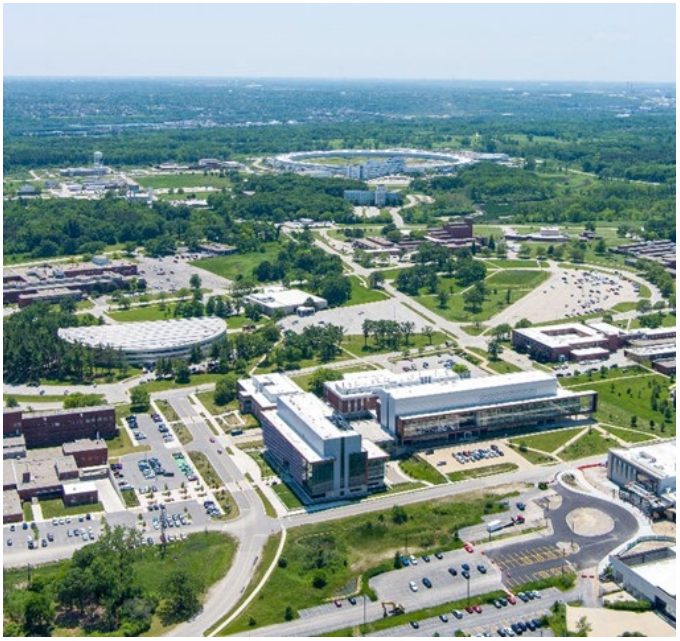
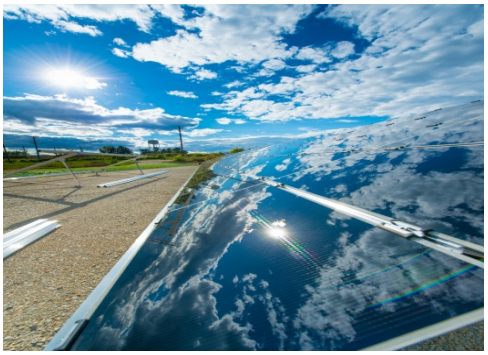
Argonne NATIONAL LABORATORY

FACILITIES DESIGN GUIDE 2021





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Approval and Revision History

Approvals

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Revision History

Revision	Date	Reason
0	11/16	Initial Issue
1	02/18	Update of building codes, rewrite of Sustainability section, various revisions throughout
2	08/21	Update of building codes, various revisions throughout

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Contents

List of Acronyms

The following is a list of the acronyms, initialisms, and abbreviations used in this document.

AASHTO	American Association of State Highway and Transportation Officials
ABA	Architectural Barriers Act
ACI	American Concrete Institute
AHU	air handling unit
AISC	American Institute of Steel Construction
ALARA	as low as reasonably achievable
amp	ampere
ANSI	American National Standards Institute
APS	Advanced Photon Source
Argonne	Argonne National Laboratory
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
ATLAS	Argonne Tandem LINAC Accelerator System
AV	audio/video
AWG	American wire gauge
AWWA	American Water Works Association
BAS	building automation system
BD+C	Building Design and Construction
BICSI	Building Industry Consulting Service International
BIS	Business and Information Services Division
CAAPP	Clean Air Act Permit Program
cal/cm^2	calories per centimeter squared
CAV	constant air volume
CFL	compact fluorescent
CFR	Code of Federal Regulations
CORAL	Chemical Inventory Tracking
DB	dry bulb
dB	decibel
DOE	U.S. Department of Energy
DOE G	U.S. Department of Energy Guide
DOE HDBK	U.S. Department of Energy Handbook
DOE O	U.S. Department of Energy Order
DOE-STD	U.S. Department of Energy Standard

EF	entrance facility
EISA	Energy Independence and Security Act
EMI	electromagnetic interference
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESH	Environment, Safety, and Health Division
°F	degrees Fahrenheit
FAC	Facilities Division
fc	foot-candle
FEMA	Federal Emergency Management Agency
FEMP	Federal Emergency Management Program
FHA	Fire Hazards Analysis
FPE	fire protection engineer
fps	feet per second
gal	gallon(s)
GIS	geographic information system
GPF	gallons per flush
GPM	gallons per minute
GSA	General Services Administration
HDPE	high-density polyethylene
HPSB	high-performance sustainable building
HVAC	heating, ventilation, and air conditioning
Hz	hertz
IAC	Illinois Administrative Code
IBC	International Building Code
IECC	International Energy Conservation Code
IEEE	Institute of Electrical and Electronics Engineers
IEPA	Illinois Environmental Protection Agency
IES	Illuminating Engineering Society of North America
IDOT	Illinois Department of Transportation
in.	inches
IP	internet protocol
IS	Infrastructure Services Directorate
IT	information technology
kW	kilo watt
LAN	local area network
LED	light-emitting diode
LEED	Leadership in Energy and Environmental Design

LMS	Laboratory Management System
MAQ	maximum allowable quantity
MCC	motor control center
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NETA	InterNational Electrical Testing Association
NFPA	National Fire Protection Association
NPDES	National Pollution Discharge Elimination System
NPH	natural phenomena hazard
NRCA	National Roofing Contractors Association
NRTL	Nationally Recognized Testing Laboratory
NWM	Nuclear and Waste Management Division
OSFM	Office of the Illinois State Fire Marshal
OSHA	Occupational Safety and Health Administration
QA	Quality Assurance
PA	public address
PMO	Project Management Organization
PP	Program Plan
PPE	personal protective equipment
psf	per square foot
psi	pound per square inch
PVC	polyvinyl chloride
RFID	radiofrequency identification
RTU	rooftop unit
SCADA	supervisory control and data acquisition
sf	square feet
SME	subject matter expert
SNAP	Significant New Alternatives Policy
SRI	solar reflectance index
SSCs	structures, systems, and components
SSWS	Standard Specifications for Water and Sewer Main Construction (Illinois)
SWPPP	Storm Water Pollution Prevention Plan
THHN	thermoplastic high-heat-resistant, nylon-coated
THWN	thermoplastic heat- and water-resistant, nylon-coated

TIA	Telecommunications Industry Association
TR	telecommunication rooms
UL	Underwriter Laboratories
UPS	uninterruptible power supply
USDA	U.S. Department of Agriculture
UST	underground storage tank
UV	ultraviolet
VAC	volts alternating current power
VAV	variable air volume
VFD	variable frequency drive
WB	wet bulb

1 Introduction

The Infrastructure Services Directorate (IS) of Argonne National Laboratory (Argonne) has responsibility for developing and maintaining the site, buildings, and physical plant of the laboratory. This document provides the requirements for facilities-related codes, designs, and items specific to Argonne.

Architects and engineers must create designs according to Argonne's Codes of Record listed in Section 1.2 and the facilities-related U.S. Department of Energy (DOE) orders and standards listed in Section 1.1. This guide lists industry standards throughout. Argonne recognizes that new ideas and advances occur in the industry and encourages architects and engineers to communicate with Argonne's designated project manager and subject matter experts (SMEs) if techniques contrary to those listed in this guide would provide better value to Argonne.

Argonne must follow the procurement standards of the Federal Acquisition Regulations, which require multi-source selection. Except in very limited situations, sole source specifications are not allowed. If a manufacturer preference is listed, it is recommended that alternate sources be listed, and the bids for that portion of the work have exposed pricing.

1.1 DOE Orders and Standards

Argonne is bound by the Argonne Prime Contract. Clause 1.97 (last revised 2/6/09) of the Prime Contract addresses laws, regulations, and DOE directives: "the contractor shall comply with the requirements of applicable Federal, State, and local laws and regulations (including DOE regulations), unless relief has been granted in writing by the appropriate regulatory agency." In addition, "The Contractor will perform the work of this Contract in accordance with each of the Contractor Requirements Documents appended to this Contract as 'Appendix I'."

DOE orders (DOE O) and standards (DOE-STD) related to facilities design include the following:

- DOE O 420.1C, *Facility Safety*, establishes facility and programmatic safety requirements for DOE and the National Nuclear Security Administration for nuclear safety design criteria, fire protection, criticality safety, natural phenomena hazards (NPH) mitigation, and the System Engineer Program.
- DOE-STD-1020, *Natural Phenomena Hazards Analysis and Design Criteria for Department of Energy Facilities*, provides guidance for analyzing and designing the facility structures, systems, and components (SSCs) needed to implement the requirements of DOE O 420.1C and to ensure that the SSCs will be able to effectively perform their intended safety functions under the effects of NPHs.
- DOE-STD-1189, *Integration of Safety into the Design Process*
- DOE-STD-1066, *Fire Protection*

- DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Asset*; this order provides DOE with direction for program and project management when acquiring capital assets with the goal of delivering projects within the original performance baseline, cost, and schedule, and fully capable of meeting mission goals.
- DOE O 414.1D, *Quality Assurance*, defines roles and responsibilities for providing quality assurance for DOE products and services.
- DOE O 436.1, *Departmental Sustainability*
- 10 CFR 851, *Worker Safety/Health Program*, outlines the requirements for a worker safety/health program to ensure that DOE contractors and their workers operate a safe workplace.

1.2 Codes and Standards

DOE O 420.1C, *Facility Safety*, is the document for establishing facility and programmatic safety requirements for DOE. It requires contractors and Argonne to identify the applicable industry codes and standards, including the International Building Code (IBC), and the applicable DOE requirements and technical standards. The following codes have been adopted as the Codes of Record at Argonne.

- 2021 International Building Code
- 2021 International Fire Code
- 2021 International Mechanical Code
- 2021 International Plumbing Code
- 2020 NFPA 70, *National Electrical Code®*
- 2021 NFPA 101, *Life Safety Code®*
- Architectural Barriers Act (ABA) standards in lieu of IBC Chapter 11

Refer to the following chapters for additional secondary codes, standards, and/or guides. Whenever a code is listed, it refers to the latest version of the code in place at the time of preliminary design.

1.3 Argonne Procedures

The following list shows the main facilities-related requirements from the Argonne Laboratory Management System (LMS) procedures and policies:

- ESH-4.8, *Hazardous Materials – Hydrogen Safety*
- ESM-19, *Electrical Installation Safety, Section 19.4, Lightning Protection for Argonne Buildings*
- ESH-11.2, *Fire Protection – General Fire Safety*
- ESH-11.3, *Fire Protection – Flammable and Combustible Liquids*

- ESH-11.6, *Fire Protection – Fire Barriers*
- ESH-11.7, *Fire Protection – Portable Fire Extinguishers*
- ESH-19.1, *Design Criteria for Facilities – Exit Systems and Life Safety*
- ESH-19.3, *Design Criteria for Facilities – Emergency Lighting Systems*
- LMS-PROC-14, *Fixed Ladders*
- LMS-PROC-46, *Clean Air Act and Air Pollution Control Compliance*
- LMS-PROC-115, *Reporting and Responding to Releases of Oil and Hazardous Substances to the Environment*
- LMS-PROC-139, *Emergency Eye Washes and Safety Showers*
- LMS-PROC-210, *Ventilation for Hazard Control*
- LMS-PROC-220, *Trailers and Other Moveable Structures*

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2 Civil and Environmental

2.1 Codes and Standards

2.1.1 Federal/National

- *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act,* EPA 841-B-09-001, December 2009
- *Guidance for Federal Agencies on Sustainable Practices for Designed Landscapes*
- *Illinois Native Plant Guide,* U.S. Department of Agriculture (USDA)
- *Architectural Barriers Act* (ABA), Accessibility Standards
- *https://mutcd.fhwa.dot.gov/kno_2009r1r2.htm* (MUTCD)
- EO 13751, *Safeguarding the Nation from the Impact of Invasive Species*
- EO 13690, *Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input* (which revises EO 11988, *Floodplain Management*)
- 40 CFR Part 82 Subpart F, *Recycling and Emissions Reduction*
- 40 CFR Part 82 Subpart G, *Significant New Alternative Policy*

2.1.2 State

- *Illinois Department of Transportation (IDOT) Bureau of Design and Environmental Manual;* Part II – Project Development; Part IV – Roadway Design Elements; Part VI – Other Highway Design Elements
- *Illinois Standard Specifications for Water and Sewer Main Construction (SSWS)*
- *Illinois Urban Manual*
- *IDOT Standard Specifications for Road and Bridge Construction*, latest edition
- 41 Illinois Administrative Code (IAC) Part 160, *Storage, Transportation, Sale And Use Of Gasoline And Volatile Oils: Rules And Regulations Relating To General Storage*
- 41 IAC Part 180, *Rules of Aboveground Storage Tanks* (ASTs)
- 41 IAC Part 172, 174, 175, 176, and 177, *Rules of Underground Storage Tanks* (USTs)
- 35 IAC Part 201, *Permits and General Provisions (Air)*

2.1.3 Trade Standards

- *American Society of Civil Engineers (ASCE) Standard Guidelines for the Design (45-05), Installation (46-05), and Operation (47-05) of Urban Stormwater Systems; ASCE 60 Sanitary Sewer Design*

- American Water Works Association (AWWA) standards
- *American Association of State Highway and Transportation Officials (AASHTO)—Policy on Geometric Design of Highways and Streets (Green Book)*; *Roadside Design Guide, RSDG-4*; *Roadway Lighting Design Guide, GL-7*
- *Illuminating Engineering Society of North America (IES) Lighting*

2.1.4 Argonne National Laboratory

- LMS-POL-2, Environmental Policy
- LMS-POL-6, *Traffic Safety*
- LMS PROC-46, *Clean Air Act and Air Pollution Control Compliance*
- LMS PROC-115, *Reporting and Responding to Releases of Oil and Hazardous Substances to the Environment (Section 5)*
- LMS-PROC-122, *Water Pollution and Control*
- *Clean Air Act Permit Program (CAAPP) Permit*
- J512-109-T002, *Excavated Soil Management Plan*
- *National Pollution Discharge Elimination System (NPDES) Permit #IL0034592*
- *Resource Conservation and Recovery Act Permit*
- *Spill Prevention, Control, and Countermeasures Plan*
- *Storm Water Pollution Prevention Plan (SWPPP) for the Argonne Site (Special Condition #9 of the NPDES Permit)*

2.2 General Requirements

All projects and actions executed by Argonne require a review per the requirements of the National Environmental Policy Act (NEPA). Prior to the start of detailed design, the designer shall review the documented "Environmental Review Evaluation form" for the planned action and incorporate any stated requirements.

