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Guided Exercise:

Laboratory Design Review

Design Document

Sandia National Laboratories

International

BIOLOGICAL THREAT REDUCTION

BEP

CBEP

Cooperative Biological Engagement Program

Part I: Guided Exercise Overview

Guided Exercise Description

Overview

There are numerous aspects to the laboratory design process that will lead to a successful laboratory facility project. Laboratory design requires the input of many stakeholders, providing guidance throughout every phase of the process to include space programming, pre-design criteria, layout analysis, and design approvals. This guided exercise will provide students with the opportunity to apply the knowledge they have gained from various Laboratory Design courses by reviewing a laboratory plan and identifying and discussing areas where design can enhance biosafety and biosecurity.

Scope

The goal of this exercise is to strengthen the student's confidence and ability to review laboratory design documents from a risk based perspective, including:

- Demonstrating comfort and familiarity with laboratory design documents
- Demonstrating comfort and familiarity with laboratory design best practices
- Identifying issues that may affect biosafety and biosecurity
- Providing critical analysis and recommend mitigation strategies.

Learning Level based on Bloom's taxonomy

- ✓ knowledge
- ✓ comprehension
- ✓ application
- ✓ synthesis
- ✓ evaluation

Length of Guided Exercise

3.5 hours

Guided Exercise Objectives

At the end of this Guided Exercise, Students will be able to:

Organizational Objectives

- Demonstrate comfort and familiarity with laboratory design principles and practices.
- Identify issues related to laboratory design that may affect biosafety and biosecurity.
- Provide critical analysis of laboratory designs and recommend mitigation strategies.

Instructional Objectives

- To illustrate, and have students participate in, methods of design and analysis that promote good laboratory design.
- To illustrate how good design practices work to improve laboratory operations and enhance biosafety and biosecurity.
- To encourage students to participate in the laboratory design process and provide feedback from multiple perspectives.

Personal Objectives

Know

- Principle factors which govern laboratory design
- Methods for analysis of laboratory design
- Laboratory design concepts that impact biosafety and biosecurity

Feel

- Confident in reviewing laboratory design documents
- Prepared to analyze and discuss laboratory plans
- Able to identify areas where design can enhance biosafety and biosecurity

Do

- Describe the critical factors when analyzing a laboratory design
- Provide feedback to guide the laboratory design review process
- Recommend mitigation strategies to improve laboratory operations and enhance biosafety and biosecurity.

Key Messages

1. Risk assessment should be a primary driver of the laboratory design process and selection of biorisk mitigation strategies.
2. Biosafety requires consideration at all levels of design, from the seletion and placement of equipment in a room, to the organization of containment barriers around a zone, to the airflow strategy within the building.
3. Biosecurity design can be integrated seamlessly into the building layout when considered early in programming and planning.
4. Laboratory design should be developed in conjunction with the protocols followed when personnel, materials/laboratory animals, and waste move throughout the facility.

Evaluation Strategy

Level 1 (satisfaction):	Students will complete a satisfaction survey about their experience with the guided exercise.
Level 2 (learning):	Students will complete a "learning contract" for the next steps needed to begin implementation of the laboratory design principles and strategies learned.
Level 3 (behavior):	Desired behavior is for students to participate in additional learning opportunities related to laboratory design – this behavior will be evaluated three to six months post-training and may encompass additional courses.
Level 4 (organizational change):	A repeat of the training needs assessment will be performed at least annually – this annual assessment can be compared to the baseline assessment to determine improvements in laboratory design competency.

