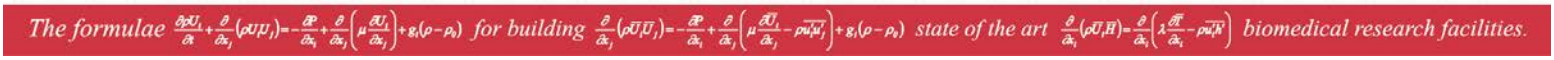
The National Institutes of Health | Division of Technical Resources | Office of Research Facilities

Design Requirements Manual **News to Use**

December 2017

Vol. 02, No. 12



Vision Panels in Laboratory Doors

As a rule laboratory doors should remain closed: a basic requirement of Biosafety in Microbiology and Biomedical Laboratories (BMBL) is that laboratory doors have closers and be kept closed to maintain air pressurization and containment[1]. Additionally, self-closing doors are a requirement in fire-rated corridors. Labs are also hazardous places, so visual connections from corridors and between labs enhances safety. In order to address both BMBL and safety requirements the DRM Chapter 4, Sections 4.2.2.8 *Laboratory Door Glazing*, 4.2.3.8, *Animal Research facility Door Glazing* and 4.9.3.2, *Interior Doors*, require that all laboratory doors have vision panels.

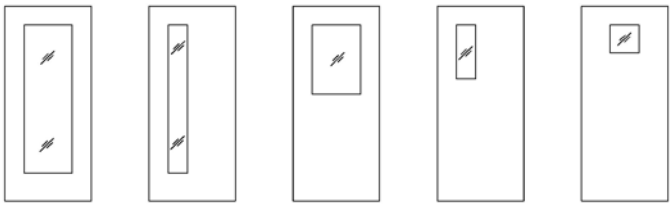


Figure 1: Typical vision panel configurations.

Vision panels in doors accomplish a number of important functions:

- The interior of a laboratory can be observed without opening the door. This allows an event in the lab to be seen that would otherwise be unnoticed.
- In the occurrence of an event, people outside of the lab can observe the conditions and assess the risks before entering the lab.
- Vision panels allow people entering and exiting the lab to see a person on the other side of the door, reducing the potential of being hit by a swinging door, which is a particular concern in small labs and narrow corridors.
- In the case of anterooms and vestibules, vision panels allow people to see into the vestibule and anticipate when doors can be opened.
- Vision panes are a way of bringing borrowed light into interior spaces and creating a sense of openness. Vision panels are less expensive and use less wall space than sidelights, transoms or other glazing options.

Vision panels can be in a number of sizes and configurations, depending on their purpose and function (figure 1). Small panels can be used if quick observation is needed. Larger panels can be used for greater observation or for borrowed light. Vision panel size and configuration should be selected based on a number of considerations, including:

Doors design, including vision panel size and detailing, should match building standard if possible, especially if the door is in a public corridor lined with similar doors.

Large vision panels can provide an expansive view into the lab. This can visually connect related labs, and can be part of a tour or inspection route where lab functions are observed without entering the lab.

- Small vision panels are easier to fit with light-control covers and colored light filters.
- The entire door assembly, including the vision panels, must be appropriately UL rated for the wall in which it is installed.

The door and vision panel must be compatible with the function of the laboratory that it serves. Considerations include:

- Laboratories requiring blacked-out or light-controlled conditions should be fitted with hinged or sliding light-tight covers (figure 2). It should be noted that optical labs, microscope rooms and other light-sensitive labs can benefit from having vision panels during set-up and other non-operational times, and use the covers for light control during sensitive operations.
- In addition to covers, vision panels can be installed with a red filter of the appropriate wavelength to control lighting for animal holding rooms with diurnal lighting systems.
- Specialty doors with vision panels are available for radio frequency (RF) and x-ray shielding, ballistic and blast resistant and many other specialty applications.
- The vision panels in high-traffic areas should be sized to allow for door protection plates and rails.

Figure 2: Light-tight cover on lab door.

There may be very specialized condition or laboratory functions that the laboratory designers think may be incompatible with vision panels. In this case DTR, DOHS and other appropriate offices should be contacted to review the specific conditions and requirements. If no special conditions exist it is incumbent to the lab to determine the best vision panel configuration.

Reference:

[1] Biosafety in Microbiology and Biomedical Laboratories, https://www.cdc.gov/biosafety/publications/bmbl5/bmbl.pdf

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Further details on this month's topic are available on the DRM website DRM Chapter 4 Architectural Design
https://www.orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/DesignRequirementsManual2016

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Design Requirements Manual **News to Use**

November 2017

Vol. 02, No. 11

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The Design Review Process

Research facilities play a significant role in supporting scientific advances to improve the health of the Nation. The main objective when designing these facilities is to ensure that the research is conducted in a safe, efficient and functional facilities. Facility designs must be reviewed by technical professionals and institutional stakeholders before construction begins to verify and validate project compliance with applicable building codes, standards and guidelines.

Designers must take into consideration that facilities are institutional assets that function beyond the tenure of the current occupant. They must think ahead and consider all factors involved for a facility to function properly and be flexible to allow changes in research protocols without major disruption. Throughout the years renovations must be made to accommodate changing needs or new users who may move into the space. Maintenance must also be taken into account so spaces can be maintained and serviced to provide for minimal disruptions to research.

NIH's Division of Technical Resource (DTR) Intake Center provides a design review process that is systematic, comprehensive and documented. Each project submitted for design review is tracked and managed by the Intake Center throughout the design review phase. This office utilizes the following tools to manage each project and ensure the review process meets high standards.

- Design Review Requirements Checklist – A PDF questionnaire checklist determines the required NIH review offices, and calculates the number of hard copy drawings the A/E will need to submit for review based on the project scope. This checklist is submitted to the Intake Center and serves as the first requirement in creating a project in the DTR Permit Review site for tracking.
- DTR Permit Review Site – A SharePoint site designed as a central location for all design documents, comments and responses during the design review process. Its automated notification features allow this site to assist in keeping track of due dates for submissions and review comments in order to follow project schedules. An external website, for outside A/E firms, is part of the DTR Permit Review site to submit documents and responses to comments. Projects approved for construction are archived in this same site for record and future reference.
- Permit Review Coordinators (PRC) – As one of the main key components during the design review process, the PRC manages the DTR Permit Review site. They provide technical support to Project Officers, A/E's and Reviewers in order for projects to move forward and issue the appropriate construction permit.

The NIH Permit Review Board (PRB) consists of NIH Divisions and Offices, each one which provide important key aspects for all technical reviews that are vital to the success of the project. The makeup of the PRB review for a particular project is based on the Design Review Requirements Checklist and project scope.

