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Conceptual Design Report for the Materials and Fuels Complex (MFC) Research Collaboration Building (RCB)

Flad Architects
Flad Structural Engineers
Affiliated Engineers, Inc.

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FIGURES

TABLES

ACRONYMS

ADA: Americans with Disabilities Act

AHU: Air Handling Unit

ANSI: American National Standards Institute

ASCE: American Society of Civil Engineers

ASHREA: American Society of Heating, Refrigerating & Air-Conditioning Engineers

ASME: American Society of Mechanical Engineers

ASPE: American Society of Plumbing Engineers

AT: Air TerminalV

BAS: Building Automation System

BEA: Battelle Energy Alliance, LLC

CDR: Conceptual Design Report

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act of 1980

DDC: Displace Data Channel

DOE: Department of Energy

DOE-NE: U.S. Department of Energy Office of Nuclear Energy

ENS: Emergency Notification System

FMG: Factory Mutual Global

FMRC: Factory Mutual Research Corporation

FOR: Functional and Operational Requirements

IBC: International Building Code

IEEE: Institute of Electrical and Electronics Engineers

IESI: Illuminating Engineering Society of North America

IESNA: Illuminating Engineering Society of North America

IFC: International Fire Code

INL: Idaho National Laboratory

ISMS: Integrated Safety Management System

MFC: Materials and Fuels Complex

NEC: National Electrical Code

NECA: National Electrical Contractors Association

NFPA: National Fire Protection Association

NS&T: Nuclear Science and Technology

NSUF: Nuclear Science User Facilities

OSHA: Occupational Safety and Health Administration

QL: Quality Level

QLD: Quality Level Determination

RCRA: Resource Conservation and Recovery Act

RD&D: Research, Development and Demonstration

SDS: Safety Data Sheet

SMACNA: Sheet metal & Air Conditioning Contractors' National Association

SMR: Surface Metallic Raceway

UL: Underwriters Laboratories

USDA: U.S. Department of Agriculture

VFD: Variable Frequency Drive

Conceptual Design Report for the MFC Research Collaboration Building (RCB)

1. BACKGROUND

The capabilities provided by the Idaho National Laboratory's (INL) Materials and Fuels Complex (MFC) are a major contributor to the mission of the Nuclear Science and Technology (NS&T) Program within INL. The mission of NS&T is to provide nuclear energy research, development and demonstration (RD&D) for the U.S. Department of Energy Office of Nuclear Energy (DOE-NE).

In order for MFC to support the growing demand for nuclear energy research in support of the DOE Gateway for Accelerated Innovation in Nuclear (GAIN) initiative and Nuclear Science User Facilities (NSUF) Program, MFC must undergo significant physical transformation to its infrastructure and support facilities.

MFC currently lacks space to adequately address emerging materials and fuels research activities defined by NS&T. Space for researchers to collaborate with external users does not exist in near proximity to MFC. Capability gaps being addressed by this facility include availability of space to conduct critical small scale experiments, mock-up envisioned process, and develop experimental instrumentation, data visualization equipment and analysis infrastructure. To close these capability gaps and to provide adequate office space, Battelle Energy Alliance (BEA) has identified the need for a modern research collaboration building.

2. OBJECTIVES AND SCOPE

The objective of this Conceptual Design Report (CDR) is to provide conceptual design information and details for a facility that meets the DOE approved mission need statement and provides the basis for Critical Decision Equivalent (CDE)-1 approval by the DOE.

The objective of the project is to create easily accessible research and collaboration space to house MFC and other external nuclear energy research personnel, dry laboratory space, and space for internal and external researchers to perform data analysis in support of experiments. The facility will be designed and space will be allocated for external nuclear energy researchers to train, work and collaborate with MFC researchers. A laboratory area will be designed and constructed to accomplish instrument development, benchtop fabrication, and prototyping in support of experiments and experimental equipment. The entire building will be a non-radiological facility.

2.1 Alternatives

2.1.1 Siting Alternatives

The alternatives identified in the approved mission need statement were evaluated in this effort with the following results:

- No action: Space utilization studies show that MFC facilities are currently at full capacity. With the increased demand for nuclear energy research and MFC resources necessary to fulfill this demand, this alternative has been eliminated.
- Site the new facility inside of the MFC security area: This alternative was eliminated based on a thorough siting analysis (see Section 3.4 below).
- Site the new facility outside of the MFC security area on the east side of the parking lot: This alternative was eliminated based on a thorough siting alternatives analysis (see Section 3.4 below).

- Site the new facility outside of the MFC security area on the north side of the parking lot west of the current MFC-701 guard station and vehicle security check point: This alternative is the recommended site based on a thorough siting alternatives analysis (see Section 3.4 below).

2.1.2 Acquisition Strategy

The mission need statement also defined alternative acquisition strategies for the building. The alternatives defined in the mission need statement are listed below.

To evaluate the potential acquisition strategies, a team of subject matter experts from DOE-ID, INL Cost Estimating, INL Project Management, MFC Facility Management and INL Security were convened to assess the advantages, disadvantages and cost benefits associated with each alternative. The first part of the evaluation compared the advantages and disadvantages.

2.1.2.1 Split Acquisition Strategy

- Design-Bid-Build for the Site Preparation Scope of Work (Utility Corridor and Security Fence Relocation).
  - Site preparation design would be performed by INL engineering (or subcontracted to local engineering firm with strong MFC experience base);
  - Site preparation construction would be bid to pre-selected local construction subcontractors with strong MFC field experience (a common practice at INL).
- Design-Build for Building Design and Construction
  - Design and construction of building would be bid to qualified local and non-local construction and architectural-engineering firms**.**
- **Advantages:**
  - Relocating the security fence and providing essential utilities near the building site prior to facility construction reduces uncertainty and risks to the building contractor. Industry experience demonstrates that costs for building design and construction are lower when a “green-field” construction site is available.
  - Allows site preparation activities to be accomplished in advance of building construction. This shortens the overall project schedule, delivering the building to the users sooner.
  - The knowledge and expertise associated with MFC utilities and security systems resides with personnel at the INL. This will increase the efficiency of the design process and reduce design costs. INL experience shows that designs that are site specific and have DOE or INL specific requirements are inefficient and usually lack in quality when performed by external firms not normally engaged in INL work.
- **Disadvantages:**
  - If any construction field changes are required due to unforeseen events/conditions, INL would be responsible for those field changes. This represents a risk for cost management of the project.

2.1.2.2 Single Acquisition Strategy

- Design-Build for Entire Work Scope (Site Preparation & Building).
- **Advantages:**
  - Industry studies show projects have lower overall costs for design-build contracts especially when projects are not complex and use industry codes/standards and standard construction techniques.
  - Cost risks associated with design errors and resulting field changes for site preparation would be borne by the Contractor.
  - Provides a fixed cost for the entire project scope as compared to just the building scope.
- **Disadvantages:**
  - Design of the utilities and security fence/systems is unique and site-specific. This results in higher risk for the design-build contractor. Contractors will need to research existing utility and security system configurations and requirements to perform the design. This will impact project cost and schedule.
  - Higher risk will result in higher bid costs and schedule uncertainty. This uncertainty may also result in less or no competition. This will impact project cost, schedule and may reduce the number of bidders for the project.
  - Performance specifications for the utility and security system modifications will need to contain details typical of a design-bid-build specification to provide the necessary information concerning existing configurations and non-industry standard requirements. This will require additional INL resource hours/costs to prepare the performance specification. This will impact cost and schedule, adds solicitation risk, and places a demand on internal INL resources for detailed specification development.
  - Combining the site preparation and building design/construction will delay all construction. This will extend the project schedule and will increase project support costs (hotel costs). This will impact the overall project cost and schedule.
  - INL and local subcontract resources will still need to expend significant effort, with resulting costs, in interfacing with the design-build contractor during design and construction of the utility and security system modifications. This will impact the overall project cost and schedule.

During the second part of the evaluation, the team compared the relative cost and schedule impacts associated with each alternative. Table 1 below provides the resulting comparison. For comparison purposes, the table uses the split acquisition strategy as a base case.

Table 1: Cost and Schedule Comparison

Activity	Cost		Schedule		Basis
	Split Acquisition Strategy	Single Acquisition Strategy	Split Acquisition Strategy	Single Acquisition Strategy	
Site Preparation Design	Base Case	+$45 to $55K	Base Case	+1 Month	Cost: $5 to $10K (5 to 10%) increase in costs due to uncertainty and increased effort for design contractor to gain knowledge concerning non-industry standard design. $10 to $20K additional cost for specification development at INL. $35K to cover project support costs for 1-month extension of design/project duration ($35K/month for 1 month). Schedule: 1-month extension in design to account for design-build contractor to gain knowledge of utility and security interfaces and requirements.
Building Design	Base Case	Base Case	Base Case	Base Case	Both alternatives use same strategy for building design
Site Preparation Construction	Base Case	+20 to 40K	Base Case	Base Case	Cost: 5 to 10% increase in costs to reflect uncertainty and risk associated with non-standard design and construction.
Building Construction	Base Case	+$300K	Base Case	+4 Months	Cost: $300K to cover project support costs for 4-month extension of construction/project duration ($75K/month for 4 months). Schedule: Site preparation construction delayed and building construction initiated following site preparation.
Total	Base Case	+$365 to $395K	Base Case	+5 Months	

The contracting strategy that provides the least cost and schedule risk is the split acquisition strategy. The evaluation shows that this strategy will reduce risk and achieve a useable building up to five months earlier with an approximate $365 to $395K cost reduction in comparison to the single acquisition strategy. Use of the single acquisition strategy would result in a reduction of building space and/or capabilities.

3. BASIS OF DESIGN

3.1 Key Performance Parameters

a. Key Performance Parameters

Preliminary key performance parameters (KPPs) have been established for the project. KPPs are defined as a vital characteristic, function, requirement, or design basis that, if changed, would have a major impact on the facility or system performance. Threshold KPPs represent the minimum acceptable scope for successful delivery of MFC RCB. Achievement of threshold KPPs will be a prerequisite for approval of CDE-4.

Objective KPPs represent parameters that will enhance the project's ability to meet the mission need through delivery of expanded capabilities. If project performance is sustained, management reserve and/or contingency funds can be allocated to scope that will advance the identified objective KPPs or enhance facility performance. The KPPs provided herein are preliminary, pre-baseline objectives. The final threshold and objective KPPs will be established as part of CDE-2.

- Threshold KPP

  Design and construct a multipurpose research building with the following critical characteristics:

  1. Research work spaces (either enclosed or open) for a minimum of 45 research scientists.
  2. Research and development laboratory with a minimum of 1,000 sq. ft. gross floor area.
  3. Multipurpose research collaboration areas on each floor of the building.

  This KPP will be verified through as built drawing reviews and inspection of the constructed facility.

- Objective KPP

  Design and construct a research building with work spaces for 55 research scientists.

3.2 Functional and Operational Requirements

This conceptual design is based on the functional and operational requirements defined in FOR-303, "Functional and Operational Requirements for the MFC Research Collaboration Building."

3.3 Assumptions

- Design and construction resources will be available to provide necessary services in a timely and effective manner;
- The recommended building acquisition strategy of design-build will be accepted by DOE during CDE-1 review and approval;
- The recommended site preparation acquisition strategy of design-bid-build will be accepted by DOE during CDE-1 review and approval;
- The proposed siting location will be accepted by DOE during CDE-1 review and approval.

3.4 Siting Considerations and Alternatives

The siting considerations and alternatives were evaluated in Conceptual Design Report, CDR-159, "Conceptual Design Report for the Research Collaboration Building Site Preparation." The alternatives analysis resulted in proposing a site location outside of the MFC security perimeter west of the MFC-701 guard station and vehicle security entry.

3.5 Environmental Considerations

The project activities have been evaluated for environmental impacts and deemed to be a categorical exclusion applicable to 10 CFR 1021, Appendix B to Subpart D, items B1.15 "Siting, construction or modification, and operation of support buildings and support structures (including, but not limited to, trailers and prefabricated and modular buildings) within or contiguous to an already developed area (where active utilities and currently used roads are readily accessible). Reference environmental checklist INL-16-111, "Materials and Fuels Complex (MFC) Research Collaboration Building."

The environmental checklist includes the following potential environmental impacts for consideration during the design and construction phases of the project:

- Air Emissions
  - Project activities may involve the use of portable generators and equipment owned by subcontractors. Emissions from portable generators are exempt from permitting if in place less than one year.
  - In addition, activities will disturb soil and likely create fugitive dust.
- Discharging to Surface, Storm, or Ground Water
  - Project activities will connect to and extend current waste water systems, if needed. Environmental personnel must pre-approve all discharges to industrial waste water systems per the MFC Industrial Waste Water Permit.
  - Project activities will connect to and extend current potable/fire water systems per Safe Drinking Water Act and Fire Water Standards and Regulations.
  - Project activities will direct potential storm water sources to the MFC storm water drainage ditches.
  - Project activities will connect to and extend current sanitary sewer systems. In accordance with the Safe Drinking Water Act Regulations, the sanitary sewer lines must meet the applicable separation distances from the potable water lines.
  - If a sanitary or industrial wastewater main line is extended and/or a lift station(s) are added, the applicable plans and specifications must be submitted to the Idaho Department of Environmental Quality for review and approval prior to construction.
- Disturbing Cultural or Biological Resources
  - Cultural resources may be present in both disturbed and undisturbed contexts outside the existing perimeter fence at MFC.
- Generating and Managing Waste
  - The proposed action would generate a variety of waste, including the following:

  - Industrial (non-hazardous, non-radioactive) waste includes typical maintenance wastes such as boxes, wood, wiring, paper, insulation, and some metals.
  - Hazardous wastes have the potential to be generated during maintenance operations on systems or equipment containing hazardous chemicals, or by using hazardous chemicals to clean or decontaminate equipment and systems. Hazardous metal waste (e.g., lead, electronics, brass, metal containing paints, etc.) may also be generated.

