DESIGN STANDARDS

The USAMRIID recapitalization project is being built in accordance with the following Loads and Serviceability Criteria Standards:

1. International Building Code 2006
2. American Society of Civil Engineers, “Minimum Design Loads for Buildings and Other Structures” (ASCE 7-05)
3. Department of Defense (DoD) – Unified Facility Code (UFC) 1-200-1 General Building Requirements
4. DoD – UFC 3-220-01A/Deep Foundations
5. DoD – UFC 3-310-01 (25 May 2005)/Structural Load Data
6. DoD – UFC 3-310-04 Seismic Design For Buildings
7. DoD – UFC 4-010-01/DoD Minimum Antiterrorism Standards for Buildings
8. DoD – UFC 4-023-03/Design of Buildings to Resist Progressive Collapse
9. American Society of Civil Engineers, “Design Guide II, Floor Vibrations due to Human Activity”

(We can provide copies of 1 and 9 and the others are readily available on-line.)

DESIGN FEATURES

The new USAMRIID has been designated occupancy category III as defined in the International Building Code (IBC) (Enclosure 1). Category III was selected based on occupant load greater than 500 and building contents that include “sufficient quantities of toxic or explosive substances to be dangerous to the public if released.” In occupancy category discussions, we determined that the facility could sustain moderate damage in a large (rare) event. Terms associated with damage and event are subjective, but the attached (Enclosure 2) includes extracts from several reference materials that provide the definitions used.

The USAMRIID replacement facility has been designed to comply with criteria established within the IBC and DoD Unified Facility Criteria (UFC) to resist effects of wind, earthquake and snow events. Of significance in this discussion is the effect of wind as related to events such as hurricanes and tornados, along with the seismic impact of earthquakes. The facility is designed to the following criteria for lateral loads:

<u>Wind Criteria</u>:

Tornados: In the past 60 years, Frederick has experienced less than 1 recorded F3, F4 or F5 tornado, which would register as above 160 to 200 miles/hour. With the factor of safety designed into the USAMRIID replacement, on top of the required criteria, the facility can withstand large events such as a F1 and F2 tornado which is significant at 113-160 mph.

Hurricanes: Frederick is not located in the coastal regions that are affected by hurricanes, and as such hurricanes do not drive building design. The greatest impact to Frederick from a hurricane is rain. Regardless, the local codes take into effect hurricane force winds where appropriate. As a precaution, the USAMRIID replacement facility is designed to perform without structural or non-structural damage through a large event like a Level 2 hurricane, which has sustained winds of up to 110 mph.

Wind Speed = 90 mph
Exposure = C
Importance Factor Iw = 1.15

Soil Pressures:

Basement: A soil pressure of 109 psf (EFW) has been utilized in accordance with the Addendum to May 2008 95% Geotechnical Report.

Tunnel: A soil pressure of 109 psf (EFW) has been utilized in accordance with the 95% Geotechnical Report.

Seismic Criteria:

Frederick is designated a seismically quiet zone with Marylanders more likely to feel an out-of-state earthquake than an in-state one. This translates to a 2.0 equivalent earthquake. The greatest magnitude earthquake registered in Maryland was 3.7 (small). In the event of a moderate earthquake, which is understood as approximately a 5.0 to 6.0, the building is anticipated to experience no structural or non-structural damage. The facility may sustain moderate damage (some localized repairable structural damage) in a large 7.0 (rare) event, but emergency systems would remain operational.

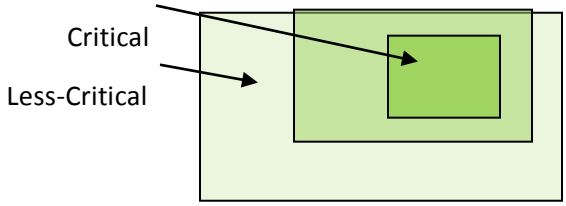
Site Class D
Occupancy Category III
Ss = 0.161
S1 = 0.051
Fa = 1.6
Fv = 2.4
SMS = 0.161 x 1.6 = 0.258
SM1 = 0.051 x 2.4 = 0.122
SDS = 2/3 x SMS = 0.172
SD1 = 2/3 x SM1 = 0.082
Seismic Design Category = B
Importance Factor IE = 1.25
R = 3
Cd = 3

Seismic Restraint of Non-Structural Components:

Based on the project's Seismic Design Category B, seismic restraint will be provided for non-structural components (A/M/E/P) related to life safety (i.e. fire protection systems, etc.) and items containing hazards (i.e. flammable or toxic hazards). Restraints for systems other than these code minimum requirements are planned (i.e. ducts from the BSL-3 and BSL-4 laboratories to their HEPA filters, etc.)