The PRB consists of the following offices and their main objectives:

Division of Technical Resources (DTR): Provides technical support through comprehensive design reviews of documents ensuring that NIH facility design conform to applicable regulations, codes, standards, policies, and guidelines.

Division of Facilities Planning (DFP): Coordinates and manages all planning related to NIH owned and leased facilities.

Division of Environmental Protection (DEP): Works to protect and enhance the NIH environment through the management of the environmental quality, compliance and waste management.

Division of Facilities Stewardship (DFS): Serves as technical experts and is charged with assessing and understanding the condition of NIH real property assets and their systems.

Division of Facilities Operations and Maintenance (DFOM): Responsible for the safe, efficient, and effective operation and maintenance of NIH real property.

Division of Occupational Health & Safety (DOHS): Evaluates compliance with occupational safety and health policies and procedures.

Division of Radiation Safety (DRS): Specialize in radiation safety, regulatory compliance and risk management for research efforts.

Division of the Fire Marshal (DFM): Verifies all NIH facility design projects meet applicable fire code requirements and addresses the fire protection and life safety needs.

Division of Physical Security Management (DPSM): Reviews and manages the physical security requirements for all NIH Facilities to provide the most secure environment possible for NIH.

Center of Information Technology (CIT): Provide the NIH community with a secure and reliable IT infrastructure.

Office of Hospital Physical Environment (OHPE): Oversees and facilitate compliance to provide a safe physical environment for patient treatment, biomedical research and occupant safety for the Clinical Center/Hospital.

Clinical Center Office of Space and Facility Management (CCOSFM): Supports the highest quality of patient safety and research support for the Clinical Center/Hospital.

As stated in Chapter 1 Section 1.5.2 Design Submissions in the DRM, Construction of a facility should only be approved after the Government (Permit Review Board) reviews the Final submission and all review comments have been satisfied. The Intake Center will issue a construction permit when all the requirements of the design review process have been met.

Through these tools and the technical expertise of staff, NIH is able to produce facilities that meet the highest level of safety, functionality, and innovation; allowing them to advance scientific research for the benefit of the world.

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Further details on this month's topic are available on the DRM website DRM Chapter 1 Section 1.5.2
https://www.orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/DesignRequirementsManual2016

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Design Requirements Manual **News to Use**

October 2017

Vol. 02, No. 10

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Architectural Mock-Ups

Laboratory buildings are often as innovative and complex as the research that they contain, so the use of mock-ups during the design and construction phases is crucial to their success. Mock-ups, ranging from room-sized to small details, allow for critical components to be tested, assessed and approved early in the process. Once constructed, mock-ups can be modified to meet performance and aesthetic requirements, and to address comments and concerns of stakeholders. Upon approval, mock-ups can be maintained for the duration of the project and used as a standard for quality, and as a basis for acceptable work.

The number and types of mock-ups should be determined based on the complexity and criticality of the project. Mock-ups may not be necessary for established construction methods and materials, but are required for assemblies that are innovative or untried, are dependent on installer skill and technique, or are essential for the success of a critical facility.

There are many types of mock-ups including:

Component mock-ups

Component mock-ups are actual building materials and components, installed as intended in the final construction. The goal of component mockups is to have an actual, full-size sample of the finished product or assembly which can be viewed by stakeholders, approved for quality, compatibility, appearance and other performance and aesthetic criteria. Mock-ups may be tested (e.g. infiltration for envelope assemblies, chemicals for laboratory surfaces, adhesion for floors) or otherwise analyzed to confirm that performance criteria and expectations are met.

- **Construction assembly mock-ups:** Assemblies built with the materials and methods intended for the final building construction. They are typically required where components are constructed in an untested or unique way. Construction assembly mock-ups should be as complete as possible, and include anchorages, adjacent assemblies, corners, terminations, sealants, transitions, joints, penetrations and other critical construction details. Construction assembly mock-ups may include sections of interior or exterior walls, roofs, casework, doors, windows or any other building component. Construction assembly mock-ups can be constructed on-site as freestanding assemblies or as part of the permanent construction.

- **Detail mock-ups:** Crucial installation, joint, connection and transition details that are dependent on workmanship, compatibility or field conditions.

- **Finish mock-ups:** Assemblies of room finishes, required to view and approve the aesthetics, transitions, installation workmanship and other details of all components. Mock-ups should include all materials and conditions, and typically include floor finish, base, wall finish, cabinetry, and ceilings. Finish mock-ups may be a portion of a room or an entire room, and may include furniture, equipment, lighting and other key room components.

Volumetric mock-ups

Volumetric mock-ups are developed to allow the flow of people, materials, functions and environmental experiences of a space to be tested before it is physically built. These visualizations allow for the optimization of the characteristics being modeled and to convey the look and feel to stakeholders who may not fully understand what the traditional lines on paper will mean experientially, after construction.

- **Physical mock-ups:** Temporary mock-ups built from cardboard or other inexpensive material to simulate the volumes and geometry of a room. They are built to full size, and allow users to physically test reaching length, sightlines, ergonomics, placement of major components and other important geometric aspects of a space. Volumetric mock-ups can be useful when designing laboratories, control rooms, patient rooms and other spaces where efficiency of movement, comfort and clearances are important.

- **Virtual mock-ups:** 3-dimensinal digital representations which give stakeholders a sense of the size, characteristics and function of a space. Virtual mock-ups can be static images, pre-programmed, or user-controlled dynamic walk-throughs. Virtual reality technology is becoming available that will allow for a more enveloped simulated experience of a space. Virtual mock-ups are useful as representational tools, but do not allow the space to be physically experienced.

Specifications

The identification of mock-ups needed for a project should be discussed with the Project Officer and stakeholders early in the design process. The requirements for mock-ups should be in the specification section for individual products, or in Division 1 Quality Requirements (MASTERSPEC Section 014000) for assemblies composed of multiple products. Specifications should clearly state the composition, size and scope of the mock-up, the location (on site or off-site), testing and whether the mock-up can be incorporated into the final construction. The architectural drawings should indicate the size and extent of large assembly mock-ups.

Conclusion

Mock-ups are invaluable tools for allowing innovative and crucial details and assemblies to be assessed, and to act as a standard by which work will be accepted.

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Further details on this month's topic are available on the DRM website DRM Chapter 4
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Design Requirements Manual **News to Use**

September 2017

Vol. 02, No. 9

The formulae $\frac{\partial \rho U_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho U U_j)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho\overline{U}\overline{U}_j)=-\frac{\partial \overline{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial \overline{U}_i}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho\overline{U}\overline{H})=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial \overline{T}}{\partial x_i}-\rho\overline{u_i'h'}\right)$ biomedical research facilities.