- Releasing Contaminants
  - Two CERCLA sites are located west of MFC-701, but are not under institutional controls. However, ground disturbance in this area should proceed with caution.
  - Project activities will likely use construction related chemicals such as adhesives, fuels, weld rod, compressed gases, lubricants, paints, etc.
  - Subcontractors must submit initial, quarterly, and final chemical inventory lists and Safety Data Sheets (SDSs) for approval by Battelle Energy Alliance, LLC (BEA) via the vendor data system prior to bringing any chemicals to the INL. The Construction Chemical Coordinator will enter these chemicals into the INL Chemical Management System.
- Using, Reusing, and Conserving Natural Resources
  - Diesel and other fossil fuels would be used during project activities. All materials would be reused or recycled where economically practicable. All applicable waste would be diverted from disposal in the landfill where conditions allow. The project would practice sustainable acquisition.
- Conditions (Actions that must be completed before the project begins):
  - Portable generators and equipment must meet opacity requirements.
  - A cultural review must be completed and documented for all proposed ground disturbance outside the perimeter fence. Any recommendations provided by INL Cultural Resource Management for avoidance of adverse impacts to any cultural resources identified must be incorporated into project planning and implementation. Stop Work procedures must also be initiated in the event that cultural materials (i.e., bones, flakes of obsidian, rusty cans or bottles, etc.) are unexpectedly encountered during excavations inside or outside the MFC perimeter fence.
  - All drinking water systems must meet the standard of 0.2 percent lead when used with respect to solder and flux and not more than a weighted average of 0.25 percent lead (this is considered lead free) required for new or replacement equipment for pipes, plumbing fixtures, fittings, and pumps that come in contact with water (i.e., wetted surfaces).
  - A Class 1 permit modification to the RCRA Permit must be approved prior to initiating any changes to the perimeter fence.
  - Construction materials must be certified asbestos-free.

3.6 Safety Considerations

- Hazard identification and mitigation associated with construction and testing activities will be conducted in accordance with applicable INL procedures including:
  - LWP-7201, “INL Construction”

- LWP-21220, "Work Management"
- LWP-6200, "Maintenance Integrated Work Control Process"

- The project manager will ensure the core functions of the Integrated Safety Management System (ISMS) are appropriately implemented in all work activities. This will be accomplished by defining the scope of work, identifying hazards, analyzing hazards, identifying controls to prevent/mitigate hazards, following established standards and requirements while performing work, and providing feedback upon completion of work.
- All team members have the responsibility and authority to initiate stop work if they encounter an environmental, safety, or quality issue.
- DOE-STD-1189, "Integration of Safety into the Design Process," applies to design and construction in DOE Hazard Category 1, 2, and 3 nuclear facilities and does not apply to this non-nuclear facility.

3.7 Quality Considerations

Quality assurance requirements will be in accordance with the INL Quality Assurance Program. The quality level (QL) for project activities is determined in QL Database Number MFC-001463, "MFC Research Collaboration Building." Quality Level Determination (QLD) MFC-001463 defines all applicable activities as QL-3. If the need arises for additional QL determinations, they will be performed in accordance with LWP-13014, "Determining Quality Levels."

3.8 Safeguards and Security Considerations

The building will have access control (i.e., key card access) into the research and laboratory areas of the building. For the current conceptual design, access control will be provided in the following areas (access control locations may be based on final design layout):

- First floor main entrance door;
- West door into 1st floor R&D laboratory;
- South and north doors from the 1st floor researcher collaboration area into the research work area;
- North door from the 2nd floor researcher collaboration area into the research work area.

The building will have roof top intrusion detection monitoring to monitor the roof area and roof top access hatch. The location of these sensors will be determined during the final design phase.

A minimum of 12 single mode fiber optic cabling shall be dedicated to security controls.

A dedicated 24" x 36" x 8" Hoffman enclosure shall be provided in the first floor dial room. One 120V 4-plex receptacle on dedicated backup power (90 minutes) shall be provided within the enclosure.

The outer perimeter security fence will be located no closer than 30 ft. from the inner perimeter security fence. The building will be located no closer than 20 ft. from the relocated outer perimeter security fence.

Impacts to the MFC Security Plan will be evaluated and mitigated during the final design phase. The MFC Security Plan will be revised as necessary prior to building occupancy.

3.9 High Performance Sustainable Building Considerations

RCB will be designed and constructed using sustainable building considerations in accordance with the DOE Guiding Principles for Federal Sustainable Buildings for new construction. In accordance with the guiding principles, the project will implement the following during design and construction, although not limited to:

- **Employ Integrated Design Principles:** Provide recommendations, utilizing an integrated project team, with regards, but not limited to, environmental impacts, health and wellness of building occupants, and the building's life cycle.
- **Optimize Energy Performance:** Ensure energy efficiency is significantly better than the current ASHRAE 90.1 standard while utilizing clean and alternative energy where possible.
- **Protect and Conserve Water:** Utilize water-efficient products throughout the facility and exceed storm water management requirements.
- **Enhance Indoor Environmental Quality:** Address ventilation and thermal comfort by allowing occupants varying control of the building systems.
- **Reduce the Environmental Impacts of Materials:** Provide/install green products, while maximizing waste recycling and minimizing construction material which is disposed at a landfill.
- **Address and Consider Climate Change Risks:** Evaluate the adaptation of the architectural and system design for future expansion, and the ramifications of climate change on these systems.

4. DESIGN DESCRIPTION

4.1 Site Design

The proposed site location for the Research Collaboration Building is located to the west of the 701 Security Building at the MFC complex (See Figure 1). Site layout and landscape development shall be designed and implemented to accomplish the following major objectives:

- Locate building per required setbacks from the adjacent access road and relocated security fence.
- Provide a minimum 10'-0" wide cast-in-place concrete walk with integral curb adjacent to the access road.
- Provide concrete walkways accessing all required building entries and exits.
- Specialty paving and seat walls adjacent to primary building entries on the south side of the proposed facility.
- Campus standard building signage wall adjacent to primary building entry.
- Site lighting per general lighting requirements of section 4.2.7.2.7d.
- Based on local climactic factors and INL's sustainability goal, landscape development should utilize xeriscape practices, thereby incorporating an irrigation-free plant palette based on native/adaptive vegetation. All proposed vegetation must be capable of surviving the typically intense climatic conditions present in the USDA Hardiness Zone 4a area of Idaho Falls.
- Building location and overall site circulation shall be coordinated with the Campus Master Plan.
- Site utility feeds per requirements of the building.

Modifications to the existing security fences will be necessary as this facility will be located outside the MFC security perimeter. Refer to CDR-159 “Conceptual Design Report for the Research Collaboration Building Site Preparation.”

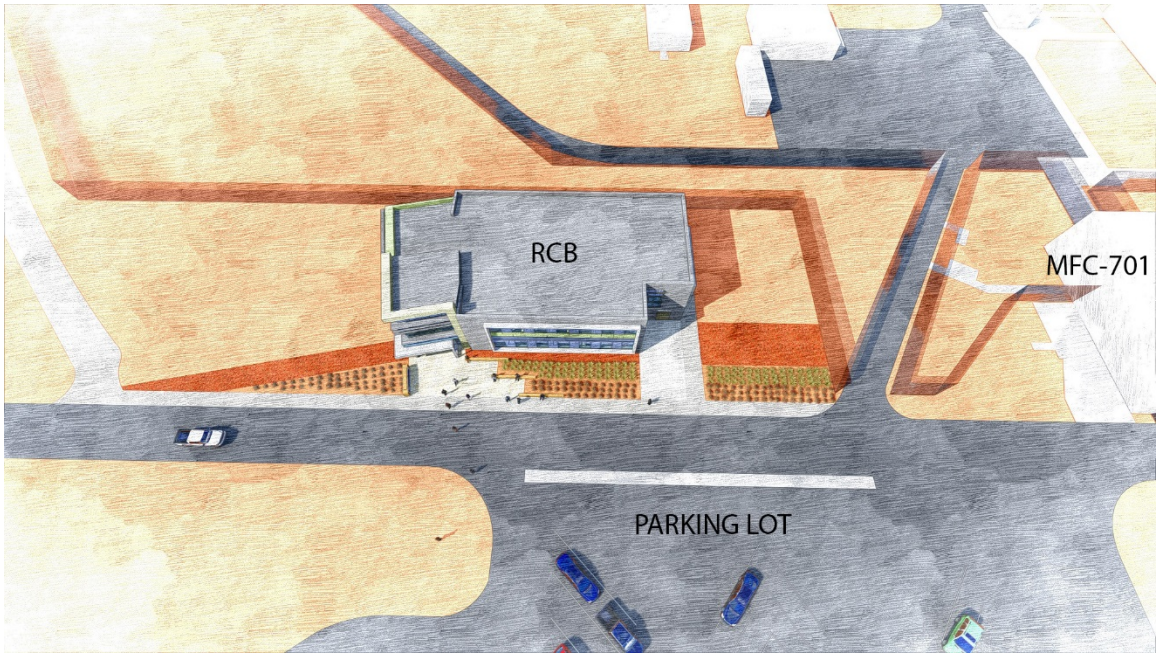


Figure 1: Proposed Site Location

4.2 Facility

4.2.1 Architectural

In order to meet the current mission needs of MFC, RCB is designed as a two-story, approximately 16,000-ft^2 facility, with an emphasis on research work space and collaboration spaces. First floor consists of resident/visitor researcher work space, research conference room, research collaboration/break areas, laboratory and mechanical space. Second floor consists of resident researcher work space and research collaboration/break areas. Refer to appendix for First and Second Floor plans. The final conceptual floor plans are a result of developing alternative concepts and numerous reviews with building stakeholders.

4.2.1.1 Occupancy

Per the International Building Code, the laboratory space and administrative areas are classified as Business Group (B), as long as the chemicals utilized within the laboratory do not exceed the allowable quantities established within the IBC.

4.2.1.2 Building Construction Type and Fire Separation

Under the International Building Code, the construction type is classified as Type IIB, non-combustible construction. Providing a fully-sprinklered building, a 1-hour-rated construction will be provided around the elevator hoistway and stair enclosure.

4.2.1.3 Space Allocation

Appropriate space allocation is based on the building stakeholders key performance parameters and goals as follows:

- Provide research work spaces (either enclosed or open) for a minimum of 45 research scientists: With 31 enclosed research workstations (approximately 3,075 Net Square Feet), 20 open research workstations (approximately 1,100 Net Square Feet), six training workstations (approximately 175 Net Square Feet), and one administrative staff workstation (approximately 50 Net Square Feet), the building footprint has accounted for 58 personnel with dedicated workstations, while also having the ability to work remotely within the various seating arrangements in the open collaboration areas.
- Provide multipurpose research collaboration areas on each floor of the building: The building design promotes collaboration with open collaboration areas located on each floor.
- Provide research and development laboratory with a minimum of 1,000 sq. ft. gross floor area: Space has been allocated for a large developmental lab (approximately 1,100 sq. ft.) with multiple benchtops and MEP service connections to allow the flexibility for testing equipment.
- Provide an area for training external researchers for entry into the MFC security area: Six training workstations have been allocated on the second floor.
- Provide an area for MFC external researchers to work during short or extended visits: The dedicated workstations throughout the facility will allow external researchers the opportunity to have a workspace to themselves.

Additional functional and operational requirements are defined in FOR-303, “Functional and Operational Requirements for the MFC Research Collaboration Building.”

4.2.1.4 Walls, Exterior

Exterior finish material pallet consists of masonry veneer, composite metal panel, corrugated metal panel, louvers and curtainwall. The typical exterior wall assembly consists of exterior to interior, semi-rigid insulation, air/vapor barrier, 5/8” exterior sheathing, 6” cold-formed metal framing with 5/8” gypsum board on the interior face. All exterior materials, with the exception of louvers and curtainwall, will be comprised of this backup wall assembly. Glazing will be selected to match their intended function. Clear glazing will be used for the public areas; tinted glazing will be utilized for the research work spaces. External solar shades will be provided for occupant comfort along the south/west facades of the building.

4.2.1.5 Insulation, Moisture Protection

Semi-rigid, continuous insulation R-value to meet/exceed the requirements of ASHREA 90.1. Air/vapor barrier to be a fluid applied membrane, with proper termination at all edge conditions and penetrations per manufacturers recommendations.

4.2.1.6 Roofing

Roofing for the facility will consist of rigid insulation, internal roof drains, and roofing system in compliance with INL-STD-139 “INL – Engineering Standard”. The roof will be white with a minimum R-value to meet ASHRAE 90.1 and the DOE Guiding Principles for Federal Sustainable Buildings.

4.2.1.7 Walls, Interior

Interior partitions will be constructed of metal studs with either single or double layer gypsum wall board, depending on the fire rating and acoustic criteria. Interior partitions surrounding the R&D Laboratory and Mechanical Room require a minimum STC 50.

4.2.2 Interiors and Finishes

Each research work area, collaboration space, conference room and laboratory space shall be comprised of all equipment and/or furniture necessary to provide a fully functional space for its intended purpose. Typical equipment/furniture is demonstrated in Table 2 below.