Develop all plans using the North American Datum 1983 (NAD83).

Site Plan Background: The designer must verify pertinent background data using available geographic information system (GIS) information from the GIS database and on-site field surveys. The site plan background map shall be exported from GIS as an Autocad file,

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Do not place any manhole structures, shut-off valves, or hand holes within stormwater conveyances such as ditches and swales, or at abruptly uneven surfaces.

2.3 Roads

The radii for all roadway intersections must be a minimum of 30 feet to accommodate truck traffic.

When road shoulders are steep, or permanent objects are located within the clear zone, provide roadway guardrails as recommended by the AASHTO Roadside Design Guide and Argonne.

Do not locate new crosswalks within 200 feet of an intersection or other crosswalks.

Roads are generally not installed with curb and gutter; IS Facilities Division (FAC) must approve their use.

Roadway lanes must be striped 11 to 12 feet wide with an additional 3-foot paved shoulder on each edge of the road unless a separate bike path exists along that road.

All roadway striping must be thermoplastic where available and compatible with the surface.

Remote service roads (identified by IS-Engineering) do not require a 3-foot paved shoulder. The road lanes must be striped 11 feet wide with a 1-foot paved edge.

Gravel and grass roads (tertiary roads) must be a minimum of 18 feet wide. The profile must have a sufficient gravel subbase in place for future paving.

Driveways do not require striping and can be reduced in width to no less than 20 feet.

All lighting poles, guy wires, culvert flared ends, and so on, must be installed at least 9 feet from the edge of the asphalt or an improved surface; 12 feet is preferred.

2.4 Walkways

Sidewalks must be at least 5 feet wide and have a minimum thickness of 5 inches of concrete that includes wire mesh reinforcing. Provide control joints at no greater spacing than 1 foot for each inch of thickness. Dowels must be installed at expansion joints and connections to existing walkways and buildings. New buildings must have haunches to support the walkway/landing at the building entrances.

When walkways or paths cross vehicular roads, they must be at a right angle, with an open view of the roadway in all directions.

All walkway intersections must have concrete corners added for maintenance support: a triangle shape with minimum 18-in. legs.

All walkways crossing shallow utilities must have reinforcing added: minimum #4 reinforcing bar every 15 in. perpendicular to the utility trench.

All intersections between walkways and roadways that require detectable warning tile must specify a cast iron tile with a red brick powder coat finish. An acceptable manufacturer is TufTile.

Increase sidewalk width to accommodate signs or bollards as required. A standard 5-foot wide sidewalk shall be increased to a minimum width of 6 feet with signs or bollards installed one foot into the walkway pavement—still providing a minimum walkway of 5 feet. Provide expansion material around the structure separating the post or foundation from the walkway structure.

All walkway interface points with roads and parking lots should be flush with the connecting surface, eliminating a raised curb at high pedestrian access points when possible.

2.5 Parking Lots

Install flush concrete curbs matching the parking lot slope along all edges of parking lots where there are no sidewalks.

Standard parking stall size must be 9 feet wide by 18 feet deep, striped to the centerline.

Prefer parking lot runoff to sheet flow into adjacent grass areas and/or into bioswales along the parking area.

Sidewalks typically must not be installed to cross a parking lot.

Do not install detectable warning tiles where sidewalks intersect with parking lots.

Parking lot layouts, including curb types, must consider where snow is stored during the winter season.

Parking space striping must be 4 in. wide and made of thermoplastic material where available and compatible, as well as the following:

- Blue striping or marking indicates parking for vehicles displaying handicap placards or plates. Handicap symbols on the pavement surface are not required.
- White indicates designated parking spaces.
- Yellow hatching or curb painting identifies areas for stopping only for loading and unloading of passengers or freight.
- Red hatching or curb painting identifies areas where no parking, standing, or stopping is allowed.
- Green painting identifies electric vehicle charging spaces.

Do not use wheel stops except in locations where facility damage or safety-related needs arise. Consider adding a 2-foot 0-in. hatched area at the end of the parking spaces along high-conflict areas to reduce encroachment of vehicles into high-risk areas/walkways.

Use yellow polyvinyl chloride (PVC) bollard cover sleeves on single pole-type bollards in lieu of painting.

2.6 Underground Utilities

All manhole covers, catch-basin access frames, and lids must be installed at the same elevation as the surrounding finished grade. All concrete tops of vaults and conical tops of manholes and basins must be a minimum 12 in. below grade. Use concrete spacer rings to fill the space between the concrete top and the bottom of the steel frame and cover.

All valve boxes (buffalo boxes) and trace wire access points shall be installed below grade in a shallow manhole with a drain. Provide sufficient room inside the manhole for access, clearance, and settlement. Cover the manhole with a standard 24-in. frame and solid lid. See Argonne Drawing J512-110-W-C001 for details and options.

All manhole covers or lids must be properly labeled per the utility system they cover.

Utility lines must have warning tape installed 18 in. above the line.

All underground utilities must have systems to trace the location of the subject lines.

2.7 Stormwater Systems

The design of stormwater collection systems must employ the EISA guidance from Section 438. Argonne calculates that the intensity of a 95th percentile rainfall event is 1.55 in. Consider exceptions if events larger than this could affect buildings.

All sewer system plans must provide a grading profile in the design documents.

Do not use beehive lids or curb drain inlets in the storm sewer system.

Standard manhole frames and lids shall be 24 in. maximum in diameter.

The inside surfaces of corrugated metal culverts must be coated with bitumen.

Sewer manholes must be a maximum of 300 feet apart, and must be closer near intersections.

The slope for storm sewers must provide a minimum flow of 3 feet per second (fps) and a maximum of less than 10 fps. The slope for sanitary and laboratory sewers must provide a minimum flow of 2 fps and a maximum of less than 10 fps.

Storm sewer inlets and outlets located in grass/maintained areas shall use a concrete mountable flared end with a bar grating set in the sloped surface. This supports improved site maintenance and safety. Culvert outlets and inlets must be located 9 feet from the edge of the roadway, driveway, or walkway crossed. Refer to Argonne drawing J524-133-W-Coo1. The size of the culvert, box culvert, or headwall and surface area served shall be considered in the inlet and outlet design.

Stormwater culverts and storm sewers must be at least 12 in. in diameter. In instances with small tributary areas, around buildings, or where clearances prevent compliance, storm sewers must be at least 8 in. in diameter.

Before repaving, utility cuts across improved surfaces should create a pavement cut that is 1 foot wider on each side of the trench.

2.8 Water and Sanitary Systems

Water supply piping design and installation (including bedding and initial backfill) must comply with the AWWA *Manual of Water Supply Practices/Design and Installation;* the *Standard Specifications for Water and Sewer Construction in Illinois;* and follow the pipe manufacturer's recommendations.

All bolted connections for underground water piping must use stainless steel bolts.

The installation of new combined fire and domestic water mains, fire hydrants, and control valves must comply with NFPA 24. This includes design, construction testing, and flushing.

Install fire hydrants more than 9 feet, and preferably approximately 12 feet, from the roadway edge. For more fire hydrant requirements, see Chapter 6.

If ductile iron or other metal piping is called for, the piping system sections must be connected to establish a continuously grounded system for cathodic protection. If non-metallic material supply pipe is being used and buried than a tracer wire must be installed directly above the supply pipe and continuous with the pipe.

Specify high-density polyethylene (HDPE) Iron Pipe Size (I.P.S.) piping for watermain. Use fusion-welded ball valves.

Thrust restraint requirements. Thrust restraints systems for pressured piping must be designed, specified, with installation locations shown on the design drawings. Thrust restraint systems such as thrust blocks, thrust anchors, or in-line anchoring must be designed per AWWA M41 and AWWA M55, *Manual of Water Supply Practices.* Fully restrained joints, an alternative method of providing thrust restraint, must also be designed. Restraint systems such as external mechanical restraints/supports are to be designed and used whenever pressured pipe leaves the soil.

Temporary and supplemental thrust restraint systems. Properly engineered temporary or supplemental restraint systems or other alternatives are to be indicated on the design drawings when a design has a supply or sewer line installation excavation that removes soil support, disturbs soil support, or causes a substantial excavation in the vicinity or parallel to an existing pressured pipe. Also, temporary or supplemental restraints shall be installed for pressure testing of newly installed supply piping if permanent restraint systems are not installed and in place. Other alternatives to temporary and supplemental restraints may include depressurizing the existing pressurized pipe with proper engineering and construction procedures to compensate for the loss of soil support.

2.9 Landscaping

Landscape designs should relate to the overall character of the Argonne site so that there is a blend from ornamental to less ornamental, and from higher maintenance to less maintenance, as distance from buildings increases. Argonne uses native species in order to blend landscapes into the natural surroundings. Plant selection must gradually shift to native species, so that design features further from buildings use only the native species found in the area.

Invasive species are prohibited in landscaping by Federal policy and law. Landscaping design selections and substitutions must be approved by Argonne before planting. Proposed plant species must also be determined safe for introduction based on whether they have a potential to become invasive or hybridize with a closely related species to create a hybrid invasive species. All contractors and landscape service providers shall conduct due diligence for proposals before the review process. Argonne's Natural Resources Management Plan is a source of information on known invasive species in the area.

The following trees are prohibited: Norway maple *Acer platanoides*; white mulberry *Morus alba*; Pear *Pyrus sp.* (all species); Tree of Heaven *Ailanthus altissima;* Eastern Serviceberry *Amelanchier canadensis*; fringe tree *Chionanthus virginicus*; and osage orange *Maclura pomifera*.

Non-native species or cultivars of the following genera are prohibited: *Amelanchier; Acer; Fraxinus; Carpinus; Ostrya; Malus; Crataegus; Quercus; Carya; Populus; Betula; Prunus; Ulmus; Morus; Gleditsa; Tilia; Platanus.* and *Cercis.* All other species would be reviewed on a case-by-case basis.

Do not plant trees within 10 feet of underground utilities or within 30 feet of intersections.

Parking lots, service areas, and utility structures should be visually screened with landscaping to minimize negative visual impacts and visually improve overall campus aesthetics.

The following is a list of grass seed mixes to use, per the IDOT:

- Type 2A salt-tolerant roadside mix must be used within 10 feet of any road or parking lot
- Types 4 and 4A must be used in wet native areas
- Types 4B and 5B must be used in wetland areas
- Types 5 and 5A must be used for dry native areas
- Type 1 lawn mixture may be used for other regularly mowed areas
- All native seeded areas must be intermixed with native plant plugs

Do not use plastic landscape edging. Consider concrete or curb style edging that is flush with the adjacent landscaped surfaces.

Avoid generic seed mixes. Native seed installations perform best when the nativity of the seed is within 100 miles of the Argonne site; therefore, source seed mixes from local vendors.

Native seed mixes and flora are considered on a project-by-project basis.

Do not plant trees within 10 feet of underground utilities.

Locate trees or shrubs that produce fruit so that the fruit does not drop onto pedestrian sidewalks.

All projects that demolish trees must install new trees to replace the lost trees to the greatest extent possible. All exterior projects must install trees where practical in the immediate area of the project.

All grading along the edges of buildings or other improvements shall slope away from the edge of the building or other improved surface. Use appropriate stormwater collection systems in the design to support this concept. Address long-term settlement when developing the design.

2.10 Outdoor Lighting

See Section 8.9 for exterior lighting requirements.

2.11 Environmental

2.11.1 Water/Soil

Provide gate valves on all trench drains used in the loading dock areas of new buildings that handle bulk deliveries of chemicals (including diesel fuel). Equip buildings that receive incidental amounts of chemicals with a spill kit at the loading dock (a gate valve is not required).

Chlorinated water used for conditioning new water mains must not discharge to storm water. Chlorinated water must discharge into the laboratory sewer system or, if the laboratory sewer is not available, the water must be dechlorinated before discharging into the sanitary sewer system.

Remove construction spoils (clay and topsoil) from the Argonne site unless they can be immediately reused on site. Reuse excavated soils on the project to the extent practicable.

Building drains for cooling towers must discharge to the laboratory sewer system, not to the storm sewer system, and not to the sanitary sewer unless no other options are available.

Construction projects must follow Argonne specifications for erosion and sediment control. Use settling basins as the preferred method of removing suspended solids from storm water, along with conventional silt fences or excelsior logs.

Obtain the appropriate permits and permissions as follows:

- All projects disturbing the surface and creating the potential for erosion shall have an Erosion Control Plan. For construction projects, this is described in standard specification 01014.
- For all projects with 1 acre or more of land disturbance, the construction contractor must complete a SWPPP for submittal to Argonne. Argonne will review and submit to the Illinois Environmental Protection Agency (IEPA) to obtain the NPDES stormwater permit for the project.
- The Permit Program for U.S. Army Corps of Engineers construction in or near jurisdictional wetlands requires that, in general, construction activities must maintain a 30-foot vegetated buffer between the activities and a wetland. If construction takes place within the delineated boundary of a wetland, Corps permitting is required. Recent Corps and U.S. Environmental Protection Agency (EPA) definitions of *adjacency* with regard to wetlands result in most Argonne wetlands being jurisdictional and therefore subject to Corps permitting. A trained ecologist must delineate the wetland before construction, to determine the buffer.