Based on the increased level of importance of the facility due to the building function (research involving infectious agents), wind, earthquake and snow loads used in the building structure design are larger than those used in a standard building design. Non-structural systems (architectural, mechanical, etc.) also have improved system reliability and survivability above code minimum requirements. In addition, the facility design meets these additional criteria that add to the facility stability in the event of a natural disaster.

Inherent in the building design is a layering of less-critical to critical functions that can best be described as "a box within a box." This layering provides additional protection from natural disasters as functions become more critical.



The building structure is comprised of concrete and steel and enhancements have been incorporated to make the building structure more robust than a normal, heavy framed research facility. The building envelope has been strengthened for force protection, which includes the use of laminated glass restrained in the frame to protect against glass hazards and prevent the glass from leaving the frame. Non-structural systems have undergone more rigorous analysis than normal and are, in response to this analysis, more robust. This includes additional seismic bracing of mechanical systems above building code minimum requirements.

The critical functional areas have been designed to standards that provide significant additional protection to the containment functions above and beyond the overall building structure. As a result, these critical areas are designed to handle twice the potential impact indentified above.

Frederick, MD is an area of moderate frequency, small events. This description translates into being an area that has events that are well below the design level events.

HAZARD ASSESSMENTS

The EIS assessed the following hazards:

1. Biological aerosol release from a BSL-3 laboratory

2. Biological aerosol (liquid) release from a BSL-4 laboratory
3. Escape of an infected animal (rodents and lagomorphs, nonhuman primates)
4. Biological agent shipping
5. Terrorist acts
6. External acts (accidental release of biological test materials, fire or explosion, accidental aircraft crash)
7. Potential risk to the public from contact with BSL workers
8. Cumulative impacts of the above (1-7) associated with the operation of the three NIBC containment laboratories

During the NRC study, the committee asked for additional information about infected animal and insect escape. The following information was provided:

Information on any animal escapes (species, numbers, location):

No animals have escaped from the USAMRIID into the local community. Very sporadic occurrences of animals escaping or being accidentally released from their primary enclosures (cages) have been documented. In all but one instance, the animal(s) was/were safely captured and returned to their enclosure without escaping the actual housing room in which they were maintained. The only known exception involved two nonhuman primates (NHP) that were discovered in late 1995 in a walled off, nonfunctional elevator maintenance room during a renovation project in building 1412. That incident was fully disclosed to the local media in a press release dated November 3, 1995. Those are the only animals ever known to have escaped both their primary enclosure and the room in which they were housed.

The escape of the two animals was known at the time of occurrence, but due to the unique construction of the building and security of all possible exit points, the animals were deemed lost in the building and not capable of escape to the outside. Based on examination of the two animals after they were discovered, it was believed that they gained access to the elevator mechanical room when it was still accessible and operational, but were never able to get back out. Due to the elevated temperatures and extremely dry conditions in this area of the building, the animals succumbed and essentially mummified. The access was at some point sealed over and the animals were never found until the renovation project began. These animals were never exposed to any biological agents and were not housed under containment conditions at the time of their escape.

Numerous measures are taken to ensure that animals do not escape from their primary enclosures and very specific standard operating procedures are in place (e.g. USAMRIID SOP AC-03-01) to address the extremely rare occurrence of an animal that may escape from a primary enclosure. NHP cages have numerous security latches and are further secured by use of padlocks. Rodents and other small to medium- sized research animals are also secured within closed caging systems or open systems with secure latching mechanisms or openings too small to allow the animals to escape. All housing and procedure rooms are equipped with self-closing doors as recommended by

the “Guide for the Care and Use of Laboratory Animals.” Movement of animals between different areas of the Institute is conducted using a combination of anesthesia (for NHP) and secure transport containers or closed small cages with tops secured using retaining devices.

Daily monitoring of animals:

In non-containment, NHPs, rabbits, and rodents are observed by both caretakers (for cage condition and overall animal condition) and technicians or veterinarians (health and welfare rounds) 365 days a year.

In containment, animals are observed at least once a day, 365 days a year. For safety and security reasons, we limit the number of personnel entering these areas, and therefore, the caretaker may be the only person observing these animals on any given day. However, for animals under study and requiring treatments, diagnostic sampling, or monitoring for illness, there may be personnel entering those rooms and observing animals up to 4 times a day. Closed Circuit Television (CCTV) cameras are also present in all containment animal rooms.

