFFF site comprises an area of approximately 41 ac (16.6 ha). Approximately 17 ac (6.9 ha) of the site are developed with buildings, facilities, or paving. The remaining 24 ac (9.7 ha) are landscaped in either grass or gravel. No highways, railroads, or waterways traverse the MFFF site, and the movement of material and personnel to and from the MFFF site takes place via the Savannah River Site (SRS) internal road system.

A double perimeter intrusion detection and surveillance (PIDAS) fence surrounds the Protected Area (PA) of the MFFF. The PA occupies approximately 14 ac (5.7 ha) and is roughly square in shape. The MFFF Administration Building and the Gas Storage Facility are located outside the PA. The Secured Warehouse Building, which is located adjacent to the site access road, is an integral part of the outer PIDAS security barrier. All other buildings and facilities of the MFFF lie within the PA.

Three categories of structural design requirements are defined. The categories, loadings, and structures are defined in detail in subsequent sections and are summarized as follows:

- **Seismic Category I (SC-I)** – Normal, severe, and extreme environmental loads, including the design basis earthquake and tornado, which are applied to principal SSCs.

- **Seismic Category II (SC-II)** – Normal, severe, and extreme loading with extreme loads limited to the design basis earthquake. These loads are applied to structures whose failure could adversely impact principal SSCs (i.e., secondary seismic interaction).
- **Conventional Seismic (CS)** – Normal, severe, and extreme loads with extreme loads limited to conventional seismic loads as specified by the Uniform Building Code.

Table 11.1-1 identifies the structures located at the MFFF site and defines the seismic category classification of each. The following section briefly describes the MFFF buildings and structures and includes conceptual general arrangement drawings.

11.1.3 Major Components

11.1.3.1 MOX Fuel Fabrication Building (BMF, SC-I) (Figures 11.1-2 through 11.1-32)

The MOX Fuel Fabrication Building consists of three areas: the MOX Processing Area (BMP), the Aqueous Polishing Area (BAP), and the Shipping and Receiving Area (BSR). The MOX Processing Area is approximately 300 ft (91 m) by 300 ft (91 m) by 64 ft (20 m) high, with three basic floor levels and numerous, smaller, intermediate platforms to accommodate the various process equipment and operations. The Aqueous Polishing Area is approximately 120 ft (37 m) by 140 ft (43 m) by 80 ft (24 m) high with seven basic floor levels. The Shipping and Receiving Area is approximately 120 ft (37 m) by 165 ft (50 m) by 64 ft (20 m) high with three floor levels, except in the Truck Bay Area where there are two levels. All three building areas have a common roof level. The base levels of the MOX Processing Area and the Shipping and Receiving Area are at grade (finished floor elevation of 273 ft [83 m]), and the base level of the Aqueous Polishing Area is approximately 17 ft (5.2 m) below grade (elevation 256 ft [78 m]).

The overall basic structural framing system for the MOX Processing Area and the Shipping and Receiving Area consists of reinforced concrete frames of columns and beams with concrete shear walls, floor, and roof slabs. The basic structural framing system for the Aqueous Polishing Area is reinforced concrete walls, floor, and roof slabs. Interior partitions are constructed of reinforced concrete. The roof structure is a flat reinforced concrete slab (details discussed below) with a membrane top. All personnel doors are hollow metal in metal frames. There are a number of special doors for security or function, such as rolling (roll-up) doors, as well as a number of removable wall panels for removal or replacement of processing equipment.

The base mat of the entire MOX Fuel Fabrication Building is a minimum 4 ft (1.2 m) thick reinforced concrete. Exterior walls of the MOX Fuel Fabrication Building are reinforced concrete with an additional outer reinforced concrete retaining wall. This wall, which is part of the outer security barrier, is approximately 3 ft (0.9 m) away from the exterior wall of the MOX Fuel Fabrication Building, and the space between the two walls is filled with an engineered fill material that provides security functions.

The structural roof slab of the MOX Fuel Fabrication Building is reinforced concrete with engineered fill material atop the roof slab, which is covered by an additional concrete slab. This roof system also provides a security function.

11.1.3.2 Emergency Diesel Generator Building (BEG, SC-I) (Figure 11.1-33)

The Emergency Diesel Generator Building is a single-story (24 ft [7.3 m] inside ceiling height), slab-on-grade reinforced concrete building with a footprint of approximately 44 ft (13 m) by 143 ft (44 m) or 6,300 ft^2 (585 m^2). Heating, ventilation, and air conditioning (HVAC) equipment for the Emergency Diesel Generator Building is located on an elevated, structural-steel-framed, concrete deck located above the switchgear rooms. Air intake and exhaust vents for the diesel generators themselves are in the individual diesel rooms and are geometrically configured to preclude entry of the design basis tornado missile.

11.1.3.3 Safe Haven Buildings (BSH, SC-II) (Included in Figures 11.1-3, -11, -16, and -24)

The five Safe Haven Buildings are located at grade and at the emergency exits from the MOX Fuel Fabrication Building. The safe havens are single-story (8 ft [2.5 m] inside ceiling height) buildings with a footprint of approximately 46 ft (14.0 m) by 50 ft (15.2 m) or 2,300 ft^2 (214m^2). The same outer security barrier that protects the exterior walls and roof of the MOX Fuel Fabrication Building also protects the exterior walls and roof of the Safe Haven Buildings.

11.1.3.4 Reagent Process Building (BRP, CS) (Figure 11.1-34)

The Reagent Process Building is a single-story (12 ft [3.7 m] inside roof/ceiling height) building of approximately 10,000 ft^2 (929 m^2). The floor is reinforced concrete slab on grade with a perimeter strip footing adequate for the building loads and soil conditions. The exterior walls and roof are constructed of concrete.

11.1.3.5 Administration Building (BAD, CS) (Figures 11.1-35 and 11.1-36)

The Administration Building is a two-story, steel-framed structure. The first story is slab on grade, and the second story is lightweight concrete on metal decking and bar joist framing. The exterior walls consist of masonry or metal veneer.

11.1.3.6 Secured Warehouse Building (BSW, CS) (Figure 11.1-37)

The Secured Warehouse Building is a single-story (24 ft [7.3 m] eave height), slab-on-grade, metal building of approximately 8,000 ft^2 (743 m^2) with metal roofing and siding. The Secured Warehouse Building receives and stores the materials, supplies, and equipment received in the PA that are stored onsite for future use. The Fresh Fuel Shipping Package Storage/Maintenance Area provides storage and space for incidental periodic maintenance of these shipping packages.

11.1.3.7 Technical Support Building (BTS, CS) (Figures 11.1-38 and 11.1-39)

The Technical Support Building is a steel-framed building supported on spread footings. The floor covers an area of approximately 43,000 ft^2 (3,995 m^2) and is slab on grade. The Technical Support Building is located between the Administration Building and the MOX Fuel Fabrication Building. It provides the main support facilities for MOX Fuel Fabrication Building personnel. It serves as the sole personnel access into and out of the PA access (except for vehicle drivers escorted in and out of the Vehicle Access Portal). Such activities as badging, photo identification, search, and pass-through take place in the personnel access portal in the Access

Control Area. The Technical Support Building is not directly involved in the principal processing functions of the MFFF. Supporting activities and facilities located in this building include health physics facilities, an electronics maintenance lab, a mechanical maintenance shop, personnel locker rooms, and a first aid station.

11.1.3.8 Standby Diesel Generator Building (BSG, CS) (Figure 11.1-40)

The Standby Diesel Generator Building is a single-story (18 ft [5.5 m] eave height), slab-on-grade, metal building, with metal roofing and siding. The building has a footprint of approximately 5,500 ft^2 (511 m^2). The building contains two standby diesel generators. Supporting electrical equipment is located adjacent to the diesel generator rooms and is separated by firewalls.

11.1.3.9 Miscellaneous Site Structures (CS)

The miscellaneous site structures include a bulk gas storage pad, HVAC and process chiller pads, diesel fuel filling station, electric transformer pads, and other minor structures.

11.1.4 Control Concepts

This section is not applicable to buildings and structures.

11.1.5 System Interfaces

Civil structural systems interface with the site and all plant systems because they provide protection and support for SSCs.

11.1.6 Assurance Measures for Non-Principal SSCs

11.1.6.1 Seismic Category II (SC-II) Structures

11.1.6.1.1 Functions of SC-II Structures

SC-II structures must maintain integrity during the design basis earthquake to avoid adverse impact on principal SSCs.

11.1.6.1.2 Requirements for SC-II Structures

11.1.6.1.2.1 Structural Analysis Requirements for SC-II Structures

SC-II structures are analyzed for the loads and loading combinations identified in Section 11.1.6.1.4.1. Appropriate consideration is given to the load distribution on the structure (e.g., point loads, uniformly distributed loads, or varying distribution of loads) and the end restraint conditions applicable for the structural component being considered.

Analyses may be performed using equivalent static loads, with appropriate consideration of impact effects for moving loads as specified for the particular loads described in Section 11.1.7.4.1.

11.1.6.1.2.2 Seismic Analysis Requirements for SC-II Structures

The seismic analysis requirements for SC-II structures are the same as specified in Section 11.1.7.4.1.3 (under "Seismic Loads") for SC-I structures.

11.1.6.1.2.3 Structural Design Requirements for SC-II Structures

Design of SC-II Concrete Structures

The design of SC-II concrete structures uses the ultimate strength design methods in accordance with the requirements of ACI-318, *Building Code Requirements for Reinforced Concrete Structures*.

All structural concrete used in construction of SC-II structures has a minimum compressive strength of 4,000 psi. All reinforcing steel used in SC-II structures has a minimum yield strength of 60,000 psi.

Concrete expansion anchors for SC-II structural applications are of the undercut or wedge type design.

Design of SC-II Steel Structures

SC-II steel structures are designed in accordance with AISC ASD, *Manual of Steel Construction, Allowable Stress Design*. Elastic design methods are generally used for steel design. However, under extreme loading conditions, plastic design methods may be used.

11.1.6.1.2.4 Foundation Design Requirements for SC-II Structures

The maximum allowable static and dynamic/seismic soil-bearing pressures are presented in Table 11.1-2. Foundations for SC-II structures are designed in accordance with the appropriate requirements of Section 11.1.6.1.2.3.

11.1.6.1.3 Codes and Standards for SC-II Structures

Codes and standards applied to the MFFF SC-II structures are the same as those specified in Section 11.1.7.3, except the following are not applicable:

- ACI-349-97, *Code Requirements for Nuclear Safety-Related Concrete Structures & Commentary*
- ACI-349.1R-91, *Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures*, Reapproved 1996
- ACI-349.2R-97, *Embedment Design Examples*
- ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities*.

11.1.6.1.4 Values for SC-II Structures

11.1.6.1.4.1 Structural Design Loads for SC-II Structures

Design loads are based upon anticipated building loads (i.e., dead loads, live loads, operating and transient loads, and natural phenomena hazard loads). These loads are divided into three classifications (normal loads, severe environmental loads, and extreme environmental loads) as specified in Section 11.1.7.4, except the only extreme environmental load considered is the design basis earthquake (E'). The MFFF site design criteria are summarized in Table 11.1-2. The structures located at the MFFF site, along with their seismic category classification, are provided in Table 11.1-1.

11.1.6.1.4.2 Loading Combinations for SC-II Structures

Loading combinations for the design of SC-II structures and facilities are the same as the loading combinations for SC-I structures, as specified in Section 11.1.7.4, except the only extreme environmental load considered is the design earthquake (E').

11.1.6.1.4.3 Applicability of Loads for SC-II Structures

The following criteria are considered when determining applicable loading combinations for the design of the MFFF structures:

- Live loads are applied fully, partially, totally removed from the members, or shifted in location and pattern as necessary to obtain the worst-case loading conditions for maximizing internal forces and moments for all loading combinations. Impact forces caused by moving loads are applied where appropriate.
- Appropriate construction loads are considered in the service loading combinations. Construction methods and sequence are considered, and appropriate loading conditions are applied to ensure the structural integrity of partially erected or open structures.

11.1.6.2 Conventional Seismic (CS) Structures

11.1.6.2.1 Functions of CS Structures

CS structures protect and support conventional quality SSCs.

11.1.6.2.2 Requirements for CS Structures

Structural analysis and design of CS structures are in accordance with the Uniform Building Code.

11.1.6.2.3 Codes and Standards for CS Structures

The following are the codes and standards for CS structures:

- International Conference of Building Officials (ICBO)
- Uniform Building Code, 1997.

11.1.6.2.4 Values for CS Structures

Design loads for CS structures are normal, severe, and extreme loads with extreme loads limited to conventional seismic loads as specified by the Uniform Building Code.

11.1.7 Design Basis for Principal SSCs

11.1.7.1 Functions of SC-I Structures

SC-I structures provide the following functions:

- Support principal SSCs during normal, severe, and extreme loading conditions
- Provide confinement functions as part of secondary and tertiary confinement systems
- Protect principal SSCs from the effects of normal, severe, and extreme environmental loads
- Protect principal SSCs from the effects of temperature extremes, including design basis internal and external fires, by providing fire barriers
- Protect principal SSCs from the effects of design basis man-induced events, including potential load drops.

11.1.7.2 Requirements for SC-I Structures

11.1.7.2.1 General Structural Analysis Requirements

SC-I structures are designed for the loads and loading combinations specified in Section 11.1.7.4. Appropriate consideration is given to the load distribution on the structure (e.g., point loads, uniformly distributed loads, or varying distribution of loads) and the end restraint conditions applicable for the structural component being considered.

Analyses may be performed using equivalent static loads, with appropriate consideration of impact effects for moving loads as specified for the particular loads described in Section 11.1.7.4. The special provisions outlined in Section 11.1.7.4.1.3 (under "Seismic Loads" and "Tornado Loads for SC-I Structures") are used for performing analyses for seismic loads and tornado missile impact loads, respectively.

11.1.7.2.1.1 Seismic Analysis Requirements for SC-I Structures

The design basis earthquake free-field acceleration, defined in Table 11.1-2 and Section 11.1.7.4.1.3 (under "Seismic Loads"), is applied at grade.

Analysis methods for converting the design basis earthquake acceleration into seismic loads on SC-I structures are as defined in Section 11.1.7.4.1.3 (under "Seismic Loads"). Seismic loads are applied simultaneously to structures in the three orthogonal directions, and the three-dimensional effects of each of these inputs are considered. Seismic load forces and moments may be combined using the "square root of the sum of the squares" (SRSS) method or the

100-40-40 Percent Rule described in American Society of Civil Engineers (ASCE) Standard 4 to determine the resultant design basis earthquake loads on structural components.

When designing structures for seismic loads, consideration is given to the additional seismic loads resulting from accidental torsion, indicated in NUREG-0800, Section 3.7.2, Subsection II.11. This additional seismic loading accounts for variations in material densities, member sizes, architectural features, equipment loads, etc. At each level under consideration (floor levels or roof), the accidental torsion is equal to the applicable lateral seismic inertia force times 5% of the maximum building dimension at the level being considered.

11.1.7.2.1.2 Tornado Missile Impact Analysis Requirements

The SC-I structures are analyzed for the effects of tornado-generated missiles. This analysis has been performed in accordance with the guidance provided in NUREG-0800, Section 3.5.3, Subsection II with the tornado-generated missile spectrum as defined in Table 11.1-2. The response of a structure to missile impact depends largely on the location of impact on the structure, on the material properties of the structure, on the dynamic properties of the missile, and on the kinetic energy of the missile. Both the local and overall effects of missile impact are examined, with appropriate consideration given to impact effects of the loading. Some localized overstressing, deformation, and damage are permissible for structures subjected to missile impact. It is acceptable to allow inelastic or plastic structural response when examining the effects of missile impact.

The modified National Defense Research Committee formula, as specified in ASCE 58, *Structural Analysis and Design of Nuclear Plant Facilities*, is used to estimate missile penetration. The missile barrier thickness is selected to preclude perforation through the concrete barrier and to avoid generation of secondary missiles as a result of scabbing.

The overall effects of missile impact on a structural system are investigated to ensure that the structure retains its integrity and functionality subsequent to a missile strike. One missile impacting a structure at any given time is considered.

11.1.7.2.2 Structural Design Requirements for SC-I Structures

11.1.7.2.2.1 Structural Design Requirements for SC-I Concrete Structures

The design of SC-I concrete structures uses the "ultimate strength design methods" in accordance with ACI-349, *Code Requirements for Nuclear Safety-Related Concrete Structures*.