Student Description (for Guided Exercise design purposes)

Number of Students: 10 to 25; 3-5 small groups with an equal number of people in each

Biorisk Management Role:

- ✓ Architects
- ✓ Designers
- ✓ Biorisk Management Advisors/Advocates
- ✓ Scientific/Lab Management

Audience Assumptions: (assumed range is indicated by shaded cells)

		Novice		Practitioner		Expert
Education	Scientific/ Design	1	2	3	4	5
	LDGE*	1	2	3	4	5
Expertise	Scientific/ Design	1	2	3	4	5
	LDGE	1	2	3	4	5
Competence	Scientific/ Design	1	2	3	4	5
	LDGE	1	2	3	4	5
**LDGE = "Lab Design Guided Exercise". See definitions for terms in resources section*						

Language of instruction; translation or interpretation anticipated: English (for design purposes)

Prerequisites	Biosafety Risk Assessment Biorisk Characterization and Evaluation Biorisk Management Strategies Laboratory Programming and Pre-Design Laboratory Design Best Practices Laboratory Building Systems Optional for Biosecurity Focus: Biosecurity Risk Assessment Laboratory Biosecurity Incident Management and Response
Pre- or post-work required for completion	None.
Certificates or documents of completion:	None other than certificates of completion associated with prerequisite courses.
Preparation for future coursework	This guided exercise is intended to be a final wrap up for the Laboratory Design module.
Anticipated next steps	TBD

Instructional Environment

Number of Instructors/Staff required:	TBD depending on number of Students – optimal ratio is 1 Instructor per no more than 12 Students
Instructor Qualifications:	Instructors should be experienced Biorisk Management Advisors, preferably with some laboratory planning and design experience, and must have completed the Global Biorisk Management Curriculum (GBRMC) orientation, and be enrolled in the GBRMC training network.

Learning Environment

Media:	Instructor-led exercise.
Exercises & Activities	
Experience (Activists)	Students will be asked to consider their experiences with their work and the information provided through the perquisite courses in regard to the design or operation of laboratory facilities.
Reflection (Reflectors)	Students will be asked to reflect on their work experiences and the information provided through the perquisite courses to develop means of analyzing laboratory layouts with respect to their functionality, safety and security.
Models (Theorists)	Students will apply the methods of organizing laboratory layouts and describing their functionality introduced through the prerequisite courses to analyze laboratory layouts.
Practice (Pragmatists)	Students will be given the opportunity to illustrate lab safety and security features and to comment upon how these influence laboratory design.

On-Site Specifics

Location	TBD
Room organization	Clusters of tables to facilitate small groups (no more than 5 Students per group)
Dress code and/or important cultural considerations	TBD

Instructional Materials

Equipment & Supplies	Easels and large format paper (1 per group) 10 large scale copies of lab plan per group Markers (enough for up to 5 groups plus instructor(s)) Large scale laminated plan & dry erase markers for instructor demonstrations

6 x 8 inch Post-it notes (no lines)
Pens
Laptop computer with laboratory layout loaded
Projector
Name tags/lanyards or Tent Cards
Notepads
OPTIONAL: Tracing paper (1 large roll per group)

Student Handouts

Student notes, including laboratory scenario and preliminary questions
Sample plans and diagrams
List of reference books, articles and guidelines
Glossary
CWA 15793

Resources

Dependencies

Authorities

References

CWA 15793
WHO Laboratory Biosafety Manual
Laboratory Biosecurity Handbook
Biosafety in Microbiological and Biomedical Laboratories
Guide for the Care and Use of Laboratory Animals
Whole building design guide (website)
Laboratory Design Guide
Building Type Basics for Research Laboratories
Glossary of terms

Terms used in this document

- Knowledge – remembering the material in the same form as it was taught.
- Comprehension – student's ability to understand the material by (for example) explaining or summarizing key messages.
- Application – ability to use the material in a new or given situation
- Synthesis – ability to put together learning material in a new whole entirety. For example, using the material to create a new program or plan.
- Evaluation – ability to judge the value of the material presented as a peer (to be able to critically advise or judge others on their application and synthesis of this learning material).
- Novice – a person who is new to the circumstances, work, etc. in which s/he is placed; beginner.
- Practitioner – a person engaged in the practice of a profession; a person who practices something specified.
- Expert – a person who has special skill or knowledge in some particular field; specialist; authority; trained by practice.
- Education – the act of acquiring particular knowledge or skills, as for a profession.

- Expertise – the process of personally observing, encountering or undergoing something; knowledge or practical wisdom gained from what one has observed, encountered, or undergone.
- Competence – Possession of a suitable or sufficient skill, knowledge, experience, etc. for some specified purpose; properly qualified.

