Laboratory Design Guide

2018

Safety Resources

University of Saskatchewan

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1 Purpose

The *Laboratory Design Guide* defines the requirements for all laboratories and research areas and ensures all new and remodeled laboratories at the university illustrate standard health and safety elements. Specific guidelines for critical features of a general laboratory (e.g. fume hoods, hazardous materials storage) are in accordance with federal, provincial and municipal legislation and bylaws, and best practices. Those involved in laboratory design, construction and renovation projects are responsible for complying with these and any additional requirements set out in local, provincial or other applicable legislation. The guide's intent is to provide a safe environment for laboratory personnel to conduct their work.

The University of Saskatchewan is committed to maintaining all laboratory and research facilities to a minimum basic level nuclear substance and/or biocontainment level II laboratory standards (refer to Table 1). Any researcher requiring alternate laboratory classification must receive Safety Resources approval prior to initiation of the renovation or construction project (regardless of the funding source). For classification of an existing laboratory space, please contact Safety Resources.

Adherence to the *Canadian Council for Animal Care Guidelines, Volumes 1 and 2* with special reference to the "*Guidelines on: Laboratory Animal Facilities – Characteristics, Design, and Development*" is required for small or large animal facility laboratory design, construction and renovation projects. For small or large animal facility assistance, contact the Research Services and Ethics Office to speak to the University Veterinarian.

The *Laboratory Design Guide* is **not** all inclusive as it is designed for standard research laboratories using chemicals, biologicals and radioactive materials. It does not account for unique regulatory issues and design situations. For information on building codes, consult federal, provincial and municipal legislation and by laws, and best practices.

2 Responsibilities

2.1 University Personnel, Project Managers, Contractors, Design Professionals and those involved in laboratory construction projects

- Comply with the *Laboratory Design Guide*;
- Ensure personnel in their charge are aware of, and adhere to the *Laboratory Design Guide*;
- Comply with all university health, safety and environmental protection requirements;
- As applicable, comply with the requirements of university issued biosafety and/or nuclear substance permits;
- As applicable, comply with federal/provincial licence, permit or certification requirements for the work space(s) and/or activities;
- Comply with college/division/department/unit requirements; and
- Comply with responsibilities relating to vacating research spaces, work and storage areas, and for properly decommissioning spaces they are working in.

2.2 Safety Resources

Safety Resources shall:

- Implement and maintain the *Laboratory Design Guide* and processes in support of health, safety and environmental due diligence;
- Assist personnel at all stages and prior to the initiation of the renovation or construction project;
- As applicable, comply with the requirements of university issued biosafety and nuclear substance permits;
- As applicable, comply with federal/provincial license, permit or certification requirements for the space(s) and/or activities; and
- Ensure compliance with university and legislative requirements.

The college/division/department/unit/faculty is responsible for all costs associated with the construction or renovation.

Table 1: Design Guide Checklist

Regulatory or Standard Reference[1]	Minimum Requirement	Yes	No	N/A	Comments
	A. Structure and Location				
CBS 3.1.1	Containment zones and associated corridors are separated from public and administrative areas by a door.				
CBS 3.1.2 University Standard CNSC GD-52 (G2)	Dedicated paper/computer work stations within the containment zone to be segregated from radioactive work areas, laboratory work stations, animal rooms, animal cubicles and post mortem rooms (PM rooms).				
	B. Containment Barrier				
CBS 3.2.1	Openable windows positioned on the containment barrier are to include effective pest control and security (e.g. screens).				
	C. Access Security				
CBS 3.3.1 CNSC GD-52 (D1)	Doors to the containment zone to be lockable and an access control system (key, keypad, key fob, other) will be in place to ensure that only authorized persons have access.				
CNSC GD-52 (D3)	Any windows on the ground floor will be secured to prevent unauthorized access to the room.				
CBS 3.3.2	Biohazard warning signage (including the international biohazard warning symbol, containment level, name and telephone number(s) of contact person, and entry requirements) to be posted at the containment zone point(s) of entry.				
CBS 3.3.3	Where unique hazards exist, project-specific signage to be posted at the animal room, animal cubicle, and post mortem room (PM room) point(s) of entry.				