All structural concrete used in construction of SC-I structures has a minimum compressive strength of 4,000 psi. All reinforcing steel used in SC-I structures has a minimum yield strength of 60,000 psi.

The design of SC-I embedded plates and concrete expansion anchors is in accordance with the requirements of ACI-349, ACI-349.2R, *Embedment Design Examples*, and ACI-355.1R, *State-of-the-art Report on Anchorage to Concrete,* as appropriate. Concrete expansion anchors for SC-I structural applications are of the undercut or wedge type design.

The requirements of ACI-349 are supplemented by the following provisions:

- Special consideration is given to the anchorage pull-out capacity (i.e., reduced concrete failure cone) especially when the anchor is near the free edge of the concrete, and/or anchors are closely spaced, and/or the anchor(s) are placed in the tension zone of the slab.
- Baseplate flexibility is taken into account when calculating anchor bolt loads.
- The failure cone angle used is consistent with industry data for the specific application.
- The embedment length of ductile anchors is chosen such that the ratio of the nominal anchor pull-out capacity (concrete) to the anchor minimum tensile capacity (steel) is greater than or equal to 1.50.
- Expansion anchor bolts are designed to have the following minimum factor of safety between the bolt design load and the bolt ultimate capacity determined from static tests:
  - Four (4.0) for wedge and sleeve anchor bolts
  - Three (3.0) for undercut anchors.

  The ultimate capacity of the anchor bolt accounts for the shear-tension interaction, minimum edge distance, and proper bolt spacing.
- The energy absorption capability (deformation capability after yield) is considered for the anchor material.
- The effects of cyclic loading are considered in the anchor bolt design.

11.1.7.2.2.2 Structural Design Requirements for SC-I Steel Structures

SC-I steel structures are designed in accordance with AISC N690, *Specification for the Design, Fabrication and Erection of Steel Safety-Related Structures for Nuclear Facilities*. Elastic design methods are generally used for steel design. However, under the extreme loading conditions of seismic or missile impact loading, plastic design methods and use of ultimate steel strength may be used.

Structural steel connections can be designed as either friction or bearing type bolted connections or welded connections. Bolted connections are designed in accordance with AISC N690, *Specification for Structural Joints Using ASTM A325 or A490 Bolts*. Welded connections are designed in accordance with AISC N690 and AWS D1.1, *Structural Welding Code*.

The requirements of AISC N690 are supplemented by the following provisions:

- In Section Q1.0.2, the definition of secondary stress applies to stresses developed by temperature loading only.
- The following notes are added to Section Q1.3:

  "When any load reduces the effect of other loads, the corresponding coefficient for the load shall be taken as 0.9, if it can be demonstrated that the load is always present or occurs simultaneously with other loads. Otherwise, the coefficient for that load shall be taken as zero."

"Where the structural effects of differential settlement are present, they shall be included with the dead load 'D'."

- The stress limit coefficients for compression in Table Q1.5.7.1 are as follows:
  - 1.3 instead of 1.5, stated in footnote (C), in loading combinations 2, 5, and 6
  - 1.4 instead of 1.6 in loading combinations 7, 8, and 9
  - 1.6 instead of 1.7 in loading combination 11.
- The following note is added to Section Q1.5.8:

  "For constrained (rotation and/or displacement) members supporting safety related structures, systems, or components, the stresses under loading combinations 9, 10, and 11 shall be limited to those allowed in Table Q1.5.7.1 as modified by provision above. Ductility factors of Table Q1.5.8.1 (or the provision below) shall not be used in these cases."
- For ductility factors 'μ' in Sections Q1.5.7.2 and Q1.5.8, the provisions of NUREG-0800, Section 3.5.3, "Barrier Design Procedures," Subsection II.2, Appendix A, are substituted in lieu of Table Q1.5.8.1.
- In loading combination 9 of Section Q2.1, the load factor applied to load P_a is 1.5/1.1 = 1.37, instead of 1.25.
- Sections Q1.24 and Q1.25.10 are supplemented with the following requirements regarding painting of structural steel:
  - Shop painting will be in accordance with Section M3 of AISC ASD, 9th Edition.
  - All exposed areas after installation are field painted (or coated) in accordance with the applicable Section M3 of AISC ASD, 9th Edition.
  - The quality assurance requirements for painting (or coating) of structural steel are in accordance with ANSI N101.4 as endorsed by Regulatory Guide 1.54, *Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants*.

Welding activities associated with SC-I structural steel components and their connections are accomplished in accordance with written procedures and meet the requirements of AWS D1.1. The visual acceptance criteria are as defined in NCIG-01.

11.1.7.2.2.3 Foundation Design Requirements for SC-I Structures

The maximum allowable static and dynamic/seismic soil-bearing pressures are presented in Table 11.1-2. The design of foundations for SC-I structures meets the appropriate requirements of Section 11.1.7.2.2.1.

For evaluation of subsurface conditions, to include liquefaction and dynamic settlements, bedrock motions based upon a 2,000-year recurrence frequency bedrock spectrum are used, scaled so that when amplified through the site soil profile, the resulting surface ground motion will have 0.20g peak ground acceleration. A settlement monitoring program is implemented for

SC-I structures. Settlement monuments are provided to track total and differential settlement. Actual versus predicted settlement is evaluated.

11.1.7.3 Codes and Standards for SC-I Structures

Codes and standards applied to the MFFF include the following:

American Concrete Institute (ACI)

- ACI-224R-90, *Control of Concrete Cracking in Concrete Structures*
- ACI-301-99, *Standard Specifications for Structural Concrete*
- ACI-315-99, *Details and Detailing of Concrete Reinforcement*
- ACI-336.2R-88, *Suggested Analysis and Design Procedures for Combined Footings and Mats*
- ACI-349-97, *Code Requirements for Nuclear Safety-Related Concrete Structures & Commentary*
- ACI-349.1R-91, *Reinforced Concrete Design for Thermal Effects on Nuclear Power Plant Structures*, Reapproved 1996
- ACI-349.2R-97, *Embedment Design Examples*
- ACI-351.1R-99, *Grouting for Support of Equipment & Machinery*
- ACI-352R-91, *Recommendations for Design of Beam-Column Joints in Monolithic Reinforced Concrete Structures*, Reapproved 1997
- ACI-352.1R-89, *Recommendations for Design of Slab-Column Connections in Monolithic Reinforced Concrete Structures*, Reapproved 1997
- ACI-355.1R-91, *State-of-the-art Report on Anchorage to Concrete*, Reapproved 1997
- ACI-360R-92, *Design of Slabs on Grade*, Reapproved 1997
- ACI-351.2R-94, *Foundations for Static Equipment*
- ACI-439.3R-91, *Mechanical Connections of Reinforcing Bars*
- ACI-SP-152-95, *Design and Performance of Mat Foundations*
- ACI-503R-93, *Use of Epoxy Compounds with Concrete.*

American Institute of Steel Construction (AISC)

- AISC ASD, *Manual of Steel Construction, Allowable Stress Design*, 9th Edition, 1989
- ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities*
- AISC, *Seismic Provisions for Structural Steel Buildings*, April 1997.

American Society of Civil Engineers (ASCE)

- ASCE Standard 4-98, *Seismic Analysis of Safety Related Nuclear Structures*
- ASCE Standard 7-98, *Minimum Design Loads for Buildings and Other Structures*
- ASCE Standard 8-91, *Specification for the Design of Cold-Formed Stainless Steel Structural Members*
- ASCE Standard 58-80, *Structural Analysis and Design of Nuclear Plant Facilities.*

American Welding Society (AWS)

- AWS-D1.1-98, *Structural Welding Code – Steel*, 1998
- NCIG-01, *Visual Weld Acceptance Criteria for Structural Welding of Nuclear Power Plants*, Revision 2, EPRI NP-5380.

American Association of State Highway and Transportation Officials (AASHTO)

- *Standard Specifications for Highway Bridges*, Sixteenth Edition, 1996.

American National Standards Institute (ANSI)

- ANSI N101.4, *Quality Assurance for Protective Coatings Applied to Nuclear Facilities*, 1972.

American Iron and Steel Institute (AISI)

- AISI, *Specifications for the Design of Cold-Formed Steel Structural Members*, 1986.

American Society for Testing and Materials (ASTM)

- Research *Council on Structural Connections, Specification for Structural Joints Using ASTM A325 and A490 Bolts*, 1985.

Code of Federal Regulations (CFR)

- 10 CFR Part 70, *Domestic Licensing of Special Nuclear Material*
- 10 CFR Part 73, *Physical Protection of Plants and Materials.*

SRS Engineering Standards Manual (WSRC-TM-95-1)

- Engineering Standard No. 01060, *Structural Design Criteria*, Revision 4, dated September 1999
- Engineering Standard No. 01110, *Civil Site Design Criteria*, Revision 3, dated April 11, 2000.

11.1.7.4 Values for SC-I Structures

11.1.7.4.1 Structural Design Loads for SC-I Structures

Design loads are based upon anticipated building loads (i.e., dead loads, live loads, operating and transient loads, and natural phenomena hazard loads). These loads are divided into three classifications (normal loads, severe environmental loads, and extreme environmental loads) consistent with the guidance provided in NUREG-0800, Section 3.8.4, "Other Seismic Category I Structures." MFFF site design criteria are summarized in Table11.1-2. The structures located at the MFFF site, along with the seismic category classification, are provided in Table 11.1-1.

11.1.7.4.1.1 Normal Loads

Normal loads are those loads associated with normal operation of the MFFF. Normal loads include the following: dead loads (D); live loads (L); hydrostatic fluid pressure loads (F); lateral soil pressure loads (H); thermal loads (T_o); and pipe, HVAC duct, conduit, and cable tray reaction loads (R_o). These loads are defined in the following subsections.

Dead Loads

Dead loads (D) are gravity loads and are defined as any loads, including related internal moments and forces, that are constant in magnitude, orientation, and point of application. Dead loads include the mass of the structure, any permanent equipment loads, and any permanent hydrostatic loads that have constant fluid levels. The weight of permanent items (e.g., roofing materials, wall materials, equipment, cable trays, mechanical piping, and HVAC equipment and ducts) is included in the dead load.

Live Loads

Live loads (L) are defined as any normal loads, including related internal moments and forces, that may vary with intensity, orientation, and/or location of application. Movable equipment loads, loads caused by vibration, any support movement effects, and operating loads are types of live loads. The following subsections provide design requirements for the various types of live loads.

Floor Live Loads

Minimum uniformly distributed live loads are in accordance with ASCE Standard 7 and are applied as follows:

Platform and Work Area	125 psf
Light Storage	125 psf
Heavy Storage	250 psf
Heavy Operation	250 psf
Office	100 psf
Computer Room	150 psf
Dining/Meeting Rooms	100 psf

Laboratory	200 psf
Toilet Areas	100 psf
Mechanical (Utility) Rooms	150 psf
Electrical Rooms	150 psf
Stairs, Fire Escapes, and Corridors	100 psf
Transportation Vehicle Loads	300 psf or forklift truck, 6 kip capacity (HS20-44 capacity in designated areas)
Roof	25 psf

Rain Loads

Rain loads (R) are determined in accordance with the requirements of ASCE Standard 7, Section 8. The roof system for SC-I structures is designed for a minimum rain load of 50 psf. The design load of 50 psf is equal to more than 9.6 in. (24.4 cm) in equivalent weight of standing water and is adequate to account for any effects that may result from ponding of rainwater due to deflection of the supporting roof or the blockage of primary roof drains.

Snow and Ice Loads

Snow (S) and ice (I) loads are determined in accordance with the requirements of ASCE Standard 7, Sections 7 and 10. An exposure factor of $C_e = 1.0$ is used to consider wind effects for analysis and design of roof structures resisting snow and ice loads. An importance factor of $I = 1.2$ is used for SC-I structures.

Transportation Vehicle Loads and Heavy Floor Loads

Loads caused by transportation vehicular truck traffic in designated building areas are in accordance with standard loadings defined by AASHTO. The minimum truck loading of HS 20-44 is used for wheel loading design. Special heavy-loading conditions resulting from transport of finished fuel assemblies and storage casks on trucks are considered. Heavy floor loading of 300 psf or forklift truck (6 kip capacity) in areas used for transportation, transfer, and storage of finished fuel assemblies is considered.

Crane, Elevator, and Hoist Loads

These loads apply to structural members and components required to support permanently installed cranes, hoists, and elevators. Design loads for crane and hoist supports envelop, as a minimum, the full-rated capacity of the crane, hoist, and elevator including impact loads, as well as test load requirements. The effects of crane load drop are also evaluated in accordance with guidance provided in NUREG-0612, *Control of Heavy Loads at Nuclear Plants*, for SC-I structures.

Hydrostatic Fluid Pressure Loads

Hydrostatic fluid pressure loads (F) are due to fluids held in internal building compartments. No fluid pressure loads are currently identified for the MFFF.

Lateral Soil Pressure Loads

Lateral soil pressure loads (H) on structures and/or elements of structures retaining soil are based on the density of the soil and any surcharge load, plus the hydrostatic pressure caused by the groundwater or soil saturation. The minimum lateral soil pressure loads on structures and/or elements of structures retaining soil are as defined in ASCE Standard 7, Section 5. The soil pressure caused by earthquakes based on ASCE Standard 4 is included.

Thermal Loads

Thermal loads (T_o) consist of thermally induced forces and moments resulting from operation and environmental conditions affecting the building structure. Thermal loads are based on the most critical transient or steady-state condition. Thermal expansion loads caused by axial restraint, as well as loads resulting from thermal gradients, are considered. Thermal loads considered include the ambient temperature gradient imposed on the structure by process equipment.

Pipe, HVAC Duct, Conduit, and Cable Tray Reaction Loads

Pipe, HVAC duct, conduit, and cable tray reaction loads (R_o) are those loads applied by distribution system supports during normal operating conditions, based on the most critical transient or steady-state condition. Loads are tracked to ensure that the final design envelops actual loads.

11.1.7.4.1.2 Severe Environmental Loads

Severe environmental loads are those loads that are encountered infrequently during the life of the MFFF. They include wind loads (W) and flood loads (F'). These loads are defined in the following subsections.

Wind Loads

Wind loads (W) are those pressure loads generated by the design basis wind and are determined by procedures in ASCE Standard 7, Section 6. The severe wind speed, defined in Table 11.1-2, is used in the design of SC-I buildings, structures, and facilities.

Flood Loads

Flood loads (F') are caused by exterior flood waters from the design basis flood exerting forces and moments on exterior building structures or entering a building and exerting loads on interior building structures. Flood loads on building, structures, and facilities are determined in accordance with ASCE Standard 7, Section 5.3. Guidance for determining the design basis flood is provided in Regulatory Guide 3.40, *Design Basis Floods for Fuel Reprocessing Plants and for Plutonium Processing and Fuel Fabrication Plants*. As shown in Table 11.1-2, the design basis flood and probable maximum flood elevations are well below the MFFF site elevation. Thus, flood loads are not applicable to the MFFF.

11.1.7.4.1.3 Extreme Environmental Loads

Extreme environmental loads are those loads that are credible but are not expected to occur during the life of the MFFF. They include seismic loads (E'), tornado loads (W_t), and explosive loads. These loads are defined in the following subsections. (Note: As described in Section 5.5.1, the possibility of aircraft impact is not a credible event; thus, aircraft impact is not a design basis event.)

Seismic Loads

Design Basis Earthquake Loads for SC-I Structures

In accordance with the guidance of Regulatory Guide 3.14, *Seismic Design Classification for Plutonium Processing and Fuel Fabrication Plants*, and DOE-STD-1020-94, *NPH Design and Evaluation Criteria for DOE Facilities*, all SC-I buildings, structures, and facilities at the MFFF are designed to accommodate a design basis earthquake.

The design basis earthquake for the MFFF is defined in Section 1.3.6 and summarized in Table 11.1-2. Design basis earthquake loads (E') for SC-I and SC-II buildings, structures, and facilities are determined based upon a horizontal component at the ground surface characterized by a horizontal spectrum shape from Regulatory Guide 1.60, *Design Response Spectra for Seismic Design of Nuclear Power Plants*, scaled to 0.20g peak ground acceleration. The vertical component is two-thirds of the horizontal component for all frequencies. Methods used for the soil-structure interaction (SSI) determining seismic responses from these acceleration input criteria conform to NUREG-0800, Sections 3.7.1 and 3.7.2 and the requirements of ASCE Standard 4.