Environmental Design Requirements for Mechanical and Electrical Spaces (Part 2)

Last month's News to Use looked at Section 6.1.18 of the DRM entitled "HVAC Design for Equipment Rooms". These articles are inspired by questions that have been asked since the issuance of the 2016 DRM and the requirements for mechanical and electrical rooms. While the new DRM is an incredibly diverse and useful tool in the design of NIH facilities, at 1000 double columned pages it is still limited in being able to provide design requirements for every potential condition. As discussed last month the DRM has changed from a design requirement of temperature relative to outside air ambient to one of prescribed maximum and minimum temperature requirements for mechanical and electrical spaces based on use and equipment installed. To illustrate the use of these design requirements we will be looking at two examples:

Paragraph B of 6.1.18 calls for temperatures in transformer vaults to be maintained between 18°C (65°F) and 40°C (104°F). As noted last month the intent of the DRM is to use outdoor ambient air for ventilation to the greatest extent possible, but there are cases where specific requirements such as arch flash requirements or maximum temperature/humidity ratings of equipment may mandate a lower maximum temperature of 31°C (90°F). In such cases it is the responsibility of the design team to identify these controlling design requirements and provide a design accordingly. The design team should confirm if another type or model of equipment is available, even at a higher initial cost, which would allow for outside air ventilation to maintain the equipment. The team should then compare the larger first time cost with a 20 year life cycle cost for the supplemental cooling to maintain the lower space temperatures to advise the NIH on the most advantageous design for the vault. If it is determined maintaining lower space temperature is the only or best choice a variance would not be required since the specific design parameters fall within the guidelines of the DRM. However notification of the NIH Project Officer (PO) should be done as early in the design process as possible, since supplemental cooling will be required. All analysis and calculations should be memorialized in the project Basis of Design (BOD) documents per Appendix E.

The next example would be a mechanical room where a sensitive piece of equipment such as a vacuum pump is being co-located with a steam pressure reducing station (PRV). Per paragraph A subparagraphs 1 and 4 there is a conflict of requirements. The PRV station would fall into the general design requirements of mechanical rooms with a maximum temperature of 31°C (90°F), but the vacuum pump would fall under subparagraph 4 with the requirement of 26°C (80°F). Since the issuance of the 2016 DRM there have been multiple questions regarding similar situations where the mechanical cooling requirements for the entire space would require a space equal to or greater than the base mechanical space. As noted in last month's issue that is not the intent of section 6.1.18. When this type of conflict is found, per subparagraph 4, the design team must identify the controlling design factor(s), in this case the sensitive electronic controls of the pump. Now, per subparagraph 4, the team must take all necessary steps to isolate the controlling design factor rather than design a system to address the gross area of the space. As with the first example a life cycle analysis will probably reveal that the initial costs of a divided room would be less than the costs of having to cool the larger total area. In some situations, such as the many renovation projects encountered at NIH, colocation of equipment may be unavoidable. In these cases careful design consideration needs to be given to spot cooling of sensitive equipment. This type of application usually requires careful coordination at the design phase to ensure the spot cooling is maximized to address the controlling design factor. A holistic view of the space must also be taken to address heat sources. As an example, installation of insulation sized greater than the requirements of DRM Exhibit 6.4 may help mitigate some heat load requirements.

Ultimately the designer is required to address these situations early in the design process and with a clear understanding of the equipment requirements and determination of the controlling design factors. From there space planning and critical load analysis can be used to successfully address the controlling factors without penalizing large spaces with massive systems.

The DRM should be the basis from which a design is successfully developed to meet the overall project requirements. The use of the BOD, and variance process as needed, throughout the design phase provides the communication tools for the design team and the NIH to work collectively to address these issues.

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Design Requirements Manual **News to Use**

August 2017

Vol. 02, No. 8

The formulae $\frac{\partial \rho \bar{U}_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho \bar{U}_i \bar{U}_j)=-\frac{\partial \bar{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu \frac{\partial \bar{U}_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho \bar{U}_i \bar{U}_j)=-\frac{\partial \bar{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu \frac{\partial \bar{U}_i}{\partial x_j}-\rho \overline{u_i' u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho \bar{U}_i \bar{H})=\frac{\partial}{\partial x_i}\left(\lambda \frac{\partial \bar{T}}{\partial x_i}-\rho \overline{u_i' h'}\right)$ biomedical research facilities.

Environmental Design Requirements for Mechanical and Electrical Spaces

This News to Use article is the first of several to address the question of environmental design requirements for mechanical and electrical spaces with respect to the Design Requirements Manual (DRM).

In all buildings the mechanical and electrical infrastructure is critical to every functional aspect of the building's operation. In laboratories and healthcare facilities the mechanical and electrical infrastructure is critical because a loss of power or environmental control can mean the interruption of vital research or even the death of a patient. For this article mechanical is referring to both plumbing and mechanical systems. The mechanical infrastructure within a facility usually begins within mechanical rooms, and then extends into every area of the facility. Access into the electrical infrastructure is gained through rooms and vaults located along the path of the electrical feed distribution system.

In the 2016 DRM the HVAC design requirements for equipment rooms was expanded and clarified from previous versions. Subchapter 6.1.18 "HVAC Design for Equipment Rooms" changed environmental requirements for mechanical and electrical rooms from conditions based on a temperature differential from outdoor air ambient conditions to requirements based on maintaining conditions within the space to be within specific temperature ranges. The basis for determining the applicable temperature range for a particular space is the equipment to be housed within the space. These temperature ranges have been defined to protect the equipment located in the spaces, and also to provide a minimum workable environment for those whose responsibility it is to maintain the equipment on a day to day basis.

The modern mechanical and electrical equipment room house a variety of equipment with variable needs for environmental conditions. Mechanical rooms can house heat generating equipment such as steam pressure reducing stations and steam to water heat exchangers, as well as heat sensitive equipment such as Reverse Osmosis systems with programmable logic controllers (PLCs). Likewise electrical rooms can house heat producing transformers and sensitive control panels for lighting or environmental systems. To make it even more complex electrical and mechanical equipment may be co-located within the same space, making determination of the requirements more of a challenge.

Below are some recommended steps the design professional should take to determine the design requirements for a mechanical or electrical space:

- Clearly define, and understand the requirements for, all equipment to be located in the space as early in the project design as possible. Quite often heat producing and sensitive equipment become co-located because their location is not determined early in design, or left to a contractor to locate equipment during the construction phase of the project.
- Determine if sensitive equipment such as vacuum pumps and electrical control equipment can be located in a dedicated space where specific conditioning can be provided without having to account for large heat generating loads like transformers and steam condensate pumps.
- As much as possible locate equipment spaces that have higher temperature requirements to locations where natural ventilation is readily accessible.
- Confirm all code ventilation requirements for the space. Storage of cylinders or other products within the space may change the ventilation requirements to meet other codes such as NFPA 55 or NFPA 68.
- Many designs at NIH involve renovation of existing facilities. For these designs it is critical for the design team to have a complete understanding of the existing HVAC infrastructure in and around the area of renovation. Knowing what capacities are available, even beyond the floor plan of the specific renovation, can sometimes provide resolution to the design requirements.

