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

Design Requirements Manual **News to Use**

August 2023

Vol. 02, No. 73

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.

Animal and Lab Lighting Control

Lighting control in animal rooms and laboratories can be accommodated using either central or dedicated (stand-alone) control systems. This article provides some considerations for selecting and applying them.

Lighting Control – Animal Rooms

Central Control Systems

Lighting control systems for animal holding areas are programmable using either a central automation system or a stand-alone system. In the former, the diurnal light system within a vivarium is networked and integrated with a centralized building system (e.g., dedicated lighting control or building management system) using an interface, typically an 8-pin Cat-6 modular jack. The interface will send signals through the jack to the lighting contactors that control lighting circuits or the relay cabinet. To ensure consistent diurnal cycles, on/off times and override durations are routinely checked and adjusted by authorized animal facility personnel.

A central system allows individual rooms to be programmed independently to provide customized operation based on animal species and research protocols. In this scenario, a photocell connected to the control system is placed in each holding room to monitor the actual lighting conditions. Photocell light level data (in foot-candles) should be recorded at appropriate intervals and the data should be maintained in the historian. At minimum, the photocell data must record lighting on/off operations. If the system needs to be controlled in multiple locations, it can be configured on the monitoring/control system using several PC-based systems that can be accessed over a LAN or the internet, where permitted (internet/wireless access is not permitted on NIH CIT systems), so it can be monitored and controlled remotely.

Stand-Alone Systems

In a stand-alone system, individual astronomical timers control the lighting of small new facilities and small renovations. A stand-alone system can be overridden, adjusted, or controlled through a terminal located within the vivarium administrator/manager's office. The responsible veterinary staff supervisor/manager determines and approves dimming control requirements to simulate dusk and dawn circadian cycles.

Lighting Control – Labs

Central Control Systems

Multiple laboratories can be controlled from a central location using a lighting control panel. To achieve this, all the addressable input devices such as occupancy sensors, photo sensors, digital switches, etc. and the fixtures (load) from each lab are wired to the panel's relay cabinet(s). When any input device is activated, the panel's processor compares the signal received from that input device with the software instructions and changes the state of the relay(s) accordingly.

The load (accounting for low-voltage transformer losses, if applicable) should not exceed the relay or controller's power rating designated for the given electrical feed voltage. The wattage of each connected fixture will determine how many fixtures can be powered by each controller output, with the total load in the control zone used to determine the number of outputs.

Stand-Alone Systems

Lighting control systems in laboratories are programmable based on the type of space. Lighting will automatically turn on to 50% light output when ceiling-mounted occupancy sensor(s) detect an occupant in the space. The occupant can then override the lighting fixtures to 100% light output or turn them off using a digital control switch as needed. Additionally, the occupant can set dimming levels using the raise and lower buttons/levers on a wall-mounted digital dimmer light switch. The light fixtures will automatically turn off 15 to 20 minutes after the lab becomes vacant.

If an occupant experiences false triggering or lack of triggering, the occupancy sensor's sensitivity needs to be adjusted on-site. This involves connecting the sensor's passive infrared module to a general-purpose operational amplifier circuit. Another way of increasing the sensitivity is by changing the value of a resistor or capacitor in one of the operational amplifier stages.

Daylight Harvesting

When a lab is situated adjacent to the building perimeter and has window(s) or other means of daylight transfer, daylight sensors shall be provided in lab spaces. Lighting in lighting zone(s) will automatically dim based on the daylight distribution to maintain the required light level (in foot-candles) in the lab.

Digital Lighting Control

In a traditional analog control system, the basic building block of lighting control is to zone the lighting circuit or subcircuit, with sizing being limited by the load carrying capacity of the circuit as well as the zoning/rezoning through hardwiring. In digital control systems (as described above), control devices are connected using only a single low-voltage wiring bus, and the zoning/rezoning is implemented via software, with zoning as small as a single fixture. Verification of a system's operation, changes to programming, and trending of system operation can be done remotely. As digital systems typically offer two-way communication, monitoring can be accomplished for maintenance and energy data collection.

'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/Es 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:** mario.orellana@nih.gov