Total seismic loads affecting a structure are determined by simultaneously applying the design basis earthquake accelerations in the three orthogonal directions (two horizontal and one vertical). Appropriate consideration of SSI, torsional effects, structural frequency, stiffness, and displacement is factored into structure-specific seismic load analyses. The SSI analyses for the SC-I MOX Fuel Fabrication Building and Emergency Diesel Generator Building are performed on simplified stick models representing the building characteristics (e.g., mass, rigidity, center of mass, and center of rigidity) using the computer code SASSI (Duke Engineering & Services version). From the SSI analysis, the response spectra at the foundation and each floor and roof level are obtained for building and equipment design and acceleration profile for building design.

Synthetic Time History of Free-Field Seismic Motion

Three components of the synthetic time histories for the design basis earthquake seismic motion are generated to closely match the design basis earthquake. The three components of the synthetic time histories are statistically independent of each other. The response spectrum of each component of time history motion envelops the design spectrum in accordance with the enveloping criteria in NUREG-0800, Section 3.7.1, "Seismic System Analysis." In addition, each component of time history meets the minimum power spectral density requirement specified in NUREG-0800, Section 3.7.1, Appendix A.

Soil Model

In the SSI analysis, the soil model consists of a sufficient number of idealized soil layers from the ground surface to the bedrock. The thickness of each soil layer is small enough to allow vertical propagation of shear waves having frequencies up to the desired cutoff frequencies. The properties of the idealized soil layers are developed based upon the information provided by the soil exploration report and site response analysis. Variations in soil properties are considered.

Structure Models

A 3D finite element model using standard computer structural modeling codes (e.g., ANSYS) is first generated based on the structural drawings. In addition to all applicable dead weights and equipment weights, the finite element model includes appropriate parts of the live loads (25% of the applicable live loads, which are verified during design) in the mass properties of the model.

A 3D lumped mass stick model is generated assuming the roofs and floors are rigid diaphragms. The 3D stick model is used for the SSI analysis of the MOX Fuel Fabrication Building. The 3D stick model is "tuned" such that the fundamental mode frequency in each of the three directions closely matches the corresponding modal frequency of the finite element model.

Damping Values for Structures

The following structural damping values, which are in accordance with Regulatory Guide 1.61, *Damping Values for Seismic Design of Nuclear Power Plants*, for a safe shutdown earthquake (design earthquake, E'), are used to determine seismic loading:

Structure Type	% of Critical Damping
Welded Steel	4
Bolted Steel	7
Reinforced Concrete	7

In-Structure Response Spectrum Envelope with Peak Broadening

In each of the three directions (north-south, east-west, and vertical) and at each given structural location, the in-structure response spectra from the 3D SSI analysis of the stick model for the lower-bound, best-estimate, and upper-bound soil conditions are first enveloped. A broadening of the spectrum peak(s) by 15% is then applied to the spectrum envelope. Floor flexibility, where applicable, is accounted for in the generation of the vertical in-structure response spectra.

Acceleration Profile Envelope for Static Analysis of 3D Finite Element Model of Structure

An acceleration profile in each of the north-south, east-west, and vertical directions is developed from the 3D SSI analysis of the stick model. In each given direction, the acceleration profiles from the lower-bound, best-estimate, and upper-bound soil conditions are enveloped. The acceleration profile envelope is applied as a static load to the 3D finite element model of the individual buildings for the design of structural elements.

Combination of Seismic Response Components

Two approaches may be used to combine seismic loads in the three orthogonal directions for the building analysis and design. The first approach applies the equivalent accelerations for each level from the SSI analysis to the building finite element model statically for each direction. This approach is used for the MOX Fuel Fabrication Building and Emergency Diesel Generator Building. In this approach, the equivalent accelerations are determined to ensure that the resulting global structural forces (shear and axial forces) at each level match those from the SSI analysis of the stick model of the structure. The results from the equivalent static analyses due to the equivalent accelerations applied in the three directions may be combined using the 100-40-40 Percent Rule, described in Section 3.2.7.1.2 of ASCE Standard 4, to determine the resultant design basis earthquake loads on structural components. When combining forces and moments using the 100-40-40 Percent Rule, participation factors of 100% in the primary load direction and 40% in the other two directions are applied to the individual loads, as permitted by ASCE Standard 4.

The second approach applies the applicable seismic response spectrum to the base of the structural model. This approach may be used for miscellaneous structures. Each of the three directional components of the design basis earthquake are produced responses in a structure in all three directions (i.e., three responses in the *x* direction, three in the *y* direction, and three in the *z* direction). Guidance provided by Regulatory Guide 1.92, *Combining Modal Responses and Spatial Components in Seismic Response Analysis*, and ASCE Standard 4 is used for combining modal responses and collinear responses from the three individual earthquake components. Modal responses due to each of the three individual earthquake components may be combined using the SRSS method. Any responses from modes that are clustered within a 10% frequency range may be combined by the absolute sum method in accordance with Regulatory Guide 1.92, and then the remaining responses can be combined by the SRSS method. A sufficient number of modes are considered such that the accumulated modal mass exceeds 90% of the mass of the component. After modal responses are combined to obtain one set in each of the three orthogonal directions, the collinear responses due to contributions from all three earthquake components are combined by the SRSS method.

The following examples show formulas for determining the seismic load force in the *x* direction using the two methods:

100-40-40 Percent Rule

$$\Sigma F_x = \Sigma 100\%\ F_{x\ \text{due to Ex'}} + \Sigma 40\%\ F_{x\ \text{due to Ey'}} + \Sigma 40\%\ F_{x\ \text{due to Ez'}} \qquad (11.1\text{-}1)$$

SRSS Method

$$\Sigma F_x = (\Sigma F_{x\ \text{due to Ex'}}^{\ 2} + \Sigma F_{x\ \text{due to Ey'}}^{\ 2} + \Sigma F_{x\ \text{due to Ez'}}^{\ 2})^{1/2} \qquad (11.1\text{-}2)$$

Dynamic Lateral Soil Pressure for Embedded Wall Design

The dynamic lateral soil pressures are determined based on the guidelines of ASCE Standard 4.

Tornado Loads for SC-I Structures

Tornado loads (W_t) are those loads generated by the design basis tornado specified for the MFFF. They include tornado wind pressure loads (W_w), tornado-created differential pressure loads (W_p), and tornado-generated missile loads (W_m). The tornado loads are defined in Section 1.3.3 and summarized in Table 11.1-2. The three types of tornado loads on MFFF structures and facilities are defined in the following subsections.

Tornado Wind Pressure Loads

Tornado wind pressure loads (W_w) are those pressure loads generated by the tornado wind velocity, which is the combined translational and rotational wind speed, as defined in Table 11.1-2. ASCE Standard 7, Section 6 is used to convert tornado wind velocity into effective structural pressure loads.

Tornado-Created Differential Pressure Loads

Tornado-created differential pressure loads (W_p) are those loads acting as an internal pressure loading on structures caused by the negative pressure created by the tornado. The design pressure drop and the rate of pressure drop are defined in Table 11.1-2. This internal pressure is applied to the interior surfaces of all exterior building walls and roofs of structures requiring design against the effects of a tornado. Some reduction in this pressure differential may be allowed for structures that are vented, as permitted by NUREG-0800, Section 3.3.2, "Tornado Loadings."

Tornado-Generated Missile Loads

Tornado-generated missile loads (W_m) are impact loads applied to structures caused by strikes by the missile spectra criteria specified in Table 11.1-2. The provisions of NUREG-0800, Section 3.5.3, Subsection II are considered for determining the missile loading on various types of structures.

Explosive Loads for SC-I Structures

The MFFF site is located such that explosive loads generated from nearby buildings or facilities are not a significant concern. The worst-case postulated explosive load is defined in Section 5.5.1 and summarized in Table 11.1-2.

11.1.7.4.2 Structural Design Loading Combinations for SC-I Structures

The following loads are addressed in the loading combinations used for the design of SC-I structures at the MFFF.

D = dead load
L = live load
F = hydrostatic fluid pressure load
H = lateral soil pressure load
T_o = thermal load

R_o = pipe, HVAC duct, conduit, and cable tray reaction load
W = wind load
E' = design basis earthquake seismic load
W_t = tornado loads including:
  W_w = tornado wind pressure load
  W_p = tornado-created differential pressure load
  W_m = tornado-generated missile load
T_a = thermal load (due to postulated break and including T_o)
R_a = pipe reaction (due to postulated break under thermal condition and including R_o).

Loading combinations for the design of SC-I structures are determined using NUREG-0800, Section 3.8.4, "Other Seismic Category I Structures," as a guide. Since there are no operating basis earthquake loads (E), flood loads (F'), compartmental pressure loads (P_a), or pipe break accident loads (Y_r, Y_j, or Y_m) applicable to the MFFF, these loads, although specified in NUREG-0800, Section 3.8.4, are not included in above list of loads or the loading combinations that follow.

The following definitions apply to terms used in the loading combinations specified in this section:

- For concrete structures, "U" is the section strength required to resist design loads based upon the ultimate strength design methods described in ACI 349, *Code Requirements for Nuclear Safety-Related Concrete Structure* (SC-I).
- For steel structures, "S" is the required section strength based on elastic design methods and the allowable stresses defined in Part 1 of AISC N690, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities* (SC-I).
- For steel structures, "Y" is the section strength required to resist design loads based on the plastic design methods defined in Part 2 of AISC N690 (SC-I).

11.1.7.4.2.1 Loading Combinations for SC-I Concrete Structures

The following loading combinations are used for the design of SC-I concrete structures. These loading combinations are used in conjunction with the ultimate strength design method for concrete design. Two conditions of structural loading are considered: (1) service loading conditions including severe wind, and (2) extreme loading conditions including flood.

Service Loading Combinations for SC-I Concrete Structures

Service loading combinations represent the loading conditions that SC-I structures are expected to experience during normal facility operations and during severe environmental conditions. Loads included in the service loading combinations are dead loads, live loads, hydrostatic fluid pressure loads, lateral soil pressure loads, design wind loads, flood loads, thermal loads, and reaction loads (pipe, HVAC, and/or cable tray). No seismic loads are included in the MFFF service loading combinations.

SC-I concrete structures are designed for the following service loading combinations:

$$U = 1.4D + 1.4F + 1.7L + 1.7H$$

$$U = 1.4D + 1.4F + 1.7L + 1.7H + 1.7W$$

$$U = 1.2D + 1.2F + 1.7W$$

If thermal stresses caused by T_o and/or R_o are present on the structure, the following loading combinations are also considered:

$$U = 1.05D + 1.05F + 1.275L + 1.275H + 1.275T_o + 1.275R_o$$

$$U = 1.05D + 1.05F + 1.275L + 1.275H + 1.275W + 1.275T_o + 1.275R_o$$

Extreme Loading Combinations for SC-I Concrete Structures

Extreme loading combinations represent the loading conditions that SC-I structures could experience under extreme environmental conditions. Loads included in the extreme loading combinations are dead loads, live loads, thermal loads, reaction loads (pipe, HVAC, and cable tray), design basis earthquake seismic loads, tornado loads, and flood loads. Extreme environmental loads (i.e., seismic and tornado loadings) are not considered to act simultaneously.

SC-I concrete structures are designed for the following extreme loading combinations:

$$U = D + F + L + H + T_o + R_o + E'$$

$$U = D + F + L + H + T_o + R_o + W_t \text{ (see Note 1 below)}$$

$$U = D + F + L + H + E' + T_a + R_a \text{ (see Note 2 below)}$$

Note 1: In accordance with NUREG-0800, Section 3.3.2, Subsection II.3.d, the following combinations of W_t are considered:

$W_t = W_w$
$W_t = W_p$
$W_t = W_m$
$W_t = W_w + 0.5W_p$
$W_t = W_w + W_m$
$W_t = W_w + 0.5W_p + W_m$

Note 2: $T_a = T_o$ and $R_a = R_o$, since pipe break accident loads are not applicable.

11.1.7.4.2.2 Loading Combinations for SC-I Steel Structures

The following loading combinations are used for the design of SC-I steel structures. Applicable combinations are given for designs that utilize either elastic working stress design methods or plastic design methods. In each case, loading combinations are provided for service loading conditions and for extreme loading conditions.

Service Loading Combinations for SC-I Steel Structures

Service loading combinations for SC-I steel structures encompass the same type loads as included for service loading combinations for SC-I concrete structures in Section 11.1.7.4.2.1.

Service Loading Combinations for Elastic Working Stress Design

If elastic working stress design methods are used, SC-I steel structures are designed for the following service loading combinations:

$$S = D + F + L + H$$

$$S = D + F + L + H + W$$

If thermal stresses due to T_o and/or R_o are present on the structure, the following loading combinations are also considered:

$$(1.5)S = D + F + L + H + T_o + R_o \text{ (tension members)}$$

$$(1.3)S = D + F + L + H + T_o + R_o \text{ (compression members)}$$

$$(1.5)S = D + F + L + H + T_o + R_o + W \text{ (tension members)}$$

$$(1.3)S = D + F + L + H + T_o + R_o + W \text{ (compression members)}$$

Service Loading Combinations for Plastic Design

If plastic design methods are used, SC-I steel structures are designed for the following service loading combinations:

$$Y = 1.7D + 1.7F + 1.7L + 1.7H$$

$$Y = 1.7D + 1.7F + 1.7L + 1.7H + 1.7W$$

If thermal stresses due to T_o and/or R_o are present on the structure, the following loading combinations are also considered:

$$Y = 1.3D + 1.3F + 1.3L + 1.3\,H + 1.3T_o + 1.3R_o$$

$$Y = 1.3D + 1.3F + 1.3L + 1.3\,H + 1.3T_o + 1.3R_o + 1.3W$$

Extreme Loading Combinations for SC-I Steel Structures

Extreme loading combinations for SC-I steel structures encompass the same type loads as included for extreme loading combinations for SC-I concrete structures in Section 11.1.7.4.2.1.

Extreme Loading Combinations for Elastic Working Stress Design

If elastic working stress design methods are used, SC-I steel structures are designed for the following extreme loading combinations:

$(1.6)S = D + F + L + H + T_o + R_o + E'$ (tension members)

$(1.4)S = D + F + L + H + T_o + R_o + E'$ (compression members)

$(1.6)S = D + F + L + H + T_o + R_o + W_t$ (tension members) (see note below)

$(1.4)S = D + F + L + H + T_o + R_o + W_t$ (compression members) (see note below)

$(1.7)S = D + F + L + H + E' + T_a + R_a$ ($T_a = T_o$ and $R_a = R_o$) (tension members)

$(1.6)S = D + F + L + H + E' + T_a + R_a$ ($T_a = T_o$ and $R_a = R_o$) (compression members)

Note: All six subloading combinations for tornado loads W_t that are specified in Section 11.1.7.4.2.1 are also considered in this loading combination.

Extreme Loading Combinations for Plastic Design

If plastic design methods are used, SC-I steel structures are designed for the following extreme loading combinations, as defined in NUREG-0800, Section 3.8.4, Subsection II.5:

$Y = D + F + L + H + T_o + R_o + E'$

$Y = D + F + L + H + T_o + R_o + W_t$ (consider all subloading combinations of W_t)

$Y = D + F + L + H + E' + T_a + R_a$ ($T_a = T_o$ and $R_a = R_o$)

11.1.7.4.3 Loading Combinations for SC-I Structures for Overturning, Sliding, and Flotation

In addition to the loading combinations specified in Sections 11.1.7.4.2.1 and 11.1.7.4.2.2, the loading combinations defined in Table 11.1-3 are checked to ensure the overall stability of structures against the effects of overturning, sliding, and flotation. These loading combinations are determined using NUREG-0800, Section 3.8.5, Subsections II.3 and II.5, as guides. The minimum factors of safety listed in Table 11.1-3 are satisfied for each stability condition considered.

11.1.7.4.4 Applicability of Loads

The following requirements are considered when determining applicable loading combinations for the design of the MFFF structures:

- Live loads are applied fully, partially, totally removed from the members, or shifted in location and pattern as necessary to obtain the worst-case loading conditions for

maximizing internal forces and moments for all loading combinations. Impact forces caused by moving loads are applied where appropriate.

- Appropriate construction loads are considered in the service loading combinations. Construction methods and sequence are also considered and appropriate loading conditions are applied to ensure the structural integrity of partially erected or open structures.
- Where any load reduces the overall loading on a structural member, a load coefficient of 0.9 is applied to that load component in the loading combination. The reducing coefficient is only used for loads that are always present or that always occur simultaneously with other loads. The 0.9 reducing coefficient is used in lieu of the code-specified coefficient.
- Tornado loads are applied to roofs and all exterior walls of SC-I structures. Where the exterior walls do not establish the tornado pressure boundary, appropriate interior walls are designed as the tornado pressure boundary.