- All proposed laboratory and sanitary wastewater sewer systems connecting to Argonne's wastewater treatment plants must submit the appropriate permit application forms to the IEPA and receive IEPA approval for the proposed systems before starting construction. These requirements come from Section 35 of the IAC Part 309, Subpart B. Appropriate IEPA forms to submit to IEPA include, but are not limited to, the following:
  - WPC-PS-1, *Application for Permit or Construction Approval*
  - Schedule A/B, *Private Sewer Connection or Sewer Extension*
  - Schedule P, *Erosion Control*

Coordinate these submittals with the Argonne water pollution SME.

All new construction designs, regardless of square footage, must consider and implement, if feasible, onsite management of storm water by green infrastructure and low-impact development. For projects that must submit an SWPPP to the IEPA, the document must discuss post-construction green infrastructure.

Keep all waste containers, oil containers, and cylinders under shelter if stored outside. Label all containers. Ensure that containers used to collect used oil or waste materials remain closed except when adding material to them.

Secondary containment must be provided for any containers used to store oil in quantities of 55 gallons (gal) or greater.

Do not dispose of wastewater generated during projects inside buildings through identified building storm drains.

2.11.2 Air

General Permitting:

- All projects involving a physical or operation modification at a permitted air emission unit must be evaluated against the permit requirements. See CAAPP Permit #95090195 for a list of these units.
- All projects involving the creation of a new air emission source must be properly permitted prior to construction. Examples include programmatic projects beyond bench-scale, radionuclide emitting units, large-scale demolition, combustion units, and boilers. Emissions may consist of Criteria Pollutants or Hazardous Air Pollutants.

Emergency Generators:

- New emergency generators must meet EPA New Source Performance Standards (NSPS) requirements, in most cases meaning Tier 3 emission standards.
- Emergency generators should be below 1,118 kW max output when feasible. Larger generators require additional permitting.

Radionuclide Emissions:

- All projects involving radionuclide emissions to the air must be properly permitted prior to construction and/or demolition. This includes, but is not limited to, research, demolition, accelerator facilities, and waste handling.

Refrigerants and Refrigerant-containing Appliances:

- See the Refrigerant Management Program Description Document for detailed requirements.
- New appliance must meet EPA Significant New Alternatives Policy (SNAP) requirements in 40 CFR 82 Subpart G.
- Existing appliance maintenance and demolition must meet the work-practice requirements in 40 CFR 82 Subpart F.

Aboveground and Underground Storage Tanks

Aboveground Storage Tanks (ASTs):

- Formal application is required to the Office of the Illinois State Fire Marshal (OSFM) prior to installation of a new AST.
- New ASTs must meet applicable Underwriter Laboratories (UL) listing requirements.

Underground Storage Tanks (USTs):

- Any work planned on USTs or equipment relating to USTs must be evaluated prior to that work taking place. The Illinois OSFM has strict requirements that, in most cases, require only state-certified technicians working on USTs and UST related equipment.
- Formal application is required to the Illinois OSFM prior to any demolition activity.

2.12 Signage

Argonne's IS Project Management Organization (IS-PMO) department must review and approve plans for any non-regulatory (that is, building and guidance) sign. Engineering must approve plans for MUTCD standard road signage.

Foundations for non-roadway signs and other structures should be designed and built to allow lawn-mowing equipment space to maintain the lawn along the edge of the structure's base. This can be accomplished using expanded concrete pads, etc. The earth/grass shall be flush with the pad and slope away from the structure.

Handicap parking space identification signs shall include the International Symbol of Accessibility. Signs identifying van parking spaces shall contain the designation "van accessible." Signs shall be installed per ABA guidelines.

Where steel surfaces or structures are exposed to salt-laden environments, provide additional protection for the exposed surfaces. The identified surfaces shall be coated a minimum of 18 in. above the road or walking surfaces. The components identified shall be applied with a second coating over the original standard coating with an epoxy-based protective system to extend the material life in high-stress areas such as structures along roads, parking lots, docks, walkways, and building entrances where salt applications frequently occur. The target systems are guardrails, handrails, structural steel columns, bases of buildings, and other structures.

3 Architectural

3.1 Codes and Standards

- 29 CFR 1910, *General Industry Standards*
- ABA *Accessibility Standards*
- *International Energy Conservation Code (IECC),*IAC, Title 35, *Environmental Protection*
- IBC
- American National Standards Institute (ANSI)/American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE)/IES Standard 90.1-2013, *Energy Standard for Buildings Except Low-Rise Residential Buildings*
- The National Roofing Contractors Association (NRCA) Roofing Manual: *Architectural Metal Flashing, Condensation Control and Re-Roofing, 2010*
- The NRCA Roofing Manual: *Membrane Roofing Systems, 2011*
- 36 CFR 67, *Secretary of the Interior's Standards for Rehabilitation*
- DOE G 413.3-6B, *High Performance Sustainable Buildings*

3.2 Design Criteria

Occupational Safety and Health Administration (OSHA) standard 1910-Subpart D and its subsections govern the design, construction, and use of both interior and exterior walking and working areas used to access equipment, machinery, tanks, elevated platforms, other floors, or pits. The IBC regulates any walking and working surfaces used by the public that connects a building to a public space.

New construction and renovation for office space should follow the DOE revised Office Space Standard, effective 12/27/2016 and subsequent updates. This standard establishes an average of 180 square feet (sf) of usable area per person for offices and administrative workstations. Usable space calculations should follow DOE methodology for measuring office space. Whereas the General Services Administration (GSA) guidelines state the appropriate average for space use is 200 usable sf per person, and DOE standard is agreed to by the GSA, Argonne prescribes designing for an average between 180 to 200 sf of usable office area per person.

Design for full life-cycle cost analysis and effectiveness.

3.3 Roofs

New or replaced roof membrane systems must have fall protection anchors installed unless 42-in. parapet walls or guardrails are provided.

Consider the long-term maintenance and inspection of roof anchors and try to eliminate them by designing parapet walls.

Thermal Protection: Use minimum R-30 roof insulation.

Steep Slope Roofing: Design and installation of steep-sloped roofs (pitch exceeding 2:12) must have a 3-year aged solar reflectance index (SRI) of 29 or higher.

Membrane Roofing: Design and install a low-sloped roof with a minimum 3-year aged SRI of 0.55 and a minimum 3-year aged thermal emittance of 0.75 (per the Cool Roof Rating Council program) or with a minimum 3-year aged SRI of 64 (per American Society for Testing and Materials ASTM E 1980-11).

Ballasted roof systems are not allowed. Ballasted roof systems may be reused only when making small changes to existing ballasted roof systems.

All new roofing systems should be fully adhered or mechanically fastened systems.

3.4 Doors and Windows

All exterior doors (including overhead doors) located at ground level in a building shall be numbered on the exterior and interior, according to Argonne Fire Protection Standards.

All new overhead doors must have enclosed sprocket wheels and chains when placed on the exterior side of the door.

At least one entry door to laboratory and office buildings shall contain automatic door activation push-button controls to automatically activate the door for handicap accessibility. The automatic door must be located on an accessible pathway.

Door hardware must meet the specifications of Argonne's *Door Hardware Specification*, Section 08 70 00, current version.

The IECC requires replacement windows to comply with the requirements set for new construction. The requirements apply whether replacing a full window or just the sash and glazing.

3.5 Finishes and Specialties

Room signage should follow the Argonne Interior Signage Guide.

Use paint that contains low or no volatile organic compounds (VOCs). See Section 11.4.2, Site and Utility (Non-Building) Projects.

All exterior doors (including overhead doors) located at ground level in a building shall be numbered on the exterior and interior according to Argonne Fire Protection Standards.

Interior walkway markings, when required, shall be demarked with parallel yellow lines outlining the walking path with optional solid green paint in between the yellow stripes.

Working space required for electrical equipment shall be demarked with yellow lines outlining the area (unless approved otherwise by Argonne). Coordinate location with Argonne Electrical Engineer.

Follow these suggested guidelines for room identification:

- Measure the building lengthwise and divide it into 4- or 5-foot sections, called modules. The modules govern the actual number of the rooms. The room number derives even, odd from the first full module contained within its wall (for example, 101 and 103). The opposite side of the corridor is 102, 104, and so on.
- Whenever a building has multiple corridors, letter the corridors clockwise: A, B, C, and so on. The letters then help to identify the location of the room (for example, A101). A room within a room usually takes on a letter suffix for identification (for example, A101A).
- Each basement and floor level within a facility has an alphanumeric name. For example, A001 indicates the room is located in the basement within module A, B101 indicates the room is located on the first floor within module B, C201 indicates the room is located on the second floor within module C, and so on.

Room numbering must be approved by Argonne PMO Space Management prior to assignment.

Although technically a refuge area, it is acceptable to use the commonly understood terminology of shelter or tornado shelter for interior signage.

Design criteria for exits, exit systems, and related exit equipment follows ESH-19.1, Design Criteria for Facilities—Exit Systems and Life Safety.

Fire strobes and emergency lights must be white in color.

Follow these guidelines for toilet, bath, and laundry accessories:

- Restroom fixtures should be hands-free.
- Towel dispensers should contain roll towels.
- Trashcans recessed in the wall are discouraged.
- Sanitary napkin dispensers are required in women's restrooms.
- Final approval of accessory selection must be made by Argonne.

3.6 Special Construction and Equipment

Guardrail and stair rail systems for fall protection must comply with 29 CFR 1910.29, OSHA Laws and Regulations.

Fixed ladders must comply with 29 CFR 1910.23. Ladders must be inspected according to LMS-PROC-14, *Fixed Ladders*.

For occupied buildings, provide a tornado refuge area (not a storm shelter or a safe room). Size the tornado refuge according to the Federal Emergency Management Agency (FEMA) Safe Room Assessment and Design Tools in FEMA P-361, *Safe Rooms for Tornadoes and Hurricanes,* Appendix B. Design and designate the area according to FEMA P-431, *Tornado Protection, Selecting Refuge Areas in Buildings.* Refuge areas must be interior locations, ideally with short-span roof systems, reinforced masonry walls, and no glass openings.

Elevator control shall be specified as non-proprietary.

4 Structural

4.1 Codes and Standards

- ACI 318, *Building Code Requirements for Reinforced Concrete*
- ACI 530, *Building Code Requirements for Masonry Structures*
- AISC 360, *Specifications for Structural Steel Buildings* (including "Commentary")
- ASCE 7, *Minimum Design Loads for Buildings and Other Structures*

4.2 Design Criteria

Floor live loads are as follows:

- Office Space: 100 per square foot (psf)
- Laboratories: 125 psf minimum
- Mechanical, electrical, and plumbing spaces larger than 250 sf: 150 psf minimum

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Frame drift limitations:

- Story drift
  - Wind loading: H/500 or ½ in.
  - Seismic loading: H/300 or ½ in.
- Total building drift
  - Wind loading: H/400
  - Seismic loading: H/250

Note that, when used for occupied buildings or buildings containing sensitive equipment, pre-engineered metal building (PEMB) systems are not exempt from the requirements in this section and cannot use lower requirements found in the Metal Builder Manufacturers Association (MBMA) manual.

Vibration criteria:

- Evaluate vibration per AISC Design Guide 11.
- Develop requirements for low-vibration laboratories in consultation with a vibration consultant.
- Laboratories must meet a minimum of Vibration Category A (VCA) of a 150-pound. individual at 75 paces per minute for all new lab space unless the project requires more rigid criteria.

4.3 General Requirements

Structural configuration adaptability: All framing systems must have a reasonable level of adaptability incorporated in the design to account for future use of the structure.

Prefer one-way systems for cast-in-place concrete slabs in laboratory floors over two-way systems. If a two-way system is used, it must be designed to allow for penetrations by future utilities in useful locations that are clearly documented in the structural drawings.

Temporary and permanent supports for machinery and equipment must be designed for a lateral notional load of 15% of the weight of the machinery or equipment applied in any direction. Placement of the notional load is to be at the load center of gravity or at a worst-case location (whichever governs) where the notional load direction adds to the destabilizing effect.

4.4 Miscellaneous Metals

Specifically identify miscellaneous metals not specified as part of the building structure (such as ladders, ornamental metals, roof anchors, railings, and so on).

Ladders must meet all OSHA and ANSI standards.

Exterior miscellaneous metals that are ferrous must be hot-dipped galvanized or coated with an epoxy-based paint system with compatible primer.

5 Plumbing

5.1 Codes and Standards

- ANSI Z358.1, *Standard for Emergency Eyewash and Shower Equipment*
- ASHRAE 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*

5.2 Design Criteria

Maximum flowrates for plumbing fixtures:

- Water closet gallons per flush (GPF): 1.6
- Urinal GPF: 1.0
- Lavatory flowrate, in gallons per minute (GPM): 0.5
- Sink flowrate, in GPM: 1.6
- Shower flowrate, in GPM: 2.5

Fixtures in existing building replacement or renovations shall use the maximum flowrates listed above. Use of low-flow fixtures in existing buildings is to be checked for compatibility with existing infrastructure

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Use of waterless urinals is prohibited.

5.3 General Requirements

Provide backflow preventers (double detector check valves for fire protection systems) where a laboratory water system splits from the domestic water system.

New drinking fountains shall contain a water bottle filling station.

