Risk Group and Biosafety Level Acacia White

Risk Groups are used to classify microbiological agents based on their ability/severity to cause disease in humans. According to the National Institutes of Health (NIH), the lowest and least likely category to cause human disease are Risk Group 1 microbes. These agents are not consistently associated with disease in healthy adults or animals. Microbiological agents belonging to Risk Group 2 are associated with disease in humans, but rarely lead to serious pathogens, therefore infection can be preventable or therapeutically treated showing low risk of spreading to other individuals in a community environment. These diseases are not usually serious hazards to lab workers but can pose the minimum risk of infection in an individual. Risk Group 3 agents are directly associated with disease and can cause serious or lethal human disease for which preventive or therapeutic interventions may be available depending on non-regulated factors. Agents in this group pose high individual risk for infection but low community risk of spreading the pathogen, effective treatment and preventive measures are available. Risk Group 4 agents are highly likely to cause serious or lethal human disease for which interventions are seldom available. Microorganisms in this category pose a high individual risk of infection and a high community risk of spreading the infection. Usually pathogens of this stature can be readily transferred from individual to individual through direct or indirect contact. Effective treatment and preventive measures are not usually available for Risk Group 4 (RG-4) microbes.

An example of a RG1 organism is *Escherichia coli*, a bacterium often found in contaminated meat, is known to cause infection in the intestines but does not cause disease in healthy adults or animals. These bacteria are housed in Biosafety Level-1 (BSL-1) facilities not separated from the general flow of traffic in the building. BSL-1 labs should have doors (access control), a sink for hand washing, no carpet or rugs for easy cleaning, sturdy lab furniture capable of supporting anticipated loads, spacious, bench tops must be impervious to water and heat, lab windows that open must be fitted with a screen.

An example of an RG2 organism is the Herpesvirus, a viral infection that is commonly sexually transmitted causing sores, blisters, and ulcers on the mouth and genitalia. This infection is treatable with the proper prescribed antibiotics. Researchers handling the Herpesvirus will work in a lab following the BSL-2 criteria. Laboratories in Biosafety Level-2 must have self-closing doors/locks within the institution’s policies, an eyewash station, sink (manually, hands-free, or automatically operated) located near the exit door, the lab should be designed for easy cleaning/ decontamination, no carpets or rugs, sturdy furniture and space between lab benches, bench tops must be impervious to water and heat, chairs used in laboratory work must be covered and disinfected, windows that open to the exterior must be fitted with screens. These BSL-2 labs must also contain Biosafety cabinets (BSCs) so that fluctuations in air supply

and exhaust do not interfere with proper operations, a HEPA filtered exhaust A method for decontaminating all laboratory wastes should be available in the facility (ex: autoclave).

An example of a RG3 pathogen is the Yellow Fever virus, which is a viral infection transmitted by a bite from infected mosquitoes and when transmitted to humans, the virus can damage the liver and other internal organs and be Laboratory doors must be self-closing/locking in accordance with the institution policies. The laboratory must be separated from

areas that are open to unrestricted traffic flow within the building with restricted lab access. Access to the laboratory must be established through two self-closing doors. A dressing room may be included between the two self-closing doors. Laboratories must have a sink that is either hands-free or automatically operated, and located near the exit door. If the laboratory is segregated into different laboratories, a sink must also be available for hand washing in each zone, additional sinks may be required. The laboratory must be designed so that it can be easily cleaned and decontaminated. Carpets and rugs are not permitted. Seams, floors, walls, and ceiling surfaces should be sealed. Spaces around doors and ventilation openings should be capable of being sealed to facilitate space decontamination. Floors must be slip resistant, impervious to liquids, and resistant to chemicals. Consideration should be given to the installation of seamless, sealed, resilient or poured floors, with integral cove bases. Walls should be constructed to produce a sealed smooth finish that can be easily cleaned and decontaminated. Ceilings should be constructed, sealed, and finished in the same general manner as walls. Laboratory furniture must sturdy and spaciously spaced out. Bench tops must be impervious to water/heat. All windows in the laboratory must be sealed. BSCs must be installed and located

away from doors, heavily traveled laboratory areas, and other possible airflow disruptions. Vacuum lines must be protected with HEPA filters. Eyewash stations must be available in the laboratory. A ducted air ventilation system is required along with a visual monitoring device, must be provided at the laboratory entry. Audible alarms should be also being included to detect air change. HEPA filtered exhaust air from a Class II BSC can be safely re-circulated into the laboratory environment. A method for decontaminating all laboratory wastes should be available in the facility, preferably within the lab. Facility design consideration should be given to means of decontaminating large pieces of equipment before removal from the laboratory.

A RG4 agent, the Ebola virus for example will be studied in a BSL-4 lab setting because this virus is a rare but deadly virus that causes bleeding inside and outside the body damaging the immune system and organs. BSL-4 (suit or cabinet lab) facilities follow the following criteria: The BSL-4 suit laboratory consists of either a separate building or an isolated zone within a building. Laboratory doors must have locks the rooms must be arranged to ensure exit by sequential passage through the chemical shower, inner (dirty) change room, personal shower, and outer (clean) changing area. Entry must be through an airlock fitted with airtight doors whoever enters must wear a positive pressure suit supplied with HEPA filtered breathing air. The breathing air systems must have redundant compressors, failure alarms and emergency backup. A chemical shower must be provided to decontaminate the positive pressure suit before the worker leaves the laboratory. In the event of an emergency, a gravity fed supply of chemical disinfectant, and automatically activated emergency power source must be provided. Sinks should be placed near procedure areas and be connected to the wastewater decontamination system. Walls, ceilings, and floors must be monolithic, sealed and coved. All penetrations in suit storage room and the inner change room must be sealed. Drains, if present, in the laboratory floor must be connected directly to the liquid waste decontamination system. Sewer vents must have protection and must have no backflow from the laboratory occurs. Atmospheric venting systems must be provided with two HEPA filters in series and be sealed up to the second filter.

Laboratory furniture must be of spacious setup, not having any sharp edges, simple and stable in construction. Windows must be break-resistant and sealed. BSCs and other primary containment barrier systems must be installed so that fluctuations of the room air supply and exhaust do not interfere with proper operations. An eyewash station must be readily available in the laboratory area. A ventilation system is provided. Only laboratories with the same HVAC requirements may share ventilation systems if gas-tight dampers and HEPA filters isolate each individual laboratory system. The ventilation system must be monitored and alarmed to indicate

malfunction or deviation from design parameters. Decontamination methods must be provided so that materials and equipment that cannot be decontaminated in the autoclave can be safely removed from the BSL-4 laboratory. Liquid effluents within the laboratory must be decontaminated before being discharged to the sanitary sewer. A double-door, pass through autoclave(s) must be provided for decontaminating materials passing out of the cabinet laboratory. The BSL-4 must be tested to verify that the design and operational parameters have been met prior to operation. Lastly, a BSL-4 lab must have the appropriate communication systems must be provided between the laboratory and the outside (e.g., voice, fax, and computer).

I found very little information on BSL-5. I do however know that it is associated with microbes/beings from outer space.

# Reference:

* <https://www.safety.caltech.edu/documents/22-biohazardous_agent_classification.pdf>
* <http://spacearchitect.org/pubs/SAE-2002-01-2469.pdf>
* <https://www.cdc.gov/training/QuickLearns/biosafety/>
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