Table 2: Equipment/Furniture

Standard Research Workspace *(29)*	• 30x72 sit/stand workstation with task chair • CPU with dual monitors • 18Dx42Lx22H lateral file • 24Dx24Wx66H storage tower • 30x60 multipurpose freestanding table with two multipurpose chairs • Provide data/power provisions for a future wall mounted flat panel TV
Large Research Workspace *(2)*	• 30x72 sit/stand workstation with task chair • CPU with dual monitors • (2) 18Dx42Lx22H lateral file • 24Dx24Wx66H storage tower • 36x72 multipurpose freestanding table with eight multipurpose chairs • Provide data/power provisions for a future wall mounted flat panel TV
Standard Research Workstation *(9 secure; 8 non-secure)*	• 30x60 desk with task chair • CPU with dual monitors for secure workstations only • 30Dx15Wx50H storage tower • 20x72 laminate work surface with 30Wx28H locking, open box lateral file • 50Hx80W privacy panel between workstations • 54H panel, width varies, refer to floor plans
Research Collaboration Conference Room *(1)*	• 48x144 2-piece conference table with 20 chairs • 90” wall mounted flat panel TV • (2) 21x72 credenzas • Tele/Com & video conferencing capable
Small Research Workstations *(9 secure; 2 non-secure)*	• 30x48 sit/stand workstation with chair • 40” privacy screen and cableway • 30Dx15Wx46H storage tower • CPU with dual monitors for secure workstations only

1st Floor Research Collaboration Space	• All tables with square edge on casters (size/shape varies, refer to plans) • (2) Booth/table seating (provide power) • (4) Lounge seating with tablet arm • (15) Chairs on casters • (1) 36”x72” Tables with multipurpose chairs • (1) Mobile monitor stand with 65” monitor • (1) Projector and screen *Provide commercial grade furniture per final approval by the Contractor
2nd Floor Research Collaboration Space	• (1) Booth/table seating (provide power) All tables with square edge on casters (size/shape varies, refer to plans) • (21) Chairs on casters • (1) 36”x72” Tables with multipurpose chairs • (1) Projector and screen *Provide commercial grade furniture per final approval by the Contractor
1st Floor Break Area	• 150” of lower cabinets (drawers and doors) with solid surface countertop and 42” double sink • 96” length of 30” high upper cabinets • 36” Side-by-side refrigerator/freezer • Microwave • Free-standing ice/water machine, provide water filtration (first floor only) • Provisions for coffee machine (hard piped connection)
2nd Floor Break Area	• 150” of lower cabinets (drawers and doors) with solid surface countertop and 42” double sink • 96” length of 30” high upper cabinets • 36” Side-by-side refrigerator/freezer • Microwave • Provisions for coffee machine (hard piped connection)
1st Floor Copy/Print	• 52” of lower cabinets (drawers and doors) with laminate countertop • 96” length of 30” high upper cabinets • Leased Copy/Printer

2nd Floor Copy/Print	• 156” of lower cabinets (drawers and doors) with laminate countertop • 156” length of 30” high upper cabinets • Leased Copy/Printer
Mothers Room	• 108” of lower cabinets (drawers and doors) with laminate countertop and a single hand wash sink • 48” length of 30” high upper cabinets • 30” Dia. Round table with a chair
Laboratory	• (14) 30x60 Heavy-duty workbenches with storage • Shelving located above workbenches (maximize shelving as space allows in final design) • (1) 48” fume hood • (1) 18” x 36” Flammable storage cabinet (to be procured by INL) • (1) 18” x 36” Chemical storage cabinet (to be procured by INL) • (1) Tool Box (to be procured by INL) • (1) Safety shower/eye wash
Telecommunications Rooms	• 4’ x 8’, ¾-inch plywood AC grade plywood backboard fire treated on all sides with a minimum 2-hour fire rating or as required by local code. • Minimum (3) 4-Post Equipment Racks (7 Ft H x 19-inch W x 29-inch D); 1 rack - OSP fiber & Copper, 1 rack - CAT 6A Distribution, 1 - rack network switch equipment • (4) 8-Inch Double-sided Vertical Cable Managers • (2) 100-amp dedicated electrical panels (total 200-amp service) • 18-inch cable runway (ladder rack) over all equipment racks, includes retaining posts and bend radius management and corner brackets • 48-inch wire basket tray system installed above equipment racks and cable runway, used to support CAT 6A cable service loops • Dedicated HVAC • 36-inch entrance door with door swing outward, no thresholds

All research workstations (standard and small) shall be comprised of reconfigurable furniture. The workstation furniture shall be mobile (e.g., on casters) and adjustable to allow reconfiguration based on the user's needs.

Wall finishes will be painted gypsum board, unless otherwise noted. Typical floor finish materials are demonstrated in Table 3: Finishes below.

Table 3: Finishes

Program Space	Finish
Collaboration Areas/Break Room	Ground polished concrete, stained
Research Work Areas, Hallways, Conference Room, Mothers' Room	Carpet
Mechanical Room, Janitor Closet, MDF, IDF	Sealed concrete
Toilets	Wall and floor tile
Laboratory	Resinous Epoxy (static dissipative floor)
Stair (back of house)	Rubber treads/risers with safety nosing

4.2.3 Structural

4.2.3.1 Structural Systems Description

The MFC Research Collaboration Building will consist of a two story steel structure, clad with metal panel, curtainwall and masonry veneer. The second floor plate will consist of a normal weight concrete topping on composite steel deck with structural steel beams and girders. The roof plate will consist of steel roof deck with structural steel beams and girders. Columns will be wide-flange or HSS steel members. Lateral loads from wind and seismic will be transferred by the roof and floor diaphragms to steel braced frames or moment frames.

1. **Roof**
   - Deck: 1 1/2" inch deep steel roof deck.
   - Beams: Non-composite wide-flange members
   - Girders: Non-composite wide-flange members
   - Deflections: Gravity load deflections under total loads are to be less than L/240 with live load deflections less than L/360.
2. **Research Work Spaces and Support Area Floor**
   - Floor Slab: 2-inch-thick composite steel floor deck with 4 1/2 inches of normal weight concrete topping above deck flutes. Rebar reinforcing in slab to control cracking.
   - Beams: Wide-flange steel members, composite with concrete slab by means of headed welded shear studs.
   - Girders: Wide-flange steel members designed for partial composite action.
   - Columns: Wide-flange or HSS steel members.

Deflections: Gravity load deflections under total loads are to be less than L/360. Perimeter beams will have live load deflections less than L/600 to accommodate cladding systems

The slab-on-grade recommendations for different areas of the facility are as follows: 5-inch thick reinforced concrete slab at Research Work Spaces and Support areas, 6-inch thick reinforced concrete slab at Mechanical areas, and a 10-inch thick reinforced concrete slab at the Developmental Laboratory. The slab-on-grade for the Developmental Laboratory is to be isolated from adjacent slabs. It is recommended that all slab on grade be underlain by a vapor barrier and 8 inches to 12 inches of compacted granular material.

4.2.3.2 Foundation and Soil Conditions

It is recommended that building columns be supported by spread footings. Concrete frost walls on strip footings extending at least 5 feet below exterior grade are recommended at the perimeter of the building. Spread and strip footings shall be placed on original undisturbed soil/rock or engineered fill as recommended by the Geotechnical Engineer. A Geotechnical Report (investigation currently in progress) is required during the next phase of the project to confirm recommendations and provide additional parameters for foundation design.

4.2.3.3 Design Loads

Facility to be designed per DOE-STD-1020 (Natural Phenomena Hazards), INL-STD-139 (Engineering Standards) and ASCE 7-10 "Minimum Design Loads for Buildings and Other Structures". The governing building code is the International Building Code, 2012 edition.

1. **Roof Dead Loads (Excludes Mechanical Equipment)**

   Roofing & Insulation ..... 18 psf
   Steel deck ..... 2 psf
   Superimposed dead load ..... 15 psf
   Steel framing ..... 10 psf
   TOTAL ..... 45 psf

2. **Roof Snow Loads**

   Ground snow load pg ..... 26 psf (plus drifting)
   Building Importance Factor, I (ASCE 7/Risk Category II) 1.0
   Exposure Factor Ce 1.0
   Thermal Factor Ct 1.0
   Minimum Flat Roof Snow Load pf ..... 30 psf

3. **Flood Loads**

   The INL local precipitation site standard for a 25-year, 6-hour storm is 1.4 inch total.

4. **Floor Dead Loads – Research Work Space/Support**

   Composite deck ..... 70 psf
   Allowance for concrete ponding ..... 5 psf
   Superimposed dead load ..... 20 psf
   Steel Framing ..... 15 psf
   TOTAL ..... 110 psf

5. **Floor Live Loads**

   Research Work Space and Support ..... 100 psf
   Corridors and Common Areas ..... 100 psf
   Developmental Laboratory ..... 500 psf

Mechanical ..... 150 psf

6. **Wind Loads**

Basic Wind Speed (3-second gust) ..... 115 mph
Wind Exposure C
Risk Category (ASCE 7) II
Wind Directionality Factor K_d 0.85
Internal Pressure Coefficient GC_{pi} ..... +0.18/-0.18

7. **Seismic Loads**

Seismic Site Class ..... C (to be confirmed by Geotechnical Engineer)
Risk Category (ASCE 7) II
Spectral Response Coefficient S_S ..... 0.313 g
Spectral Response Coefficient S_1 ..... 0.124 g
Design Spectral Response Acceleration S_{DS} ..... 0.251 g
Design Spectral Response Acceleration S_{D1} ..... 0.138 g
Seismic Design Category C
Importance Factor I (ASCE 7) 1.0

4.2.4 HVAC

4.2.4.1 Base Design Criteria

1. Applicable Codes
   a. The Mechanical Systems will be designed in accordance with the following Codes:
      1) International Mechanical Code - 2012
      2) International Energy Conservation Code - 2012
2. Applicable Guidelines and Standards
   a. The Mechanical Systems will be designed in accordance with appropriate portions of the following Guidelines and Standards:
      1) Design Guidelines
         a) ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
         b) ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality, 2007 Edition
         c) Guiding Principles for Sustainable Federal Buildings
      2) National Fire Protection Association (NFPA) guidelines and standards including the following:
         a) NFPA 72 - National Fire Alarm Code
         b) NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems, 2009 Edition
         c) NFPA 101 – Life Safety Code, 2009 Edition
         d) NFPA 110 – Standard for Emergency and Standby Power Systems, 2010 Edition
      3) Occupational Safety and Health Administration (OSHA)

3. Outdoor Design Conditions
   a. Summer
      1) Dry-Bulb Temperature = 93°F
         a) (Based on INL Engineering Standards STD-139-23 3000 page 3 of 4 for personal comfort)
      2) Wet-Bulb Temperature = 61°F
         a) (Based on INL Engineering Standards STD-139-23 3000 page 3 of 4 for personal comfort)
   b. Winter
      1) Dry-Bulb Temperature = -14°F
         a) (Based on INL Engineering Standards STD-139-23 3000 page 3 of 4 for personal comfort).
4. Indoor Design Conditions
   a. Developmental Laboratory Space
      1) Dry-Bulb Temperature
         a) Summer = 75°F ± 2°F
         b) Winter = 72°F ± 2°F
      2) Relative Humidity
         a) Summer = No humidity control beyond DX cooling
         b) Winter = Mechanical humidification not planned
   b. Research Work Space, Conference and Administrative Support Areas
      1) Dry-Bulb Temperature
         a) Summer = 75°F ± 3°F
         b). Winter = 72°F ± 3°F
      2) Relative Humidity
         a) Summer = No humidity control beyond DX cooling
         b) Winter = Mechanical humidification not planned
   c. Toilet Spaces
      1) Dry-Bulb Temperature
         a) Summer = 75°F ± 3°F
         b) Winter = 72°F ± 3°F
      2) Relative Humidity
         a) Summer = No humidity control beyond DX cooling
         b) Winter = Mechanical humidification not planned
   d. Telecommunication Rooms
      1) Dry-Bulb Temperature = 64ºF-75°F ± 5°F (year round)
      2) Relative Humidity = 30% RH minimum mechanical humidification

e. Mechanical and Electrical Rooms
   1) Dry-Bulb Temperature
      a) Summer = 85°F Maximum
      b) Winter = 60°F Minimum
   2) Relative Humidity = No requirement

f. Elevator Machine Room
   1) Dry-Bulb Temperature = 75°F (year round)
   2) Relative Humidity = No requirement

g. Unoccupied Spaces
   1) Dry-Bulb Temperature = 65 - 95°F
   2) Relative Humidity = Mechanical humidification not planned

5. Heating and Cooling Loads
   a. Electrical
      1) Research Work Spaces, Conference, and Administrative Support Areas
         a) Lighting = 1.5 watts per sq ft
         b) Equipment = 1.0 watts per sq ft
      2) Conference Rooms & Collaboration Room
         a) Lighting = 1.5 watts per sq ft
         b) Equipment = 2.0 watts per sq ft
      3) Workstations
         a) Lighting = 1.5 watts per sq ft
         b) Equipment = 2.5 watts per sq ft
      4) Collaboration/Breakroom
         a) Lighting = 1.5 watts per sq ft
         b) Equipment = 3.0 watts per sq ft
      5) Toilet Rooms
         a) Lighting = 1.5 watts per sq ft
         b) Equipment = 0 watts per sq ft
      6) Corridor
         a) Lighting = 0.5 watts per sq ft
         b) Equipment = 0 watts per sq ft
      7) Developmental Laboratory
         a) Lighting = 1.0 watts per sq ft
         b) Equipment = 2.0 watts per sq ft
   b. Occupancy
      1) The occupancy heat rejection will be based on 2009 ASHRAE Handbook of Fundamentals, Chapter 18. Heat gain values will be Moderately Active Work space for all occupancies;
         a) Sensible = 250 Btuh/person
         b) Latent = 200 Btuh/person

2) The number of occupants in each space will be based on ASHRAE Standard 62.1-2007 or the actual occupant density listed in the facility program.

c. Infiltration

1) The building heat loss calculations will include an infiltration load based on 1.5 cfm of infiltration air per linear foot of exterior wall with windows, per floor level, and 1.0 cfm of infiltration air per linear foot of exterior wall without windows, per floor level.