Tables

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Table 11.1-1. Building Seismic Classifications

Buildings	Abbreviation	Seismic Category
MOX Fuel Fabrication Building	BMF	SC-I
- MOX Processing Area[a]	BMP	SC-I
- Aqueous Polishing Area[a]	BAP	SC-I
- Shipping and Receiving Area[a]	BSR	SC-I
Emergency Diesel Generator Building	BEG	SC-I
Safe Haven Buildings	BSH	SC-II
Reagent Process Building	BRP	CS
Administration Building	BAD	CS
Secured Warehouse Building	BSW	CS
Technical Support Building	BTS	CS
Standby Diesel Generator Building	BSG	CS

Facilities, Structures, and Areas	Abbreviation	Seismic Category
Gas Storage Facility	UGS	CS
Switchyard	ESW	CS
Main Access	WMA	CS
Service Access	WSA	CS
Vehicle Access Portal	WVA	CS
HVAC Chiller Pads	VCX,Y, or Z	CS

[a] These areas are part of the MOX Fuel Fabrication Building.

Table 11.1-2. Summary of MFFF Site Design Criteria

Criterion	Value
Severe Wind (SC-I and SC-II)	Three-second wind speed: 130 mph Missile criteria: 2- by 4-inch timber plank, 15 lb at 50 mph (horizontal); max. height 50 ft (see Note 1)
Extreme Wind/Tornado (Wind Loads) (SC-I)	Three-second wind speed: 240 mph Atmospheric pressure change: 150 psf Rate of pressure drop: 55 psf/sec (see Note 1)
Tornado Missile Spectrum (SC-I)	<u>2- by 4-inch timber plank</u> Mass: 15 lb Horizontal Impact Speed: 150 mph Vertical Impact Speed: 100 mph Maximum Height: 200 ft <u>3-inch diameter standard steel pipe</u> Mass: 75 lb Horizontal impact speed: 75 mph Vertical impact speed: 50 mph Maximum height: 100 ft <u>3000-lb automobile</u> Horizontal impact speed: 25 mph, rolls and tumble
Wind (CS)	Basic winds: 107 mph (Note 1)
Floods	Design basis flood level: 207.9 ft above msl Probable maximum flood level: 224.5 ft above msl Site grade level ≈ 272 ft above msl
Precipitation (SC-I)	Rain loading: 50 lb/ft^2 Accumulative precipitation: Fifteen minutes: 3.9 inches One hour: 7.4 inches Three hours: 14.1 inches Six hours: 16.7 inches Twenty-four hours: 22.7 inches
Snow and Ice Loads (SC-I)	Snow/ice loading: 10 lb/ft^2
Seismic (Ground Motion) (SC-I and SC-II)	Free field: 0.2g (horizontal); 0.13g (vertical)
Foundation Design Bearing Pressure	(Under evaluation; laboratory testing is in progress)
Groundwater	190 ft to 220 ft above msl
Explosions	(Under evaluation; review of credible events in progress)
Aircraft Impact	Not applicable

Note 1: For determining wind and tornado loads using the ASCE 7 procedure, the following definitions apply: I = 1.0; Exposure Category = C; K_{zt} = 1.0; and K_d = 1.0.

Table 11.1-3. Minimum Factors of Safety

Loading Combination	Overturning	Sliding	Flotation
D + F + H + W	1.5	1.5	-
D + F + H + E'	1.1	1.1	-
D + F + H + W_t (Note 1)	1.1	1.1	-
D + F + F'	-	-	1.1

Note 1: When checking for overall structural stability, only the tornado load case of $W_t = W_w$ is considered.

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Figures

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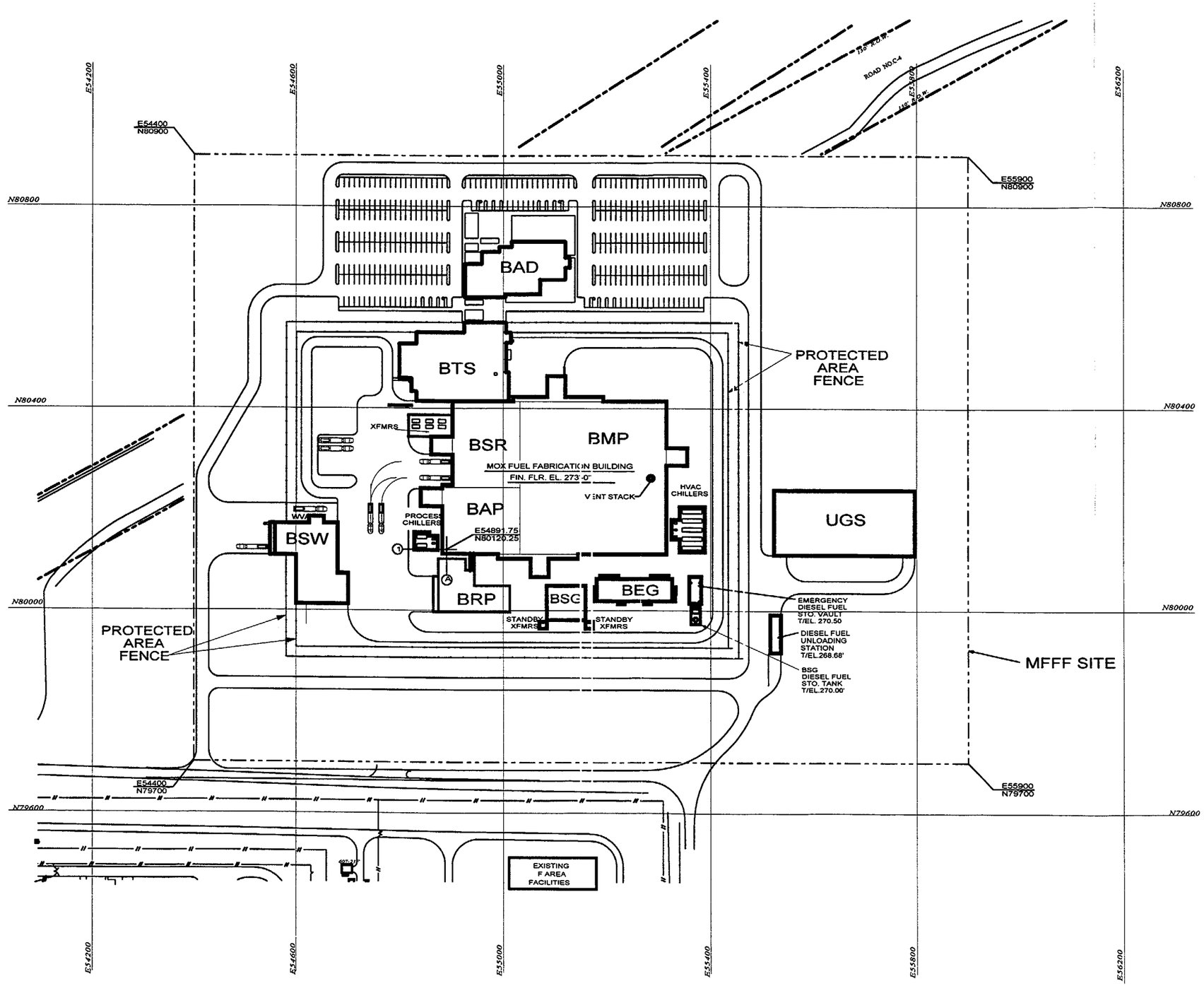

BUILDING LEGEND

MOX FUEL FABRICATION BUILDING

BMP MOX FUEL FABRICATION AREA
BAP AQUEOUS POLISHING AREA
BSR SHIPPING AND RECEIVING AREA

SUPPORT BUILDINGS/STRUCTURES

BTS TECHNICAL SUPPORT BUILDING
BAD ADMINISTATION BUILDING
BSW SECURED WAREHOUSE BUILDING
BRP REAGENTS PROCESSING BUILDING
BSG STANDBY DIESEL GENERATOR BUILDING
BEG EMERGENCY DIESEL GENERATOR BUILDING
UGS GAS STORAGE AREA
WVA VEHICLE ACCESS PORTAL

AREAS:

SITE BOUNDARY AREA	41.32 ACRES
INSIDE FENCE AREA	13.29 ACRES
OUTSIDE FENCE AREA	28.03 ACRES

Figure 11.1-1. MFFF Site Plan

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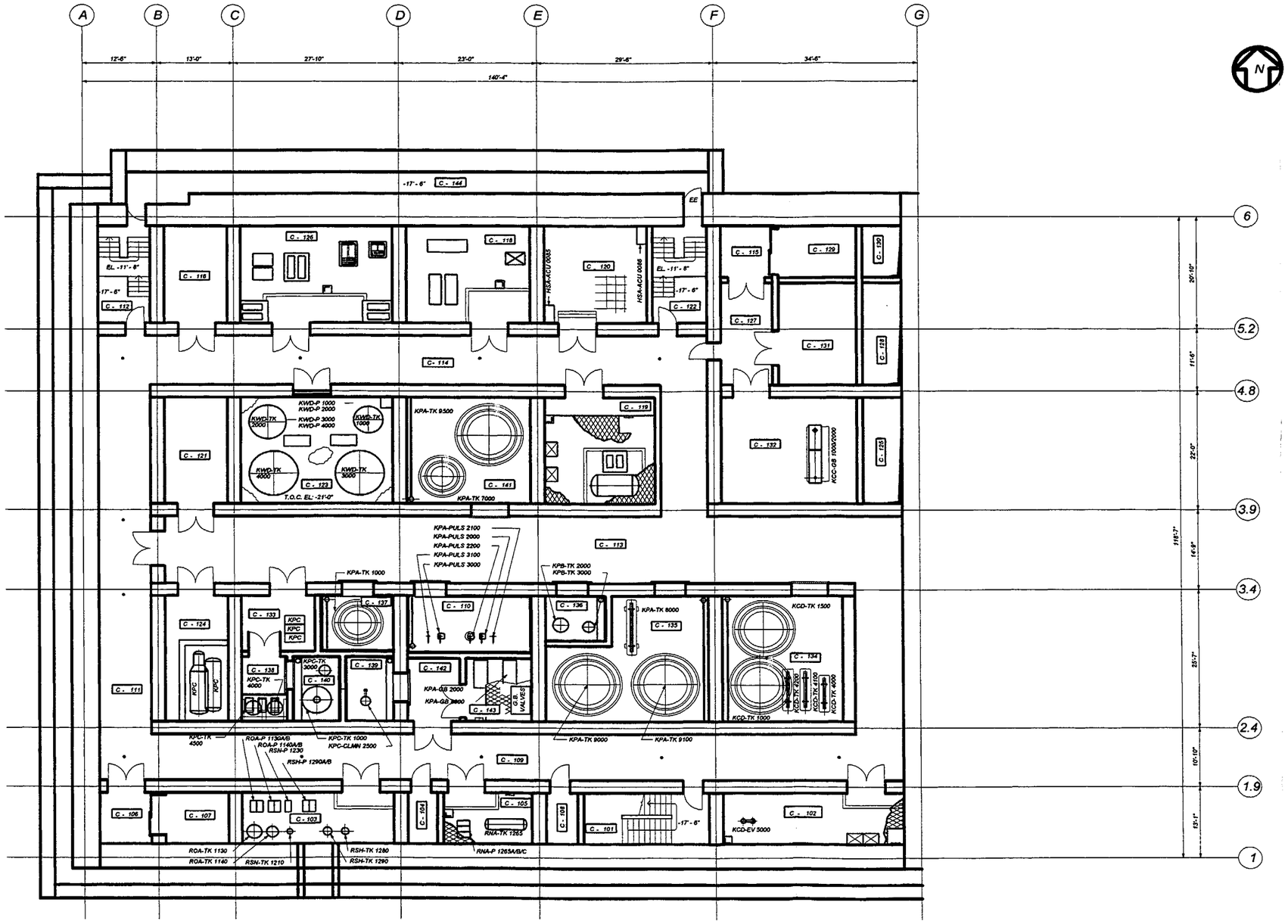

ROOM IDENTIFICATION			
NUMBER	DESIGNATION	CONFINEMENT ZONE	ROOM LOCATION
C - 101	STAIRS	C2	F-1.9
C - 102	KCD VAPORIZER ROOM	C2	G-1.9
C - 103	DECANTING ROOM	C2	D-1.9
C - 104	TECHNICAL ROOM	C2	D-1.9
C - 105	VESSELS ROOM,REAGENTS	C2	E-1.9
C - 106	ELEVATOR LOBBY	C2	B-1.9
C - 107	SERVICE ELEVATOR	C2	B-1.9
C - 108	TECHNICAL ROOM	C2	E-1.9
C - 109	PERSONNEL AND MATERIAL CORRIDOR	C2	E-2.4
C - 110	PULSED COLUMN ROOM,KPA	PC	D-3.4
C - 111	PERSONNEL AND MATERIAL CORRIDOR	C2	B-2.4
C - 112	STAIRS	C2	B-5.2
C - 113	PERSONNEL AND MATERIAL CORRIDOR	C2	E-3.4
C - 114	PERSONNEL AND MATERIAL CORRIDOR	C2	D-4.8
C - 115	ELEVATOR LOBBY	C2	F-6
C - 116	UTILITY ROOM	C2	B-5.2
C - 118	PUMP ROOM,REAGENTS	C2	E-5.2
C - 119	KPC ROOM	C2	E-4.8
C - 120	ELECTRONICS ROOM	C2	E-5.2
C - 121	LIQUID WASTE	C2	B-3.9
C - 122	STAIRS	C2	F-5.2
C - 123	VESSELS ROOM,KWD	C2	C-4.8
C - 124	LIQUID WASTE	C2	B-3.4
C - 125	UTILITY CHASE	C2	G-4.8
C - 126	PUMP ROOM,REAGENTS	C2	C-5.2
C - 127	AIR LOCK	C3b	F-5.2
C - 128	UTILITY CHASE	C2	G-5.2
C - 129	SERVICE ELEVATOR	C2	F-6
C - 130	UTILITY CHASE	C2	G-6
C - 131	FILTER ROOM	C3b	F-5.2
C - 132	CANNING DEVICE ROOM,KCB	C3b	F-4.8
C - 133	PUMPS ROOM,KPC	C2	C-3.4
C - 134	VESSELS ROOM,KCD	PC	F-2.4
C - 135	VESSELS ROOM,KPA	PC	F-3.4
C - 136	VESSELS ROOM,KPB	PC	E-3.4
C - 137	VESSELS ROOM,KPA	PC	D-3.4
C - 138	VESSELS ROOM,KPC	C2	C-2.4
C - 139	VESSELS ROOM,KPC	PC	D-2.4
C - 140	VESSELS ROOM,KPC	PC	D-2.4
C - 141	VESSELS ROOM,KPA	PC	E-3.9
C - 142	AIR LOCK	C3b	D-2.4
C - 143	GLOVE BOX ROOM,KPA	C3b	E-2.4
C - 144	EMERGENCY EGRESS TUNNEL	C2	D-6

PC = PROCESS CELL

Figure 11.1-2. Aqueous Polishing Area - Process Conceptual Layout - Level 1 (Elevation –17'-6")

