

News to Use

Design Requirements Manual

The formulae $\frac{\partial x_i}{\partial y_j} + \frac{\partial (pU_i)}{\partial y_j} = -\frac{\partial p}{\partial y_j} + \frac{\partial (pU_i)}{\partial y_j} + g_i(\rho - \rho_0)$ for building $\frac{\partial (pU_i)}{\partial y_j} = -\frac{\partial p}{\partial y_j} + \frac{\partial (pU_i)}{\partial y_j} - \rho_0 u_j$ + $g_i(\rho - \rho_0)$ state of the art $\frac{\partial (pU_i)}{\partial y_j} = \frac{\partial (pU_i)}{\partial y_j} - \rho_0 u_j$ 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: ms252u@nih.gov

Building Automation Systems – Part II BSL3, Animal Holding Room and ABSL3 Requirements

Level 3 Biological Safety Laboratories (BSL3) and Animal Biological Safety Laboratories (ABSL3) facilities are critical zones designed with robust directional airflow controls and pressurization monitoring systems. The control sequence and actual responses of all drives, sensors, fans, dampers and damper actuators shall be carefully examined, implemented and maintained at all times.

The following summarizes the Building Automation Systems (BAS) requirements generally implemented where applicable:

BAS components shall be selected and tested so that in any realistic failure scenario (power failures, single or multiple component failures, maintenance functions, etc.), the airflow will not be reversed; automatic dampers shall fail in safe positions; the supply air flow rate will decrease more quickly than the exhaust for negative containment spaces or vice versa for positive spaces.

Differential pressure monitors on critical containment zones shall be provided to indicate the room differential pressure (visual readout) and shall alarm when the pressure goes beyond adjustable thresholds and time durations established in concert with the Division of Occupational Health and Safety (DOHS) and the researcher.

Airflow tracking control shall maintain differential pressures of -12.5 pa (-0.05 inch of water) and -25 pa (-0.1 inch of water) between adjacent spaces. There shall never be a condition in which the control system goes outside this range for more than two minutes and directional airflow must be sustained by drawing air into the laboratory from "clean" areas toward 'potentially contaminated areas'. Additionally, a visual strobe shall alarm whenever any given space pressure becomes the reverse of its intended pressure for more than 20 seconds (i.e., when a negative pressure space becomes positive) or whenever the HVAC system fails. The laboratory shall be designed such that under failure conditions the airflow will not be reversed.

Air valve damper actuators shall be 'fast -acting' able to stroke the dampers within 2 seconds. Damper fail positions shall be selected to fail in the direction that would maintain pressurization. Fail in last position actuators shall only be used with specific permission. If a BSL3 facility requires multiple levels of room pressurization, digital differential pressure monitors shall be provided for each pressure controlled zone and shall monitor pressure between each zone and its adjacent reference zone. Pressures shall be maintained to ensure proper directional airflow between zones.

All controllers in a BSL3 lab area shall be provided with stand-alone capability at the suite level. The A/E shall clearly indicate both tracking relationships between airflow terminals and clearly indicate the bio-containment boundaries of a suite that shall be controlled by the same controller. The A/E shall work with the researcher to analyze the potential for loss of containment due to a controller failure or a controller LAN communication failure and design the controller configuration to minimize risk. Fail positions of the air valves shall be such that containment shall be maintained in the event of failures.

In BSL3 spaces, as the spaces are constructed "tight" to have minimal leakage, a cross-limiting loop shall be provided (the control sequence shall automatically reset the flow rate set point in the lead terminal box upon detection of excessive flow differential) to restrict the leading system from exceeding the lagging system by a specified value which shall be set to prohibit excessive door opening forces. As an example, if the normal offset is to have the general exhaust volume 150 cfm higher than the supply, another control loop shall restrict the general exhaust flow to no more than 300 cfm above the supply. Values shall be set such that the control loops do not interact under normal operation. Cross limiting does not apply to chemical fume hoods, biosafety cabinets, canopy hoods, or other safety equipment.

Controllers monitoring and adjusting the HVAC in BSL3 areas shall be primary controllers. Zone terminal unit controllers shall be on uninterruptible and emergency power so they can continue to control through power interruptions. Controllers shall have the capability to automatically restore their volatile memory upon loss of current.

Use a hard-wired interlock between supply controller and exhaust controller to provide supply and exhaust system status so that the lagging system can confirm operation of the leading system in the absence of the controller LAN communication. Where multiple controllers are controlling the exhaust system, status outputs shall be wired in parallel.

Where fireman's override controls are used, the A/E shall consult with the Division of the Fire Marshal (DFM) to determine the damper positions when the override mode is activated. They shall continue normal operating positions, but this shall be evaluated on a case by case basis.

Animal Holding Rooms and ABSL3:

Animal care shall always take precedence over system component protection. Animal holding rooms shall be controlled to temperature, humidity, airflow on a room by room basis. The control strategies are similar to those for the lab BAS control requirements.

The monitored points and hardware requirements associated with the zone (for zone related equipment requirements, see the applicable equipment) shall be as follows:

- Space Temperature (high accuracy and water proof sensor).
- Space Differential Pressure with local indication (where differential pressure is monitored).
- Space Humidity (+/-5% of set point when humidifier is used).
- Supply Air Humidity.
- Supply Air Humidity for High Limit (if not done with a local limit).
- Air Change Calculation either via terminal flow sensors or flow measuring stations.
- Light level monitoring shall be considered but may be part of a separate system as long as the required Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) data is stored.
- Supply/exhaust velocity (total/static differential) pressure.

Where Animal Holding Rooms are classified as ABSL3, requirements of BSL3 laboratories apply.