2) The following infiltration rates will be used for doors:

a) 200 cfm per door for exterior main doors

b) 5 cfm per square foot for exterior overhead doors

6. Ventilation Rates

a. The minimum ventilation (outdoor air) rates will be as follows (ach=air changes per hour):

1) Research Work Spaces, Conference and Administrative Support Area

a) Based on Table 6-1 of ASHRAE 62.1 Standard 2007

7. Seismic Criteria

a. Seismic design will be based on IBC requirements.

8. Noise Criteria

a. Sound attenuation equipment will be provided based on standard design practice. Results are not guaranteed due to many items not under control of the design team and actual building usage.

4.2.4.2 Systems Descriptions

1. Electric Heating System

a. System Description

1) Electric heat will serve AHU heating coils and terminal heating devices such as reheat coils, unit heaters, cabinet unit heaters, baseboard finned tube, etc.

b. Reserve Capacity and Redundancy

1) There will be no redundancy.

c. Equipment and Material

1) Cabinet unit heaters will be provided for entry vestibules, and storage areas not otherwise heated by the air system.

2) The electric heating and reheat system will also include the following components:

a) Reheat coils

b) Unit heaters

c) Cabinet unit heaters

d) Finned tube radiation

3) Finned tube radiation will provide to heat exterior glazing/walls where the heat loss exceeds 200 btuh/lineal foot of wall.

2. Humidification System: No mechanical humidification system will be provided except for the dial room(s).

3. Air Handling Systems
   a. System Description
      1) One air handling unit (AHU) will be provided. The AHU will service the entire building except the Dial Room.
      2) System will be a single duct variable air volume reheat system, providing electric heating and DX cooling to the spaces. The minimum outside air percentage will be determined in accordance with ASHRAE Standard 62, and full airside economizer capability will be provided.
      3) Systems will consist of factory packaged split system air handling unit, and will be located in the first floor equipment room. Condensing units will be located outside the equipment room.
      4) Air will be supplied to all appropriate spaces and a portion of this air will be returned to the air handling units. The remaining portion of air not returned to the air handling units shall be utilized as make-up air for the exhaust systems. Return air ceiling plenum will be used to collect return air from the spaces.
      5) Ducted return air system will be used to convey return air from ceiling plenums back to back to the AHU.
      6) Air handling system will operate with occupied, unoccupied and morning warm-up control cycles.
      7) Supply air ductwork will be lined for 5 ft. downstream of air terminal devices for sound control.
      8) Sound attenuating flexible duct up to 6 ft in total length, will be provided at the supply diffusers to control noise. Sound attenuators at the discharge of air terminal devices will not be provided unless required to meet noise criteria.
      9) An air cooled condensing unit will be utilized with DX cooling coils in the air handling units to provide mechanical cooling for the building.
      10) Ductwork will be constructed in accordance with SMACNA Standards for appropriate pressure class. Ductwork will be sealed to meet SMACNA Seal Class A as a minimum and to limit ductwork leakage not exceeding 1% of the design flow rate for high pressure ductwork and 2% for low pressure ductwork.
      11) The Dial Room will be heated by an electric coil and cooled and dehumidified by a DX fan coil unit located in the mechanical equipment room with supply and return air ducted to the Dial Room. An electric humidifier will be provided to maintain a minimum 30% RH.
   b. Design Criteria
      1) Air Handling Unit Component Sizing
         a) Maximum allowable nominal face velocities or pressure drop are as follows:

Air Intake Louvers:	400 fpm through free area of louver
Electric Heating Coils:	500 fpm
Cooling Coils:	400 fpm
Pre-filters and Final-filters:	400 fpm
Sound Attenuating Devices:	1200 fpm or 0.25” wg

      2) Duct System Distribution Criteria
         a) Supply Ductwork Sizing (based on diversified cfm)
         b) From Air Handling Unit to Air terminal (AT) Device:

Maximum pressure drop of 0.15"/100 ft when ≤ 10,000 cfm
Maximum velocity of 1,500 fpm when > 10,000 cfm
Maximum velocity of 1,500 fpm when > 10,000 cfm in mechanical room, risers in shafts, and where space constraints dictate

c) Duct size to AT device = AT inlet size up to 8 ft from AT.

d) From Air Terminal Device to Supply Diffuser
Maximum pressure drop of 0.1"/100 ft when ≤ 8,000 cfm
Maximum velocity of 1,500 fpm when > 8,000 cfm

e) Return/Exhaust Ductwork Sizing
Maximum pressure drop of 0.1"/100 ft when ≤ 8,000 cfm
Maximum velocity of 1,500 fpm when > 8,000 cfm

3) Reserve Capacity and Redundant Systems
   a) There will be no redundancy.
   b) Air handling system will be sized with 10% reserve capacity.

c. Equipment and Material
1) The air handling units will be of galvanized steel double wall construction. The units will consist of the following components:
   a) Outside Air Intake Damper
   b) Air Mixing Devices
   c) 30% (Merv 7) Efficient Prefilters (as rated on ASHRAE Standard 52.1)
   d) Electric Preheating Coils
   e) DX Cooling Coils
   f) Supply Fan with VFD
   g) Fan Discharge Sound Attenuating Device (if required)
   h) Smoke Detector at Supply Air Discharge Ductwork
   i) Isolation/Smoke Dampers (if required by code)
2) Supply fans will be double width double inlet centrifugal type with airfoil blades. Fan speed and air volume will be modulated through variable frequency drives (VFDs) controlled by supply duct static pressure controller.
3) Return fans will be double width double inlet centrifugal type with air foil blades. Fan speed and air volume will be modulated through VFDs controlled by return fan discharge static pressure controller.
4) The return fans will include the following components:
   a) Isolation/Smoke Damper at return fan (if required by Code)
   b) Smoke Detectors at Return Fan Inlet Ductwork
   c) Fan Inlet Side Sound Attenuator (if required)
   d) Return Fan with VFD
   e) Return Air Damper
   f) Relief Air Damper
5) The supply air terminals (ATs) will have internal liner with. ATs will be provided with system pressure independent DDC controllers with 24 V electric actuators.

6) Sound attenuating devices will be packed type with liner between air stream and packing.

d. Distribution

1) High pressure galvanized steel ductwork will distribute supply air from the air handling unit to the supply air terminal devices.
2) Low pressure galvanized steel ductwork will be utilized downstream of supply terminal devices to distribute supply air to the spaces.
3) Individual enclosed Research Work Spaces up to three spaces having a common exterior exposure or a common interior space, and common occupancy, may be served by one supply air terminal device.
4) One air terminal device will be provided where individual space temperature control is required.
5) Supply air ductwork will be externally insulated with fiberglass insulation.

4. Mechanical Room Air Handling System

a. System Description

1) Heating will be provided by electric unit heaters.
2) Cooling will be provided by ventilation air from the building air handling unit

5. Specialty Developmental Laboratory Exhaust System

a. System Description

1) The system will service specialty point exhausts in the Development Laboratory space, including exhaust hood and connections to specialty equipment. Exhaust point locations will be determined during final design.
2) System will consist of one exhaust fan and will be controlled via occupied/unoccupied control.

b. Design Criteria

1) Duct Distribution Criteria
   a) Exhaust ductwork sizing:
   b) Maximum pressure drop of 0.10"/100 ft of ductwork
   c) Maximum velocity of 1500 fpm
2) Reserve Capacity and Redundant Systems
   a) There will be no redundancy.
   b) During power outages the exhaust fans will be off.

c. Equipment and Materials

1) The exhaust system will consist of the following components:
   a) Roof mounted exhaust fan.
   b) Automatic damper at fan inlet.
   c) Sound attenuating devices at fan inlet will consist of lined ductwork ten feet in length.
   d) Variable air volume fume hood.

d. Distribution

1) Ductwork will be galvanized steel.

6. Toilet room Exhaust Systems
    a. System Description
        1) The system will service toilet rooms, janitor's closets, etc.
        2) System will consist of one exhaust fan and will be controlled via occupied/unoccupied control.
        3) The exhaust system will be constant volume.
    b. Design Criteria
        1) Duct Distribution Criteria
            a) Exhaust ductwork sizing:
            b) Maximum pressure drop of 0.10"/100 ft of ductwork
            c) Maximum velocity of 1500 fpm
        2) Reserve Capacity and Redundant Systems
            a) There will be no redundancy.
            b) During power outages the exhaust fans will be off.
    c. Equipment and Materials
        1) The exhaust system will consist of the following components:
            a) Roof mounted exhaust fans.
            b) Automatic damper at fan inlet.
            c) Sound attenuating devices at fan inlet will consist of lined ductwork ten feet in length.
    d. Distribution
        1) Ductwork will be galvanized steel.
7. Building Automation System
    a. System Description
        1) Mechanical systems will be controlled and monitored through a DDC based Building Automation System (BAS) with distributed processing at the local level. The overall building controls will be Alerton Bacnet system. Electric actuation will be utilized for all valves and dampers.
    b. Design Criteria
        1) Building Automation System (BAS) will integrate with the INL site wide control and monitoring network.
        2) DDC controllers will utilize distributed architecture and will not rely on "front-end" or higher level controller to perform required control sequence.
        3) Each DDC controller will have a minimum of 10% spare points of each type (DI, DO, AI and AO) at each panel. For universal joints, the spares will be divided evenly between the analog and digital types of points.
        4) All DDC system primary LAN controllers, PCs, and communications equipment that monitor life safety and critical points (fire alarm, elevator emergency, etc.). These controllers will be supported by UPS for minimum of 4 hours.

4.2.5 Piping and Plumbing

4.2.5.1 Base Design Criteria

1. Applicable Codes
   a. The Piping Systems will be designed in accordance with the following Codes:
      1) Uniform Plumbing Code, 2009 Edition
      2) ASME B31.9, 2014
      3) ASME B31.3, 2004
2. Applicable Guidelines and Standards
   a. The Piping Systems will be designed in accordance with appropriate portions of the following Guidelines and Standards:
      1) National Fire Protection Association (NFPA) guidelines and standards including the following:
         a) NFPA 54 National Fuel Gas Code, 2012 Edition
         b) NFPA 55, Standard for the Storage, Use and Handling of Compressed and Liquefied Gases, 2010 Edition
         c) NFPA 70, National Electric Code, 2011 Edition
      2) ANSI Z358.1 Emergency Eyewash and Shower Equipment, 2009
      3) American Society of Plumbing Engineers (ASPE) databooks
      4) ASHRAE standard 189.1-2014 sections 6.3.2, 6.4.2, and 6.4.3
      5) Guiding Principles for Sustainable Federal Buildings

4.2.5.2 System Descriptions

1. Storm and Drainage
   a. System Description
      1) A storm drainage system will be provided to convey rainwater from flat roofs through the building wall onto grade.
      2) Secondary roof drainage will be accomplished by using a dedicated piped overflow drainage system separate from the primary storm drainage system which will discharge through the building wall onto grade.
   b. Design Criteria
      1) The primary storm drainage system will be sized based on a maximum rainfall rate of 1.2 in/hr. The secondary storm drainage system will be sized based on the same design criteria as the primary system.
   c. Distribution
      1) Below ground storm piping, if any, will be service weight hub-and-spigot cast iron pipe with neoprene push-on compression joints.
      2) Above ground storm piping will be hubless cast iron pipe with heavy duty stainless steel clamps.
      3) Roof and overflow drain bodies and above ground storm, secondary roof drainage piping will be insulated to prevent condensation.
2. Sub-soil Drainage
   a. System Description

1) If a sub-soil drainage system is required by the Geotechnical Report, it will convey exterior footing groundwater to a sump. The effluent will be pumped into the building storm drainage system.

b. Design Criteria

1) Design criteria for the subsoil drainage system will be defined by the Geotechnical Report.

c. Equipment and Material

1) Subsoil drainage will flow to grade.

2) Distribution

a) Subsoil drainage piping, will be polyethylene perforated piping with mechanical couplings.

3. Sanitary Waste and Vent

a. System Description

1) A sanitary waste and vent system will be provided for all plumbing fixtures and other devices that produce sanitary waste. Plumbing fixtures will be drained by gravity through conventional soil, waste and vent stacks and building sewers to the site sewer.

2) All fixtures will have traps and will be vented through the roof. Vent terminals will be located away from air intakes, exhausts, doors, openable windows and parapet walls at distances required by the plumbing code.

b. Design Criteria

1) The sanitary waste piping will be pitched to maintain a minimum velocity of 2 fps when flowing half full.

2) The sanitary vents and the venting system will be designed and installed so that the water seal of a trap will be subject to a maximum pneumatic pressure differential equal to 1" water column. This will be accomplished by sizing and locating the vents in accordance with the venting tables contained in the plumbing code.

c. Equipment and Material

1) Floor drains and indirect waste receptors will be provided with trap seal inserts when subject to loss of their trap seals due to evaporation caused by infrequent use.

2) All sanitary waste piping which collects clear water condensate from air handing equipment will be insulated to prevent condensation on the piping.

d. Distribution

1) Below ground sanitary waste and vent piping will be service-weight hub-and-spigot cast iron pipe with neoprene push-on compression gaskets.

2) Above ground sanitary waste and vent piping will be hubless cast-iron pipe with heavy duty stainless steel clamps.