Once all of the above information is collected and initial layouts determined, the designer can start to define the spaces based on the breakdowns within the DRM for Equipment Room HVAC design. The intent of the DRM is to design a system that is as reliant on outdoor air ventilation as possible to reduce energy costs for predominantly unoccupied spaces. Supplemental heating and cooling systems can then be designed to maintain the space within the temperature requirements of the DRM.

Where specific conditions are found where requirements of the DRM cannot be met, the condition should immediately be brought to the attention of the Project Officer. The issues can then be addressed with Division of Technical Resources through the Variance process as found in Chapter 1 and Appendix K of the DRM. As can be seen, early identification of issues is critical for maintenance of project schedule and determination of the most efficient resolution.

In upcoming News to Use articles we will be addressing specific aspects of HVAC design for mechanical spaces and electrical rooms, based on questions that have been received since the issuance of the 2016 DRM.

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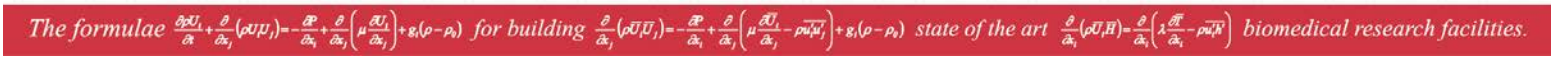
Design Requirements Manual **News to Use**

July 2017

Vol. 02, No. 7



Equipment Schedule: DRM Appendix G

During the programming and subsequent phases of any laboratory project it is essential to properly document the equipment that will be used in the lab in an Equipment Schedule. Equipment has a major impact on the design of any lab, and will affect all aspects of the design, including but limited to:

Space: Adequate space must be provided for equipment, including space for operation and ancillary components. Space must also be adequate for installation, removal and maintenance.

Layout: Equipment must be located in an arrangement that is safe, and which promotes an efficient sequence of operations. The most hazardous or sensitive equipment is generally located farthest from the entrance.

Utilities: The quantity and locations of power (normal, uninterrupted, emergency), piped services and other utilities must be adequate to support the planned equipment, and to provide a degree of flexibility for additions and upgrades.

Air Supply and Distribution: HVAC systems must be designed to dissipate equipment heat load and to provide exhausts, laminar flow and other specialized equipment requirements.

Cost: Equipment is a major cost of any project, even if the equipment is existing. Existing equipment must be moved and may have to be installed by the contractor, calibrated and certified.

Process

The programming process must include equipment planning. A first step is a survey and inventory of the equipment currently used which will be moved or duplicated in the new space. Information collected includes make and model number, size and clearances, utility requirements and all other parameters required for equipment installation and operation. A next step is the selection of new equipment. Discussions with users must include all anticipated equipment as well as potential future equipment acquisitions or upgrades. It must be acknowledged that equipment and processes evolve, so selection of equipment may involve assumptions. It is good practice to develop a preliminary equipment list early in the programming process which is updated and revised as more information becomes available. Knowing that additional changes are inevitable, the construction documents should not be designed overly proscriptively to specific equipment, but should include factors that allow a degree of flexibility to allow for equipment substitutions and additions. Small, plug-in, benchtop equipment is usually not an important factor and may not have to be included in equipment planning if adequate bench space and electrical outlets are provided.

Key Parameters

In order to design the laboratory to accommodate equipment key parameters must be obtained and documented. The level of detail will vary by the complexity of the equipment, and should be determined by the project. Typical parameters for each piece of equipment include:

- Make and Model: The specific make and model should be provided for existing equipment and for new equipment, if known. For equipment with many similar manufacturers and models (refrigerators, for example) a 'basis of design' model should be selected for planning purposes.
- Quantity: Some equipment may be needed in quantity due to capacity, usage or the need for redundancy.
- Dimensions: Required equipment dimensions (width, depth, height) in metric or imperial, following project requirements (See Appendix E, A-E Submission Requirements). Dimensions should include clearance for air circulation, opening of covers and doors and all other space required for installation, operation and maintenance.
- New or Existing: determination of whether equipment exists or will be purchased for the project.
- Responsibility for Furnishing and Installing: Documentation of whether the equipment is contractor furnished (CF) or government finished (GF), and contractor installed (CI) or government installed (GI). Generally equipment which is hard-connected is contractor installed, and equipment which is built-in is contractor furnished.
- Power Requirements: Electrical connection requirements, including volts, phase, wattage, receptacle type and emergency.
- Heat Output: Heat generated by the equipment, in both standing and running conditions.
- Special Requirements: Include any special or unusual parameters which could impact the placement, connections, installation or operation of the equipment. These vary widely and can include weight, vibration production or sensitivity, hazards, connections to building mechanical or utility systems, special environmental conditions, the need for ancillary or support equipment, and required adjacency to other equipment or laboratory component.

DRM Appendix G

Appendix G is a sample Equipment Schedule. The Schedule contains a level of information appropriate for many lab projects. Depending on the complexity of the project the A/E may simplify or expand the Schedule as appropriate, adding columns to included parameters important for the specifics of the project and its equipment. The Schedule is provided as an example, but it does not have to be used; the A/E may use a different format or layout that they prefer if it contains the requisite information.

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Design Requirements Manual **News to Use**

June 2017

Vol. 02, No. 6

The formulae $\frac{\partial \rho U_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho U U_j)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho\overline{U}\overline{U_j})=-\frac{\partial \overline{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial \overline{U_i}}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho\overline{U}\overline{H})=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial \overline{T}}{\partial x_i}-\rho\overline{u_i'h'}\right)$ biomedical research facilities.

Room Data Sheets: DRM Appendix F

During the programming and design development phases of any project it is essential to understand and document the functional requirements, features, and elements in every laboratory room. This information must be compiled by the architects and engineers (A/Es) through interviews with the users, surveys of the users' existing facilities, and experience with other laboratories with similar functions. The goal is to establish all of the salient parameters so that a safe and efficient laboratory can be designed.

The definition and compilation of requirements is the foundation of the Basis of Design (BOD), which is required for every project (see DRM Appendix E, A/E Submission Requirements). One key component of the BOD is the Room Data Sheet. Room Data Sheets are provided for a number of typical laboratory room types in Appendix F of the DRM.