[1] CBS: Canadian Biosafety Standard, CNSC GD-52: Canadian Nuclear Safety Commission Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms

Regulatory or Standard Reference[1]	Minimum Requirement	Yes	No	N/A	Comments
	C. Access Security (Cont'd)				
CBS 3.3.9 CNSC GD-52 (B20, B21)	Space to be provided for the storage of PPE used in the containment zone and to separate these items from personal clothing. Hooks, lockers, shelves or spaces within dedicated change areas are examples of dedicated storage space for PPE.				
	D. Surface Finishes, Casework and Fixtures				
CBS 3.4.1 CNSC GD-52 (B2, B5, B6, B8, B9, B10)	Surfaces and interior coatings, including, but not limited to, floors, ceilings, walls, doors, frames, casework, benchtops, and furniture, to be cleanable, non-absorbent, and resistant to scratches, stains, moisture, chemicals, heat, impact, repeated decontamination, and high pressure washing, in accordance with function. If joint required, joint must be sealed.				
CBS 3.4.4 CNSC GD-52(B7)	The countertop will include a lip to prevent run-off onto the floor. If the countertop abuts a wall, it will either be coved or have a backsplash installed tight to the wall, to be sealed at the wall-bench junction and continuous with work surfaces.				
CNSC GD-52 (B1)	Flooring will have an impervious, chemical resistant, and washable. Carpeting will not be used.				
CNSC GD-52 (B4)	Flooring will be coved up walls and cabinets to prevent spills from penetrating underneath them.				
CBS 3.4.5	Floors to be slip-resistant in accordance with function.				
CNSC GD-52 (B11)	Work surface will be reinforced to bear the weight of any shielding material that may be placed on the work surface.				

[1] CBS: Canadian Biosafety Standard, CNSC GD-52: Canadian Nuclear Safety Commission Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms

Regulatory or Standard Reference[1]	Minimum Requirement	Yes	No	N/A	Comments
	E. Air Handling / HVAC/ Ventilation				
CNSC GD-52 (E1)	Laboratory will be at negative pressure with respect to surrounding areas. Air flow will always be from the area of low radiation.				
CNSC GD-52 (E2)	Laboratories will have a minimum of 6 air changes per hour.				
CNSC GD-52 (E6)	Fume hoods will not be located adjacent to a single means of access to an exit, due to possible volatility of the fume hood contents.				
CNSC GD-52 (E7)	To avoid interference, supply air vents will be installed away from fume hoods.				
CNSC GD-52 (E21)	Fume hood exhaust ducts will not connect with other exhaust systems (other fume hoods is acceptable). Provisions will be made to ensure that the exhaust from one area cannot flow into another area.				
CNSC GD-52 (E22)	Fume hood exhaust ducts will be constructed of corrosion-resistant material appropriate to the substances to be used in the fume hood. All joints will be smoothly finished and sealed.				
CNSC GD-52 (E25)	Fume hood exhaust ducts will contain only vertical sections. (If horizontal sections are to be used, detailed information will be submitted to show how collection of condensates or liquids coming in from the discharge point will be limited; horizontal ducts will slope at least 2.5 cm per 3 meters (1 inch per 10 feet) downward in the direction of the airflow to a suitable drain or sump.)				
CNSC GD-52 (E28/E29) SOHS section 66	Fume hood exhausts will be located on the roof as far away as possible from any air intakes, to prevent recirculation of the fume hood emissions (minimum recommended distance is 15.24 m from an intake). If the air intake will be less than 15.24 m from the stack, rain caps on the stack will be avoided.				
CNSC GD-52 (E30)	The stack velocity will be at least 1.4 times the average wind velocity.				