4. Domestic Water

a. System Description

1) Domestic water will be provided to all toilet room fixtures, electric water coolers/drinking fountains, sinks, emergency shower/eyewash units, and any other devices that require a domestic water supply.

2) Hot water at 120°F will be provided to all fixtures and devices that require hot water. The emergency fixtures (showers and eyewashes) will be supplied with tepid water.

b. Design Criteria

1) The piping will be sized to limit the velocity in any section of the system to a maximum of 8 fps for cold water system and 4 fps for hot water and hot water circulating systems.

2) Water heater will be sized for 100% of the design hot water load.

c. Equipment and Material

1) A water meter will be provided on the building service entrance. The water meter will be sized for the building's maximum design flow rate.

2) Domestic hot water will be produced by a simplex, electric, storage-type water heater. Point-of-use electric water heaters may also be utilized for hot water service.

3) The hot water system temperature will be maintained by recirculating the hot water through a continuous loop with an in-line circulating pump.

4) Duplex alternating water softeners will be installed ahead of the water heaters.

5) Water hammer arrestors will be provided at all quick closing solenoid valves and at other potential water hammer sources.

6) Tepid water to emergency safety station fixtures will be provided by local thermostatic mixing valves with cold water bypass device.

d. Distribution

1) The domestic hot and cold water systems will be Type L copper tube with wrought copper fittings and soldered joints. Solder will be lead-free, 95-5 type solder. Piping 2-1/2" and larger and located in mechanical equipment rooms may be rolled groove mechanical joints.

2) The hot water system will be insulated in accordance with Code. The cold water system will be insulated to prevent condensation from forming. Isolation valves will be provided at all riser connections, branch piping run-outs to fixture groups, and at devices requiring maintenance.

5. Plumbing Fixtures

a. System Description

1) All plumbing fixtures will be new, commercial grade products.

2) Plumbing fixtures designated as barrier-free will be manufactured and installed in accordance with local, state and federal accessibility requirements.

b. Equipment and Material

1) Water closets will be wall hung, vitreous china, with elongated bowls. Flush valves will be piston type, 1.28-gallon flush.

2) Urinals will be wall hung, vitreous china, washout type. Flush valves will be piston type, sensor operated, battery powered, 0.125-gallon flush.

3) Lavatories will be solid surface material integral with the countertop. Faucets will be hot and cold mixing type, wrist blade handles, 0.5 gpm flow control.

4) Mother's room and break room sinks will be countertop mounted stainless steel. Faucets will be hot and cold mixing type, 1 gpm flow control.

5) Electric water coolers will be wall mounted, self-contained, dual level, sensor operated, with stainless steel cabinets and disposable activated carbon water filters.
6) Janitor sinks will be floor mounted, molded stone, drop front, with stainless steel splash panels. Faucets will be hot and cold mixing type with hose connections and vacuum breakers.
7) Exterior hose bibbs will be flush mounted, freeze resistant, with vacuum breakers and loose key operators.
8) Mechanical room hose bibbs will be surface mounted, with vacuum breakers.
9) Emergency showers and eyewashes will be combination shower eyewash units with floor mounting flanges. The fixtures will comply with ANSI Z358.1.

6. Non-Potable Water System
   a. System Description: Non-potable water system is not anticipated for this facility.
7. Compressed Air
   a. System Description
      1) Compressed air will be provided to all Developmental Laboratory area at a pressure of 100 psig and a dew point of -40°F. Compressed air will be provided as required by space program.
   b. Design Criteria
      1) Compressed air piping system will be sized based on 2 scfm per outlet plus any flow required for individual pieces of equipment. Diversity factors will be applied to laboratory outlets as indicated below:

Table 4: Compressed Air System Diversity Factors

Number of Outlets	Diversity Factor	Minimum Flow (scfm)	Empirical Formula for Flowrate (scfm)
1-5	1.00	0	No. of Outlets*1
6-12	0.80	10	5+(No. of Outlets-5)*5/7
13-33	0.60	20	10+(No. of Outlets-12)*10/21
34-80	0.50	30	20+(No. of Outlets-33)*20/47
81-150	0.40	80	40+(No. of Outlets-80)*20/70

      2) The piping system will be sized to limit pressure drop across the system to maximum of 10% of pressure regulator outlet pressure.
      3) The compressors will be controlled by pressure switches in receiver set to operate between 100 and 115 psig. Each compressor will be sized for 100% of the maximum total demand. The compressors will be controlled on lead/lag/alternate basis.
   c. Equipment and Material
      1) Compressed air will be produced by duplex, oil-free, reciprocating air compressors. Compressors will be base mounted and located in the mechanical room. Air will be treated with coalescing filters and particulate filters and dried with simplex refrigerated air dryers. Compressed air will be stored in an ASME rated receiver with outlet pressure regulator.
   d. Distribution
      1) Compressed air piping system will be Type L copper tube with wrought copper fittings and soldered joints. Solder will be lead-free, 95-5 type solder.

8. Special Gases
   a. System Description
      1) Special gases will be provided to all points of use in the laboratory as required by the Owner. Special gases may include but not be limited to: nitrogen, helium, argon, carbon dioxide, and oxygen. There shall be three separate manifolds located in the mechanical room and three separate distribution systems.
   b. Design Criteria
      1) The special gas system will be designed to provide 100 psig special gas at the most remote lab outlet. The system will be sized based upon a load of 1 scfm per outlet and the total number of connected outlets connected to the system. Any point loads for specific equipment will be added to the outlet load after any diversity factors are applied.

Table 5: Special Gases System Diversity Factors

Number of Outlets	Diversity Factor	Minimum Flow (scfm)	Empirical Formula for Flowrate (scfm)
1-5	1.00	0	No. of Outlets*1
6-12	0.80	5	5+(No. of Outlets-5)*5/7
13-33	0.60	10	10+(No. of Outlets-12)*10/21
34-80	0.50	20	20+(No. of Outlets-33)*20/47

   c. Equipment and Material
      1) Special gases service will be supplied by a duplex cylinder manifold system. The number of cylinders on each system will be based upon building use criteria, but will not be less than two cylinders per bank. The manifold system will be an automatic switchover type set to distribute special gases at 100 psig.
   d. Distribution
      1) Special gases piping will be Type 316, ASTM A213, ASTM A269, stainless steel tube with compression fittings and joints.

4.2.6 Fire Protection

4.2.6.1 Base Design Criteria

1. Applicable Codes, Guidelines and Standards:
   a. The Fire Protection Systems will be designed in accordance with the following Codes, Guidelines and Standards:
      1) NFPA 13, Standard for the Installation of Sprinkler Systems, 2010 Edition
      2) NFPA 14, Standard for the Installation of Standpipe and Hose Systems, 2010 Edition
      3) NFPA 30, Flammable and Combustible Liquids Code, 2012 Edition
      4) NFPA 45, Standard on Fire Protection for Laboratories Using Chemicals, 2011 Edition
      5) NFPA 55, Compressed Gases and Cryogenic Fluids Code, 2010 Edition
      6) NFPA 72, National Fire Alarm and Signaling Code, 2010 Edition
      7) International Building Code (IBC), 2012 Edition
      8) International Fire Code (IFC), 2012 Edition

9) Underwriters Laboratories (UL) Fire Protection Equipment Directory
10) Factory Mutual Global (FMG) Property Loss Prevention Data Sheets
11) Factory Mutual Research Corporation (FMRC) Approval Guide

4.2.6.2 System Descriptions

1. Standpipe System
   a. System Description
      1) The building will be protected by a manual wet, Class I Standpipe System without hoses or hose cabinets if the elevation of the third floor slab is more than 30 feet above the lowest level of fire department vehicle access.
   b. Design Criteria
      1) The design of the standpipe system will comply with NFPA 14.
   c. Distribution
      1) The standpipe system piping will be black steel.
      2) Piping will either be Schedule 10 with welded fittings or roll groove couplings or Schedule 40 with welded fittings or roll groove couplings
      3) A 2½" fire department valve will be provided on the stair's intermediate landing between each floor level. Additional fire department valves will be provided on the roof and at other locations as required by Code or the local authority.
      4) All roof fire department valves will be protected from freezing with shutoff valves located inside the thermal envelope of the building.
2. Wet Pipe Sprinkler System
   a. System Description
      1) The building will be protected throughout with hydraulically calculated wet sprinkler systems. All areas of the building will be protected per NFPA 13, including electrical rooms (i.e. switchgear rooms, transformer rooms, generator rooms, electrical closets, and similar rooms), loading docks, stair towers, exterior canopies, concealed spaces above suspended ceilings, and mechanical rooms.
   b. Design Criteria
      1) The sprinkler system for the building will be designed and installed in accordance with NFPA 13 including seismic requirements.
      2) All systems will be hydraulically calculated with a computer calculation program using the Hazen-Williams method.
      3) If there are no special owner or insurance carrier recommendations, the following sprinkler design densities shall apply:
         a) Areas designated as Light Hazard will be designed for a minimum sprinkler flow of 0.10 gpm per sq. ft. over the most hydraulically remote 1500 sq. ft. Hydraulic calculations will account for a hose stream demand of 100 gpm at the connection to the water supply.
         b) Areas designated as Ordinary Hazard Group 1, and where stockpiles of combustibles do not exceed 8 ft., will be designed for a minimum sprinkler flow of 0.15 gpm per sq. ft. over the most hydraulically remote 1500 sq. ft. Hydraulic calculations will account for a hose stream demand of 250 gpm at the connection to the water supply.

c) Areas designated as Ordinary Hazard Group 2, and where stockpiles of combustibles do not exceed 12 ft., will be designed for a minimum sprinkler flow of 0.20 gpm per sq. ft. over the most hydraulically remote 1500 sq. ft. Hydraulic calculations will account for a hose stream demand of 250 gpm at the connection to the water supply.

d) Areas in which compressed gases or cryogenic fluids are stored or used will be designed for a minimum sprinkler flow of 0.20 gpm per sq. ft. over the most hydraulically remote 3000 sq. ft. Hydraulic calculations will account for a hose stream demand of 250 gpm at the connection to the water supply.

e) Areas in which flammable or pyrophoric compressed gases or cryogenic fluids are stored or used will be designed for a minimum sprinkler flow of 0.30 gpm per sq. ft. over the most hydraulically remote 2500 sq. ft. Hydraulic calculations will account for a hose stream demand of 500 gpm at the connection to the water supply.

4) The hydraulic calculations will account for a hose stream demand of 500 gpm at the base of the riser.

c. Equipment and Material

1) The type of sprinkler installed in a particular area will be selected by the Engineer and the Project Architect. Generally, concealed sprinklers will be installed in areas having suspended ceilings. Pendent or upright sprinklers will be installed in areas without ceilings. Sidewall sprinklers will be provided only when other types cannot be utilized.

2) A fire pump is not anticipated for this building; however, verification of campus water flow test is necessary to confirm this assumption.

d. Distribution

1) The piping for the wet pipe sprinkler system will be black steel.

2) Piping 2" and smaller in size will be Schedule 40 with threaded joints.

3) Piping larger than 2" will be Schedule 10 with welded fittings or roll groove couplings or Schedule 40 with welded fittings, threaded joints, or roll groove couplings.

4.2.7 Electrical

4.2.7.1 Base Design Criteria

1. Applicable Codes, Guidelines, and Standards

a. The Electrical Systems will be designed in accordance with the following Codes:

1) IEEE, Institute of Electrical and Electronics Engineers

2) IESI, Illuminating Engineering Society of North America

3) NEC, (Current) National Electrical Code

4) NECA, National Electrical Contractors Association

5) NEMA, National Electrical Manufacturers Association

6) UL, Underwriters Laboratories

7) NFPA 70, 72, 101, 110, 780

8) ADA, Americans with Disabilities Act Accessibility Guidelines

9) Idaho National Laboratory Engineering Standards – STD-139-26 0000

10) Guiding Principles for Sustainable Federal Buildings

2. Load Calculation Criteria

a. Functional Area	Load Density (VA/sq ft)
1) Research Work Space Receptacle	4.0
2) Lighting	Refer to Lighting Section
3) General Receptacle	2.0

3. Equipment Sizing Criteria

a. Secondary Design Voltages

1) Motors larger than 1/2 HP	480Y/277V, 3 phase, 3 wire
2) General Lighting	277V, 1 phase, 3 wire
3) Specialty Equipment	208Y/120V, 3 phase, 4 wire
4) Receptacles, Motors less than 1/2 HP	120V, 1 phase, 3 wire

b. Equipment Sizing Criteria

1) Branch Circuit Load Calculations

a) Lighting	Actual Installed VA
b) Receptacles	180 VA per outlet
c) Multiple Outlet Assemblies	180 VA per 2'-0"
d) Special Outlets	Actual installed VA of equipment served
e) Motors	125% of Motor VA

2) Demand Factors

a) Lighting	125% of installed VA
b) Receptacles	100% of first 10 kVA installed plus 50% of balance
c) Motors	125% of VA of largest motor plus 100% of VA of all other motors
d) Fixed Equipment	100% of total VA installed

3) Minimum Bus Sizes

a) 480Y/277V Lighting Panels	100A
b) 480V Equipment Panels	225A
c) 208Y/120V Equipment	225A
d) Panels	
e) 208Y/120V General	225A
f) Receptacle Panels	
g) 480V Motor Control Center	600A

4) Power Factor Correction

a) Motors larger than 60 HP will include power factor correction capacitors in the MCCs.