Purpose

Room Data Sheets serve many purposes, including:

- Establishing a record of what has been requested by the users, and serving as a sign-off that all of the users' requirements have been accurately recorded.
- Defining functional requirements for reference action by multiple design disciplines throughout the design process.
- Documenting important aspects of the room for review by Division of Occupational Health & Safety (DOHS), Division of Physical Security Management (DPSM), Division of Technical Resources (DTR) and other applicable stakeholders as outlined in Chapter 2 of the DRM.

Process

The programming process must begin with an understanding of the workflow and processes of the lab, and any associated risks and hazards. Laboratory rooms are highly specialized by their nature and must be individually planned by A/Es experienced with laboratory design. Planning should be in consultation with staff familiar with the room's intended use, as well as all applicable stakeholders. Planning should strike the appropriate balance between flexibility and economy, should address the comfort and safety of room and building users, the performance of current and anticipated scientific procedures, and the efficient utilization of space and resources.

Once they have been determined, the physical and programmatic requirements of the rooms must be recorded in Room Data Sheets. Important aspects to be recorded, including but not limited to:

- Optimal requirements needed for the lab to function, including dimensions and basic environmental and utility needs. Also included are minimum DRM-mandated requirements for any lab, including accessibility, door size, ceiling height, handwashing sink, eye wash, flammable storage cabinet, and storage and equipment space.
- Safety and risk assessment of the lab. This will be done in conjunction with the lab users, DOHS, DPSM and other stakeholders, based on the procedures performed and the agents used in the lab. The assessment will determine the BSL level of the lab and the number and types of safety and containment devices, including but not limited to chemical fume hoods, biological safety cabinets, chemical storage and safety showers. Other requirements may include physical security devices, vestibules, and engineering systems.
- Whether the space is normally occupied, and by how many people. Appropriate workstations must be provided for occupants.
- Adjacency, proximity, or connectivity to labs or other functions within the building.
- Finishes, including floor, wall, ceiling, casework, and benchtops. These should address moisture, chemical wash-down, high traffic and other unusual conditions.
- Sensitivity to outside disturbances (e.g. noise, vibration, radio frequency radiation) and the need for remediation (e.g. shielding, vibration isolation).
- Environmental requirements, including temperature, humidity, air exchange rates, relative room pressurization, filtering and air quality.
- Services to be provided, including piped services (compressed air, vacuum, gasses), water (pure, domestic, lab).
- Equipment, including physical dimensions, installation and mounting (floor mounted or benchtop, loose or fixed), power and utility needs, and heat output. For large or equipment-intensive projects an Equipment Schedules should be used. See DRM Appendix G for sample Equipment Schedule.

DRM Appendix F

Appendix F provides 15 sample Room Data Sheets for common laboratory room types in BSL-2, BSL-3, ARF and other common facility types. The Room Data Sheets provided are not intended to be comprehensive and using them is not a substitution for a thorough programming process. These sheets are intended be used as a preliminary basis, and must be edited appropriately.

The forms provided in Appendix F are examples of Room Data Sheets with a level of information appropriate for many projects. Depending on the complexity of the project the A/E may determine that forms with greater or lesser level of detail are appropriate, and the A/E may have a different format or layout that they prefer to use.

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DRM Appendix F

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Design Requirements Manual **News to Use**

May 2017

Vol. 02, No. 5

The formulae $\frac{\partial \rho U_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho U U_j)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho\overline{U}\overline{U}_j)=-\frac{\partial\overline{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial\overline{U}_i}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho\overline{U}\overline{H})=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial\overline{T}}{\partial x_i}-\rho\overline{u_i'h'}\right)$ biomedical research facilities.

A/E Submission Requirements: DRM Appendix E

Construction documents (CDs) are critical elements in any construction project. Although the primary purpose of CDs is to convey the design intent of the designers to the contractor, CDs serve many other important functions, including:

- Providing the Division of Technical Resources (DTR) and other review offices with the information needed to review the documents for compliance with the Design Requirements Manual (DRM) and applicable codes and standards.
- Providing the Project Officer with information to ensure that all aspects of the contract are being met, that applicable Interim Life Safety Measures (ISLM) and Construction Risk Assessment (CRA), phasing and other aspects of the project are being addressed.
- Providing the facility users information to confirm that their programmatic requirements are being met, as defined in programming meetings and documented in the Basis of Design.
- Upon project completion, providing a basis for as-built drawings, to be used as a record of construction and for future maintenance work and renovation projects.

To address all of these prerequisites, Appendix E of the DRM, *A/E Submission Requirements* provides direction for the development and submission of CDs. Appendix E is not intended to establish the Scope of Work for individual design contracts but to provide baseline principles and good-practice requirements for CDs that can be applied appropriately for all projects.

Coordination, Constructability, Phasing and Maintainability

CDs are developed to be constructed, and their development must address the issues of coordination, constructability, phasing and maintainability, all of which impact construction schedule, cost and operations.

Coordination is required to ensure that the documentation of all disciplines, and of the documents within each discipline (plans, sections, details, specifications, Basis of Design) agree with each other, convey the same information, and do not have conflicts. It is a requirement that A/E dedicates the appropriate time and staff to fully review and ensure coordination of all project documents before submission to avoid request for information (RFI), change orders and delays.

Constructability is the ease and efficiency of the construction process. All construction documentation must be reviewed to optimize constructability by eliminating or minimizing potential obstacles, including incompatible systems, untried techniques or details, overly long-lead items, uncoordinated or incomplete CDs or overly complex phasing.

Phasing is the planned sequential construction of portions of a project so that areas come on-line and/or off-line in stages for the benefit of building operations or occupancy. The A/E must work with Project Officers to eliminate or simplify phasing where possible. The A/E shall develop clear and concise phasing documents for all disciplines so that the work during and at the end of all phases is complete and coordinated.

Maintainability means the facility is designed and constructed in a manner which promotes efficient and high quality maintenance procedures with minimal impact to facility function and operations. The A/E must review design concepts for maintainability with facility personnel early in the project to obtain their input. A facility design with maintainability as part of its central planning will result in increased user satisfaction, greater equipment longevity and lower life cycle costs.

Drawings

The construction drawings shall convey the required information in a manner that is easy to understand, follows industry standards, and is legible in all standard formats (digital and paper, in full and half-size). Drawings shall be prepared in CAD following the National CAD/CIFM Standards, and in Building Information Modeling (BIM) for large and complex projects, or as required in the Statement of Work (SOW). Specific NIH drawings standards, as outlined in Appendix E, shall be followed to ensure consistency and completion of information provided.