[1] CNSC GD-52: Canadian Nuclear Safety Commission Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms, SOHS: Saskatchewan Occupational Health and Safety Regulations

Regulatory or Standard Reference[1]	Requirement	Yes	No	N/A	Comments
	E. Air Handling / HVAC/ Ventilation (Cont'd)				
CNSC GD-52 (E31)	The stack height will be at least 3.05 m above the highest point on any adjacent roofline or air intake. Discharge will be directed vertically upward.				
CNSC GD-52 (E32)	Stacks will be placed downwind of the air intakes (based on the average wind direction).				
CNSC GD-52 (E26/E27)	Fume hood exhaust fans will be placed close to the discharge point and outside the building.				
University Standard	Fume hood exhaust fan motor to be mounted outside the exhaust duct.				
CNSC GD-52 (E24)	Fume hood exhaust ducts will be marked at 3 meter intervals with a hazardous warning symbol.				
CNSC GD-52 (E13)	Fume hoods will be labelled to show which fan or ventilation system they are connected to.				
CNSC GD-52 (E14)	The face velocity of the fume hood will be at a minimum of 0.5 m/s.				
CNSC GD-52 (E19)	Fume hood exhaust fans will be connected to an emergency power system to maintain functionality if a power failure occurs.				
CNSC GD-52 (E23)	Fume hood exhaust ducts will be clearly identified on plans supplied to maintenance personnel.				
	F. Facility Services				
CNSC GD-52 (B19)	Emergency lighting will be provided within the laboratory.				
University Standard	A distance of 1.5 meters will be provided between electrical outlets and emergency showers.				
CNSC GD-52 (C7)	Faucets with vacuum or cooling line attachments will include back-flow protection devices.				

[1] CBS: Canadian Biosafety Standard, CNSC GD-52: Canadian Nuclear Safety Commission Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms, ANSI Z358.1: American National Standard for Emergency Eyewash and Shower Equipment

Regulatory or Standard Reference[1]	Minimum Requirement	Yes	No	N/A	Comments
	F. Facility Services (Cont'd)				
CBS 3.6.4 and 3.6.5 CNSC GD-52 (B12/B14/B15/B16)	Sinks to be provided and located to facilitate handwashing near the laboratory exit. Sinks provided for handwashing to be equipped with "hands-free" capability, made of a material that is readily decontaminated and have overflow outlets. The hand washing sink will be separate from the wash-up/disposal sink in the lab.				
CNSC GD-52 (C6)	Sink drain traps will be accessible.				
CNSC GD-52 (C3)	Drains will be constructed of chemical-resistant material.				
CNSC GD-52 (C4)	A backflow protection device will be in place to prevent potentially contaminated effluent from entering the public water system.				
ANSI Z358.1	An ANSI compliant emergency shower/eyewash station will be readily accessible to workers who may be exposed to hazardous substances. Readily accessible means accessible within 10 seconds/16 meters anywhere in the risk area.				
ANSI Z358.1	Each emergency shower/eyewash station will be identified with a highly visible safety sign.				
CBS 3.6.6 CNSC GD-52 (B17/B18) SOHS 312-313	Emergency eyewash and shower equipment to be provided in the laboratory or in close proximity to the room. This must be supplied with continuous tepid/lukewarm water.				
University Standard	Emergency natural gas shut-off valves will be located outside the laboratory.				

[1] CBS: Canadian Biosafety Standard, CNSC GD-52: Canadian Nuclear Safety Commission Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms, SOHS: Saskatchewan Occupational Health and Safety Regulations, ANSI Z358.1: American National Standard for Emergency Eyewash and Shower Equipment

Regulatory or Standard Reference[1]	Minimum Requirement	Yes	No	N/A	Comments
	G. Storage				
SOHS 365	Combustible and flammable liquids are to be kept in receptacles that meet the requirements of the *National Fire Code of Canada 1990*.				
CNSC GD-52 (G6)	An accessible area will be designated to store materials and equipment used for decontamination and monitoring (spill kits, survey meters where required, contamination meters where required).				
SOHS 314	Self-contained enclosures, rooms, or buildings that are isolated from work-related areas and worksites used to store flammable, oxidizing, corrosive, toxic, or dangerously reactive chemicals shall be adequately vented. These areas should also be protected from conditions including excessive temperature, shock or vibration that could reduce the stability or increase the potential hazards of the substance.				
	H. Essential Equipment				
	Autoclaves				
University Standard	Approval from Safety Resources required prior to purchase.				
Technical Safety Authority of Saskatchewan	Permit to install an autoclave and operate an autoclave must be obtained				
CBS 3.7.15	An autoclave, where present, to be capable of operating at the appropriate temperature for decontamination, as determined by validation.				