If both a shower and eyewash are required, use only a combination shower/eyewash unit, so that the same person can use the components simultaneously. If engineering limitations exist, request variance for alternatives (LMS-PROC-139, *Emergency Eyewashes and Safety Showers*).

- *Prudent Practices in the Laboratory-Handling and Disposal of Chemicals*, National Research Council, National Academy Press, Washington, D.C. Available from ESQ Industrial Hygiene group.
- CDC/NIH, 5th edition, *Biosafety in Microbiological and Biomedical Laboratories*.

All new or repaired water supply systems shall be tested at one and a half times their working pressure using a hydrostatic pressure test. The supply system shall hold this pressure for a minimum of 2 hours.

All sections of new or repaired waste and vent piping shall be capped, plugged, and tested with not less than 10-foot head of water. This test shall remain in place for not less than 2 hours.

Mechanical press connections and soldering are acceptable joining methods for copper piping.

Power sump pumps, sewage ejector pumps, and associated controls should be powered from an emergency power panel. If the installed systems are duplex, only one pump must be powered from an emergency power panel.

Faucets must have replaceable cartridges instead of needing to replace a diaphragm annually.

Flagg pipe is found in older buildings on some domestic potable water systems (it has the same appearance as copper pipe, but has a similar outer diameter to steel pipe). When connecting to existing flagg piping, make connections using a lead-free flagg adapter and transition to copper pipe.

All back flows, main drains, fire protection test stands, and floor drains must drain to the laboratory sewer system. If it is not practical to access the laboratory sewer system, get Argonne approval to use the sanitary system. Never use the storm drain system for these purposes.

Laboratory drain piping shall be acid-resistant polypropylene (Enfield or Orion) unless connected to non-acid resistant piping downstream. Non-pressurized systems shall be mechanical joint. Pressurized systems shall be electrical-fused joint.

Label all piping per Argonne standards:

Pipe Service	Lettering Color	Background Color
Condensate Drain	Black	Yellow
Domestic Cold Water	White	Green
Domestic Hot Water	Black	Yellow
Domestic Hot Water Circulating	Black	Yellow
Sanitary Sewer	Black	Yellow
Vent	Black	Yellow
Storm Sewer (Primary and Secondary)	White	Green
Secondary Waste	Black	Yellow
Tempered Water	Black	Yellow
Tempered Water Return	Black	Yellow

6 Fire Protection

6.1 Codes and Standards

In addition to the codes and standards listed in Section 1.2, the Argonne Fire Protection Program Description lists the applicable DOE technical standards, building codes, NFPA codes and standards, and other industry codes and standards. The following is an abbreviated list:

- DOE O 420.1C, *Facility Safety*
- DOE-STD-1066, *Fire Protection*
- NFPA 1, *Fire Code*
- NFPA 2, *Hydrogen Technologies Code*
- NFPA 10, *Standard for Portable Fire Extinguishers*
- NFPA 13, *Installation of Sprinkler Systems*
- NFPA 24, *Private Fire Service Mains*
- NFPA 30, *Flammable and Combustible Liquids Code*
- NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*
- NFPA 55, *Compressed Gases and Cryogenic Fluids Code*
- NFPA 72, *National Fire Alarm and Signaling Code*
- NFPA 80A, *Recommended Practice for Protection of Buildings from Exterior Fire Exposures*
- NFPA 101, *Life Safety Code*
- NFPA 400, *Hazardous Materials Code*
- NFPA 780, *Standard for the Installation of Lightning Protection Systems*
- NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials*
- NFPA 1144, *Standard for Reducing Structural Ignition Hazards from Wildland Fire*

Other NFPA codes and standards are to be used, as applicable, based on the operation and design of new facilities or structures, or the extent of modifications. Applicable codes and standards must be identified in the preliminary design or scoping stage. Where conflicts exist between NFPA codes and standards and the IBC, the more conservative requirement applies.

6.2 New Facilities and Modifications

A Fire Hazards Analysis (FHA) is required for new facilities where the value is greater than $177 million, represents a unique fire safety risk, is a modification to a facility that increases the value above $177 million, or introduces a unique fire safety risk. Unique fire safety risks include, but are not limited to:

Facilities that will exceed the maximum allowable quantities (MAQs) of hazardous materials listed in the IBC, NFPA 30, NFPA 55, or NFPA 400.

Facilities that are within the scope of NFPA 45, NFPA 654, NFPA 801, or another applicable NFPA code or standard that requires a hazard or risk assessment.

FHAs are required to be initiated at the preliminary design or scoping stage. FHAs must be completed by or under the direction of a qualified fire protection engineer (FPE).

The occupancy of new facilities at Argonne can generally be classified as below:

Description	IBC	NFPA 101
Primarily office space with ancillary lab and mechanical space	Business Group B	Business
Data centers	Business Group B	Business
Primarily low or ordinary hazard laboratory space with adjacent offices and mechanical space	Business Group B	Industrial
High hazard laboratory space with adjacent offices and mechanical space	High Hazard Group H (H-1, H-2, H-3, H-4, or H-5)	High-Hazard Industrial
Support buildings primarily mechanical spaces	Factory F-2	Industrial or Special-purpose Industrial
Warehouses low and ordinary hazard contents	Storage	Storage

New facilities exceeding 5,000 sf of floor area must be of Type I or Type II construction as defined in the IBC.

All Argonne facilities (new and modified) are required to be protected by an automatic suppression system and fire alarm system unless otherwise approved by an Argonne FPE.

All spaces utilized as laboratories shall be protected by a fire detection system unless otherwise approved by an Argonne FPE.

Fire areas must be established that limit an MFPL to less than $412 million. Fire walls or other separation approaches may be used to meet this requirement. Other separation approaches must be approved by an Argonne FPE.

New facilities shall be designed to achieve a hazard rating of Slight per the NFPA 1144, Section A.4.1.2, Example Structural Rating Form. Moderate hazard ratings shall be approved by an Argonne FPE. Significant and Severe hazard ratings are not permitted.

For new facilities, additions to existing facilities, and roof replacements:

- Roof coverings shall be Class A as defined in ASTM E 108-11, *Standard Test Methods for Fire Tests of Roof Coverings*, or UL-790, *Standard for Standard Test Methods for Fire Tests of Roof Coverings*.

- Metal deck roof systems shall meet the requirements of Class I construction as defined in FM Global Loss Prevention Data Sheets 1-28R, *Roof Systems*, and 1-31, *Metal Roof Systems*.

When high-value property (single pieces or clusters of equipment with a replacement value greater than $5.9M) or mission-critical equipment is subject to flooding discharge of automatic sprinkler system and/or use of manual hose streams, protection against water damage shall be provided.

6.3 Fire Water Supplies

New water mains shall be designed and installed in accordance with NFPA 24, *Installation of Private Fire Service Mains and Their Appurtenances.* New water mains shall be made of HDPE, meeting standard AWWA C906, *Polyethylene Pressure Pipe and Fittings, 4 in. through 63 in. (100 mm through 1,650 mm), for Waterworks,* ductile iron pipe size with a minimum dimension ratio of 13.5.

Lead-ins shall be hydraulically designed as part of the sprinkler system design and shall be at least the size of the riser but not less than 4 in. Lead-ins shall be provided with a post-indicating valve between the street main and the building.

Hydrants must be more than 40 ft. from the building. All exterior ground floor building surfaces shall not be more than 300 ft. to a hydrant. Fire hydrants must be manufactured by Waterous, Clow, or Mueller. Alternatives must be approved by an Argonne FPE and the Argonne Fire Department.

6.4 Fire Suppression Systems

All Argonne facilities (new and modified) are required to be protected by an automatic suppression system and fire alarm system unless otherwise approved by an Argonne FPE.

Automatic Sprinkler systems shall be designed in accordance with NFPA 13, *Installation of Sprinkler Systems*. The following minimum design choices are required for sprinkler systems:

- A minimum occupancy classification of Ordinary Hazard Group 1 must be used.
- New sprinkler systems must be designed with a required supply pressure at least 10% but not less than 10 pound per square inch (psi) below the water supply curve.
- Piping 2 in. and below shall be Schedule 40 screwed or flanged. Where screwed or flanged components are not available, alternatives must be approved by an Argonne FPE.
- Mechanical grooved fittings must only be used with roll grooved pipe. Cut grooved pipe is not allowed.

- Control valves must be rising stem Outside Screw and Yorke type. Butterfly valves are not allowed.
- Fire Department connections must be 5-in. Storz type.
- Tamper switches on control valves are not permitted. Argonne utilizes a chain and lock to control valves.
- Piping shall be painted red, unless otherwise approved by an Argonne FPE.

Non-sprinkler fire suppression systems shall be designed and installed in accordance with the applicable NFPA code or standard. Alternatives codes or standards must be approved by an Argonne FPE prior to use and shall be approved during or before the first design review.

6.5 Fire Detection and Alarm Systems

A means to notify responders and building occupants in case of a fire shall be installed/ available in new facilities.

All spaces utilized as laboratories shall be protected by a fire detection system unless otherwise approved by an Argonne FPE.

Fire detection and alarm systems shall be provided in facilities that meet the following conditions:

- A fire alarm system is required by the IBC or an applicable NFPA code or standard,
- The facility has a fire suppression system, or
- A fire alarm system is required by an FHA, Process Hazard Analysis, or other hazard analysis.

Fire Detection and Alarm Systems shall be designed and installed in accordance with NFPA 72, *National Fire Alarm and Signaling Code.* To ensure compatibility, Fire Protection shall be informed of and approve of the proposed type of fire alarm control panel during the project design phase.

New fire alarm systems shall be Honeywell Notifier Onyxworks, Honeywell XLS Series, or Siemens FireFinder-XLS for new buildings or major construction to an existing building. Alternatives shall be capable of communicating with the Argonne existing front end and shall be approved by an Argonne FPE or the Argonne Fire Systems Engineer.

When the existing fire alarm control panel does not support the type of renovation being performed in a building, the fire alarm control panel installed for the renovation shall be of enough capacity to handle the entire building.

Fire Alarm system battery sizing calculations must be submitted with the shop drawings and prior to installation of equipment. Fire alarm systems connected to an emergency circuit supported by a generator require 24 hours of standby battery backup plus 5 minutes in alarm (15 minutes voice/evacuation). All other fire alarm systems require 60 hours of standby battery backup plus 5 minutes in alarm (15 minutes voice/evacuation).

6.5.1 New Fire Alarm Systems

All fire alarm systems must be monitored by the Argonne Fire Department Alarm Office.

All fire alarm systems shall be supervised, and all trouble signals will also report to Argonne Fire Department Alarm Office.

All fire alarm control panels shall be able to interface with the existing alarm office monitoring front end equipment, or a Dorado Transceiver and Receiver must be provided.

A Keltron radio alarm communicator transmitter shall be installed on all fire alarm systems for reporting to Argonne Fire Department Alarm Office.

All fire alarm panels shall have supervised programmable individual switches or auxiliary manual controls for bypassing audio/video (AV) circuits, elevator controlling equipment, air handling unit (AHU) shutdown, door control features, fire shutter doors, smoke control, beam detectors, and emergency power off equipment to override automatic alarm functions selectively. All switches must be returned to the normal automatic position to clear system trouble.

The annunciator panel shall duplicate all functions of the fire control panel.

All fire alarm panels including the main fire control panel, annunciator panels, and subpanels should all be on a dedicated emergency circuit.

All fire alarm control panels shall have the breaker location marked on the inside of the panel door and the circuit breaker number marked on the outside of the door.

All wiring shall be run in at least 3/4-in. conduit. Metal raceway (wire mold type) may be used in exposed locations. All pull and junction boxes will specifically be painted red.

All wiring shall be color coded. All the circuits in the system shall be wired with American Wire Gauge (AWG) 14, minimum, stranded copper, thermoplastic high-heat-resistant, nylon-coated (THHN)/thermoplastic heat- and water-resistant, nylon-coated (THWN) conductor, installed in metallic conduits unless otherwise noted. Color coded wires shall be in accordance with the following scheme, which shall be maintained throughout the system, without color change in any wire run:

- Data Loop Circuit — #14 twisted pair, 14/2 Red/Yel THHN (vendor: E2 GRAYBAR; Part #14AWG THHN YEL RED TWISTED)
- 24VDC Device Power #14 Red/Black THHN
- Strobe Circuit #12 THHN
- Speaker Circuit #16 twisted pair, THHN

For device identification, install address plates on all addressable components, indicating the address of the device. Labels are to be of a permanent type, 24-point height; black letter on white tape is preferred. Hand lettering is specifically not acceptable.

All notification appliance circuits shall be synchronized. If the existing system is not synchronized, the system shall be synchronized unless approved by an Argonne FPE.

Duct detectors shall be programmed as supervisory points and generate a supervisory signal at both the building fire control panel and at the Argonne Fire Department Alarm Office. The duct detector shall only shut down the associated air handling unit in the area where the fire is detected; other building air handling equipment shall remain online.

When remote indicators or test switches are used for duct smoke detectors, the switch or indicator shall be mounted in a remote location that is accessible and visible near the detector. Remote indicators or test switches must be mounted between 6 feet and 4 feet above the floor.

Spare parts shall be provided in the amount recommended by the system manufacturer, and no fewer than two of each type of device installed shall be provided. Spare parts shall be turned over to the Fire Protection Group.

6.5.2 Existing Fire Alarm Systems

On retrofit projects that involve adding to existing wiring, the Constructor shall exactly match the type, size, and color of the new wiring with the existing.

Contractors will be responsible for making all terminations except where the new work ties into the existing fire alarm system.