4. Service Capacity (preliminary estimate)
   a. Building service and distribution equipment sizes shall be based on estimated maximum demand plus known or reasonable anticipated future loads. Estimated maximum demand calculations shall utilize appropriate demand factors, diversity factors and historical data as allowed in the National Electrical Code.
   b. Feeder and branch circuit sizes shall be based on the load supplied and voltage drop.

Table 6: Materials and Fuels Complex (MFC) Load Summary

	Service Capacity[1, 3, 4]	**EM/Standby System[2]**
kVA	150	N/A
VA/sf	6	N/A

Notes:

[1]Includes normal and future growth.

[2]NEC Article 701 and 702 Standby and Optional System loads. No on site back-up generation will be provided as part of this project therefore no standby power will be available to this building.

[3]Normal power building service capacity to support MFRF at 17,000 SF.

[4]Includes 25% spare capacity.

4.2.7.2 System Descriptions

1. Electric Service
   a. System Description
      1) Primary electric service at 13.8kV will be derived from Idaho National Labs (INL) campus distribution system.
2. Normal Power Services and Distribution
   a. System Description
      1) Secondary electric including service transformer service at 480Y/277 volts will be provided by the project. INL will provide connection to the utility side of the service.
   b. Equipment and Material
      1) Normal power mechanical distribution panels will be located in proximity of the motors served. Motor control centers shall not be used due to the use of VFD driven equipment.
      2) Motors not controlled via VFD shall be have local combination full-voltage starters. Operator interface devices will include H-O-A selector switches, red "run" pilot lights, and green "ready" pilot lights.
      3) Normal power distribution panels will contain bolt-on feeder circuit breakers. The capacity of the panels will be sufficient for the addition of 25% future connected load. Feeder circuit breaker space will be provided for the addition of 25% future circuit breakers.
      4) Branch circuit and lighting panelboards will contain bolt-on branch circuit breakers. The panelboards will be rated at 225 amperes, and the connected load will be limited to provide 25% future connected load. The panelboards will contain 25% spare 20A

branch circuit breakers, and space will be provided for the addition of 25% future circuit breakers.

5) Point-of-use power connection devices will include specification, grade, receptacles (120V, 20A, single-phase), power receptacles, and surface metallic raceway (SMR).
6) The SMR will be divided into two raceway compartments, one for power and one for telecommunications. The density of receptacles in the SMR will vary between 18" OC and 36" OC, depending on the location.
7) Dry type transformers will be Energy Star Labeled optimized to 35% average daily load per NEMA TP-1.
8) Equipment rooms requiring high density and flexibility of power will use SMRs and plug-in suspended horizontal busways to allow for ease of device activation.

c. Distribution
1) Secondary service will be distributed to the switchgear unit via 400 amp rated feeder conduit. The raceway will originate at the transformer and route into the main electrical room, where it will feed directly into the top of the main circuit breaker sections.
2) A digital multi-meter will be provided at the point of service panel.
3) 480Y/277V distribution will be accomplished with conduit risers. Typical at each level: the riser will deliver power to a normal power lighting panelboard and a 75 kVA, 480:208Y/120V distribution transformer.
4) Each 208Y/120V secondary distribution transformer will deliver power to a Distribution Panel. The Distribution Panel will deliver power to the branch circuit panelboards.

3. Emergency/Standby Service and Distribution
a. System Description
1) Emergency power will be supplied for emergency egress lighting, fire alarm, and security systems to support the operation of the building and associated life safety equipment.
2) Emergency power system to be supplied through battery units.

4. Grounding System
a. System Description
1) A complete low-impedance grounding electrode system will be provided for this facility. The grounding electrode system will include the main water service line, structural steel, Ufer ground, and ground ring around the perimeter of the building. The equipment grounding system will extend from the building service entrance equipment to the branch circuit. All grounding system connections will be made using exothermic welds
2) Bonding jumpers will be provided as required across pipe connections to water meters, dielectric couplings in a metallic cold water system, and across expansion/deflection couplings in conduit and piping systems.
3) All feeders and branch circuits will be provided with an equipment ground conductor. Under no circumstances will the raceway system be used as an equipment grounding conductor.

b. Design Criteria
   1) The grounding electrode system will be designed in accordance with NEC article 250.
   2) System resistance to ground will be 5.0 ohms or less.

c. Equipment and Material
   1) The reference ground for the equipment grounding system will be established from a structural ground grid as follows:
   2) A No. 4/0 AWG bare copper ground wire will be installed at 30" below grade around the entire perimeter of the building. 3/4" x 10' driven copper ground rods (test wells) will be installed and connected to this ground loop at not-greater-than 200-foot intervals with a No. 4/0 AWG bare copper conductor. Steel columns in exterior walls will also be connected to this ground loop with 4/0 AWG bare copper at intervals not to exceed 60 feet. Interior steel columns will be connected to the exterior ground loop on each side of the building at intervals not to exceed 200 feet with a No. 4/0 AWG bare copper conductor.
   3) A “Ufer” ground will be provided in the footing of the building consisting of 50 ft of 500 kcmil wire located 3” from the bottom of the footing.
   4) Wall-mounted copper ground bus will be located in the main electrical room, floor electrical rooms, and voice/data rooms. The main electrical room ground bus will be connected to exterior ground loop.

d. Distribution
   1) A separate, insulated 4/0 AWG ground wire will be provided from the main electrical room ground bus to each floor's electrical room ground buses, underground incoming water service line ahead of meter, and underground gas line at the building entrance.
   2) The main service entrance neutral will be bonded to the system ground bar within the switchboard by a removable bus bar link.
   3) A code-sized, unbroken bond leader will be connecting the electrical room ground bar to the XO terminal of the local transformers.
   4) A No. 4/0 AWG, bare copper, grounding electrode conductor will be extended to all voice/data rooms, so that those systems can be properly bonded.
   5) A separate ground wire will be provided for all circuits.

5. Lightning Protection System
   a. System Description
      1) Protect all structures and associated appurtenances with a system of conductance designed to safely divert the energy of a lightning strike to the earth while minimizing damage to the facility.
   b. Design Criteria
      1) Comply with NFPA 780 - Standard for the Installation of Lightning Protection Systems. Installing Contractor will provide a UL Master Label for the completed system.

c. Equipment and Material
   1) Materials will be rated Class I for structure heights of 75 ft or less. Class II for structure heights above 75 ft.
   2) Air terminals will be solid copper with a tapered point, 10" minimum height, and have a mounting base suitable for the location.
   3) Conductors will be bare-stranded copper, except aluminum will be used where installation is in contact with aluminum surfaces.
   4) Ground rods will be copper-clad steel, 3/4" diameter by 10 ft long, with a bronze mechanical-type conductor clamp.

d. Distribution
   1) The system layout and design will encompass all exterior surfaces of the facilities under a complete zone of protection as defined by NFPA 780. Air terminal spacing will not exceed 20 feet, except spacing up to 50 feet is allowed for non-perimeter areas of flat roofs. Locations will comply with NFPA 780 and will generally follow the building roof ridges and/or perimeters.
   2) One (1) down conductor will be provided for every 250 linear feet of building perimeter, with a minimum of two (2) conductors. Conductors will be configured to provide a two-way path to earth. Metal bodies will be bonded to the conductor system in accordance with NFPA 780.
   3) A ground rod will be connected to each down conductor. The electric power service grounding system will be bonded to the Lightning Protection System.

6. Lighting Systems

a. System Description
   1) A complete lighting system for all indoor and outdoor illumination will be provided.
   2) The indoor lighting system will consist primarily of energy-efficient LED lighting fixtures. The outdoor lighting system will consist primarily of LED lighting fixtures.
   3) The lighting will be designed to provide a visually comfortable, aesthetically pleasing environment to enable and support the tasks performed in each space. Lighting will cater to the visual needs of the building design.
   4) The lighting design shall be practical, energy-efficient, easy to maintain and appropriate for the intended function of each space.
   5) For ease of maintenance and storage requirements, the lighting design shall utilize a minimum number of different LED modules and fixtures types.
   6) In general, indoor lighting controls will consist of combination passive infrared and ultrasonic dual technology sensors in enclosed rooms.
   7) A low voltage lighting control system will be provided to control the public spaces within the building as well as the exterior lighting.
   8) Emergency/night lighting will be provided by un-switched branch circuits. These un-switched branch circuits will be fed from a central lighting inverter to provide power during a utility outage.

b. Design Criteria
   1) The basis of design for illumination levels will be in accordance with the IESNA Handbook Illumination Selection Procedure and currently accepted best professional practice.

c. Equipment and Material
   1) Luminaires
      a) Lighting of interior areas will primarily utilize LED luminaires with replaceable LED modules. Other sources including tungsten/halogen, and linear fluorescent will be given consideration for certain applications as determined appropriate to meet architectural and functional program requirements.
      b) Lighting at outdoor areas will primarily utilize LED luminaires. Ceramic metal halide may be used for certain applications where determined appropriate to meet architectural program requirements.
      c) All luminaires used on this project shall be specification grade and of a quality appropriate to the application. Where possible, multiple manufacturers will be listed for each product type. When only one product type is found suitable for the application and/or no other known acceptable product exists, unit pricing will be obtained to maintain an informed and accurate lighting budget.
   2) LED Luminaires
      a) LED modules will have a minimum CRI of 80, conform to 3-step MacAdam Ellipse binning, and a color temperature as agreed upon by the design team and building owner, unless noted otherwise.
      b) LED Lamps shall meet LM79 and LM80 standards.
      c) Will be rated at greater than or equal to 70% lumen maintenance at 50,000 hours of operation.
      d) Dimming drivers will be used in select areas and will have a minimum range of 100% to 1% of the measured light output in select luminaires in operating and procedure rooms and conference rooms.
      e) EXIT signs will be INL Fire Marshal approved LED type.
   3) Lighting Control –
      a) Lighting in conference rooms will be controlled by local switching/dimming with connection to ceiling mounted vacancy sensors.
      b) Occupancy sensors will be used in spaces such as restrooms, private and open work areas, storage areas. Occupancy sensors will be passive infrared or a combination infrared/ultrasonic type.
      c) Daylighting control will be provided in all areas as required by ASHRAE 90.1 2010.

d. Typical Lighting Conditions

1) For purposes of defining and developing lighting concepts, “lighting typicals” have been established to describe the lighting approach for each space. The following section is intended to outline and define the various “lighting typicals”, which are descriptions of the lighting approach for each kind of space. Where space types are found not to have been assigned, the most appropriate lighting standard consistent with this document should be used.

a) Site Lighting – Street and post top luminaires will be provided for general illumination.

b) Exterior Lighting – Additional lighting will be provided at the drop off areas by means of downlights located in the canopy areas and/or column and building mounted luminaires. Exterior lighting shall also be provided on all sides of the building to illuminate the area between the building and the perimeter security fence, as well as reduce overall building shadows.

c) Public Lobby Areas – The lighting will be designed to illuminate the dominate wall surfaces to create a “lantern” effect drawing people into the space.

d) Additional accent lighting to be determined as design progresses.

e) Support Spaces – Lighting within support spaces will vary based on the use and finish of the space. Support spaces such as enclosed research work spaces will primarily use recessed direct/indirect “volumetric” luminaires. Typical spaces will use 2’ x 4’ luminaires. Lighting for support spaces such as storage rooms and utility rooms will utilize recessed flat-lensed LED luminaires.

f) Toilet Rooms – Illumination will be provided as indicated below for public vs. single use toilets.

g) Large public toilet rooms will have a linear perimeter lighting system at the walls. Additional down lighting will be provided as necessary for safety.

h) Single- use toilets will have a linear wall mount LED luminaire above the sink and a LED downlight centered in the room.

i) Mechanical/Electrical Spaces – Lighting within the mechanical and electrical rooms will consist of 4’ industrial LED luminaires.

j) Lighting control will be provided by the building low voltage lighting control system for the public spaces of the building and the exterior lighting.

e. Distribution:

1) In general lighting will be 277V.

2) All lighting circuit wiring will be in conduit and routed concealed within walls, partitions, or ceiling spaces. Surface-mounted conduit will be minimized and used only in non-finished spaces.

3)

4) The ampacity of lighting circuits will be sized for 25% future growth plus 125% continuous loading factor per the National Electric Code.