Part II: Guided Exercise Outline/Schedule							
Day	**Segment time (min)**	**Time**	**Topic**	**Instructional Method**	**Slide #**	**KM #**	**T/F**
1	5 min	0:05	Welcome & Introductions		N/A	N/A	
	5 min	0:10	Introduction to Guided Exercise goals and objectives	Instructor presents brief introduction to Guided Exercise goals and objectives	N/A	N/A	T
	5 min	0:15	Hand out Guided Exercise laboratory design worksheet		N/A	N/A	F
	15 min	0:30	Scenario and selection of laboratory design drivers	Instructor guides a review of the Guided Exercise scenario, then students review options provided in the student worksheet (Part I) and select the type of research activities that will occur in the proposed laboratory (students will pick an agent, laboratory animal model, and any specialized equipment or procedures)	N/A	N/A	T/F
	60 min	1:30	Review laboratory layout	In groups students analyze a laboratory plan, addressing the questions in Part II of the student worksheet.	N/A	N/A	F
	15 min	1:45	BREAK				
	15 min	2:00	Laboratory Design Presentation Preparation	Based on their review of the laboratory layout and responses to the questions in Part II of the student worksheet, students will prepare a brief presentation demonstrating their proposed risk-based laboratory design modifications.	N/A	N/A	F

	45 min	2:45	Laboratory Design Presentations	Each small group will present their proposed risk-based laboratory design modifications.	N/A	N/A	F
	15 min	3:00	Laboratory Design Review	Instructor leads a review of the student presentations and laboratory design principles and practices.	N/A	N/A	T/F
	30 min	3:30	Summary and Wrap Up	Instructor to summarize Guided Exercise goals and objectives, pass out Level 1 evaluations KFD for the students. After activity Instructors will fill out Level 2 evaluations.	N/A	N/A	
KM = key messages ; T/F = teaching versus facilitation (instructor-based versus student-based)							

Reference Materials for Further Study

A Design Guide for Energy Efficient Research Laboratories. Website. http://ateam.lbl.gov/Design-Guide/

ASHRAE Laboratory Design Guide. 2002. Ian B.D. McIntosh, Chad B. Dorgan, Charles E. Dorgan. American Society of Heating, Refrigerating and Air Conditioning Engineers.

Biosafety in Microbiological and Biomedical Laboratories (BMBL) 5th Edition, 2009. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institutes of Health. Available online at: http://www.cdc.gov/biosafety/publications/bmbl5/

Building Type Basics for Research Laboratories. 2nd Edition, 2001. Daniel D. Watch, Stephen A. Kliment, Perkins & Will. John Wiley & Sons, Inc.

CWA 15793, CEN Workshop Agreement, Laboratory Biorisk Management. 2011. European Committee for Standardization. Available online at: ftp://ftp.cenorm.be/CEN/Sectors/TCandWorkshops/Workshops/CWA15793_September2011.pdf

Guide for the Care and Use of Laboratory Animals. 8th Edition, 2011. Institute for Laboratory Animal Research, National Research Council of the National Academies. The National Academies Press.

International Building Code. 2006 International Code Council. Available online at: http://publicecodes.cyberregs.com/icod/ibc/2006f2/index.htm

Laboratory Biosafety Manual. 3rd Edition, 2004. World Health Organization. Available in multiple languages online at: http://www.who.int/csr/resources/publications/biosafety/WHO_CDS_CSR_LYO_2004_11/en/

Laboratory Biosecurity Handbook. 2007. Reynolds Mathewson Salerno, Jennifer Marie Guadioso. CRC Press.

Laboratory Design Guide. 3rd Edition, 2005. Brian Griffin. Architectural Press, Elsevier.

NFPA 45: Standard on Fire Protection for Laboratories Using Chemicals. 2011. National Fire Protection Association. Available online at: http://www.nfpa.org/

Problem Seeking: An Architectural Programming Primer. 5th Edition, 2012. William M. Peña, Steven A. Parshall. John Wiley & Sons, Inc.

Whole Building Design Guide. Website. http://www.wbdg.org/