At those agreed upon tie-in points, the contractor shall leave a loop of at least 2 feet of wire either in the tie-in box or hanging outside of it.

Tie-in points must be easy to access (6-foot ladder maximum), and at an existing junction box.
All signaling line circuit devices must be assigned their unique address and all evacuation appliances must be labeled with their existing or new bell/strobe circuit number. (Sample B-2).
All notification appliances shall be mounted at the same height requirement as notification appliance devices in a clearly visible location.
All existing Fire Alarm Systems to be replaced with a new system in an occupied building shall continue to be operational until the new Fire Alarm system is up and running, otherwise, 24-hour Fire Watch shall be provided by the Contractor.

6.6 Fire and Smoke Protection Features

Fire Barriers shall be provided in accordance with the IBC and applicable NFPA codes and standards. Confinement barriers required by a process analysis shall be based on the anticipated maximum fire exposure and duration, and have a minimum rating of 2 hours, or shall be approved by an Argonne FPE.
Fire barriers shall be documented on a layout drawing(s). A schedule of opening protective devices (fire doors, fire dampers, and so on) shall be provided and shall show, at a minimum, size, rating, fusible link rating (if applicable), and if the device interfaces with a fire detection and alarm system.
Installation of fire barrier firestop systems in new facilities shall be performed by qualified installers and visually inspected by a qualified inspector or Argonne FPE. Firestop systems shall be UL listed or Factory Mutual (FM) approved for their application. Where a listed firestop system does not exist, an equivalent system shall be approved by an Argonne FPE based on a listed system.

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7 Heating, Ventilation, and Air Conditioning and Refrigeration

7.1 Codes and Standards

- 40 CFR Part 82 Subpart F, *Recycling and Emissions Reduction*
- 40 CFR Part 82 Subpart G, *Significant New Alternative Policy*
- ASHRAE 15, *Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants*
- ASHRAE 55, *Thermal Environmental Conditions for Human Occupancy*
- ASHRAE 62, *Standards for Ventilation and Indoor Air Quality*
- ASHRAE 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*
- ASME B31.1, *Power Piping Design*
- ASME B31.3, *Process Piping Design*
- ASME B31.9, *Building Services Piping*
- ASME Boiler and Pressure Vessel Code Section IX
- ANSI Z9.5 *Laboratory Ventilation Systems Standards*
- LMS-PROC-210, *Ventilation for Hazard Control*
- Sheet Metal and Air Conditioning Contractors' National Association, *Duct Construction Standards*

7.2 Design Criteria

Indoor design temperature (unless otherwise specified for programmatic requirements)

- Occupied:
  - Cooling: 74°F dry bulb (DB), relative humidity <60%
  - Heating: 72°F DB
  - Humidification not provided for comfort conditions
- Unoccupied:
  - Maximum: 80°F DB
  - Minimum: 60°F DB

Outdoor design temperature (for laboratory and critical spaces)

- Cooling: 95°F DB, 78°F wet bulb (WB)
- Heating: -15°F DB

Outdoor design temperature (for all other areas)

- Cooling: 95°F DB, 75°F WB
- Heating: -10°F DB

Site utility information

- Chilled water
  - Supply temperature: 44°F
  - Return temperature: 56°F

Steam and condensate

- Steam supply: 190 psig saturated steam at building entrance. Steam temperature is approximately 380°F.
- Steam condensate return: 40 psig and below. Condensate temperature is approximately 150°F.

Natural Gas

- The site natural gas distribution operates between 12 to 15 psig.

7.3 Heating, Ventilation, and Air Conditioning (HVAC)

Changes or extensions to an existing system need a thorough analysis to understand the effect on the original system, and to determine the capacity available for expansion.

When designing for heating or cooling:

- **Heating**: Designs generally must use the site's central steam system. In buildings too distant from the steam supply, or unsuitable for connection to the system, use electric heat.
- **Cooling**: Designs generally must use the site's central chilled water system. In buildings too distant from the chilled water supply, or unsuitable for connection to the system, use condensing units or separate chiller systems.

Obtain approval from Argonne before designing any auxiliary systems.

Phase out existing use of ozone-depleting materials and specify in new projects the use of substitutes for ozone-depleting substances. Information on SNAP alternatives by sector is available on the EPA website.

Humidification is not provided to make buildings comfortable. Provide humidifiers to meet laboratory requirements.

Compressed air is generally available as a building-specific utility at 90 psig.

Do not locate equipment on a roof. You must obtain approval from Argonne before designing roof-mounted equipment.
Equipment cooling with domestic water is prohibited.
Process cooling directly from site chilled water is prohibited. Isolate process cooling from site chilled water via a heat exchanger.
Filtration for central system air handling units shall meet minimum efficiency rating value (MERV) 13 ratings.
Insulate all cold or hot ductwork and equipment for energy efficiency and to prevent surface condensation.
Provide manufacturer's recommended minimum clearance around all mechanical equipment, piping, valves, fittings, and accessory items. Provide minimum clearance to access, maintain, and remove or replace equipment if no recommendation exists.
For exhaust fans located interior to the facility, condensate removal for the exhaust stacks shall be integrated into the design.
Incorporate energy conservation into system designs, such as variable air volume (VAV) distribution systems and variable frequency drives (VFDs) for fans and pumps.
Commission all systems before turning them over to Argonne.

7.4 HVAC Piping

The following rules apply to HVAC piping:

- Insulate all cold or hot piping for energy efficiency and to reduce condensation.
- Install cooling and heating control valves with manual bypasses.
- Incorporate provisions for disassembly into the piping design.
- Label all piping per Argonne standards:

Pipe Service	Lettering Color	Background Color
Steam supply*	Black	Yellow
Steam condensate return	Black	Yellow
Heating water supply/return	Black	Yellow
Chilled water supply/return	White	Green
Heat recovery supply/return	White	Green
Process cooling water supply/return	White	Green
Pure water supply/return	White	Blue
Condensate drain	Black	Yellow
Compressed air*	Black	Yellow
Refrigerant relief vent	Black	Yellow
Lab cold water	Black	Yellow
Lab hot water	Black	Yellow
Lab hot water circulating	Black	Yellow
Lab sewer	Black	Yellow
Lab vent	Black	Yellow
Laboratory gases	White	Black

* Labels must identify pressure of fluid.

Do not use grooved-pipe coupling systems in inaccessible areas such as pipe chases.

Press fit (interference fit) pipe connections are allowable for all systems other than steam, toxic, and flammable systems.

All new or repaired water supply system shall be tested at one and a half times its working pressure. This test shall be performed using hydrostatic pressure. The supply system shall hold this pressure for a minimum of 2 hours.

Indoor steel pipe shall be A53 Grade B, type S or E.

7.5 Laboratory Exhaust Systems

Conceptual design to include the following based on programming information:

- Proposed laboratory ventilation rates for laboratory spaces for Argonne Industrial Hygiene risk hazard analysis.
- Evaluate the use of VAV systems for all projects to determine applicability.
- Exhaust system materials – Verify suitability for the chemicals and materials planned to be used.
- Fume hood type – Specify VAV, constant air volume (CAV), CAV with restricted bypass, and so forth.
- Laboratory ventilation control devices – verify compatibility with existing systems.

Negatively pressurize laboratories to surrounding areas unless directed otherwise by Argonne (with approval from Industrial Hygiene). Design air movement to flow from clean areas to less clean areas.

Follow LMS-PROC-210, *Ventilation for Hazard Control,* for ventilating fume hoods, gas cylinder storage cabinets, gloveboxes, and biosafety cabinets, and other hazard control devices.

Radiological systems shall be reviewed by the ALARA group.

Provide redundancy on laboratory exhaust systems where loss of exhaust may release contaminants resulting in unsafe exposure to personnel or significant loss of scientific operation. Redundancy on makeup air may be required if ability to egress any area is impacted by a loss of supply air.

Power serving redundant exhaust fans shall be split between emergency and normal power such that the loss of any one electrical service shall not impact the pressurization and safety of the laboratory conditions.

All laboratory chemical hoods must have an airflow monitor and alarm system capable of detecting when face velocity drops 15 feet per minute below set flow rate, and capable of warning operators about the malfunction.

An in-field ASHRAE 110 test is required for low flow hoods.

Provide airflow matrix with minimum and maximum flow rates for terminal points or air valves inside the lab space.

7.6 Utilities Systems: Central Steam and Natural Gas

Welding on fired pressure vessels requires National Board of Boiler and Pressure Vessel Inspectors R Certificate of Authorization.
Welding on piping, fired, and unfired pressure vessels requires welder certification to ASME Boiler and Pressure Vessel Code Section IX.
All Boiler House and site distribution piping (steam, condensate, and natural gas) shall follow ASME B31.1.
Boiler House and site steam piping is designed to Class 300.
Boiler House and site condensate piping is designed to Class 150 and Class 125, depending on the location.
Natural gas system is designed to Class 300 and Class 150, depending on the location.
All utilities steam and condensate existing piping material is A53 seamless pipe. New piping shall either be A53 Grade B or A106 Grade B.
Site natural gas distribution piping is ASTM D2513 (medium-density, yellow polyethylene piping). All new installation, or repairs shall be the same. All fittings shall be compatible with the ASTM D2513 pipe and be fusion welded.
Existing steam piping 2-1/2 in. and larger is schedule 40, 2 in. and smaller is schedule 80.
All condensate piping sizes shall be schedule 80.
All site distribution steam and condensate piping shall be welded construction unless otherwise specified.
All gaskets shall be metal spiral wound instead of fibrous type gaskets.
For welded construction, all components; valves, pipe, fittings, and so on that are 2-in. diameter and smaller can be socket-weld. All diameters larger than 2 in. shall be butt-welded.
All butt-welds shall have the root pass welded by Gas Tungsten Arc Weld or Gas Metal Arc Weld method. Subsequent weld passes can use Shielded Metal Arc Weld method.
All fittings shall be forged.
Valves shall have forged bodies. Exceptions are in larger diameters where forgings are not readily available. Where cast bodies are required, bodies shall be made of cast steel.
Cast iron valves shall not be used.

8 Electrical

8.1 Codes and Standards

- NESC, *National Electrical Safety Code ANSI/Institute of Electrical and Electronics Engineers (IEEE) C2*
- ASHRAE 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*
- Insulated Cable Engineers Association
- International Electrical Testing Association (NETA)
- NFPA 70, *NEC*
- NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*
- NFPA 70E, *Standard for Electrical Safety in the Workplace*
- NFPA 72, *National Fire Alarm and Signaling Code*
- NFPA 79, *Electrical Standards for Industrial Machinery*
- NFPA 110, *Standard for Emergency and Standby Power Systems*
- NFPA 780, *Standard for Lightning Protection*
- ESM-19.4, Electrical Safety—Lightning Protection
- ESH-19.3, Design Criteria for Facilities—Emergency Lighting Systems

8.2 Design Criteria

Design electrical systems to use redundancy and serviceability of equipment to avoid unnecessary outages.

Use two separately derived power sources with an acceptable transferring scheme or a main-tie-main configuration for facilities that cannot experience prolonged power outages.

Include the following design calculations with all electrical designs:

- Equipment amperage ratings
- All electrical loads
- Emergency and required standby power
- Short circuit analysis
- Voltage drops

Electrical designs must include the following studies, drawings, and diagrams:

- Provide studies for arc flash and overcurrent device coordination.
- Provide labeling per NFPA 70E.
  - All Arc Flash information shall be described as per code and set to the same unit of measure, either feet or inches, but not a combination of both.
- Provide approved Absence of Voltage Test devices for equipment >12 calories per centimeter squared (cal/cm2), main busses of low voltage switch gear, and motor control centers (MCCs) <600 VAC.
- Determine and supply electrical space planning diagrams.
- Develop and provide usage and consumption rates for systems such as generators, transformers, and critical systems.

For any electrical equipment with an arc flash energy greater than 12 cal/cm², provide a maintenance switch to lower energy to the 12 cal/cm², or remote racking and remote switching device.

Receptacles controlled by lighting controllers or occupancy sensors should be green in color and printed with controlled symbol per the NEC.

Receptacles powered by the Emergency System shall be red in color with light-emitting diode (LED) indication of power.

8.3 Design Requirements

The application and/or installation of shared neutrals within an electrical design is NOT allowed.

All electrical designs and concepts shall develop and incorporate an Arc Flash Circuit Analysis and Coordination Study that meets the following criteria:

- For applications below 1000 VAC provide Electrical Power systems Analysis and Operation software (Electrical Transient Analyzer Program® [ETAP]), most current version including completed final program file and hard copy of analysis.
- 1000 VAC and greater applications use Power Systems Design Software (SKM Systems Analysis, Inc.), most current version.
- The study shall include proper coordination of all the trip devices with settings from source to load.

- The study shall include both AC and DC applications for all disconnects, panel boards, transfer switches, MCC, switchgear, switchboards, uninterruptible power supplies (UPSs), solid state controllers, and electrical equipment that requires service, down to the 208 VAC level, stating the arc flash and shock personal protective equipment (PPE) requirements per current NFPA 70E, IEEE 1584, and OSHA 1910.
- Results of short-circuit analysis listing equipment that is applied above its short-circuit current rating, and appropriate recommendations.
- Results and recommendations of time-current analysis, including time-current curves.
- Arc flash spreadsheet in form of a table. It must include a listing of all equipment that had arc flash hazard levels calculated as part of the study. This listing should include the calculated three-phase bolted fault current, predicted arcing fault current, upstream protection device identity with its opening time, working distances, arc flash boundary, incident energy, and incident energy at arc flash boundary.
- A tabulated form showing the worst-case incident energy calculated for each bus and the associated mode of power system operation. Report must include incident energy calculated for each bus for each mode of operation.
- Documentation of all study input data, including utility available fault currents; cable sizes, types, and lengths; motor data; breaker types and settings; fuse sizes and types; and so on.
- Documentation of the software manufacturer, exact version of software used, and configuration settings used to do the study.
- List of assumptions that were made for cable lengths, transformer impedances, and other equipment.
- Additional information may be included where it enhances understanding of the electrical system and arc flash study.
- Advisory statements covering the impact of changes to the power system, including overcurrent protective devices or system operation and potential impact on arc-flash incident energies.
- The single lines must show cable lengths, electrical device ratings, bolted fault current, and PPE requirements for all buses and components.
- Argonne must receive a copy of the program files that Argonne may update for future changes in accordance with NFPA 70E.