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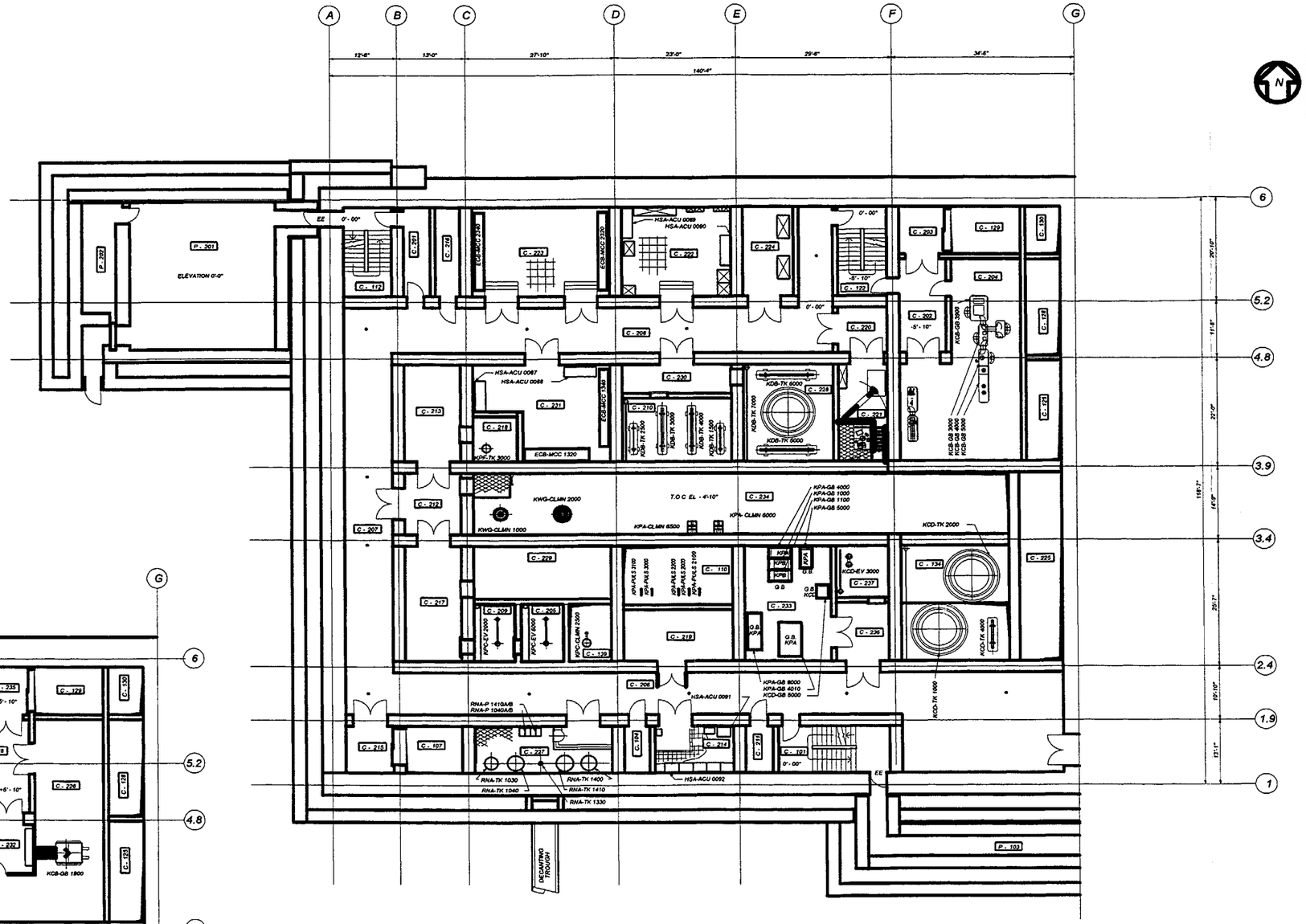

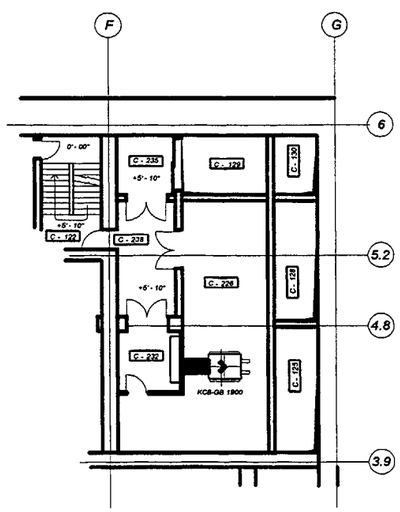

INTERSTITIAL

ROOM IDENTIFICATION			
NUMBER	DESIGNATION	CONFINEMENT ZONE	ROOM LOCATION
C - 201	ACCESS TO C-112	C2	B-5.2
C - 202	AIR LOCK	C3b	F-4.8
C - 203	ELEVATOR LOBBY	C2	F-5.2
C - 204	POWDER SAMPLING ROOM	C3b	F-5.2
C - 205	EVAPORATOR ROOM.KPC	PC	D-3.4
C - 206	PERSONNEL AND MATERIAL CORRIDOR	C2	D-1.9
C - 207	PERSONNEL AND MATERIAL CORRIDOR	C2	B-3.4
C - 208	PERSONNEL AND MATERIAL CORRIDOR	C2	D-4.8
C - 209	EVAPORATOR ROOM.KPC	PC	C-3.4
C - 210	VESSELS ROOM.KDB	PC	D-3.9
C - 211	TECHNICAL ROOM	C2	E-1.9
C - 212	AIR LOCK	C3b	B-3.4
C - 213	LIQUID WASTE	C3b	B-3.9
C - 214	ELECTRONICS ROOM	C2	E-1.9
C - 215	ELEVATOR LOBBY	C2	B-1.9
C - 216	UTILITY CHASE	C2	C-5.2
C - 217	LIQUID WASTE	C3b	B-3.4
C - 218	VESSELS ROOM.KPF	PC	C-3.9
C - 219	NEUTRON COUNTING ROOM	C2	B-2.4
C - 220	AIR LOCK	C3b	F-4.8
C - 221	SAMPLING ROOM	C3b	F-4.8
C - 222	ELECTRONICS ROOM	C2	D-5.2
C - 223	ELECTRICAL ROOM	C2	C-5.2
C - 224	AIR CONDITIONER	C2	E-5.2
C - 225	UTILITY CHASE	C2	C-3.4
C - 226	TUMBLING MIXER ROOM	C3b	G-5.2
C - 227	VESSELS ROOM.REAGENTS	C2	D-1.9
C - 228	VESSELS ROOM.KDB	PC	E-4.8
C - 229	KWG ROOM	PC	D-3.4
C - 230	AIR LOCK	C2	D-4.8
C - 231	RAD ROOM	C2	D-4.8
C - 232	MOTORS ROOM	C3b	F-4.8
C - 233	GLOVE BOX ROOM.KPA,KPB	C3b	E-2.4
C - 234	ACTIVE GALLERY	PC	E-3.9
C - 235	ELEVATOR LOBBY	C2	F-6
C - 236	AIR LOCK	C3b	F-2.4
C - 237	EVAPORATOR ROOM.KCD	PC	F-3.4
C - 238	AIR LOCK	C3b	F-5.2
P - 201	SAFE HAVEN	C1	A-6
P - 202	SALLY PORT MAINTANENCE	C1	A-6

PC = PROCESS CELL

Figure 11.1-3. Aqueous Polishing Area - Process Conceptual Layout - Level 2 (Elevation 0'-0")

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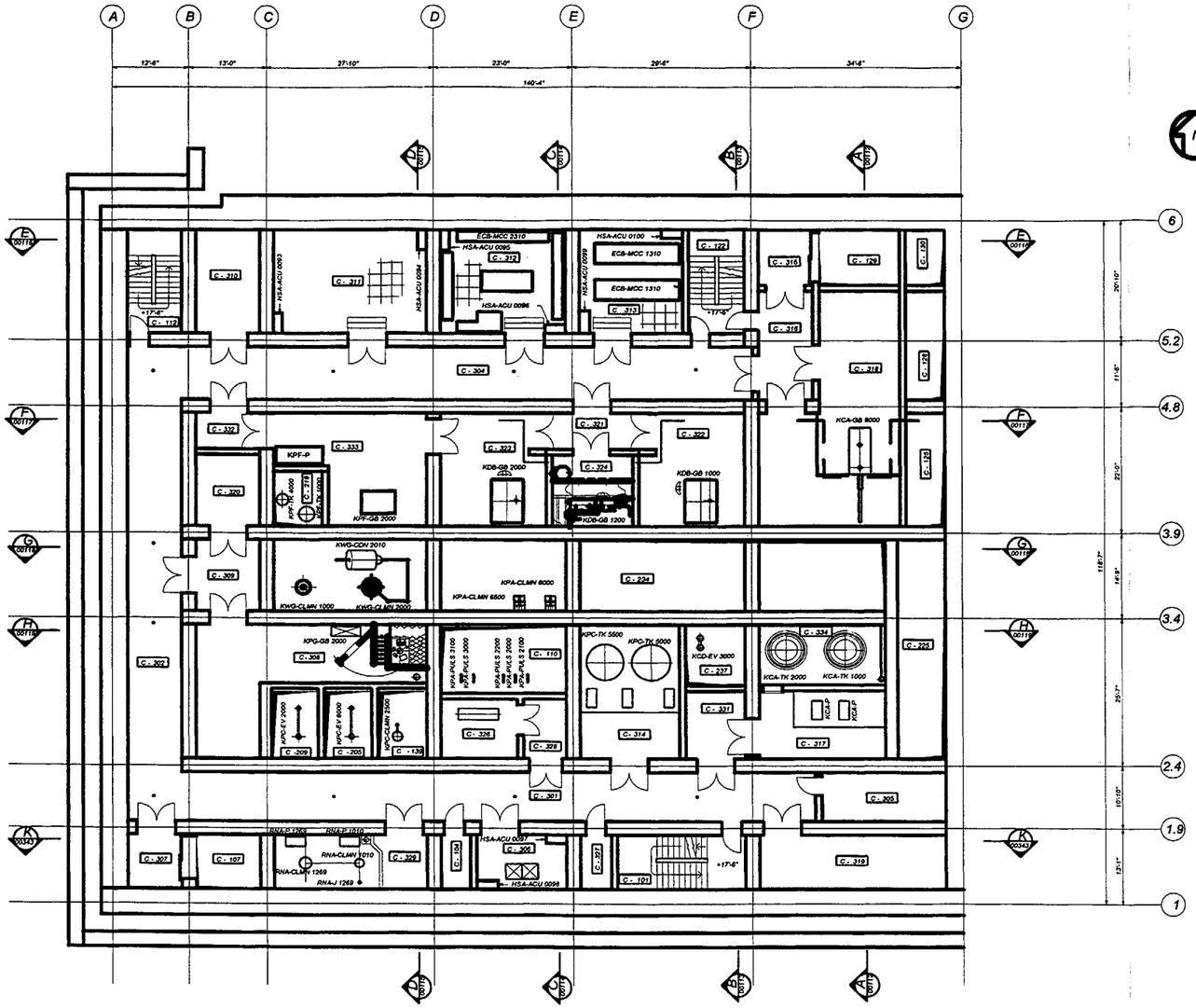
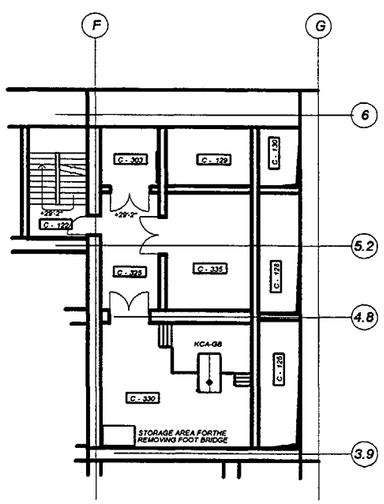


ROOM IDENTIFICATION			
NUMBER	DESIGNATION	CONFINEMENT ZONE	ROOM LOCATION
C - 301	PERSONNEL AND MATERIAL CORRIDOR	C2	E-2 4
C - 302	PERSONNEL AND MATERIAL CORRIDOR	C2	B-3 4
C - 303	ELEVATOR LOBBY	C2	F-6
C - 304	PERSONNEL AND MATERIAL CORRIDOR	C2	D-5 2
C - 305	TECHNICAL ROOM	C2	G-1 9
C - 306	ELECTRONICS ROOM	C2	E-1 9
C - 307	ELEVATOR LOBBY	C2	B-1 9
C - 308	SAMPLING ROOM	C3b	C-3 4
C - 309	AIR LOCK	C3b	B-3 4
C - 310	UTILITY CHASE	C2	C-5 2
C - 311	ELECTRONICS ROOM	C2	D-5 2
C - 312	ELECTRICAL ROOM	C2	E-5 2
C - 313	ELECTRICAL ROOM	C2	E-5 2
C - 314	VESSELS ROOM,KPC	C2	E-3 4
C - 315	ELEVATOR LOBBY	C2	F-6
C - 316	AIR LOCK	C3b	F-5 2
C - 317	PUMP ROOM,KCA	C3b	F-2 4
C - 318	FURNACE ROOM	C3b	F-5 2
C - 319	UTILITY ROOM	C2	F-1 9
C - 320	LIQUID WASTE	C3b	C-3 9
C - 321	AIR LOCK	C3b	E-4 8
C - 322	ELECTROLYZER ROOM,KDB	C3b	F-4 8
C - 323	ELECTROLYZER ROOM,KDB	C3b	D-4 8
C - 324	FILTER GLOVE BOX ROOM,KDB	C3b	E-3 9
C - 325	AIR LOCK	C3b	F-5 2
C - 326	SPARE	C3b	D-2 4
C - 327	TECHNICAL ROOM	C2	E-1 9
C - 328	AIR LOCK	C3b	E-2 4
C - 329	TANK ROOM,REAGENTS	C2	D-1 9
C - 330	PRECIPITATION ROOM,KCA	C3b	F-3 9
C - 331	AIR LOCK	C3b	F-2 4
C - 332	AIR LOCK	C3b	B-4 8
C - 333	ELECTROLYZER ROOM,KPF	C3b	D-4 8
C - 334	VESSELS ROOM,KCA	PC	F-3 4
C - 335	FILTER ROOM	C3b	F-5 2
D			
D			



INTERSTITIAL

Figure 11.1-4. Aqueous Polishing Area - Process Conceptual Layout - Level 3 (Elevation 17'-6")

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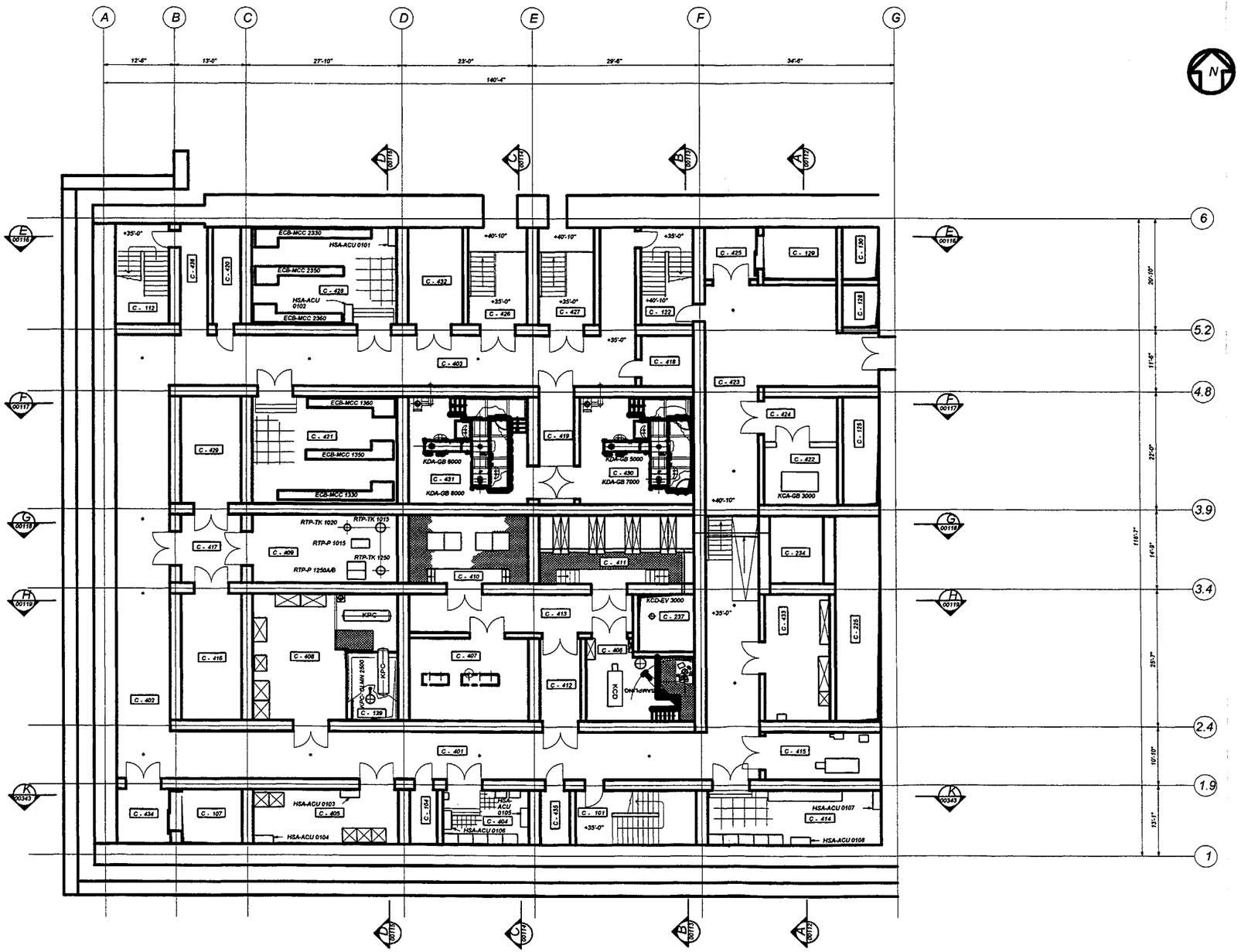