Specifications

Specifications shall be edited to reflect the specifics of the project. Each specification section must be carefully cross-referenced with the drawings and with other sections to ensure completeness and coordination. AIA MASTERSPEC® shall be used as the base document, and the A/E shall edit all MASTERSPEC® sections to ensure appropriate standards of quality for materials and systems, for conformance to the *DRM*, and to address specific project requirements.

Basis of Design (BOD) and Calculations

The BOD is a permanent record of the design process, including all requirements, decisions and rationales upon which the design is based. General BOD information include the Scope of Work, codes and standards, program, cost estimate and other required project-defining information. A BOD has discipline-specific sections that include narratives, equipment cut sheets, engineering calculations and other required discipline-defining information. Appendix E includes an outline of BOD requirements.

Metric Standards for New Construction

All final drawings and specifications for new construction shall be expressed in metric units or dual units (metric and imperial), unless other requirements are specifically provided by the project officer. The General Services Administration (GSA) Metric Design Guide, latest edition, and the Metric Guide for Federal Construction shall be used for guidance on how drawings, specifications, and other elements of metric implementation are to be addressed. All facility renovations and addition design projects shall be based on the unit type (i.e., metric or imperial) for which the facility was originally designed. Units in all design documentation (drawings, specifications, calculations, etc.) shall be consistent and shall not be mixed.

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Design Requirements Manual **News to Use**

April 2017

Vol. 02, No. 4

The formulae $\frac{\partial \rho U_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho U U_j)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho\overline{U}\overline{U_j})=-\frac{\partial\overline{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial\overline{U_i}}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho\overline{U}\overline{H})=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial\overline{T}}{\partial x_i}-\rho\overline{u_i'h'}\right)$ biomedical research facilities.

Finishes for Aseptic Facilities

In aseptic facilities (BSL-3, ABSL-3, cGMP, compounding pharmacies and other similar), finishes are a vital component in the facility's ability to function properly. The users and operators of these facilities require durable, easily cleanable, smooth, and non-shedding surfaces. Both designers and installers must be qualified and able to provide appropriate, well detailed, and well installed walls, ceilings, and floors. Section 4.4.5 of the 2016 Design Requirements Manual provides finish requirements for these facility types.

A/E's should consult facility users and stakeholders to determine the anticipated agents and methods used for cleaning, disinfection, or sterilization and protocols to be used by the program and select finishes which are compatible and will resist damage and degradation, including softening or discoloration. Materials selected should have a proven, tested record of performance with the chemical agents identified by the program. Testing shall be performed for agents individually and in combination. If a record of performance with agents is not available, a mock-up test should be conducted, documented, and passed prior to selection. It is recommended that at a minimum the finishes selected should be able to withstand regular cleaning, disinfecting and sterilizing by regular timed exposures the following chemical agents:

- Chlorine Dioxide
- 70% Isopropyl Alcohol (IPA)
- Vaporized Hydrogen Peroxide (VHP)
- Hydrogen Peroxide
- Phenolics (Vesphene IIse®, LPH®)
- Peracetic Acid and Hydrogen Peroxide (Peridox RTU®)
- IPA and Phenolics (Spor-Klenz®)

These are aggressive agents, which can rapidly degrade even quality finish materials. Coordination is required between the facilities group, the facility operators and/or cleaning vendors to ensure that these chemicals are properly applied, dwell on the surface for a sufficient time (which may vary, based on temperature and humidity) to ensure adequate kill of any agents of concern inhabiting that surface. Some agents may then need to be followed by an additional chemicals to inert, passivate, or remove the previous chemical from the surface to avoid degradation (especially perascetic acid). Chemicals field prepared from concentrate should be diluted with sterile water to avoid inadvertent surface contamination during the cleaning process.

As renovation of these facilities are complicated and costly, surface finishes should not be selected on first-cost, but on life-cycle cost basis. Systems should be impact resistant and have a minimal number of joints. All joints should be smooth, tight and sealed. Details should address eased outside corners and coved inside corners, particularly at the transition between ceiling to wall and wall to floor. All windows, doors, and mounted components should be detailed to promote cleaning and avoid horizontal ledges and difficult to clean seams and joints. All materials should resist damage due to exposure to heat and humidity as anticipated to be encountered in the life cycle of the project without degradation. All finish material selections should exhibit mold and mildew resistant properties. Wall systems should be impact-resistant and all finishes should be installed over cellulose-free (inorganic-faced) substrates.

Panelized Composite Systems:

Panelized composite wall and ceiling systems are often preferred due to their controlled-environment manufacturing, design versatility, chemical resistance, pressure/airflow resistance, and pre-engineered details. When using a panelized composite system, the A/E should ensure that:

- Installation is accomplished by manufacturer-approved installers.
- Substrate material and detailing is inspected and certified as acceptable by the manufacturer.
- A mock-up of critical details (transitions, penetrations, joints, etc.) is provided and acceptable for their intended purpose.
- Adhesives, sealants, and other components are chemical resistant and able to withstand cleaning as system panels.
- Panel systems have a Class "A" Fire Rating, both as a composite assembly and for the surface alone.

High Performance Reinforced Multi-coat Resinous Finishes:

High performance, reinforced, multi-coat, resinous paint finish on impact, water, and mold-resistant substrate can be considered for assembly finishes if there are functional advantages over panelized systems. If using a multi-coat resinous paint finish, the A/E should ensure:

- Applicators are certified as a Coating Application Specialist (CAS Level II) by the Society for Protective Coatings (SSPC) and trained and approved by the paint system manufacturer for the application of the specific products and techniques required for the application.
- Paint manufacturers inspect and certify acceptable site conditions, including environmental conditions and the condition of the substrate prior to application.
- Daily logs of the application are maintained, including wet film thickness measurements, mixture, cure, and coverage rates room-by-room, or surface-by-surface within larger rooms.
- Cure times, pot life, temperature and humidity, consistency of application, protection and other manufacturer requirements are strictly maintained.
- All applications are inspected by an independent, third party, certified coating inspector (CIP Level 3).
- The finished application is Class "A" Fire Rated.
- Components of the application are from the same manufacturer, to the greatest extent possible.

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DRM Chapter 4, Section 4.4 & 4.5.5

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Design Requirements Manual **News to Use**

March 2017

Vol. 02, No. 3

The formulae $\frac{\partial \rho U_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho U U_j)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho\overline{U}\overline{U_j})=-\frac{\partial\overline{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial\overline{U_i}}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho\overline{U}\overline{H})=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial\overline{T}}{\partial x_i}-\rho\overline{u_i'h'}\right)$ biomedical research facilities.