Information on any insectary escapes (species, numbers, location):

None. Because of the potential for an infected arthropod (e.g., mosquito or sand fly) to actively transport a pathogen, strict safety measures are in place to prevent escape. At USAMRIID, all work with infected arthropods is conducted in Suite AA-1, an animal biological safety level-3 (ABSL-3) laboratory specifically designed for arthropod research. All arthropods are maintained in cages with either a dental dam-covered entrance hole or a stocking net sleeve to provide for the introduction or removal of arthropods. The mosquito cages are placed in a secondary container, a clear plastic bag, before being placed in a climate-controlled incubator (tertiary containment). The incubators are in a room with the floor, walls, and ceilings painted white to make it easier to spot an escaped arthropod, if it should occur. The room where mosquitoes are inoculated with virus opens to another insectary room (also painted white throughout). That room is at negative pressure relative to, and opens into, the central corridor of the ABSL-3 laboratory. There are two UV light “Bug Zappers” located in this corridor to capture/kill any potential escaped insects that make it to that point, but none have ever been captured. The corridor is also equipped with two screens distal to the Bug Zappers.

To leave the containment insectary laboratory, an individual working there has to travel from the corridor into an inner change room, remove all clothing, enter a shower, and then exit into an outer change room to put “street” clothes back on. The scrubs worn in the laboratory are autoclaved before removal from the suite. The door from the central corridor is at negative pressure to the inner change room, which is at negative pressure to either the exiting shower or entrance corridor, both of which are at negative pressure to the outer change room. The outer change room is at negative pressure to a non-containment corridor. There are three additional doors before access outside the

building. Many of these doors have security device requirements. Taken together, it is extremely unlikely that any arthropod, infected or not, would ever be able to escape from this containment laboratory.

In accordance with the NRC report, the hazard analyses will not be repeated based on the committee's high degree of confidence in the policies and procedures in place at USAMRIID to provide protections for workers and the public.

TABLE 1604.5
OCCUPANCY CATEGORY OF BUILDINGS AND OTHER STRUCTURES

OCCUPANCY CATEGORY	NATURE OF OCCUPANCY
I	Buildings and other structures that represent a low hazard to human life in the event of failure, including but not limited to: • Agricultural facilities. • Certain temporary facilities. • Minor storage facilities.
II	Buildings and other structures except those listed in Occupancy Categories I, III and IV
III	Buildings and other structures that represent a substantial hazard to human life in the event of failure, including but not limited to: • Covered structures whose primary occupancy is public assembly with an occupant load greater than 300. • Buildings and other structures with elementary school, secondary school or day care facilities with an occupant load greater than 250. • Buildings and other structures with an occupant load greater than 500 for colleges or adult education facilities. • Health care facilities with an occupant load of 50 or more resident patients, but not having surgery or emergency treatment facilities. • Jails and detention facilities. • Any other occupancy with an occupant load greater than 5,000. • Power-generating stations, water treatment for potable water, waste water treatment facilities and other public utility facilities not included in Occupancy Category IV. • Buildings and other structures not included in Occupancy Category IV containing sufficient quantities of toxic or explosive substances to be dangerous to the public if released.
IV	Buildings and other structures designated as essential facilities, including but not limited to: • Hospitals and other health care facilities having surgery or emergency treatment facilities. • Fire, rescue and police stations and emergency vehicle garages. • Designated earthquake, hurricane or other emergency shelters. • Designated emergency preparedness, communication, and operation centers and other facilities required for emergency response. • Power-generating stations and other public utility facilities required as emergency backup facilities for Occupancy Category IV structures. • Structures containing highly toxic materials as defined by Section 307 where the quantity of the material exceeds the maximum allowable quantities of Table 307.1.(2). • Aviation control towers, air traffic control centers and emergency aircraft hangars. • Buildings and other structures having critical national defense functions. • Water treatment facilities required to maintain water pressure for fire suppression.

Enclosure 1

Moderate impact. During and after a hazard event, basic vertical- and lateral-force-resisting systems of the building are expected to retain nearly all their pre-hazard event strength and stiffness. Moderate structural damage may occur as a result of the hazard event and will delay re-occupancy; however, the structural damage should not be so extensive as to prevent repair or rehabilitation.

During and after a hazard event, nonstructural systems required for normal building use, including lighting, glazing, plumbing, HVAC and computer systems, shall remain significantly functional, although cleanup and repair of some items may be required. Basic access and life-safety systems including doors, stairways, elevators, emergency lighting, fire alarms, and suppression systems shall remain fully operational.

304.2.2 Moderate impact. The tolerable impacts of the design loads are assumed as follows:

304.2.2.1 Structural damage. There is moderate structural damage, which is repairable; some delay in re-occupancy can be expected.

304.2.2.2 Nonstructural systems. Nonstructural systems needed for normal building or facility use are fully operational, although some cleanup and repair may be needed. Emergency systems remain fully operational.

305.2.1 Classification of event magnitude. For the purpose of this code, the magnitude of event shall be classified as: small, medium, large and very large. Where authoritative documents do not present magnitude of event in this format, it will be the responsibility of the designer to relate the loads to this format and to demonstrate that the minimum design performance levels will be met by the proposed design.