ROOM IDENTIFICATION			
NUMBER	DESIGNATION	CONFINEMENT ZONE	ROOM LOCATION
C - 401	PERSONNEL AND MATERIAL CORRIDOR	C2	D-1.9
C - 402	PERSONNEL AND MATERIAL CORRIDOR	C2	A-2.4
C - 403	PERSONNEL AND MATERIAL CORRIDOR	C2	D-5.2
C - 404	ELECTRONICS ROOM	C2	E-1.9
C - 405	RAD CONTROL ROOM	C2	D-1.9
C - 406	ON LINE ANALYSIS ROOM	C3b	E-3.4
C - 407	PULSATION VALVES G.B. ROOM,KPA	C3b	E-2.4
C - 408	STEAM DISTRIBUTION AND VESSELS ROOM	C2	C-2.4
C - 409	REAGENTS DISTRIBUTION ROOM	C3b	C-3.4
C - 410	DECONTAMINATION DISTRIBUTION ROOM	C3b	D-3.4
C - 411	A.C. AIR JET DISTRIBUTION ROOM	C3b	E-3.4
C - 412	AIR LOCK	C3b	E-2.4
C - 413	CORRIDOR	C3b	E-3.4
C - 414	ELECTRONICS ROOM	C2	F-1.9
C - 415	PNEUMATIC TRANSFER ROOM,KCC	C2	G-1.9
C - 416	LIQUID WASTE	C3b	B-3.4
C - 417	AIR LOCK	C3b	B-3.9
C - 418	UTILITY ROOM	C2	F-4.8
C - 419	AIR LOCK	C3b	E-4.8
C - 420	UTILITY CHASE	C2	C-5.2
C - 421	ELECTRICAL ROOM	C2	C-4.8
C - 422	GLOVE BOX ROOM,KCA	C3b	F-3.9
C - 423	PERSONNEL AND MATERIAL CORRIDOR	C2	F-4.8
C - 424	AIR LOCK	C3b	F-4.8
C - 425	ELEVATOR LOBBY	C2	F-6
C - 426	VESTIBULE (ACCESS POLISHING)	C2	E-5.2
C - 427	VESTIBULE (EXIT POLISHING)	C2	E-5.2
C - 428	ELECTRICAL ROOM	C2	D-5.2
C - 429	LIQUID WASTE	C3b	B-3.9
C - 430	ELECTROLYZER FEED ROOM,KDA	C3b	F-3.9
C - 431	ELECTROLYZER FEED ROOM,KDA	C3b	D-3.9
C - 432	RESERVE	C2	D-5.2
C - 433	COMPRESSED AIR DISTRIBUTION	C2	F-3.4
C - 434	ELEVATOR LOBBY	C2	B-1
C - 435	TECHNICAL ROOM	C2	E-1.9
C - 436	PERSONNEL CORRIDOR	C2	B-5.2

Figure 11.1-5. Aqueous Polishing Area - Process Conceptual Layout - Level 4 (Elevation 35'-0")

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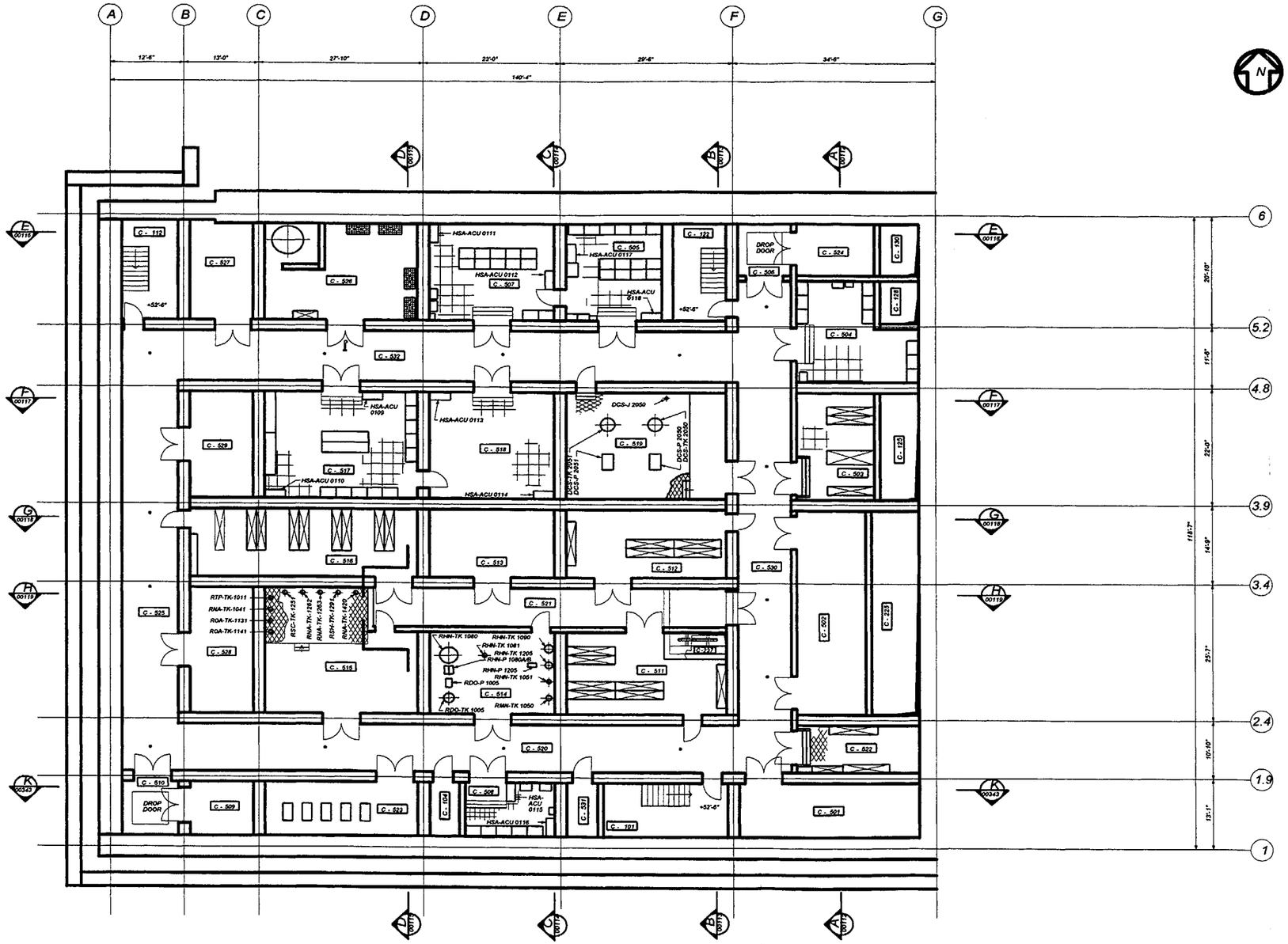

ROOM IDENTIFICATION			
NUMBER	DESIGNATION	CONFINEMENT ZONE	
C - 501	RADIOPROTECTION LABORATORY	C2	
C - 502	RADIOPROTECTION STORAGE	C2	
C - 503	COMPRESSED AIR DISTRIBUTION	C2	
C - 504	ELECTRONICS ROOM	C2	
C - 505	ELECTRONICS ROOM	C2	
C - 506	ELEVATOR LOBBY	C2	
C - 507	ELECTRICAL ROOM	C2	
C - 508	ELECTRONICS ROOM	C2	
C - 509	SERVICE ELEVATOR MAINTENANCE	C2	
C - 510	ELEVATOR LOBBY	C2	
C - 511	TRANSMITTER ROOM	C2	
C - 512	TRANSMITTER ROOM	C2	
C - 513	COOLING LOOP ROOM	C2	
C - 514	STORAGE,REAGENTS	C2	
C - 515	REAGENTS ROOM	C2	
C - 516	TRANMITTER ROOM	C2	
C - 517	ELECTRONICS ROOM	C2	
C - 518	ELECTRICAL ROOM	C2	
C - 519	DECONTAMINATION DISTRIBUTION	C2	
C - 520	PERSONNEL AND MATERIAL CORRIDOR	C2	
C - 521	PERSONNEL AND MATERIAL CORRIDOR	C2	
C - 522	COMPRESSED AIR DISTRIBUTION	C2	
C - 523	EXPANSION TANKS	C2	
C - 524	SERVICE ELEVATOR MAINTENANCE	C2	
C - 525	PERSONNEL AND MATERIAL CORRIDOR	C2	
C - 526	EMERGENCY AIR ROOM	C2	
C - 527	UTILITY CHASE	C2	
C - 528	LIQUID WASTE	C2	
C - 529	LIQUID WASTE	C2	
C - 530	PERSONNEL AND MATERIAL CORRIDOR	C2	
C - 531	TECHNICAL ROOM	C2	
C - 532	PERSONNEL AND MATERIAL CORRIDOR	C2	

Figure 11.1-6. Aqueous Polishing Area - Process Conceptual Layout - Level 5 (Elevation 52'-6")

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Figure 11.1-7. Aqueous Polishing Area - Process Conceptual Layout – Section A-A

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Figure 11.1-8. Aqueous Polishing Area - Process Conceptual Layout – Section B-B

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Figure 11.1-9. Aqueous Polishing Area - Process Conceptual Layout – Section C-C

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Figure 11.1-10. Aqueous Polishing Area - Process Conceptual Layout - Section D-D

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Figure 11.1-11. Aqueous Polishing Area - Process Conceptual Layout - Section E-E

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Figure 11.1-12. Aqueous Polishing Area - Process ConceptualLayout - Section F-F

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Figure 11.1-13. Aqueous Polishing Area - Process Conceptual Layout - Section G-G

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Figure 11.1-14. Aqueous Polishing Area - Process Conceptual Layout - Section H-H

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Figure 11.1-15. Aqueous Polishing Area - Process Conceptual Layout - Section K-K

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Oversized Drawing – See Accompanying File

Figure 11.1-16. MFFF Processing Area - Process Conceptual Layout - Level 1 (Elevation 0'-0")

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Oversized Drawing – See Accompanying File

Figure 11.1-17. MFFF Processing Area - Process Conceptual Layout - Level 2 (Elevation 23'-4")

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Oversized Drawing – See Accompanying File

Figure 11.1-18. MFFF Processing Area - Process Conceptual Layout - Level 3 (Elevation 40'-10")

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Figure 11.1-19. MOX Processing Area – Process Conceptual Layout – Section A-A Line 7 to 12

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Figure 11.1-20. MOX Processing Area – Process Conceptual Layout – Section A-A Line 1 to 7

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Figure 11.1-21. MOX Processing Area – Process Conceptual Layout – Section B-B Line 7 to 12

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Figure 11.1-22. MOX Processing Area – Process Conceptual Layout – Section B-B Line 1 to 7

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Figure 11.1-23. MOX Processing Area – Process Conceptual Layout – Section C-C Line 7 to 12

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Figure 11.1-24. MOX Processing Area – Process Conceptual Layout – Section C-C Line 1 to 7

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Figure 11.1-25. MOX Processing Area – Process Conceptual Layout – Section D-D Line M to W

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Figure 11.1-26. MOX Processing Area – Process Conceptual Layout – Section D-D Line G to M

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Figure 11.1-27. MOX Processing Area – Process Conceptual Layout – Section E-E Line M to W

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Figure 11.1-28. MOX Processing Area – Process Conceptual Layout – Section E-E Line G to M

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Figure 11.1-29. MOX Processing Area – Process Conceptual Layout – Section F-F Line M to W

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Figure 11.1-30. MOX Processing Area – Process Conceptual Layout – Section F-F Line G to M

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Oversized Drawing – See Accompanying File

Figure 11.1-31. MOX Processing Area - Conceptual Process Layout - Misc Plans and Sections

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Oversized Drawing – See Accompanying File

Figure 11.1-32. MOX Processing Area - Conceptual Process Layout - Misc Plans and Sections

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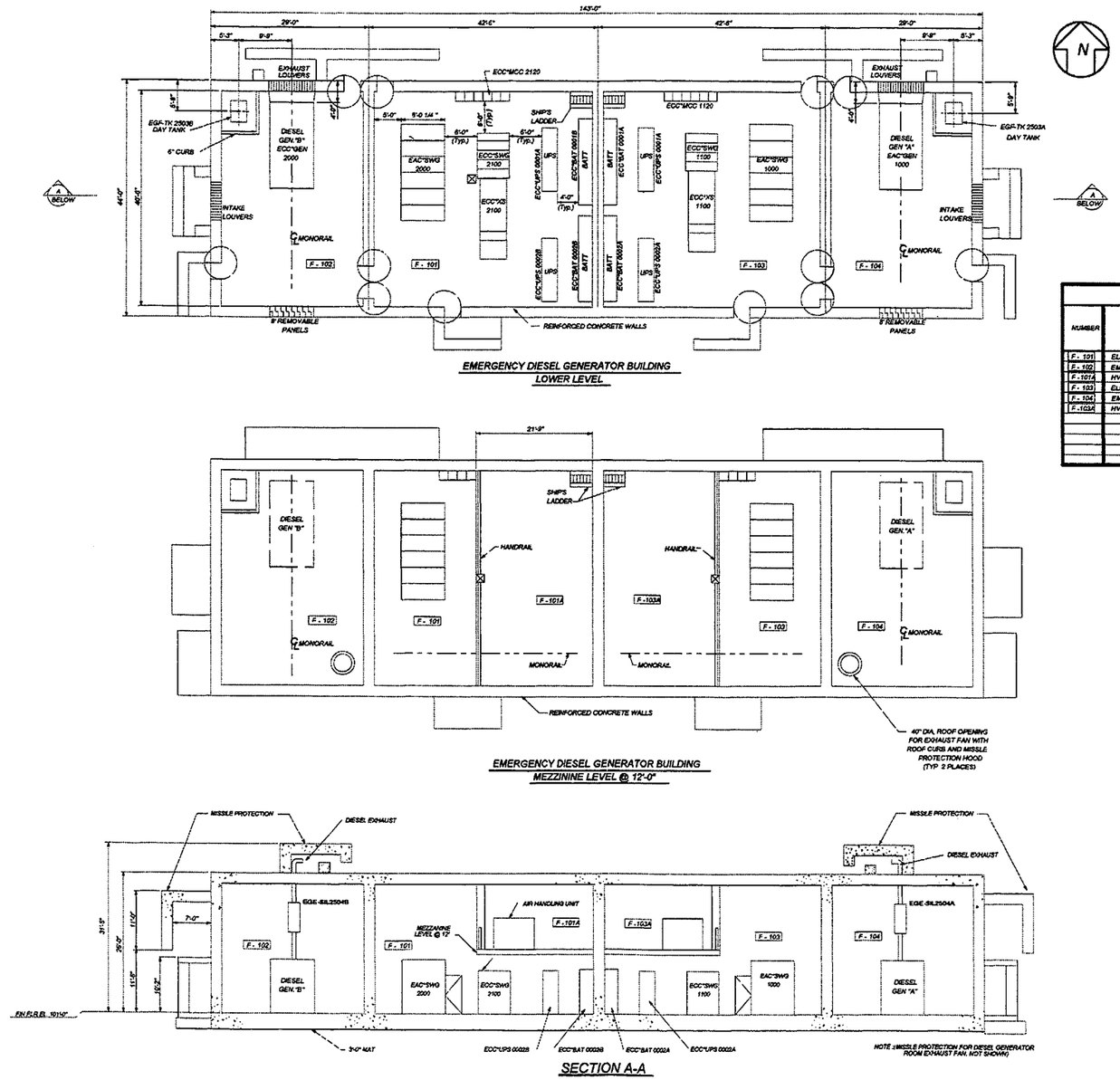

ROOM IDENTIFICATION	
NUMBER	DESIGNATION
F - 101	ELECTRICAL EQUIPMENT ROOM "B"
F - 102	EMERGENCY DIESEL GENERATOR ROOM "B"
F - 101A	HVAC ELECTRICAL MEZZANINE "B"
F - 103	ELECTRICAL EQUIPMENT ROOM "A"
F - 104	EMERGENCY DIESEL GENERATOR ROOM "A"
F - 103A	HVAC ELECTRICAL MEZZANINE "A"