Consult with Facilities Engineering regarding VFDs with disconnect and bypass switches for all critical systems, and wherever deemed appropriate.

Floor-mounted equipment shall be installed on 3 in. concrete bases. Provide a ½ in. chamfer around the pad. Pad shall extend 2 in. beyond the base of the equipment

8.4 Low Voltage Requirements

Low-voltage electrical systems are electrical systems with a voltage rating of 1000 volts and below. The following list provides the requirements for low voltage systems.

Provide panel boards with the following:

- Main circuit breakers or disconnecting means within sight (preferred panel boards are Schneider Electric)
- Voltage test station ports (preferred type: GracePort product r-3mt)
- Permanent lockout-tagout devices for 480 VAC switchboards and panels.

Provide 480-volt switchgear panels with thermal viewing ports.

Provide a ground-monitoring system with alarm contact systems for all delta-connected 480 VAC equipment.

Provide transfer switches with draw-out, containing 100% copper buss with bypass-isolation (preferred type: Russ Electric).

Provide the following for low voltage (<1000 V) cable:

- 100% copper-stranded THHN/THWN-2
- Underground in-duct bank type RHW-2

8.5 Utility Voltage Requirements

Utility voltage electrical systems are electrical systems of 1000 volts and above. This section provides the requirements for utility voltage systems

Overhead 13.2-kV and below distribution must use ComEd systems standards for pole installations.

Main power cables installed in the utility infrastructure must be single conductor, MV-105, 133% ethylene propylene rubber (EPR) insulated, copper, class B concentric stranded, and PVC jacketed.

Use class 1, cold shrink, or hot shrink voltage terminations and splices.

During the original design for underground conduit, or when removing or adding cable to underground duct banks, perform thermal and ampacity calculations to determine the spacing or conductor load capacity.

Use concrete duct banks (colored with red dye) for all underground utility cable installations.

Use rigid galvanized steel conduit for all utility applications. PVC conduit is acceptable in concrete duct banks.

Install tracer wire on all duct banks, along with marker tape identifying the voltage.

Prior to disposal, oil must be drained from transformers, containers, and a sample sent for laboratory analysis to determine the proper route for disposal. Argonne Nuclear and Waste Management (NWM) staff must dispose of oil-filled transformers. Contractor shall confirm oil has been removed prior to disposal.

Argonne recommends that new or retrofitted installations use Schweitzer Engineering Laboratories protection and control relays.

S&C is the preferred manufacturer for overhead and underground distribution equipment.

Connect any utility infrastructure equipment capable of network communication to the Schneider Electric ION supervisory control and data acquisition (SCADA) on campus.

8.6 Generator Requirements

Submit a complete set of instructions (including operating manuals, schematics, and setup instructions) to Argonne IS staff after installing and testing the emergency generator.

Install emergency generator units less than 1118 kW (1500 hp) unless directed otherwise by Argonne. Emergency generators larger than 1118 kW will require new or revised air permitting, and will affect a project's scope, schedule, and budget.

Reference Section 2.11, Environmental, of this document for requirements on air permitting, engine emission standards, and fuel storage (AST/UST) requirements.

Install a generator tap box connection for all critical systems and buildings.

Emergency generators require a minimum fuel storage to permit 24-hour runtime at full capacity.

Install, using walk-in enclosures with OSHA stairs, interior and exterior lighting, convenience outlets, space heating, and a ventilation fan for generator sizes 250 kW and above unless directed otherwise by Argonne.

Provide the following for all generator installations:

- Block heaters
- Battery charger
- Battery monitor
- Fuel polisher
- Load bank connection
- Remote alarm monitoring
- Remote fuel monitoring
- Fuel filling station or port
- Manual fuel bypass valve
- Shut-off valves on all coolant and fuel hoses
- Positive crank ventilation system
- Interstitial alarms
- Water alarms
- High/low alarms

Use a main disconnect or output breaker mounted on the Genset skid for all designs.

8.7 Grounding Requirements

Follow the recommendations of the NEC for grounding system equipment.

Use exothermic welding methods for all underground grounding connections.

Use a grounded resistance not greater than 5 ohms.

Connect main substation ground directly to site ground grid using exothermic connections or other listed approved means.

Connect all building equipment, transformer secondary grounds, and building steel to ground grid using exothermic connections or other listed approved means.

Provide ground test wells for selected grounding rods with adequate clearance and accessibility.

Provide, per NEC Article 250, equipment grounding conductors in all receptacle and lighting conduits, junction boxes, and raceways.

8.8 Indoor Lighting Requirements

New interior lighting shall conform to the IES Lighting Handbook recommendations, Federal Emergency Management Program's (FEMP) minimum requirements for luminous efficacy (lumens/Watt), and/or other guidelines as approved by Argonne engineering.

Photometric studies are required for any lighting reconfiguration and should include layout, modeled light levels in plan, and fixture specifications.

When specifying new fixtures, consider use of fixture integrated sensors/controls. See Section 9, Instrumentation.

Following these lighting technologies:

- Primary technology: LED including tubes, bulbs, or fixtures.
- Others, where approved by Argonne engineering.
- Eliminate whenever possible compact fluorescent (CFL), incandescent, halogen, T12 fluorescent, 8-foot fluorescent tubes with high output ballasts.

Use the following light bulb tube sizes: 2 feet, 3 feet, 4 feet, and U-bend.

Exit signs must use LEDs unless otherwise noted or specified by Argonne.

The recommended light bulb types are A-lamp (40/60/75/100 W equivalent); multifaceted reflector, MR16; 4-pin vertical and horizontal (CFL replacement), bulged reflector, BR30; parabolic aluminized reflector, PAR30 and PAR38.

Request clarification from Argonne regarding an indoor lighting project's desired correlated color temperature.

For rehab projects, replace entire fixture if replacing the ceiling grid. If ceiling grid remains, provide fixture retrofit kit.

8.9 Exterior and Outdoor Lighting Requirements

Design exterior lighting in high-risk conflict areas such as parking lots, intersections, driveway entrances, and crosswalks (areas of conflict) with the following considerations:

- Argonne's standard light level for these areas is an average of 0.4 foot-candle (fc) with a minimum of 0.12 fc and a uniformity ratio (average/minimum) not to exceed 6 fc.
- Lighting must illuminate the pavement surface and not cause excessive spillover into adjacent areas.
- The pole style for street lighting varies depending on installation or location. The IS-PMO must review and approve the style. Maximum pole height is 30 feet.
- Provide walkway lighting in areas such as steps/stairways, transition areas, ramps, and intermittent locations based on use, engineering judgement, and as approved by IS-FAC.

Photometric studies are required for any lighting reconfigurations.

Exterior lighting temperatures must meet the following criteria:

- Primary technology: LED tubes, bulbs, and fixtures.
- Eliminate, wherever possible, CFL, incandescent, halogen, high-pressure sodium, metal halide, low-pressure sodium vapor.
- Follow International Dark-Sky Association guidelines to minimize or eliminate light pollution

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9 Instrumentation

9.1 Codes and Standards

- ANSI/ASHRAE Standard 135, *BACnet®—A Data Communication Protocol for Building Automation and Control Networks*, including all amendments
- ASHRAE 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*

9.2 Building Automation System

BACnet is the preferred building automation system (BAS) communication protocol for control networks. Use of LONWorks, Modbus, or others may be used only when approved by Argonne.

Johnson Control's JCI Metasys® is the preferred BAS. For new buildings, or installations into buildings that do not have a BAS, additional vendors such as Honeywell and Siemens should be listed as acceptable vendors, but pricing for the BAS and its integration with the existing system should be exposed so that Argonne can evaluate which system to use.

Large, packaged equipment (chillers, boilers, rooftop units [RTUs], and so on) must have a data connection integrated to the BAS that includes electrical demand consumption information for sub-metering purposes. Critical control signals (start/stop, speed, reference, alarm, and so on) must be directly hardwired.

VFDs must have BACnet data connection integrated to the BAS that includes electrical demand and consumption information for sub-metering purposes. Critical control signals (start/stop, speed, reference, alarm, and so on) must be directly hardwired.

The BAS must integrate with all comfort heating, cooling, and airside systems, and have full control and monitoring capability. Stand-alone controls must be approved by Argonne Facilities.

BAS power must be from an emergency power panel where equipment controlled by the BAS is also powered from an emergency power panel. Include a local battery backup system or UPS that will support the load for a minimum of 10 minutes and provide power transfer ride-through capabilities.

Provide startup and commissioning of new controls and metering installations.

9.3 Lighting Controls

Lighting projects must meet or exceed the control requirements in ASHRAE 90.1.

Non-proprietary devices and systems are preferred.

Indoor lighting designs should consider the following control strategies: occupancy sensing, daylight harvesting, and bi-level/manual dimming. Individual fixtures in open areas should not turn off independently during normal operation, rather consider grouping strategies or dim to a minimum amount to avoid the "burnt out" appearance.

Exterior lighting designs should consider the following control strategies: photocell from dusk to dawn and occupancy sensing for bi-level dim. Exterior lighting should not turn off throughout the night for safety and security.

New lighting control designs should offer simplified solutions to limit the amount of hardware and wiring required on the installation, while still meeting the control capabilities listed above.

Centralized or networked lighting control systems are not required. If used, connect them to the BAS where allowable.

New lighting designs may consider use of fixture-integrated controllers and sensors to simplify the design, installation, and future reconfiguration of the spaces.

Fixtures on emergency circuits may be controlled per UL924, provided provisions are taken that automatically override any control and temporarily turns fixture on to full brightness upon interruption of normal power.

9.4 Building Systems and Large Equipment Controls

All systems and large equipment must integrate into either an existing data acquisition system or into a large-scale energy management system. If monitored, the monitoring must include electrical demand and consumption information, and any other energy sources (fuel, steam, hot water, chilled water, and so on).

Configure systems, where feasible, so that integrating new systems, performing maintenance, or expanding systems does not require a large-scale building or system shutdown.

Systems and equipment include (but are not limited to):

- Comfort cooling systems and equipment
- Chillers
- Boilers

- Packaged air handling equipment (rooftop units [RTUs], air handling units [AHUs], makeup air units [MUAs], and so on)
- Laboratory exhaust systems
- Packaged hydronic equipment (pump skids, reverse osmosis [RO] systems, de-ionized [DI] systems, and so on)
- Electrical power distribution
- Electrical standby power (generator, transfer switch, UPS, and so on)
- Elevator and other conveying equipment

9.5 Electrical Metering

Connect and integrate electrical meters to the existing electrical SCADA system and, at a minimum, report instantaneous and peak values for each of the following measurements: amperes (A), voltage (V), power demand (kW), and energy consumption (kWh).

Provide power quality metering for building services, data centers, large experiments, and similar applications.

Meter building services using revenue-grade meters.

Meter all 480-volt distribution equipment.

All electronic communicating trip units and circuit breakers must meet the minimum requirements for electrical metering.

Design metering to allow separate measurements of experimental and data center loads. Design metering to allow separate measurements of lighting, HVAC, general power, and other large loads. Readings from multiple meters may be summed to obtain total load measurements.

For data centers, meter information technology (IT) and facility loads separately for power usage effectiveness (PUE) calculations.

Provide monitoring of status and alarms for the building service's main circuit breakers, feeder circuit breakers in main switchgear and key distribution equipment, generators, transfer switches, UPSs, and similar equipment.

All Ethernet communication cabling from the network switch shall be terminated outside of any electrical cabinet and then jumped into the instrumentation cabinet for servicing purposes.

All metering and monitoring terminals must have a suitable barrier from line voltage components, for making low-voltage connections without de-energizing equipment.

9.6 Chilled Water and Heating Water Metering

Connect HVAC water meters to the BAS and measure BTU/hr and BTU.

At a minimum, meter chilled water and hot water services at the building entrance.

Use inline electromagnetic flow meters for typical applications. Use insertion electromagnetic flow meters where inline meters are not cost effective. All other technologies require specific approval.

Measure the chiller's efficiency directly, or report it to the BAS via a BACnet Master-Slave/Token Passing (MS/TP) serial or BACnet internet protocol (IP) data connection from the chiller control panel. Measure the boiler's efficiency directly, or report it to the BAS via a BACnet MS/TP serial or BACnet IP data connection from the boiler control panel.

Measure the heat exchanger's efficiency directly, or install a differential pressure sensor to sound an alarm if it detects excess fouling of the heat exchanger.

Submeter large building area loads, such as data centers or other large experimental loads.

Consider using valves with built-in metering for submetering large equipment instead of installing separate meters.

Provide suitable metering and/or rollups of measurements at water tempering generation sources.

9.7 Steam Metering

Connect steam meters to the BAS and measure lbm/hr and lbm.

Meter steam service at the building entrance.

Use orifice plate steam flow meters for typical applications. Consider specialized alternatives for applications with high turndown requirements. All other technologies require specific approval.