[1] CBS: Canadian Biosafety Standard, CNSC GD-52: Canadian Nuclear Safety Commission Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms, SOHS: Saskatchewan Occupational Health and Safety Regulations, ANSI Z358.1: American National Standard for Emergency Eyewash and Shower Equipment

Regulatory or Standard Reference[1]	Minimum Requirement	Yes	No	N/A	Comments
	Biosafety Cabinets/Equipment				
University Standard	Approval from the biosafety team at Safety Resources required prior to purchase.				
CBS 3.7.6	BSCs, where present, to be located as far as possible from high traffic areas, doors, openable windows, and air supply/exhaust diffusers.				
NSF/ANSI 49 -2016	Failure of exhaust flow will signal an alarm to the user.				
CBS 3.7.1	Certified BSCs and other primary containment devices to be provided, based on work activities.				
CBS 3.7.3	Class II B2 BSCs, where present, to be installed and set-up in a manner to eliminate reversal of airflow from the face of the BSC (i.e., puff-back) during a failure of the heating, ventilation, and air conditioning (HVAC) system or the BSC exhaust fan; where elimination of puff-back cannot be achieved, the risk associated with puff-back to be mitigated through physical and operational means.				
CBS 3.7.4	Process equipment, closed systems, and other primary containment devices to be designed to prevent the release of infectious material or toxins.				
University Standard	Minimum clearance of 30 cm will be provided between exhaust outlet on top of cabinet and any overhead obstructions.				
CBS 5.1.5	BSCs will be certified in accordance with the NSF/ANSI 49, where possible				
NSF/ANSI 49 -2016	Recommended: A voltage regulator should be installed in order to reduce the potential of variations in airflows.				
NSF/ANSI 49 -2016	B2 type cabinets will be exhausted 100% through its own duct work which has a HEPA filter installed.				

[1] CBS: Canadian Biosafety Standard, NSF/ANSI 49 -2016 2016: Biosafety Cabinetry: Design, Construction, Performance, and Field Certification

Regulatory or Standard Reference[1]	Minimum Requirement	Yes	No	N/A	Comments
	Biosafety Cabinets/Equipment (cont'd)				
NSF/ANSI 49 -2016	Roof exhaust systems serving BSCs will have a stack that extends straight upward a least 3 m (10 ft.) above the roof surface to avoid re-entrainment by the building, and should be increased in elevation when necessary to avoid the influence of surrounding structures.				
NSF/ANSI 49 -2016	Raincaps or any other structure that deflects the straight upward flow of the discharge air should be avoided.				
University Standard	The canopy above the BSC will be removable for decontaminating the BSC to get access to HEPA filters.				
CBS 3.7.14	Decontamination technologies to be provided with monitoring and recording devices that capture operational parameters.				
CBS 3.7.17	Vacuum systems to be equipped with a mechanism that prevents internal contamination.				
CBS 3.7.18	Two-way communication system(s) to be provided inside the containment barrier that allows communication between inside the containment barrier to outside the containment zone, in accordance with function.				
	Fume Hoods				
CNSC GD-52 (E9/E20)	The fume hood should not contain filters and will be constructed of smooth, impervious, washable, chemical-resistant material.				
CNSC GD-52 (E15) SOHS section 66(3)	Each fume hood will have a continuous monitoring device for proper functioning of the hood. An alarm, either visual or audible, will be present to indicate reduced air flow.				