Figure 11.1-33. General Arrangement - Emergency Diesel Generator (BEG) - Conceptual Layout

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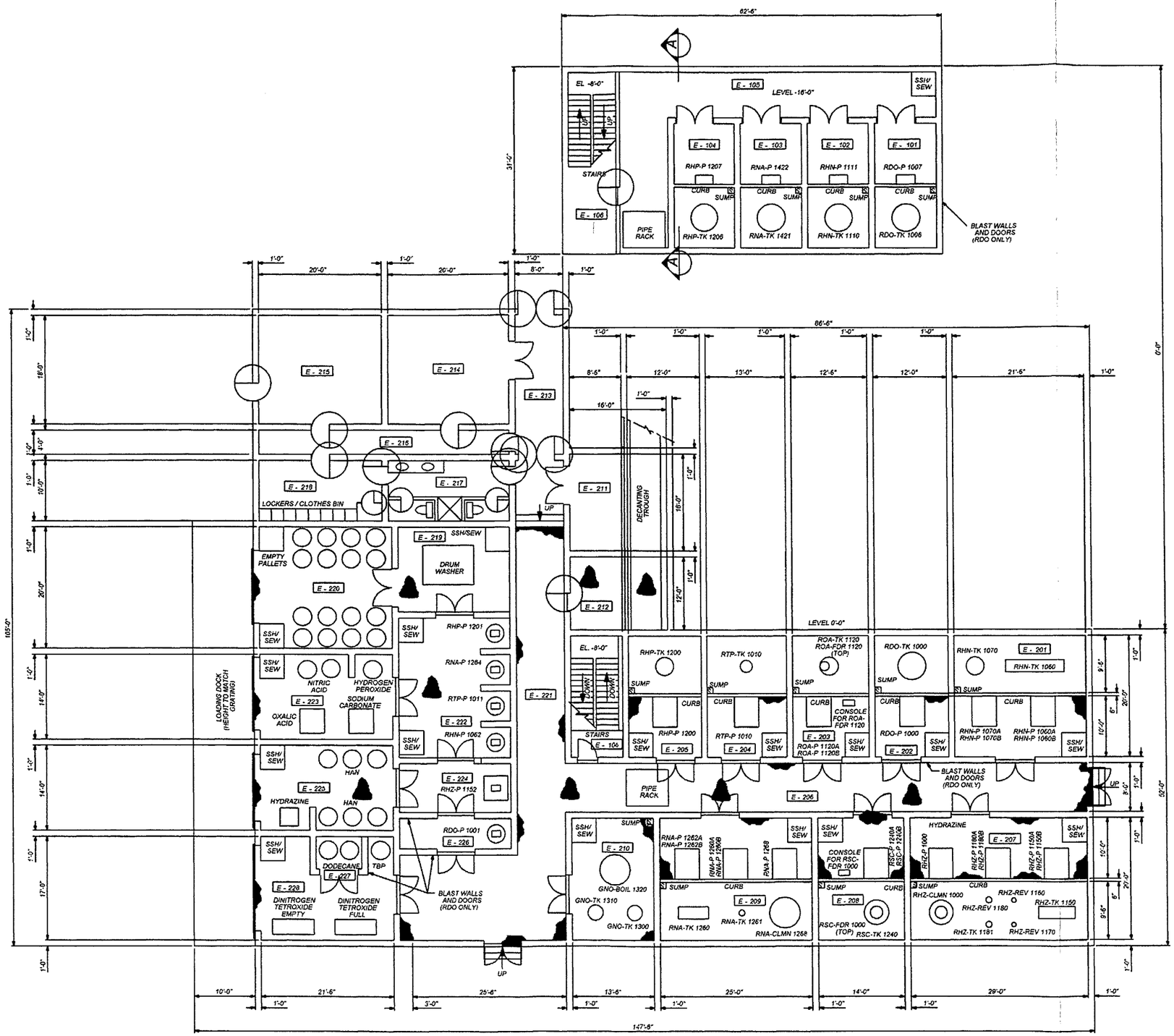

Figure 11.1-34. General Arrangement - Reagents Building (BRP) - Conceptual Layout

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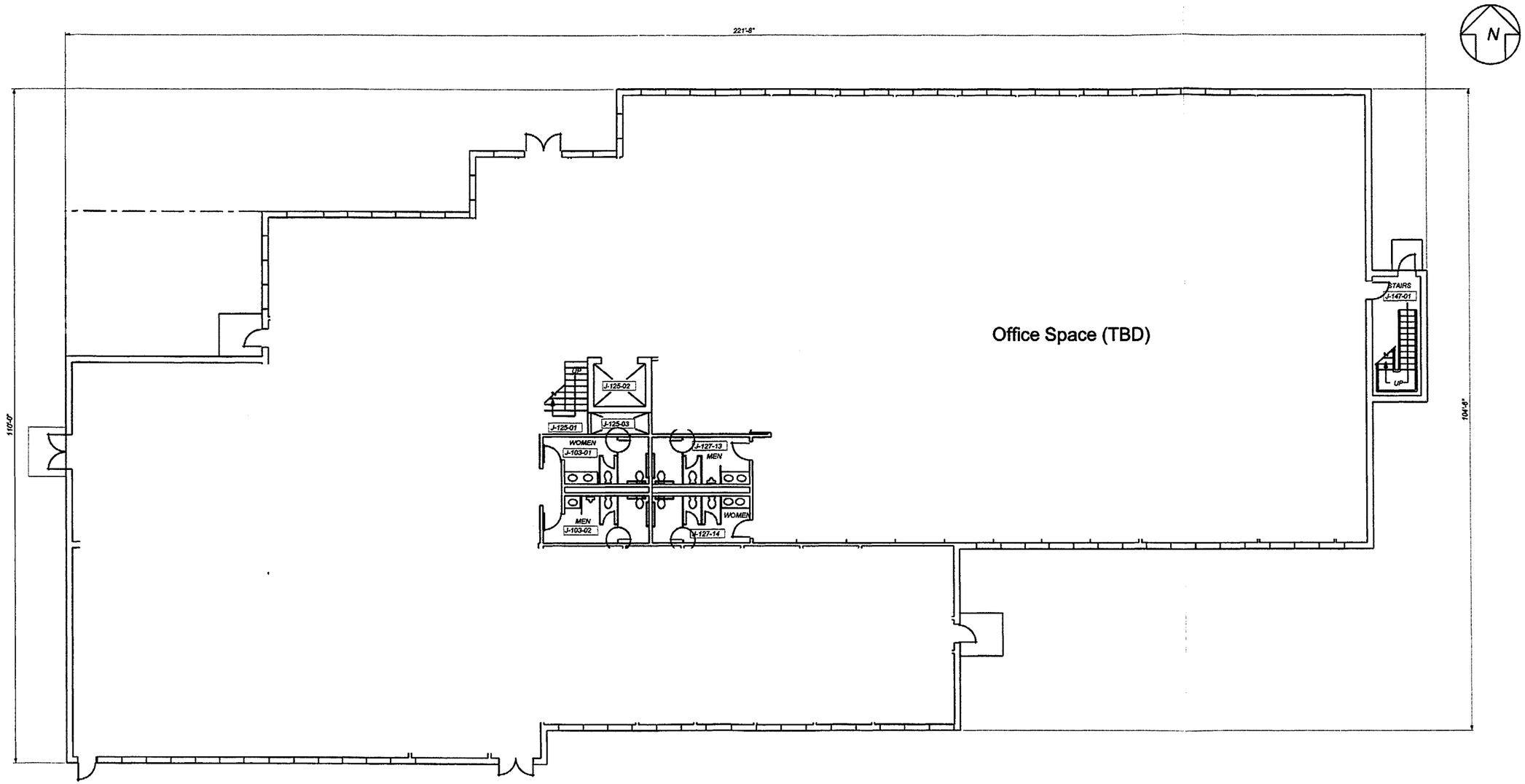

Figure 11.1-35. General Arrangement - Administration Building (BAD) - Conceptual Layout - First Floor

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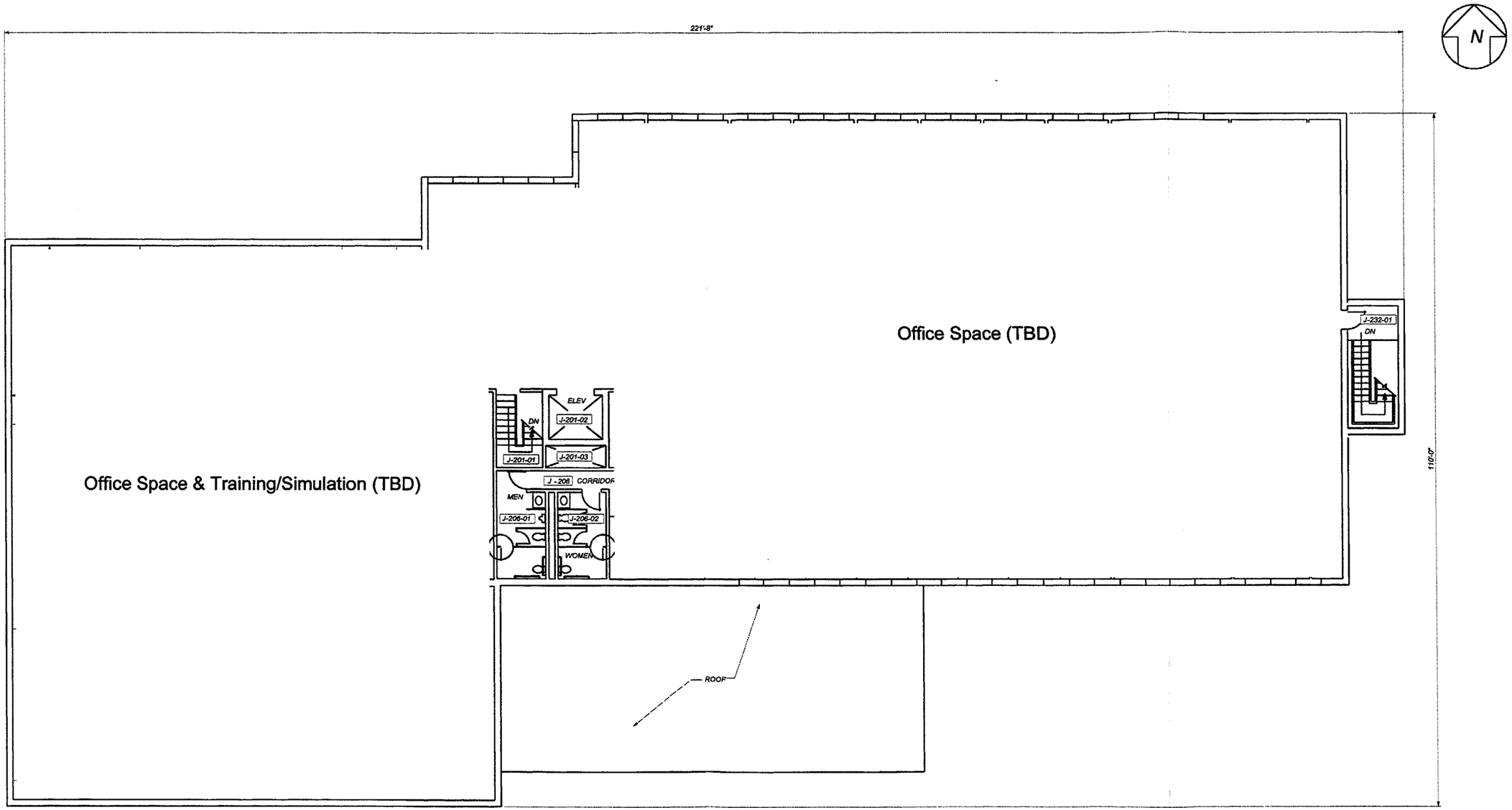

Figure 11.1-36. General Arrangement - Administration Building (BAD) - Conceptual Layout - Second Floor

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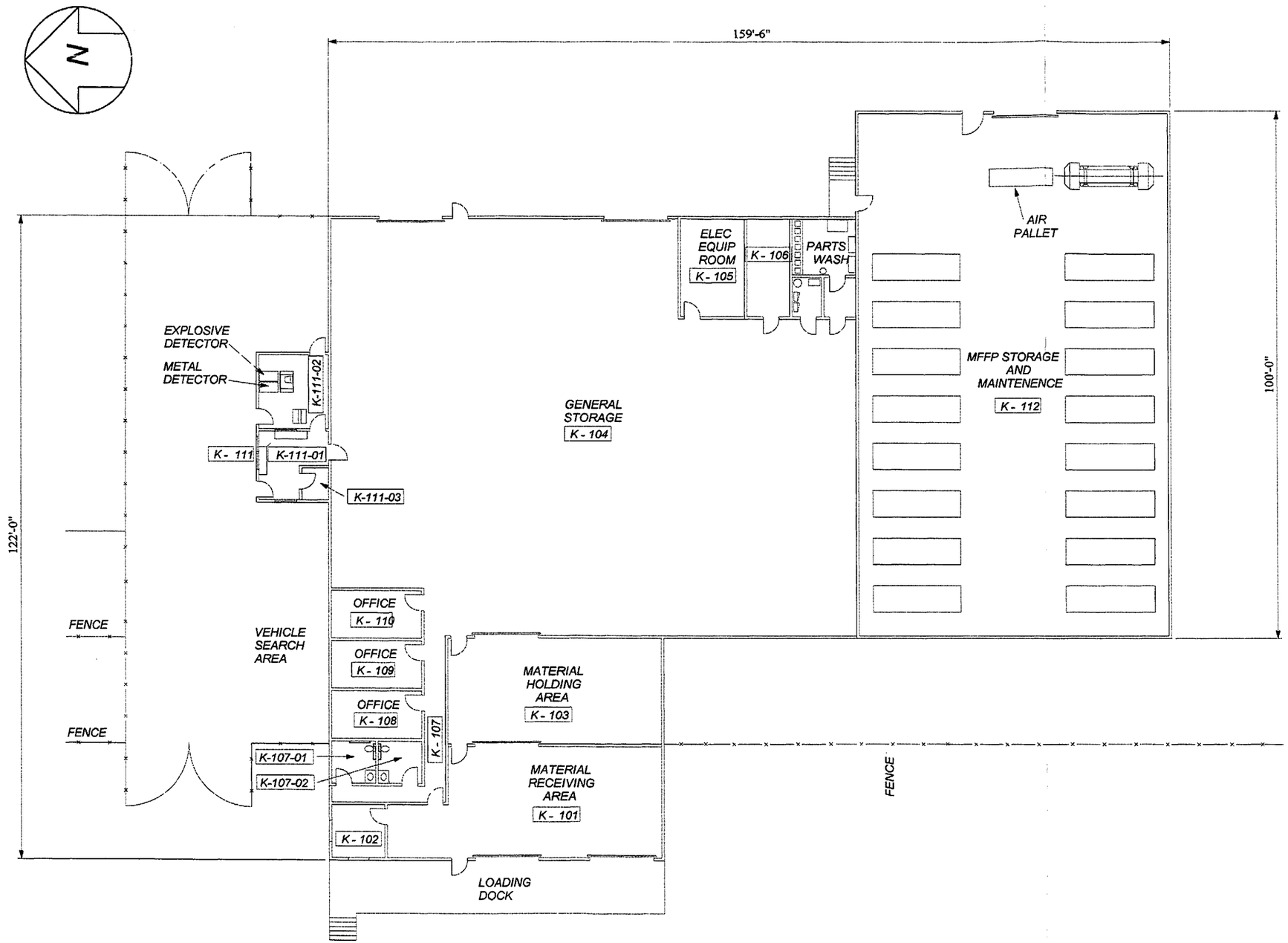