Research Laboratory – Planning Fundamentals

Before executing the design of a research laboratory project, whether it's new construction or a major renovation, it's recommended that certain activities are conducted during what is commonly called predesign. The predesign phase, which consists of both programming and planning, helps to identify and document factors that impact the project and that the design will meet the objectives of the end user. With regard to research laboratories, this includes a wide range of parameters such as the type of research, projected staffing, space requirements, existing conditions, budget, energy, life-cycle costs and considerations for future growth. The 2016 edition of the NIH Design Requirements Manual provides updated details and requirements associated with Planning and Programming in Chapter 2. Outlined below are some key planning fundamentals that should be considered during the predesign phase for research laboratories.

Identification of Stakeholders:

The NIH requires an integrated planning and design process that seeks the active and continuing participation of all stakeholders who are affected by the project from planning through activation and operation of the facility. Active participants include those involved in the development of the program and project plan. Examples of some common types of stakeholders include those with executive oversight of a Program such as the Scientific Director; end users such as Principal Investigators, their delegates, and technical staff; the architect/engineer; administrative personnel, facility manager and those with oversight over security, safety and information technology.

Project Program:

A research laboratory project includes a definition of the program for the facility, stating requirements that include organizational and design concepts, facts, goals, and space needs. A laboratory project program requires an understanding of the general processes and specialized functions to be conducted within a research lab. Different fields of research have varying demands for bench configuration, containment devices, lab utilities, support space, equipment density, safety and other criteria. Development of the project program with identified project parameters and the data collected help ensure the process, needs and requirements of the research laboratory have been understood, documented and recorded.

Laboratory Planning:

The laboratory planning process utilizes program data obtained to develop well organized, coordinated spatial concepts that successfully address user goals, functional needs, project parameters and design requirements. Adequate space should be provided to accommodate clearance requirements and laboratory components including chemical fume hoods and/or biological safety cabinets (BSC's), laboratory benches, equipment storage, and desk space. Below is a brief list of items that should be considered while engaged in laboratory planning.

1. **Determining Staffing and Space Requirements:** Each laboratory has unique program characteristics to support the number of research staff and the science behind it. The actual occupancy of each laboratory should be determined before moving towards design.
2. **Functional Relationships:** Laboratory facilities are typically organized into two basic zones: a personnel zone and a laboratory zone. The organization of the laboratory facility will be determined by the structure and operation of the program as well as practical, safety and ergonomic factors.
3. **Workplace Enhancements:** Some laboratory personnel spend a great amount of time in the lab, therefore research laboratory design should promote physical and psychological well-being and look to achieve high aesthetic, ergonomic and safety standards. This includes incorporating natural lighting, creating areas of interaction and collaboration, and increasing safety measures separating the workstation from the lab for lab personnel.
4. **Flexibility:** Designing a research lab that allows for flexibility and adaptability ensures that a laboratory can meet evolving research needs, functional changes and accommodate changing technologies in conducting scientific procedures. Examples of planning concepts surrounding flexible design include modular design, open laboratory design, careful consideration of select laboratory furnishings, and the selection of utility systems.
5. **Occupational Health and Safety Considerations:** Identifying, evaluating and mitigating potential hazards (Risk Assessment) within a laboratory environment is another essential planning element. The risk assessment process considers both biological agent and laboratory procedure hazards to determine the appropriate Biosafety Level (BSL) as well as other precautions. BSL criteria address standard microbiological practices, special practices, safety equipment, HVAC and pressure differentials, and laboratory facility design. All laboratories designed for the NIH shall be designed to BSL-2 as a minimum standard in accordance with the latest edition of the *Biosafety in Microbiological and Biomedical Laboratories (BMBL)*. Risk assessments are crucial for identifying the risks that are inherent with working with biological material and developing the appropriate safeguards.

The information provided here are just a few fundamental guidelines that should be considered during the predesign phase. Identifying the objective, goals, budget, and defining the program of requirements all contribute to helping ensure the success of the project. For more details and information as to the how the NIH establishes requirements on Planning and Programming for research facilities, please refer to Chapter 2 of the 2016 edition of the NIH Design Requirements Manual.

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DRM Chapter 2, Section 2.1

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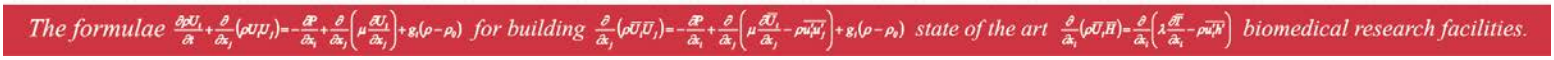
Design Requirements Manual **News to Use**

February 2017

Vol. 02, No. 2



Electrical Work Space

Electrical work space around electrical equipment is required to ensure the safety of maintenance electricians. It is necessary for facilities to be designed to provide all electrical equipment with sufficient access and workspace for safe and efficient maintenance and service of energized equipment in accordance with the latest edition of National Electrical Code (NEC). The following is an excerpt of Chapter 10, Section 2.4 *Electrical Work Space* of the 2016 DRM, which has been revised to consolidate and clarify requirements. Coordination is required with architect and other disciplines to comply with the following requirements.

10.2.4 Electrical Work Space

A. Location: Transformers, secondary substations, distribution switchgears, generators, transfer switches and other electrical distribution equipment shall not be located at the lowest points of the buildings below grade level. In addition, comply with the following requirements:

1. **Medium Voltage Transformer:** The optimal location for the medium voltage primary service transformers is indoors in a transformer vault, located separately from the service entrance switchgear room, and not in the same room as the emergency power distribution gear. The secondary service bussing shall be kept as short as possible and electrically the same length (± 10%).

2. **Low Voltage Distribution Equipment:** Locate all branch circuit panelboards and distribution panels at the center of the area being served, secured from the general public. Electrical loads shall be served from the panelboards located on the same floor and located closest to the load.

Exceptions: Lighting and power circuits within vertical stairways, elevator shafts, roofs, and interstitial areas.

B. Clearances: Provide the minimum required clearances per code for all equipment. Provide 76 mm (3 in.) minimum separation between panelboards. Lay out the electrical equipment in electrical rooms and closets such that there is an unobstructed exit path out of the room. The following minimum clearances are required for new projects around secondary switchgear:

1. 1,524 mm (5 ft.) in front
2. 1,067 mm (3 ft. 6 in.) in rear
3. 914 mm (3 ft.) on the ends

Consider additional clearance for the equipment being racked out.

C. Electrical Room and Transformer Vault: Install all substations, switchgears, switchboards, transformers, and network protectors in dedicated electrical rooms or vaults. Equipment installation shall meet the following requirements:

1. **Room Size:** Size electrical rooms to accommodate current electrical equipment and required clearances. Consideration should be given to additional room for future anticipated growth.

