

The formulae $\frac{\partial \rho U_i}{\partial x} + \frac{\partial (\rho v U_i)}{\partial x_j} - \frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j} \left(\mu \frac{\partial U_i}{\partial x_j} \right) + g_i (\rho - \rho_0)$ for building $\frac{\partial (\rho U_i H)}{\partial x_j} - \frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j} \left(\mu \frac{\partial U_i}{\partial x_j} - \rho v U_i \right) + g_i (\rho - \rho_0)$ state of the art $\frac{\partial (\rho U_i H)}{\partial x_j} - \frac{\partial}{\partial x_i} \left(\lambda \frac{\partial T}{\partial x_i} - \rho v H \right)$ 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.

'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

Further details on this month's topic are available on the DRM website DRM Chapter 6, Section 1

<https://www.orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/DesignRequirementsManual2016>