Figure 11.1-37. General Arrangement Secure Warehouse (BSW) - Conceptual Layout

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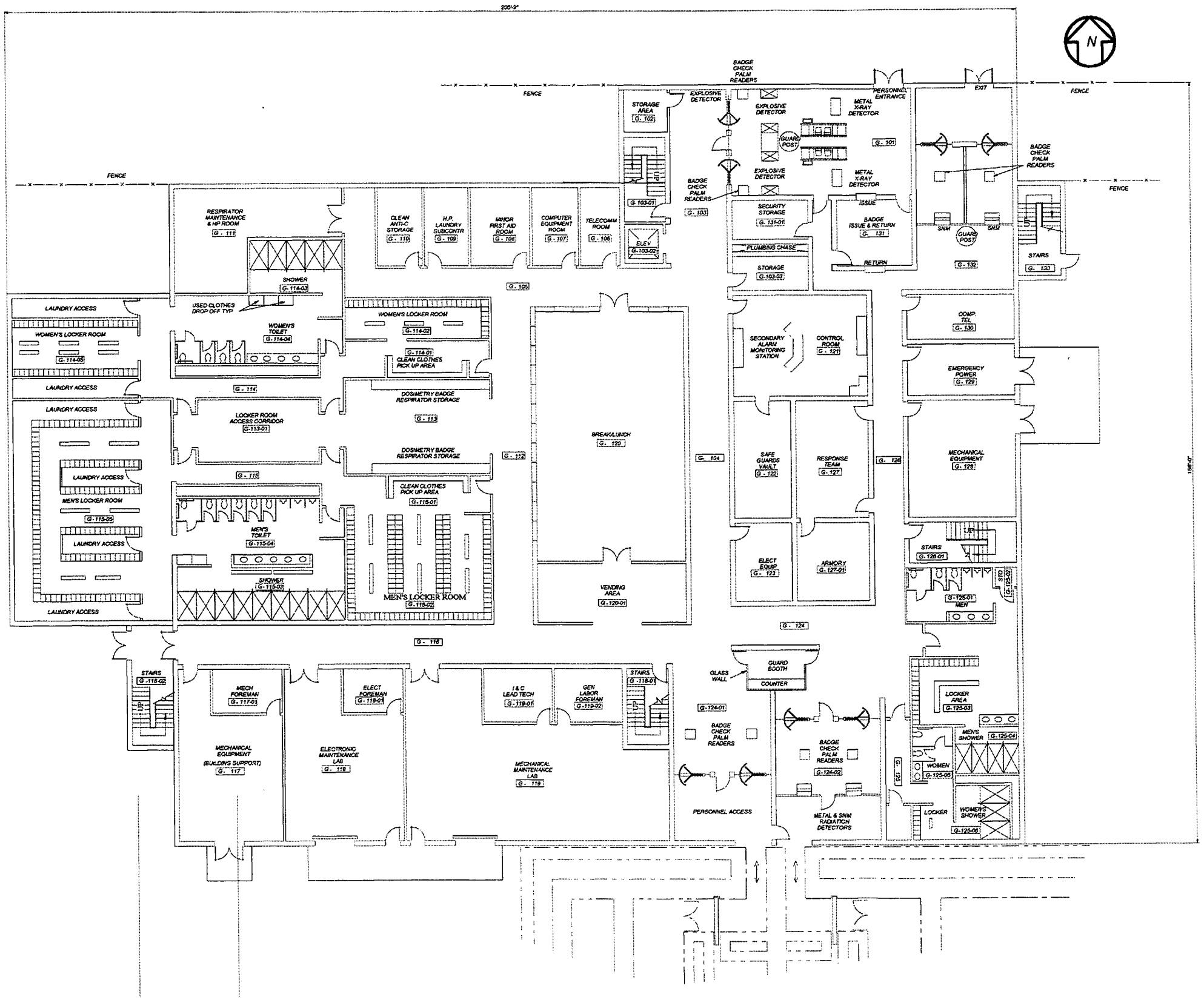

ROOM IDENTIFICATION	
NUMBER	DESIGNATION
G-101	PERSONNEL ENTRANCE
G-102	STORAGE
G-103	ELEVATOR LOBBY
G-103-01	STAIRS
G-103-02	ELEVATOR
G-103-03	STORAGE
G-104	CORRIDOR
G-105	CORRIDOR
G-106	TELECOM ROOM
G-107	COMPUTER EQUIPMENT ROOM
G-108	MINOR FIRST AID ROOM
G-109	H.P. LAUNDRY SUBCONTRACTOR
G-110	CLEAN ANTI-C STORAGE
G-111	RESPIRATOR MAINTENACE & HP ROOM
G-112	CORRIDOR
G-113	BADGE/RESPIRATOR STORAGE
G-113-01	LOCKER ROOM ACCESS CORRIDOR
G-114	CORRIDOR
G-114-01	WOMEN'S CLEAN CLOTHES PICK UP
G-114-02	WOMEN'S LOCKER
G-114-03	WOMEN'S SHOWER
G-114-04	WOMEN'S TOILET
G-114-05	WOMEN'S LOCKER
G-115	CORRIDOR
G-115-01	MEN'S CLEAN CLOTHES PICK UP/LOCKER
G-115-02	MEN'S LOCKER
G-115-03	MEN'S SHOWER
G-115-04	MEN'S TOILET
G-115-05	MEN'S LOCKER
G-116	CORRIDOR
G-116-01	STAIRS
G-116-02	STAIRS
G-117	MECHANICAL EQUIPMENT
G-117-01	MECHANICAL FOREMAN
G-118	ELECTRONIC MAINTENANCE
G-118-01	ELECTRONIC FOREMAN
G-119	MECHANICAL MAINTENACE LAB
G-119-01	I & C LEAD TECH
G-119-02	GENERAL LABOR FOREMAN
G-120	BREAK/LUNCH
G-120-01	VENDING AREA
G-121	CONTROL ROOM
G-122	SAFE GUARD'S VAULT
G-123	ELECTRONIC EQUIPMENT
G-124	PERSONNEL ACCESS AREA
G-124-01	PERSONNEL ACCESS
G-124-02	PERSONNEL EXIT
G-125	CORRIDOR
G-125-01	MEN'S TOILET
G-125-02	STORAGE
G-125-03	MEN'S LOCKER
G-125-04	MEN'S SHOWER
G-125-05	WOMEN'S TOILET/LOCKER
G-125-06	WOMEN'S SHOWER
G-126	CORRIDOR
G-126-01	STAIRS
G-127	RESPONSE TEAM
G-127-01	ARMORY
G-128	MECHANICAL EQUIPMENT
G-129	EMERGENCY POWER
G-130	COMP. TEL
G-131	BADGE ISSUE & RETURN
G-131-01	SECURITY STORAGE
G-132	PERSONNEL EXIT
G-133	STAIRS

Figure 11.1-38. General Arrangement – Technical Support Building (BTS) Conceptual Layout – First Floor

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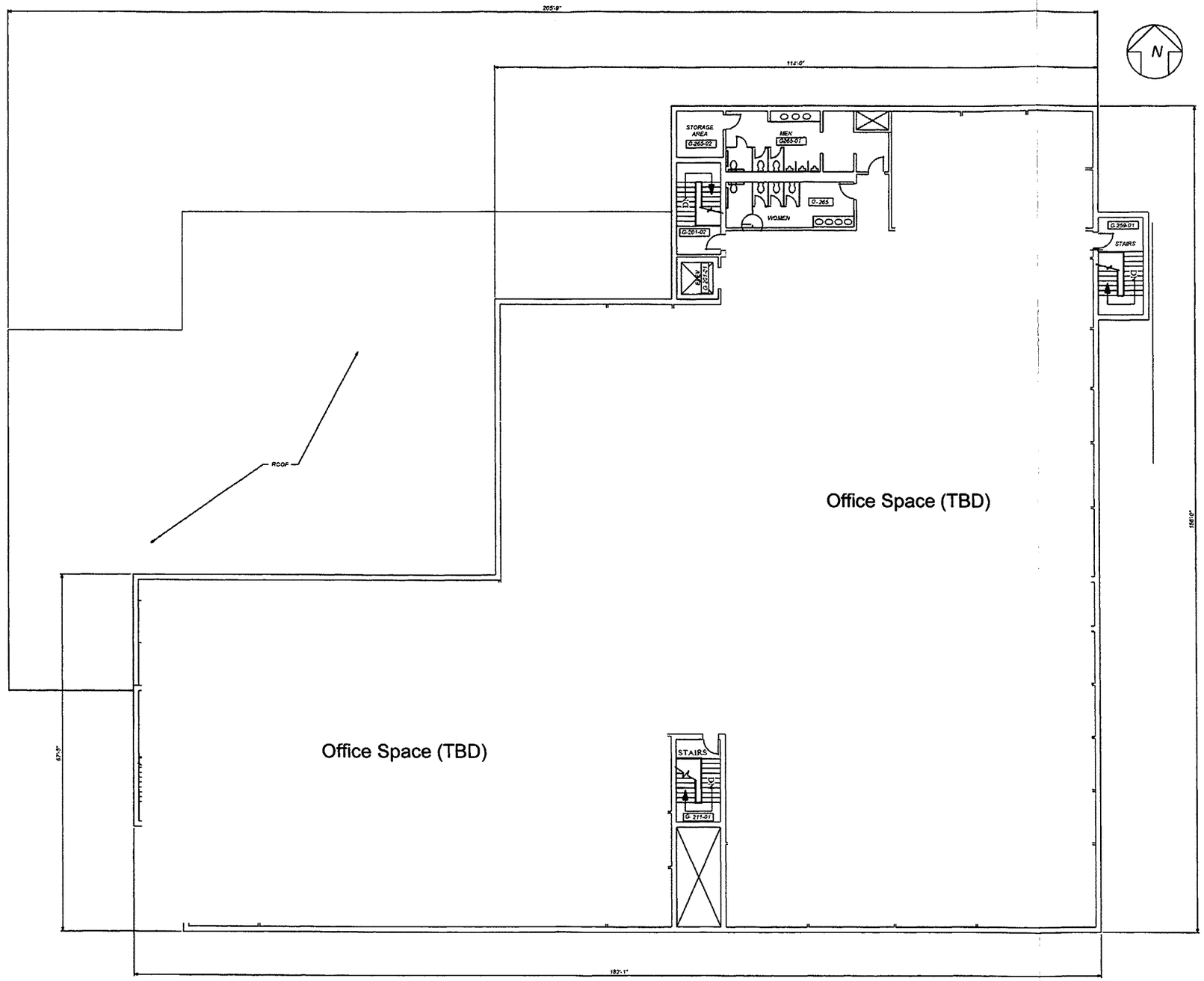

Figure 11.1-39. General Arrangement – Technical Support Building (BTS) Conceptual Layout – Second Floor

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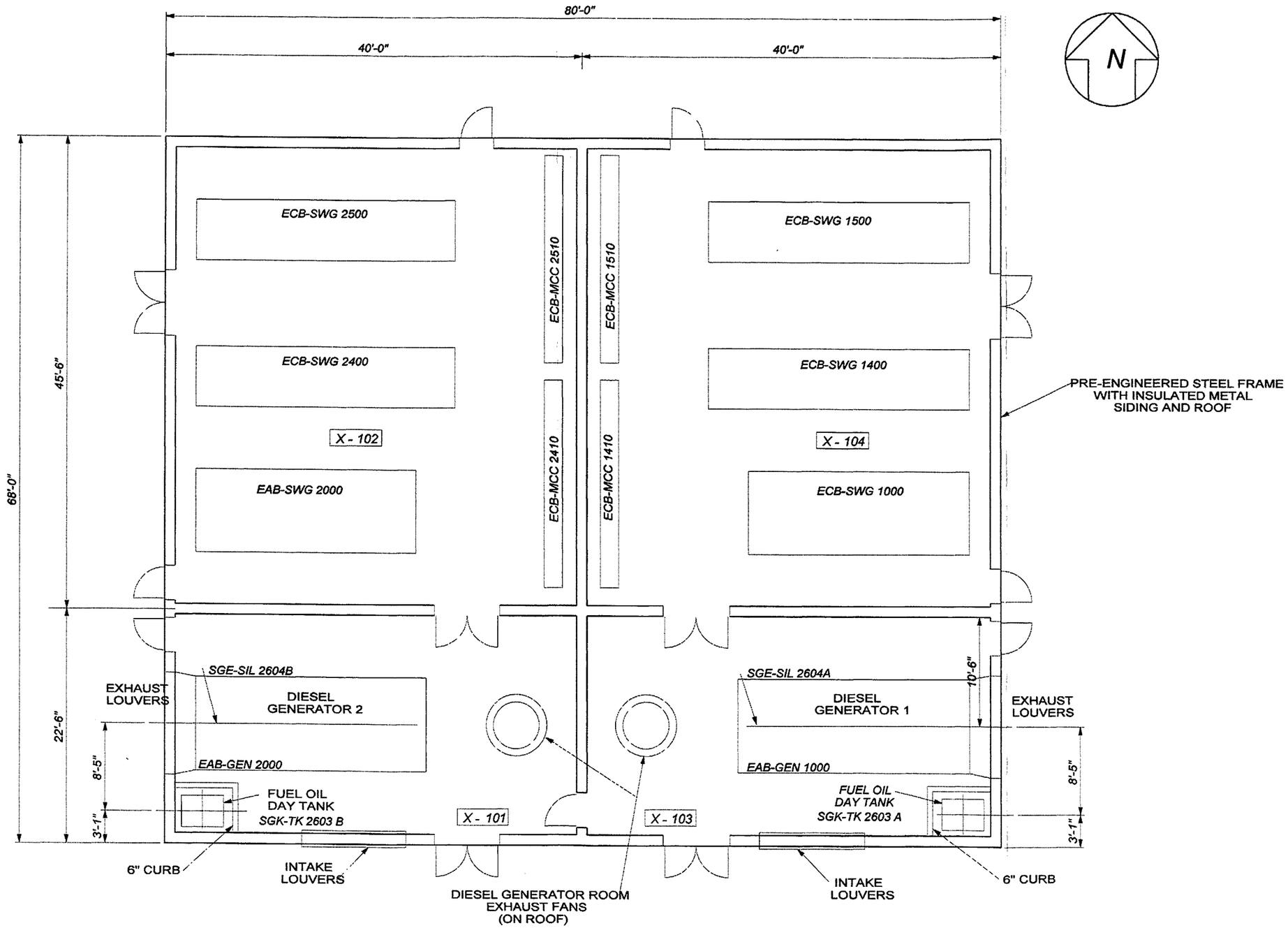

Figure 11.1-40. General Arrangement - Standby Diesel Generator (BSG) - Conceptual Layout

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THAT CAN BE VIEWED AT THE RECORD TITLED:

FIGURE 7-1:

MOX PROCESSING AREA FIRE AREA/BARRIER CONCEPTUAL LAYOUT LEVEL 1 (ELEVATION 0'-0")

WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DRAWING NUMBER:

FIGURE 7-1

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

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FIGURE 7-2:

MOX PROCESSING AREA FIRE AREA/BARRIER CONCEPTUAL LAYOUT LEVEL 2 (ELEVATION 23'-4")

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FIGURE 7-2

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

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FIGURE 7-3:

MOX PROCESSING AREA FIRE AREA/BARRIER CONCEPTUAL LAYOUT LEVEL 3 (ELEVATION 40'-10")

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FIGURE 7-3

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FIGURE 7-4:
AQUEOUS POLISHING AREA FIRE AREA/BARRIER CONCEPTUAL LAYOUT LEVEL 1 (ELEVATION 17'-6")

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FIGURE 7-4

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FIGURE 7-5:
AQUEOUS POLISHING AREA FIRE AREA/BARRIER CONCEPTUAL LAYOUT LEVEL 2 (ELEVATION 0'-0")

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FIGURE 7-6:
AQUEOUS POLISHING AREA FIRE AREA/BARRIER CONCEPTUAL LAYOUT LEVEL 3 (ELEVATION 17'-6")

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FIGURE 7-6

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FIGURE 7-7:
AQUEOUS POLISHING AREA FIRE AREA/BARRIER CONCEPTUAL LAYOUT LEVEL 4 (ELEVATION 35'-0")

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FIGURE 7-7

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FIGURE 7-8:
AQUEOUS POLISHING AREA FIRE AREA/BARRIER CONCEPTUAL LAYOUT LEVEL 5 (ELEVATION 52'-6")

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FIGURE 7-8

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FIGURE 11.1-16:

MFFF PROCESSING AREA PROCESS CONCEPTUAL LAYOUT LEVEL 1 (ELEVATION 0'-0")

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FIGURE 11.1-16

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FIGURE 11.1-17:

MFFF PROCESSING AREA PROCESS CONCEPTUAL LAYOUT LEVEL 2 (ELEVATION 23'-4")

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FIGURE 11.1-17

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FIGURE 11.1-18:

MFFF PROCESSING AREA PROCESS CONCEPTUAL LAYOUT LEVEL 3 (ELEVATION 40'-10")

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FIGURE 11.1-18

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Figure 11.1-31. MOX Processing Area - Conceptual Process Layout - Misc Plans and Sections

Figure 11.1-32. MOX Processing Area - Conceptual Process Layout - Misc Plans and Sections