2. **Clearance:** Provide clear working space around the equipment in accordance with electrical code and this manual. Columns shall not encroach on the clear working space required around equipment.
3. **Other Equipment:** Piping, ducts, or equipment not serving the dedicated electrical rooms shall not be permitted to be installed in the electrical rooms or traverse the electrical rooms.
4. **Ventilation (and/or cooling):** Rooms with transformers shall have ventilation (and/or cooling) sufficient for 2% of the total transformer kVA expressed in watts of heat load. Coordinate cooling requirement with HVAC system design. Refer to Chapter 6, Mechanical Design.

D. Electrical Closets: Electrical closets shall be provided for every 929 m2 (10,000 ft2) of area served by 208/120 V branch circuit panelboards; for every 1,858 m2 (20,000 ft2) of area served by 480/277 V lighting panelboards. Locate panelboards so that the farthest 120 V device/equipment served is no more than 30 m (100 ft.) away. General requirements for electrical closets are as follows:

1. **Stacking:** Vertically stack electrical closets in multistory buildings.
2. **Sleeves:** Provide sealed, water-tight sleeves, extending at least 76 mm (3 in.) above the floor, through the holes in floors of electrical closets.
3. **Location:** Closets shall be located away from the mechanical shafts; coordinate location with all other building systems, particularly those located in the ceiling plenum directly adjacent to the closet.

Exception 1: *Shallow closets with full doors on the long wall are acceptable in lieu of electrical closets for smaller renovations.*

Exception 2: *Secure service corridor may be used for the installation of panelboards.*

E. Equipment Removal Route: A permanent exit route shall be provided for the large electrical equipment including transformer, generator, switchgear, etc., to remove the large equipment and bring in new replacement units. A faulty transformer shall be capable of being removed while the other transformer(s) and equipment remain in place and in operation. Provide painted stripes and warning signs on the floor and walls along the exit (removal) route. See Section 5.1.5, Equipment Access.

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DRM Chapter 10, Section 10.2, Chapter 6, Chapter 5.

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Design Requirements Manual **News to Use**

January 2017

Vol. 02, No. 1

The formulae $\frac{\partial \rho U_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho U_j U_i)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho\overline{U}_i\overline{U}_j)=-\frac{\partial \overline{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial \overline{U}_i}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_j}(\rho\overline{U}_j\overline{H})=\frac{\partial}{\partial x_j}\left(\lambda\frac{\partial \overline{T}}{\partial x_j}-\rho\overline{u_j'h'}\right)$ biomedical research facilities.

'Design Requirements Manual (DRM) News to Use' is a monthly ORF publication featuring salient technical information that should be applied to the design of NIH biomedical research laboratories and animal facilities. NIH Project Officers, A/E's and other consultants to the NIH, who develop intramural, extramural and American Recovery and Reinvestment Act (ARRA) projects will benefit from 'News to Use'. **Please address questions or comments to:** shawm@mail.nih.gov

The 2016 NIH Design Requirements Manual

The National Institutes of Health (NIH), Division of Technical Resources (DTR) has now released the 2016 edition of the NIH Design Requirements Manual (DRM). The 2016 DRM was made effective on December 12, 2016 and is applicable to all design and construction projects in NIH owned and operated facilities or other facilities where construction is funded by the NIH. All design and construction contracts initiated after the effective date will be required to follow this newest edition. The 2016 DRM constitutes a major restructuring and reorganization of the previous edition with the inclusion of vast amounts of new and updated information for architects & engineers (A/E) and stakeholders to use in the facility design process.

The 2016 DRM is the most comprehensive design guide of its kind in the U.S., providing guidance to design professionals for building complex research facilities and other similar facilities. Drawing on NIH's lengthy expertise and experience with research facilities and infrastructure, the updated DRM provides insight into the intricacies and best practices involved in the design and operation of these spaces.

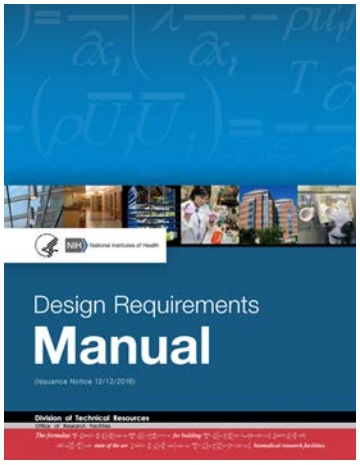
To coincide with the release of the new DRM, DTR will also be revamping the News to Use publication. Volume 2 of News to Use will cover the most recent information provided in the 2016 DRM as well as the latest in technology and relevant NIH facility construction practices.

Revisions from the 2008 DRM:

The 2016 Design Requirements Manual has undergone major changes and restructuring from the 2008 edition. Every chapter and appendix has been revised to align with the latest trends and practices in research facility design.

Some of the notable additions / changes to the 2016 edition are as follows:

- **Updated Sustainable Design Information:** In order to meet new and changing sustainability goals, the DRM now provides further guidance on the design of facilities with smaller carbon footprints and reduced energy consumption. Many new technologies, from LED lighting to better building envelope construction, have been incorporated into the requirements and align with the latest federal mandates and executive orders.
- **New Information on Critical Facilities:** As research is ever changing, so are the requirements for engineering and construction of complex research facilities. Critical facilities such as cGMP and BSL3 require systems and architecture that work in conjunction with the research being conducted. The 2016 DRM provides the latest guidance on the design and construction of these complex spaces.



- **New Information on Disaster Planning & Common Engineering Issues for Research Facilities:** Failures in engineering and architecture systems can result in disruption of operations or worse, the loss of research. Protecting research is paramount as its true cost is almost incalculable. NIH has a significant amount of expertise and lessons learned from the design and operation of research facilities and in the new 2016 DRM, DTR has included many of these valuable lessons and insights into assessing and protecting research buildings and infrastructure.
- **User-Friendly:** The 2016 DRM contains significantly more diagrams and graphics to help illustrate complex planning & design concepts. Additionally, the 2016 DRM is in an easier to read, two-column format with internal links to make reading significantly more comfortable. Lastly, the updated DRM now contains "Rationales" to help explain complex or commonly misunderstood architecture and engineering requirements.
- **New Appendices & Reference Documents:** New and updated appendices provide more concise and valuable direction to A/Es. Some new and updated appendices include: A/E Submission Requirements, Room Data Sheets, and a Sample Equipment Schedule, among others.

After a long and methodical process, the 2016 DRM has been published. It is through the efforts of many dedicated individuals that the 2016 DRM has become a reality. DTR extends our sincerest thanks to all of the people who helped improve and refine the 2016 NIH Design Requirements Manual.

Further details on this month's topic are available on the DRM website
https://www.orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/DesignRequirementsManual2016.aspx