Measure the heat exchanger's efficiency directly, or install a differential pressure sensor to sound an alarm if it detects excess fouling of the heat exchanger.

Meter condensate return.

9.8 Natural Gas Metering

Connect natural gas meters to the existing water treatment SCADA and measure therms/hr and therms.

Meter natural gas service at the building entrance.

Submeter large loads, such as boilers.

9.9 Potable, Laboratory, and Canal Water Metering

Connect potable, laboratory, and canal water meters to the existing water treatment SCADA and measure gallons per minute (GPM) and gallons.

Meter water services at the building entrance.

Use positive displacement meters for typical domestic and laboratory water metering applications. Consider turbine or paddle technologies if necessary to capture low flows. All other technologies require specific approval.

Use inline electromagnetic flow meters for typical canal water applications. Use insertion electromagnetic flow meters where inline meters are not cost effective. All other technologies require specific approval.

Submeter systems or spaces designed for high demand.

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10 IT, Networking, Telecommunications, AV, and Security

10.1 Codes and Standards

- Argonne Business and Information Services Division (BIS) Specifications, Section 27 05 32—*Structured Cabling Systems*
- ANSI/TIA-568.1-D, *Commercial Building Telecommunications Cabling Standard*
- ANSI/TIA-568.3-D, *Optical Fiber Cabling and Components Standard*
- ANSI/NECA/BICSI 568-2006, *Standard for Installing Commercial Building Telecommunications Cabling*
- ANSI/TIA-942-B, *Telecommunications Infrastructure Standard for Data Centers*
- ANSI/TIA-862-B, *Building Automation Systems Cabling Standard*
- ANSI/TIA-5017, *Telecommunications Physical Network Security Standard Working*
- ANSI/TIA-5018, *Structured Cabling Infrastructure Standard to support Distributed Antenna System*
- TIA TSB-162, Revision B, February 2021 - *Telecommunications Cabling Guidelines for Wireless Access Points*
- Argonne BIS Specifications, Section 27 21 33—*Wireless LAN Systems*
- TIA-526-7-A, *Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant*
- TIA-526-14-C, *Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant*
- TIA-568.2-D, *Balanced Twisted-Pair Telecommunications Cabling and Components Standards*
- TIA-569-E, *Telecommunications Pathways and Spaces*
- ANSI/TIA-569-D-1, *Telecommunications Pathways and Spaces: Addendum 1—Revised Temperature and Humidity Requirements for Telecommunications Spaces*
- TIA-606-C, *Administration Standard for Telecommunications Infrastructure*
- TIA-607-D, *Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises*
- ANSI/TIA-758-B, *Customer-Owned Outside Plant Telecommunications Infrastructure Standard*

10.2 Solutions Architecture and Governance

It is important to include BIS and IS in the design process. We would like set review opportunities throughout the design process.

The appropriate Argonne SME group must meet with the architects, engineers, and contractors to review the design and implementation. Argonne SME groups are as follows:

- BIS: Infrastructure networking
- BIS: Infrastructure telecommunications
- BIS: Audio/video (AV)
- IS: Safeguard security and emergency services

The Argonne project manager sends product submittals to the BIS group for review and approval before purchasing or installing IT infrastructure.

Provide construction drawings designated for telecommunications, which are separate from electrical drawings (usually designated E-XX).

Entities designing technology systems must have at least one BICSI Registered Communications Distribution Designer (RCDD) on staff.

10.3 Networking

Most buildings on the Argonne campus need network connectivity to support building services and occupants. Argonne staff procures and installs network electronic components.

Allocate a minimum of 20 rack units of adequate space in two-post racks, four-post racks, or network cabinets for networking equipment.

Two-post racks, four-post racks, or network cabinets for networking equipment must be 19 in. in width (inside rail dimension).

Allow a minimum egress of 32 in. (clear space) in front and back of two-post racks, four-post racks, and network cabinets.

The Argonne BIS Wireless LAN SME is responsible for:

- Specifying, configuring, commissioning, and procurement (financial credentials supplied by Argonne Project Management Office or Project Manager) of Argonne wireless LAN system hardware related to the project.
- Design of the facilities wireless LAN including instructions and/or pictures specifying/detailing location of the enclosures. A design package shall be provided to the architectural engineers and incorporated into the telecommunications design and drawings.
- Conducting predictive, active, and passive wireless radiofrequency (RF) pre/post surveys to determine placement and to validate/calibrate the Argonne wireless LAN.

Architects, engineers, and contractors are to verify wireless access point locations with the Argonne BIS Division's wireless LAN SME prior to:

- Final design release.
- Implementation of final finished installation.

Indoor wireless LAN access point enclosure installation criteria for contractors:

- Provide a minimum of one (1) Cat-6A (or better category) data cable for each access point location (installed per Argonne BIS Specification Section 27 05 32).
- Provide adequate and secure, bracing/support, for installing wireless access point enclosures.
- Wireless access point enclosure installations must not impede, interfere with, or block data cabling pathways, safety signage or walkway egress.
- Shall affix a label to the exterior surface of the wireless access point and enclosure (easily viewable from a standing position on the finished floor) stating the data cable identification and wireless access point identification.
- Shall install the access point at a minimum height of 8 feet above a finished floor.
- Shall install the access point at a minimum of 12–24 in. away from lighting fixtures, fire protection sprinklers/smoke detectors, public address (PA) speakers, or other sources of electromagnetic interference (EMI).
- Install the access point at least 24 in. away from lighting fixtures, fire protection sprinklers, PA speakers, or other sources of EMI.

Outdoor Wireless LAN access point bracket installation criteria for contractors:

- Install at a minimum height of 15 feet above ground level.
- Provide proper bracing to mount at least 8 in. out from exterior of building.
- Install a minimum of 24 in. away from electrical power lines, lighting fixtures, PA speakers or other sources of EMI.
- Include proper grounding and bonding.
- Verify all cables are outdoor and ultraviolet (UV) rated.
- Verify enclosures and liquid-tight flexible non-metal conduit (including connectors) are manufactured at a minimum of NEMA 4x and UV rated.

10.4 Telecommunication Rooms

Telecommunication rooms (TRs) are required in strategic locations throughout the building complex to support the communications infrastructure. Although site buildings may have one or several TRs, each building must also have an entrance facility (EF) that connects it to the outside cable plant. Every TR must have structured cabling that ties back directly to the EF. For more details, refer to Argonne's *BIS Specifications*, Section 27 05 32, "Structured Cabling Systems."

TRs must meet the following requirements:

- At least one per floor.
- Within 90 meters of furthest data cable office or station end.
- Minimum room dimensions of 10 feet wide × 12 feet long × 10 feet high.
- Contains no columns or other building infrastructure systems such as electrical or plumbing.

Provide one EF that meets the following requirements:

- On lowest floor of the building, and connecting to the external laboratory cabling conduit system.
- Minimum room dimensions of 10 feet wide × 15 feet long × 10 feet high; rectangular in shape.
- Contains no columns or other building infrastructure systems such as electrical, plumbing, and so on.

The Argonne BIS Networking SME will specify a balanced emergency and standard power requirement of either 208 V, 30 A or 110/120 V, 30 A based on BIS design requirements.

Provide proper HVAC ventilation and humidity control. Provide proper two-post racks, four-post racks, and network cabinets. Provide proper badge proximity reader and keyed door entry. Provide grounding and bonding.

10.5 Cabling Infrastructure

Cabling infrastructure is required in facilities that need IT infrastructure. This includes the cabling trays, copper and fiber cabling, racks and cabinets, patch panels, fiber shelves, outlets, faceplates, and patch cables. For details, please refer to Argonne's *BIS Specifications*, Section 27 05 32, "Structured Cabling Systems." The following are requirements concerning infrastructure:

- Provide a cable tray system
- Provide outside cable plant integration
- Contractors shall demonstrate direct experience of similar type and size structured cabling system within three (3) previous installation years.
- Contractors shall provide proof of a current manufacturer installation authorization certificate (for greater than three (3) years) related to the structured cabling system being installed.
- The architect or engineer must specify that the contractor provide a manufacturer's 20-year cabling system warranty with documentation.
- Contractor must provide the following in both an electronic and a physical disk version:
  - Documentation certifying Cat-6A cabling testing
  - As-built documentation and drawings
  - Excel file with data jack labeling
- Contractors provide 100% matching of patch cables-to-data jack on both TRs and office station areas
- Current copper cabling spec Cat-6A (or better category)
- Current fiber-optic riser rated spec (between each TR and the EF):
  - Multimode: 50-micron laser-optimized (OM4 rated) with a minimum of 12 strands
  - Single mode: (OS2, Zero Water-Peak) with a minimum of 12 strands

10.6 Telecommunications

All facilities require at least one analog phone for emergency life safety purposes. Most buildings with occupants require voice over IP phones for the office and common areas. Argonne staff procures and installs the phones. For more details, please refer to Argonne's *BIS Specifications*, Section 27 05 32, "Structured Cabling Systems."

10.7 Audio/Video and Conferencing Systems

Most facilities at Argonne require audio/video (AV) and conferencing systems. These systems are generally deployed in meeting and conference rooms, large conference centers, and in the lobbies of the facilities. The architect or engineer is responsible for the design of the cabling and mounting infrastructure. The Argonne AV team selects the AV electronic components.

Consider AV applications at the beginning of the planning process. Address plans, furniture, usage, and functionality for all meeting spaces early in the design phases. Design large offices, meeting rooms, boardrooms, collaboration spaces, and auditoriums to accommodate AV systems.

Electrical outlets are required in floor for conference tables. A quad outlet is required behind each monitor, television, projector location, and AV equipment cabinet (separate circuit).

Install a 14 1/4 in. × 9 in. × 3.88 in. back box with drywall flange behind each wall-mounted monitor or television. Provide/install adequate blocking at all wall-mounted monitor locations. Provide/install easily accessible anchor locations for wire-supported ceiling tile AV inserts (projectors, speakers)

Provide oversized conduits or clear pathways for AV cable runs as required: from conference table to displays or projector; conference table to AV equipment cabinet; and control panel to displays or projector. Provide pull strings for AV cable runs. Provide fiber runs for video and audio transmission.

Provide data runs to AV equipment as required. Please note this is not the same as CAT6aSTP for video and audio transmission.

Install a wall jack or a table connection at all presentation devices. Power, data, and phone lines must be in proximity to work surfaces adjacent to viewing devices. Provide one extra network jack for each display device leading back to the closet. No switch is required. Specify a minimum of two extra outlets at all display devices that are over 32 in. diagonal in size.

10.8 Security (Cameras, Door Access, and Alarms)

Argonne deploys security camera, door access, and alarm systems in all facilities. The preferred vendor for door access and alarm systems is DSX. The architect or engineer is responsible for designing the system. Argonne Protection Services is responsible for programming and connecting it to the lab-wide system. The following list provides the security requirements:

- Cameras must be high-definition in quality and have power-over-Ethernet capability.
- Install a network drop to the camera.
- The DSX alarm system is a standalone system that integrates with fiber optics and phone circuits. Alarm sensors need prior approval before implementation.

- The DSX door access system integrates with the network, requiring a network drop.
- The proximity readers are piv Class and are dual technology, working with 125-kHz and 13.56-MHz cards.

10.9 Public Address System

Argonne has a site-wide public address (PA) system that broadcasts announcements in the campus buildings. The PA system is part of the site emergency management system. New facilities and major modifications shall include a design to integrate the PA into the existing system.

If the PA system is part of a mass notification system, the system shall be designed per NFPA 72, *National Fire Alarm and Signaling Code.* All other PA systems shall be designed in accordance with NFPA 70, *National Electrical Code,* Article 640, unless otherwise approved by the Security, Travel, and Emergency Services-Fire Technical Support (STE-FTS) Manager.

Unless otherwise noted in NFPA 72 or NFPA 70, the PA system should be designed to provide even sound distribution throughout the designated area of ±3 decibel (dB) for the 1/1 octave band centered at 4000 Hz. The system should be capable of delivering 75 dB average program level with additional 10 dB peaking margin sound pressure level (SPL) in the area at an acoustic distortion level below 5 percent total harmonic distortion (THD).

PA wire shall be #16 twisted pair, THHN, Red/Black, shielded or installed in conduit.

PA speakers shall have recessed volume control and rated for 70-volt and 25-volt amplifiers. Speakers installed in drop ceilings shall be “Drop-in Ceiling” type with back can and recessed volume control. Speakers installed in hard ceilings shall have a back can and recessed volume control.

10.10 Chemical Tracking Radiofrequency Identification System

Buildings that have labs that store and use chemicals are required to monitor the maximum allowable quantities (MAQs) of chemicals. This is done by installing a radiofrequency identification (RFID) chemical tracking system.

If a new building will have labs that store and use chemicals, consult an ESH Coordinator from Argonne’s Environment, Safety, Health, and Quality (ESHQ) Directorate, a representative from the CORAL team (Chemical Inventory Tracking), the Building Manager, BIS Networking, and BIS Software Solutions.

MAQs depend upon the fire protection zones and building code requirements.

The number of readers depends upon the number of labs and zones. Network drops are required to support the readers. Be aware of design decisions that may impact readers and reader placement, such as door types and configurations. Other equipment or shielded rooms may affect RFIDs. The RFID readers need to be integrated with CORAL.