[1] CBS: Canadian Biosafety Standard, CNSC GD-52: Canadian Nuclear Safety Commission Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms, NSF/ANSI 49 -2016 2016: Biosafety Cabinetry: Design, Construction, Performance, and Field Certification

Regulatory or Standard Reference[1]	Minimum Requirement	Yes	No	N/A	Comments
	Fume Hoods (Cont'd)				
CNSC GD-52 (E8)	If the fume hood is the sole means of room air exhaust, a bypass will be installed to ensure ventilation when the sash is closed.				
CNSC GD-52 (E10)	Fume hood will have a means of containing a minor spill.				
CNSC GD-52 (E11)	The interior of the fume hood will have coved corners for easy decontamination and clean-up.				
CNSC GD-52 (E5)	Fume hoods will be located away from area of air currents or turbulence "(high traffic areas, doors, operable windows, air supply diffusers).				
CNSC GD-52 (E4)	Air vented through the fume hood will not be recirculated.				
CNSC GD-52 (E18)	Provisions will be in place to ensure the fume hood remains functional if a routine automatic after-hours shutdown system is in place. (This can be managed through Controls - FMD)				
	I. Miscellaneous				
University Standard	Safety Resources will review architectural drawings at 60% and 99% completion for safety concerns and provide feedback to the project manager/lead.				
CBS 4.6.37	An effective rodent and insect control program to be maintained.				
SOHS Section 68 CNSC GD-52 (G5)	There is at least 10 cubic meters of space for each worker employed at any one time at a work site. No space that is more than three meters from the floor and no space occupied by solid objects is to be taken into account.				

[1] CBS: Canadian Biosafety Standard, CNSC GD-52: Canadian Nuclear Safety Commission Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms, SOHS: Saskatchewan Occupational Health and Safety Regulations

3 Small Animal Facilities

A “small animal facility zone” is defined as an area of equal containment level. An “animal room” is defined as the room in which the small animal is housed. The containment perimeter/barrier of the small animal facility zone is continuous and non-intersecting (i.e. the zone is serviced by a single entry/exit).

Animal rooms for small animals should be designed for ease of cleaning and disinfection. Rooms should have a minimum of built-in equipment. The design of the animal facility should permit adjustment of environmental controls to meet the needs of the species as specified by the Canadian Council for Animal Care *Guide to the Care and Use of Experimental Animals*, 1993.

In addition to the criteria listed above for laboratories, the University Veterinarian at the Research Services and Ethics Office must consult on small animal facilities.

4 Large Animal Facilities

A “large animal facility zone” is defined as an area of equal containment level. A “cubicle” is defined as the room in which the large animal is housed. The containment perimeter/barrier of the large animal facility zone is continuous and non-intersecting (i.e. the zone is serviced by a single entry/exit).

Animal cubicles must be constructed to contain large numbers of microorganisms that may be present. Unlike a laboratory room where the biological safety cabinet provides primary containment, the animal cubicle serves as both the primary and secondary barrier. A “clean and dirty” (i.e. entry and exit) corridor concept is operationally preferable to a “single” corridor design. The clean and dirty corridor facilitates the traffic flow of animal handlers, scientific staff, animals, feed, equipment and samples. This design also minimizes the risks of cross-contamination between animal rooms.

In addition to the criteria listed above for laboratories, the University Veterinarian at the Research Services and Ethics Office must consult on large animal facilities.

5 Standard Review

This standard will be reviewed by Safety Resources at least once every three years. The standard may, however, be reviewed by Safety Resources at any time to correct errors or make procedural changes.

6 References

- *Safety Resources Policy*, University of Saskatchewan.
- *Biosafety Code of Practice*, Safety Resources.
- *Radiation Safety Code of Practice*, Safety Resources.
- *Canadian Biosafety Standards (CBS), Second Edition. 2015.*
- *Design Guide for Nuclear Substance Laboratories and Nuclear Medicine Rooms: Guidance Document GD-52,* Canadian Nuclear Safety Commission. 2010.
- *Saskatchewan Occupational Health and Safety Regulations*, Ministry of Labour Relations and Workplace Safety. 1996.
- NSF/ANSI 49 – 2016 Biosafety Cabinetry: Design, Construction, Performance, and Field Certification.
- ANSI Eyewash Z358.1-2014. American National Standard for Emergency Eyewash and Shower Equipment.
- Canadian Council on Animal Care Guide to Care and Use of Experimental Animals, Volume 1, 2nd Edition. 1993.