7. Voice/Data System
   a. System Description
      1) Telecommunication systems will be designed and installed to meet INL standards and requirements.
      2) The telephone and data communications system will be distributed through-out the building.
      3) The telephone and data communications system will be compatible with the existing MFC system.
      4) The building will have Wi-Fi available to all users.
   b. Design Criteria
      1) The Contractor will provide and install all system cables, and infrastructure for the system, including service cables, distribution cables and branch cables.
      2) The building will conform to the enhanced network connectivity requirements for high speed data transfer and collaboration.
      3) The network backbone infrastructure will be deployed redundantly to provide fault tolerance and will support wired, Wi-Fi, and video conferencing data streams.
      4) The building will support the Private Facility Control Network (PFCN), INL Wired Network (INET), INL Wireless Network, Foreign National Network, and the Visitors Network. Separate network switches shall be provided for the PFCN, INET and INL Wireless Network.
   c. Equipment and Material
      1) The building will have minimum 144 strand single mode fiber routed and terminated from the MFC-1728 Dial Room to the first floor Dial Room. A minimum of 48 strand SM fiber will be routed internal to the building and terminated between each floor dial room. Twelve strand single mode fiber shall be dedicated to security systems.
      2) Copper data cable wiring for the building will be CAT 6A.
      3) Minimum raceway size to be 1" conduit, with end bushings and metallic grounding clamps to terminate conduit to cable tray in the ceiling space.
      4) Cable Trays will be wire basket type and will be dedicated to telecommunications cable distribution.
      5) A flush, 5 in. square x 2.875 in. deep metal box with cable management with a 5 in. square single gang outlet box ring will be provided at each voice/data outlet location. Wall plates will be provided by Contractor.
      6) A minimum of 48-strand single mode fiber cable routed and terminated from the first floor dial room to the second floor telecom room.
   d. Distribution
      1) Conduit sleeves sized at a minimum of four 4-inch conduits will be provided between floors for Telephone/Data risers. One 1-1/4-inch conduit will be provided from each box and terminate on cable tray. Raceway, components, sleeves, cabinets, etc., will be installed in accordance with the requirements of the equipment supplied. Systems and power separation will be maintained.
      2) Cat 6A station cables will be provided in the following quantities:
         a). Wall-mounted telephones shall have one cable installed at each desired location.

b). Special services (e.g., overhead projectors, conference room floor and elevator phones) shall have a minimum of two cables per location.

c). Control systems (e.g., building controls, fire alarms) shall have a minimum of two cables per location.

d). Wireless access points shall have a minimum of two cables per location and shall be terminated on a separate, dedicated patch panel.

e). Enclosed Research Work Spaces under 144 square feet (12 × 12) shall have a minimum of two locations with each location containing four cables.

f). Standard Open Research Work Stations shall have a minimum of one location containing four cables.

g). Laboratory space shall have a minimum of one location containing four cables every 50 feet.

h). Printer/Fax/Copier Centers shall have a minimum of one location containing four cables.

i). Collaboration Areas shall have the following:

i. TV screens/monitors – one location containing two cables

ii. Interactive kiosks – one location containing two cables, if required

j). Entries or vestibules shall have one wall phone location containing one cable.

8. Fire Alarm System

a. System Description

1) The fire alarm system will be a stand-alone, fully addressable voice evacuation system. The fire alarm system will be comprised of smoke detectors, heat detectors, duct detectors, manual pull stations, and audio/visual signaling devices.

2) The fire alarm system will be networked utilizing the existing high speed Notifier-net network to transmit fire alarm signals and other emergency communications.

3) The fire alarm panel will be capable of connecting into the existing MFC high speed Notifier-net fire alarm network.

b. Design Criteria

1) The fire alarm system will comply with requirements of NFPA 72 for a protected premises signaling system except as modified and supplemented by this document.

2) A main fire alarm control panel will be located at the main electrical room.

3) A fire alarm annunciator panel will be mounted at the main building entrance.

4) Audio/visual devices will be installed in all areas of the building in accordance with the NFPA and the ADA Guidelines.

5) Smoke detectors shall be installed as required by the National Fire Protection Association, International Building Code, and the International Fire Code. Smoke detectors will be installed in, but not limited to, the following locations: air handling units, elevator lobbies, elevator machine rooms, and electrical equipment rooms.

6) Heat detectors will be installed in areas that are not feasible for smoke detectors.

7) Manual Pull Stations will be installed adjacent to all exit doors and in each elevator lobby.

8) The fire alarm system will be linked with the campus central system.

9) The fire alarm system will be able to communicate with the existing fire alarm control.

c. Equipment and Material
   1) The fire alarm system will be an electronically multiplexed voice communication system.
   2) Remote transponder panels will be used to provide supervised amplifiers and signal circuits for audio/visual devices and magnetic door holders.
   3) The system will utilize individual, addressable photoelectric smoke detectors; heat detectors; addressable manual pull stations; and addressable monitor and control modules. The system will monitor all sprinkler supervisory and water flow switches and will interface with elevators, HVAC smoke control, and smoke fire dampers.

d. Distribution
   1) All initiating and signaling devices will operate at 24VDC and will be installed in accordance with manufacturer's specifications.
   2) All wiring will be installed in conduit. Minimum conduit size will be 3/4".

9. Emergency Notification System (ENS)
   a. System Description
      1) The ENS will be integrated to the fire alarm system as a single system for economy of control panels, wiring and notification appliances. Equipment shall be listed for this intended purpose.
      2) ENS shall be installed to provide evacuation (alternating), Take Cover (steady tone at 1kHz), and Emergency Voice Announcements in all INL buildings and occupied surrounded areas.
10. Paging and Intercom System
   a. Provide a voice announcement and intercom communication system serving the entire building.
   b. The voice announcement and intercom system will be compatible with the existing MFC voice paging system.
11. Security System
   a. System Description
      1) A security system will be provided by INL that may consist of the following items:
         a) Card Readers
         b) Passive Infrared Motion Detectors
         c) Dual Technology Motion Detectors
         d) Auxiliary Power Supplies
         e) Wiring
   b. Equipment and Material
      1) The extent of the work will consist of a pathway system, consisting of conduit, cable tray and cable management system.

4.3 Utilities

Siting considerations and alternatives were evaluated in CDR-159, "Conceptual Design Report for the Research Collaboration Building Site Preparation." As a result, the selected site utility lengths were minimized to reduce utility costs, while allowing MFC to maximize the building budget. Refer to CDR-159 for anticipated site utility connections.

4.4 Cost Summary for Selected Alternative

See Cost Estimate File IE78-D, "MFC Research Collaboration Building," for costs associated with the proposed alternative.

4.5 Key Technical Risks

Technical risks inherent in the design and construction of this type of facility are schedule constraints due to inclement weather or changing site conditions. The work scope is standard design and construction and the schedule needed to complete such a facility is well understood. This experience and knowledge will reduce schedule risk

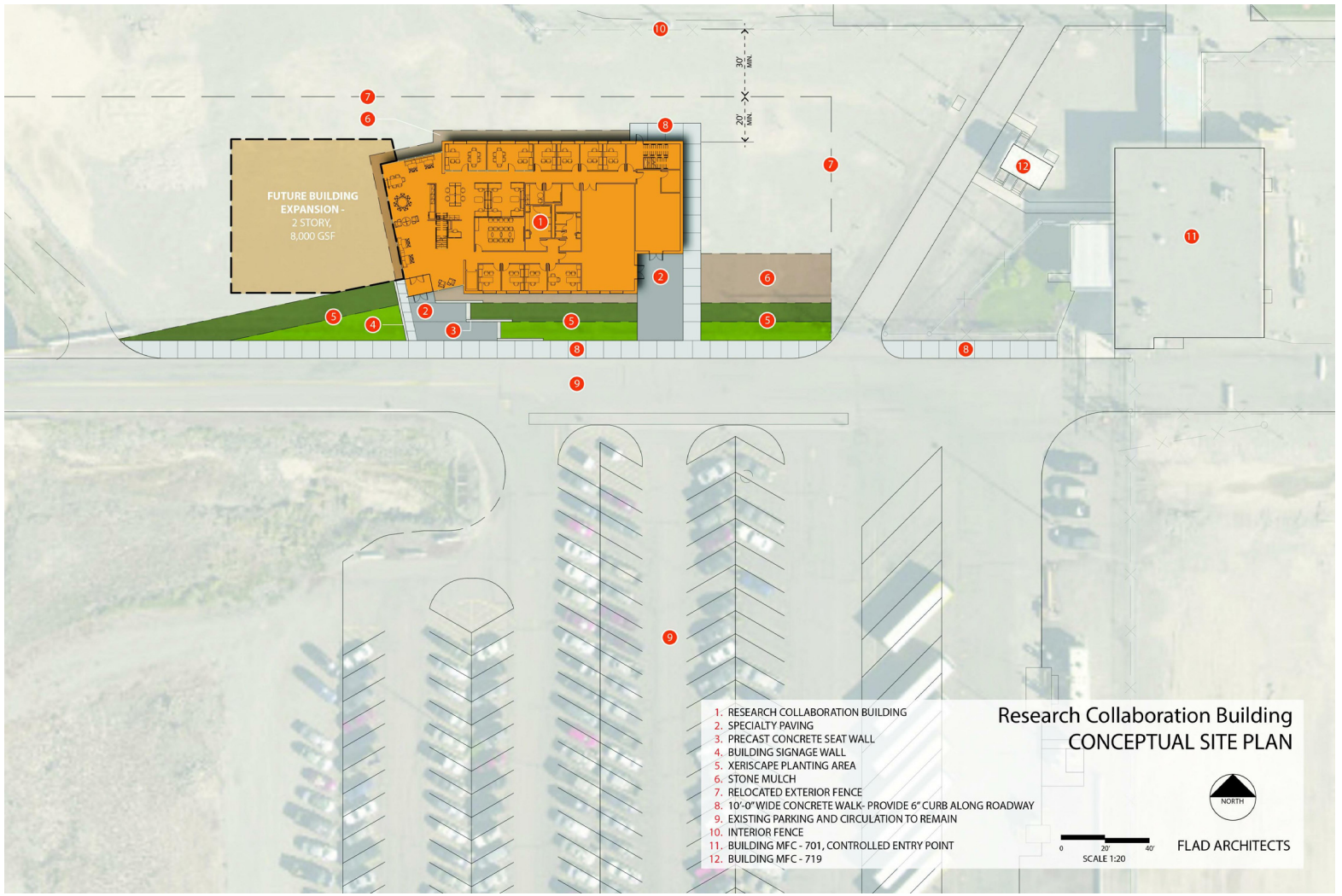
The risk evaluation, to be included in the project execution plan (PLN-5260), will identify and evaluate strategies for mitigation of these and other identified project risks. Risks currently being evaluated include:

- Cost and availability of construction resources;
- Establishing adequate design detail to limit post award construction field changes;
- Subcontractors not familiar with INL requirements and interfaces;
- Delays due to long lead procurements;
- Delays due to inadequate resources;
- Congestion at the MFC work site;
- Risk of capital costs exceeding the GPP limits;
- Unexpected or changing work site conditions;
- Encountering radiologically contaminated soil;
- Encountering rock or unanticipated underground utilities/interferences.

5. APPENDIX

The following drawings are attached as part of the appendix:

- L-100 Site Plan
- A-121 Floor Plan Level 1
- A-122 Floor Plan Level 2
- A-201 Exterior Elevations
- A-202 Exterior Elevations
- A-901 Exterior Perspectives
- A-902 Interior Perspectives



1. RESEARCH COLLABORATION BUILDING
2. SPECIALTY PAVING
3. PRECAST CONCRETE SEAT WALL
4. BUILDING SIGNAGE WALL
5. XERISCAPE PLANTING AREA
6. STONE MULCH
7. RELOCATED EXTERIOR FENCE
8. 10'-0" WIDE CONCRETE WALK- PROVIDE 6" CURB ALONG ROADWAY
9. EXISTING PARKING AND CIRCULATION TO REMAIN
10. INTERIOR FENCE
11. BUILDING MFC - 701, CONTROLLED ENTRY POINT
12. BUILDING MFC - 719

Research Collaboration Building CONCEPTUAL SITE PLAN

NORTH

0 20' 40'
SCALE 1:20

FLAD ARCHITECTS

Flad Architects
Flad Structural ENGINEERS
AEI Affiliated Engineers

Stamps & Approvals

Project Key Plan

NOT FOR CONSTRUCTION

Rev.	Date	Description

Project Title

INL Idaho National Laboratory

Idaho National Laboratory

MFC - MATERIALS AND FUELS COMPLEX

Research Collaboration Building (RCB)

Project Phase: CONCEPT DESIGN

Date	Drawn By
11/28/16	RP
Project Number: 16277-06	Checked By: MM

Sheet Title: **SITE PLAN**

Sheet Number	Rev. No.
L-100	

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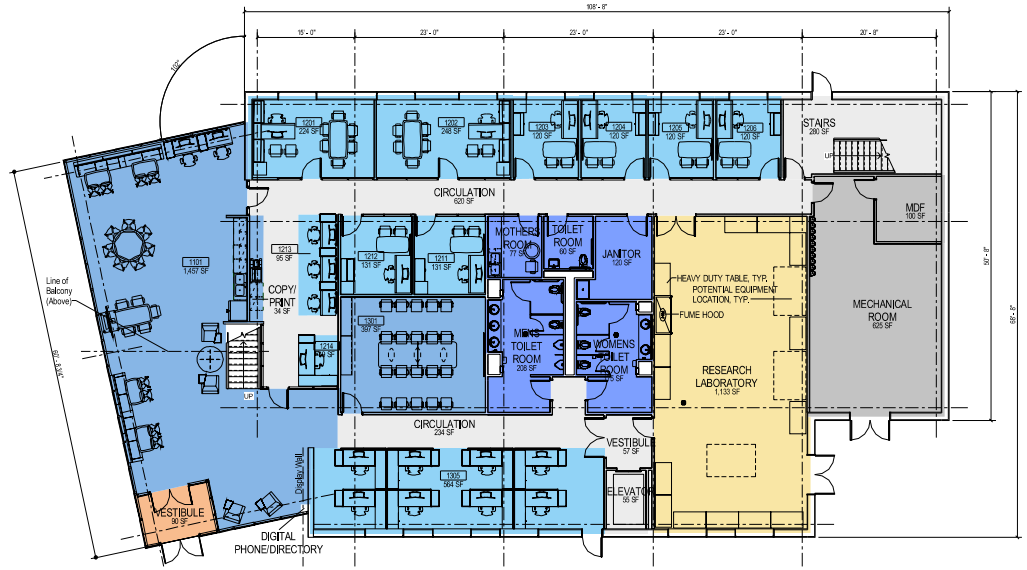
GENERAL NOTES:
1. INTERIOR PARTITIONS AROUND THE R&D LABORATORY AND MECHANICAL ROOM TO HAVE A 50 STC MIN.