11 Sustainability

11.1 Codes and Standards

- ASHRAE 62.1
- ASHRAE 55
- ASHRAE 90.1
- DOE O 436.1, *Departmental Sustainability*
- EO 13693, *Planning for Federal Sustainability in the Next Decade, Sections 6, 7, and 11 (all other sections revoked as of January 21,* 2021)
- EO 14008, *Executive Order on Tackling the Climate Crisis at Home and Abroad*
- *Guiding Principles for Sustainable Federal Buildings and Associated Instructions*, The Council on Environmental Quality (December 2020)

11.2 Design Criteria

All construction projects must meet the requirements of DOE O 436.1, *Departmental Sustainability*, and all associated flow-down requirements, such as the National Energy Conservation Policy Act, the Energy Policy Act, and EISA Section 432.

All construction projects must incorporate *Guiding Principles for Sustainable Federal Buildings* (Guiding Principles) as appropriate, based on the scope and scale of the project. More information about Guiding Principles appears on the Federal Energy Management Program.

Project teams should use the Argonne-developed workbook and outline specification to assist with incorporating Guiding Principles into their projects (as applicable per section 11.3, New Construction Projects and Major Renovations). The Guiding Principles Workbook serves as a tool to provide Argonne specific considerations for meeting Guiding Principles, and is used to track and document compliance on construction projects. The Sustainable Design Outline Specifications provides specific guidance that supports compliance with the Guiding Principles and is aligned to appropriate CSI Division in the Masterformat master list. The outline specification also incorporates Federal Sustainable Acquisition requirements, which are required for all purchases. See Sustainable Acquisition, Office of Environment, Health, Safety and Security, and Sustainable Acquisition in Contracts or Purchasing Agreements, FedCenter.gov.

Argonne has already documented compliance with High Performance Sustainable Building (HPSB) requirements for buildings 46, 214, 216, 224, 241, 242, 302, 386, 431, 432, 433, 434, 435, 436, 438, 440, and 446. Future improvements at these buildings should maintain compliance with Guiding Principles and projects should maximize the use of the Guiding Principles Workbook and Sustainable Design Outline Specification in the design process. Improvements at additional buildings will be documented for compliance with Guiding Principles so the building can be submitted for full compliance at a future date.

11.3 New Construction Projects and Major Renovations

All new building construction greater than 5,000 gross square feet must achieve compliance with Guiding Principles. Project teams should start using the Guiding Principles Workbook at the conceptual design phase and update the workbook throughout the design and construction process to ensure and document compliance. Evidence of compliance should be saved to the project file consistent with the Workbook instructions. The Sustainable Design Outline Specification provides specific submittal requirements that align with Guiding Principle compliance.

Major renovation, repair, and alteration of existing buildings greater than 5,000 gross square feet or where the combined design and construction costs is greater than $2 million must strive to incorporate Guiding Principles to the greatest extent possible. The Guiding Principles Workbook should be used to track and document compliance and associated documents saved in the project file.

New construction projects greater than $10,000,000 may also be LEED v4 BD+C Gold Certified in addition to achieving compliance with the Guiding Principles. Project teams should consult with the PMO Project Manager and the Sustainability Program Manager at the start of the project to discuss the inclusion of LEED. Documentation for LEED BD+C and HPSBs needs to be completed simultaneously and submitted to their respective online tools.

11.4 Other Projects

11.4.1 Existing Buildings

All other projects that include renovation, repair, or alteration of existing buildings must consider Guiding Principles and work to achieve as many metrics as feasible and appropriate within the scope. The Guiding Principles Workbook can be used to evaluate and incorporate design elements to support the Guiding Principles. At a minimum, the Sustainable Design Outline Specification should be used in the design for appropriate divisions to ensure that Federal sustainable acquisition requirements are met. Energy efficiency improvements achieved as the result of existing building renovation, repair, or alterations should be documented for the project file even if overall energy reduction targets are not fully met.

11.4.2 Site and Utility (Non-Building) Projects

Argonne is using the Envision Rating System as a tool to identify strategies for incorporating sustainability into non-building infrastructure projects to address both DOE requirements and other sustainability opportunities. Projects in this category may use the Envision Checklist to identify and document sustainability opportunities and incorporate those into the project design. Project teams should consult with the PMO Project Manager and the Sustainability Program Manager at the start of the project to discuss the inclusion of Envision. More information about Envision is available at the Institute for Sustainable Infrastructure.

11.4.3 Other Infrastructure Projects

At a minimum, all construction projects must consider including products and supplies that have a lesser or reduced effect on human health and the environment over their life cycle compared to competing products or services that serve the same purpose, as outlined in Section11.5. These performance requirements for product and services are provided in the Sustainable Design Outline Specification for each use.

11.5 Federal Sustainable Acquisition

Federal sustainable acquisition and procurement seeks to reduce materials use and environmental impacts of products and services procured for federal agencies over the entire life cycle of the product or project. Statutory mandates require that purchasing preference are given for products and services that meet specific environmental performance and sustainability factors. Purchases should also consider products and services designated by the EPA and other voluntary programs. All projects, regardless of size, must consider sustainable acquisition aspects to the greatest extent practicable. Performance requirements for product and services are incorporated in the Sustainable Design Outline Specification.

11.5.1 Statutory Mandates

Statutory mandates require purchase preference be given for items that fall into the categories described below.

Recycled Content

For EPA-designated products that are or can be made with recovered materials, provide products that meet the minimum recommended content levels as identified under the Comprehensive Procurement Guidelines program. Information on designated products and the associated recommended content levels is available on the EPA website.

Energy-Efficient Products and Services

Provide energy-consuming products that either earn the ENERGY STAR label and meet ENERGY STAR specifications for energy efficiency, or meet FEMP purchasing specifications for energy efficiency. Complete product specifications and updated list of qualifying products

appear on the ENERGY STAR and FEMP websites. Electronic products may also be Electronic Product Environmental Assessment Tool (EPEAT)-registered to demonstrate energy efficiency requirements are met. Information on product specifications, registration requirements, and updated lists of qualifying products is available on the Global Electronics Council website.

BioPreferred and Biobased Products

Provide products that meet minimum biobased content percentages for biobased products designated by the U.S. Department of Agriculture (USDA) for Federal procurement. Visit the BioPreferred website for a complete list of designated products and the associated minimum biobased content level requirements.

11.5.2 Products and Services Identified by EPA and Other Voluntary Programs

SNAP

Phase out existing use of ozone-depleting materials and specify in new projects the use of substitutes for ozone-depleting substances. Information on SNAP alternatives by sector is available on the EPA website.

WaterSense Labeled

Select WaterSense labeled fixtures and equipment as applicable. Information for complete specifications and updated lists of qualifying products is available on the EPA website.

Safer Choice

Select environmentally preferable products and services as defined by the EPA, including the Safer Choice labeled products. Information about qualifying products is available on the EPA website.

11.6 General Requirements

Project teams should document and track compliance with Guiding Principles by taking a graded approach based on the complexity of the project. The Sustainability Program Manager should be consulted early in the planning phase to ensure Guiding Principles requirements are understood, especially for new construction and major renovation projects.

Argonne has already documented compliance with Guiding Principles for the buildings listed in Section 11.2. To ensure that compliance with Guiding Principles continues over time, any improvements at these buildings must fully comply with Guiding Principles and documentation must be shared with the Sustainability Program Manager at the completion of the project, regardless of project size.

New construction and major renovation projects, described in Section 11.3, must document compliance with Guiding Principles by collecting and entering supporting information into the tracking tool from the EPA's ENERGY STAR portfolio manager.

Other projects, described in Section 11.4, should collect documentation for Guiding Principles compliance on selected metrics and save in the project file.

All other projects should collect documentation that addresses Federal Sustainable Acquisition (Section 11.5) and save the information in the project file.

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12 Non-Reactor Nuclear Facilities and Accelerator Facilities

12.1 Introduction

The reference documents listed in this section do not necessarily apply to all non-reactor nuclear facilities as defined in 10 CFR 830, *Nuclear Safety Management*, or to all accelerator facilities. To determine applicability, use the hazard categorization process defined in DOE-STD-1027, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.*

Reference Argonne's Prime Contract, *DOE Contract DE-AC02-06CH11357*, to ensure current applicability of the DOE references identified below.

For brevity, this list identifies higher level regulations, codes and standards and may not include all flow-down documents.

12.2 Federal Rules

- 10 CFR 708, *DOE Contractor Employee Protection Program*
- 10 CFR 830, *Nuclear Safety Management*
  - Subpart A, *Quality Assurance Requirements*
  - Subpart B, *Safety Basis Requirements*
- 40 CFR 61, *National Emission Standards for Hazardous Air Pollutants*
  - Subpart H, *National Emission Standards for Emissions of Radionuclides Other than Radon from DOE Facilities*
- 10 CFR 835, *Occupational Radiation Protection*
  - Subpart K, *Design and Control*

12.3 DOE Orders

- DOE O 414.1D, *Quality Assurance*
- DOE O 420.1C, *Facility Safety*
- DOE O 420.2C, *Safety of Accelerator Facilities*
- DOE O 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*
- DOE O 458.1, *Radiation Protection of the Public and the Environment*

12.4 DOE Standards

- DOE-STD-1020, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*
- DOE-STD-1027, *Hazard Categorization of DOE Nuclear Facilities*
- DOE-STD-1066, *Fire Protection*
- DOE-STD-1073, *Configuration Management Program*
- DOE-STD-1189, *Integration of Safety into the Design Process*
- DOE-STD-3020, *Specification for HEPA Filters Used by DOE Contractors*
- DOE-STD-3024, *Content of System Design Descriptions*

12.5 DOE Guides and Handbooks

- DOE Guide (G) 414.1-2B, *Quality Assurance Program Guide*
- DOE G 420.1-1A, *Nonreactor Nuclear Safety Design Criteria for use with DOE O 420.1, Facility Safety*
- DOE G 420.2-1A, *Accelerator Facility Safety Implementation Guide for DOE O 420.2C, Safety of Accelerator Facilities*
- DOE G 441.1-1C, *Radiation Protection Programs Guide for Use with Title 10, CFR, Part 835, Occupational Radiation Protection*
- DOE-Handbook (HDBK)-1132, *Design Considerations*
- DOE-HDBK-1169, *DOE Handbook Nuclear Air Cleaning Handbook*
- DOE-HDBK-1215, *Optimizing Radiation Protection of the Public and the Environment for use with DOE O 458.1, ALARA Requirements*

12.6 Other Reference Documents

- American Conference of Governmental Industrial Hygienists 2096, Industrial Ventilation: A Manual of Recommended Practices for Design
- American Glovebox Society-G006, Standard of Practice for the Design and Fabrication of Nuclear Application Gloveboxes
- ASME NQA-1, Quality Assurance Requirements for Nuclear Facility Applications

12.7 Argonne Procedures, Guides, and Guidance

- **General**
  - LMS-PROC-339, ALARA Review of Facility Design and Modifications, including Exhibit A: ALARA Program Facility Design and Control Implementation; Exhibit B:

General Radiological Facility Design Features for the use of Dispersible Radioactive Material

- Facility Segmentation – *See* DOE-STD-1027*, Facility Hazard Categorization, Section 3.0*

- **Hazard Category 1, 2, and 3 Nuclear Facilities *(Consult with the Cognizant System Engineer)***
  - NWM-PP-523, *Quality Assurance Program Plan*
  - NWM-PP-525, *Configuration Management Program*
  - NWM-QA-701, *Procurement Control*
  - NWM-QA-901, *Design Process*
- **Less than Hazard Category 1, 2, and 3 Nuclear Facilities**
  - Materials Design Laboratory Project, *Specific Recommendations -Radiological Design Criteria*
- **Accelerator Facility – Advanced Photon Source (APS)**
  - *APS/AES Design and Drafting Standards*
  - APS-PPR-ADM-00-A022-000020, *APS Design Reviews*
- **Accelerator Facility – Argonne Tandem LINAC Accelerator System (ATLAS)**
  - ATLAS: *Administrative - Configuration Management Program*
- **Accelerator Facility – Argonne Wakefield Accelerator Facility**

None

- **Accelerator Facility – Low-Energy Accelerator Facility (LEAF), Intermediate Voltage Electron Microscopy–Tandem**
  - EGS-PP-100, *Configuration Management Program Plan for Accelerators*

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13 Temporary Facilities

13.1 Codes and Standards

- DOE EP-0108, Standard for Fire Protection/Construction Safety of DOE Electronic Computer/Data Processing Facilities
- ASCE 7/ANSI A58.1, Section 6, *Wind Loads*
- ASCE 7/ANSI A58.1, Section 7, *Snow Loads*
- ESH 19.3, *Emergency Lighting Systems*
- LMS-PROC-220, *Trailers and Other Movable Structures*
- NEC Article 645
- 29 CFR 1910, *General Industry Standards*
- International Building Code®, Section 1111.0, *Snow Load*

13.2 Design Criteria

For design purposes, the basic wind speed (as derived by the University of California Research Laboratory, pub. 53526 rev. 1) is 80 mph. Use exposure C for all calculations.

For office environments, continuously provide 20 cfm (cubic feet per minute) of outside air per person.

Floor load rating must be 40 lb/sf for commercial and office uses.

Install fire extinguishers per NFPA 10, *Standard for the Installation of Portable Fire Extinguishers*.

Install emergency lighting per ESH 19.3, *Emergency Lighting Systems*. Exterior night lighting is required above each exterior door.

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ABOUT ARGONNE NATIONAL LABORATORY

Argonne is a U.S. Department of Energy Laboratory managed by UChicago Argonne, LLC, under contract DE-AC02-06CH11357. The Laboratory's main facility is located near Chicago at 9700 South Cass Avenue, Lemont, Illinois 60439, USA. For information about Argonne and its pioneering science and technology programs, visit **www.anl.gov**.

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