FIRST FLOOR	8,387 GSF
SECOND FOOR	7,616 GSF
SUBTOTAL	16,003 GSF

	ENCLOSED RESEARCH WORKSTATION	OPEN RESEARCH WORKSTATION	TRAINING WORKSTATION
FIRST FLOOR	8	12	0
SECOND FLOOR	23	8	6
SUBTOTAL	31	20	6

0' 4' 8' 16'

NORTH

1 FLOOR PLAN - LEVEL 1
1/8" = 1'-0"

Flad Architects
Flad Structural ENGINEERS
AEI Affiliated Engineers

Stamps & Approvals

Project Key Plan

NOT FOR CONSTRUCTION

Rev.	Date	Description

Project Title

Idaho National Laboratory

Idaho National Laboratory

MFC - MATERIALS AND FUELS COMPLEX

Research Collaboration Building (RCB)

Project Phase: CONCEPT DESIGN

Date	Drawn By
11/28/16	MS
Project Number: 16277-06	Checked By: MM

Sheet Title: **FLOOR PLAN - LEVEL 1**

Sheet Number	Rev. No.
A-121	

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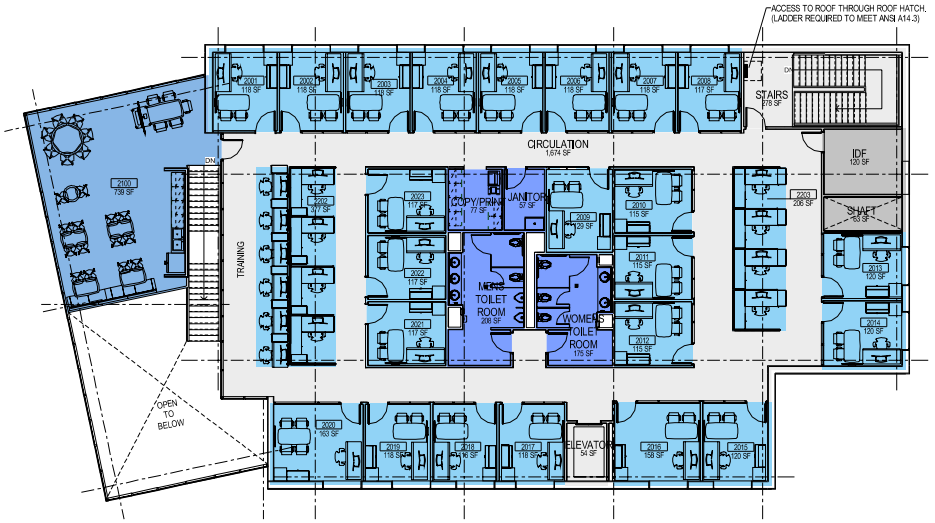

Legend

- Building Support
- Circulation
- Mechanical
- Research Collaboration
- Research Workspace

1 **FLOOR PLAN - LEVEL 2**
1/8" = 1'-0"

0' 4' 8' 16' NORTH

Flad Architects
Flad Structural ENGINEERS
AEI Affiliated Engineers

Stamps & Approvals

Project Key Plan

NOT FOR CONSTRUCTION

Rev.	Date	Description

Project Title

Idaho National Laboratory

Idaho National Laboratory

MFC - MATERIALS AND FUELS COMPLEX

Research Collaboration Building (RCB)

Project Phase: CONCEPT DESIGN

Date	Drawn By
11/28/16	MS
Project Number: 16277-06	Checked By: MM

Sheet Title: **FLOOR PLAN - LEVEL 2**

Sheet Number	Rev. No.
A-122	

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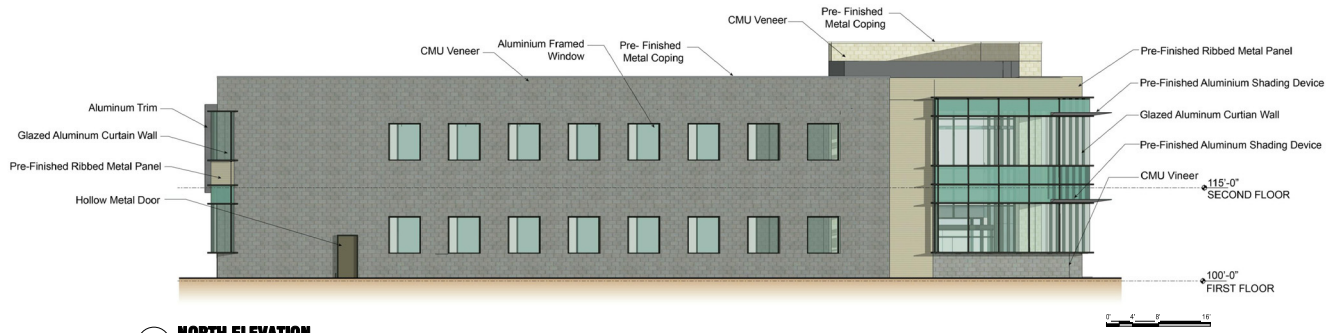
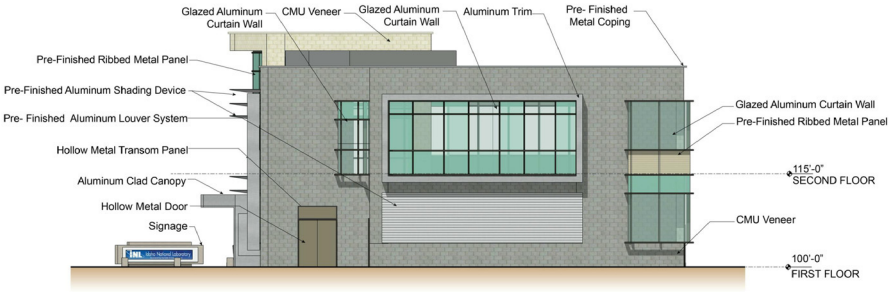


1 NORTH ELEVATION
1/8" = 1'-0"



2 EAST ELEVATION
1/8" = 1'-0"

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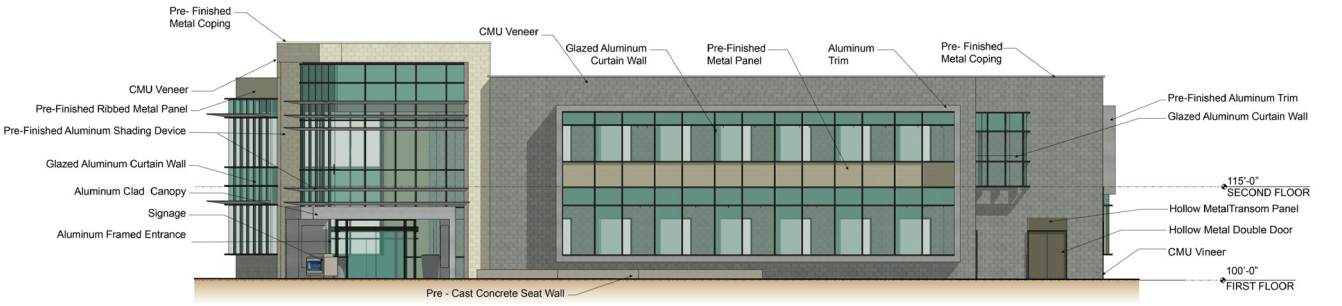
Project Number: 16277-06	Checked By: MM

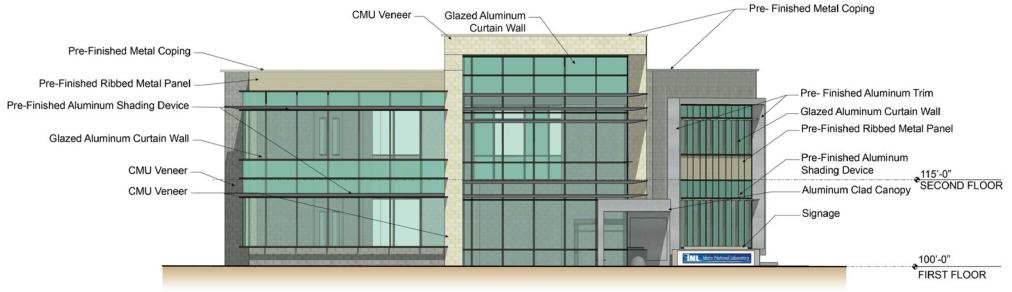
Sheet Title: **EXTERIOR ELEVATIONS**

Sheet Number	Rev. No.
A-201	

11/28/2016 12:48:58 PM



1 SOUTH ELEVATION
1/8" = 1'-0"



2 WEST ELEVATION
1/8" = 1'-0"

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Project Key Plan

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Rev	Date	Description

Project Title

Idaho National Laboratory

MFC - MATERIALS AND FUELS COMPLEX

Research Collaboration Building (RCB)

Project Phase: CONCEPT DESIGN

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Sheet Title: **EXTERIOR ELEVATIONS**

Sheet Number	Rev. No.
A-202	

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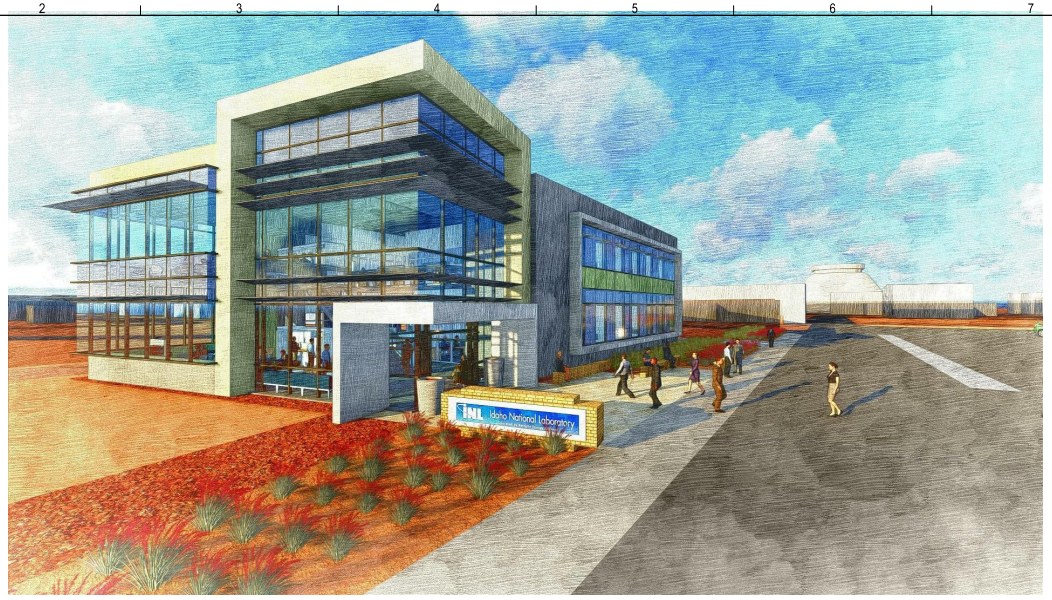

1 **ENTRY PERSPECTIVE**
NTS

2 **OVERALL PERSPECTIVE**
NTS

11/28/2016 12:50:09 PM

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Project Key Plan

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Rev.	Date	Description

Project Title

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MFC - MATERIALS AND FUELS COMPLEX

Research Collaboration Building (RCB)

Project Phase
CONCEPT DESIGN

Date	Drawn By
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Sheet Title
EXTERIOR PERSPECTIVE

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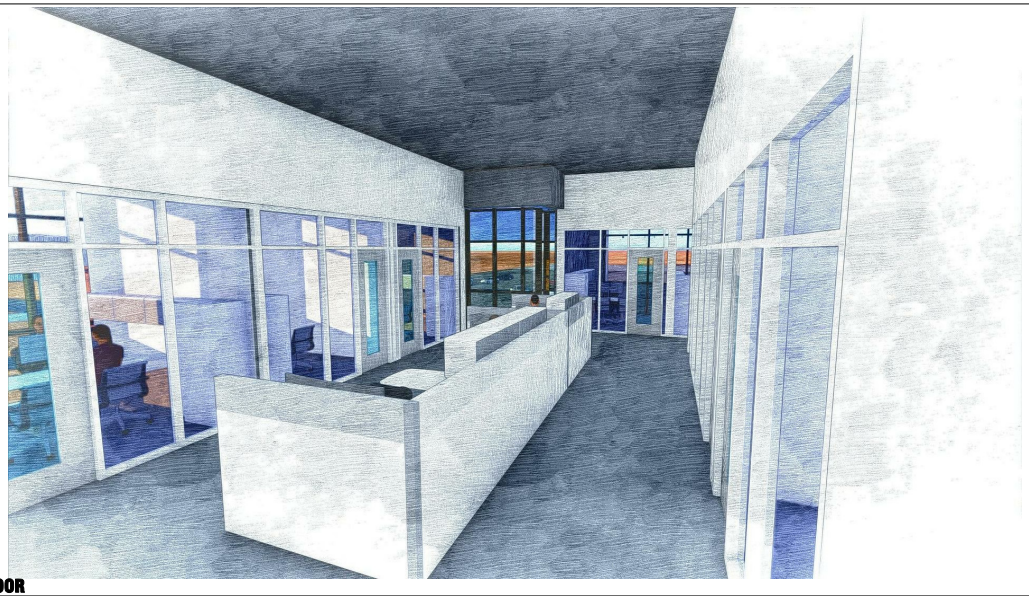
A-901	

1 **COLLABORATION AREA**
NTS



2 **WORK AREA - SECOND FLOOR**
NTS

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Project Key Plan

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Research Collaboration Building (RCB)

Project Phase
CONCEPT DESIGN

Date	Drawn By
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Project Number	Checked By
16277-96	MM

Sheet Title
INTERIOR PERSPECTIVE

Sheet Number	Rev. No.
A-902	

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