Introduction

Since the collapse of the Soviet Union, many biological laboratories and institutes in the FSU have lacked the financial resources or the required knowledge to provide modern biosecurity and biosafety training for their personnel. This situation represents a serious threat, as poor training increases the risk of a biological accident or of improper pathogen accounting, storage and transportation which could contribute to the illicit acquisition of biological agents by terrorist groups. To address this challenge, Canada’s Global Partnership Program has been working with several key institutes to develop regional biosecurity and biosafety training centres in Russia, Ukraine and Kazakhstan.

These training centres will assist, inter alia, with improving awareness of modern biosecurity/biosafety practices and concerns, thereby resulting in decreased risk of terrorist acquisition of deadly pathogens or accidental release of a biological agent. Delivering this standardized course curriculum represents a key activity for the 3 training centres.

Course Description

This course provides an overview of biosecurity/biosafety and the practices, equipment, and facilities for the safe and secure handling of dangerous pathogens in a laboratory setting. It is intended for biosafety professionals, scientists, managers, maintenance personnel, engineers and architects involved in the design, operation or maintenance of laboratories handling infectious agents.

Course Objectives

This course provides an overview of the critical aspects of biosecurity, biosafety and biocontainment. Participants will learn how to assess risks for biohazards in the laboratory setting and the strategies to appropriately manage these risks. By the end of the course, participants will be familiar with international best practices in biorisk management.
**Content**

This course is offered as a series of modules which include presentations, videos and group discussion. Course concepts are further reinforced through hands-on exercises, demonstrations and visits to containment laboratories. In addition, the course provides the opportunity for various segments or modules to be offered as stand-alone shorter courses.

The course is comprised of the following Modules:

- Introduction to Biosafety and Biocontainment *(Module 1)*
- Biosafety and Biocontainment Concepts and Strategies *(Module 2)*
- Biosecurity Concepts and Strategies *(Module 3)*
- Risk Assessment *(Module 4)*
- Biosafety Program Management *(Module 5)*
- Risk Communication *(Module 6)*
- Biocontainment Facilities *(Module 7)*
- Operational Biosafety Practices and Procedures *(Module 8)*
- Biological Safety Cabinets *(Module 9)*
- Animal Biosafety and Facilities *(Module 10)*
- Facility Operations and Maintenance *(Module 11)*
- Disinfection and Decontamination *(Module 12)*
- Waste Management *(Module 13)*
- Bioethics *(Module 14)*
- Transportation of Infectious Substances *(Module 15)*
- Emergency Planning and Response *(Module 16)*

**Teaching the Modules**

Biosafety professionals with comprehensive practical experience serve as instructors for this course. However, professionals such as facility operators, architects and engineers involved in the design, construction and operation of biocontainment facilities may also serve as instructors for specific modules applicable to their profession. Each training session must also be carefully planned and adapted to best suit the intended audience.
Module 1: Introduction to Biosafety and Containment

Objectives

- Describe the history and incidence of laboratory-acquired infections (LAI)
- Describe incidents of secondary transmission from the laboratory
- Outline the types of laboratory accidents leading to LAIs
- Explain the role of aerosols in LAIs
- Illustrate the importance of biosafety and biocontainment in minimizing the risk of LAIs

Training Tools and Reference Material


Participant Discussion on In-house Laboratory-acquired Infections and Lessons Learned
Module 2: Biosafety and Biocontainment Concepts & Strategies

Objectives

- Describe the assignment of microorganisms into risk groups
- Understand the relationship between risk groups and biosafety levels
- Outline the four biosafety levels
- Describe the concepts of primary and secondary barriers
- Outline concepts for animal pathogen containment
- Identify key biosafety guidelines and standards

Training Tools and Reference Material

*Laboratory Biosafety Manual.* World Health Organization. 2004
geo.international.gc.ca/cip-pic/library/biological-en.aspx (Russian version)

www.phac-aspc.gc.ca/ols-bsl/lbg-ldml
gEO.international.gc.ca/cip-pic/library/biological-en.aspx (Russian version)

*Laboratory Biorisk Management Standard.* CEN Workshop Agreement 15793. 2007
(available in Russian)

“Biosafety 101” Instructional DVD

Copies of Manuals/Guidelines to be distributed to participants
Module 3: Biosecurity Concepts and Strategies

Objectives

- Understand the relationship between biosecurity and biosafety
- Describe the challenges of a biosecurity program for microorganisms
- Outline the key components of a biosecurity program (physical security, pathogen accountability, personnel reliability, transport security, information security)
- Describe an emergency response plan for breaches of biosecurity

Training Tools and Reference Material


Biorisk Management: Laboratory Biosecurity Guidance, World Health Organization. 2006
geo.international.gc.ca/cip-pic/library/biological-en.aspx (Russian version)

Biosafety in Microbiological and Biomedical Laboratories. Section VI: Principles of Laboratory Biosecurity. Centres for Disease Control and National Institutes of Health. US Govt Printing Office. 2007


“Laboratory Biosecurity: Build Security into Good Laboratory Practices” Instructional Course. www.cdc.gov/od/ohs/biosecurity_training

Copies of Manuals/Guidelines to be distributed to participants
Module 4: Risk Assessment

Objectives

- Describe components of a risk assessment for microorganisms
- Outline factors affecting risk assessment (agent, host, environment, behavioural)
- Describe risk management strategies
- Understand the process of a job hazard analysis
- Identify current biorisk management and risk assessment initiatives
- Describe the components of an ideal risk assessment for laboratories handling dangerous pathogens

Training Tools and Reference Material


Laboratory Biorisk Management Standard. CEN Workshop Agreement 15793. 2007 (available in Russian)

Wagener, S. et al. Biological Risk Assessment in the Laboratory. 2007 (available in Russian)

Biosafety Risk Assessment Wiki. www.biosafetyriskassessment.org


Risk Assessment Case Studies
**Objectives**

- Describe the structure of a biosecurity and biosafety program
- Describe the roles and responsibilities for management, committees, biosafety officers and individuals
- Outline the biosecurity and biosafety issues to be incorporated into the program

**Training Tools and Reference Material**

*Laboratory Biosafety Manual.* World Health Organization. 2004
geo.international.gc.ca/cip-pic/library/biological-en.aspx (Russian version)

*Laboratory Biosafety Guidelines.* Public Health Agency of Canada. 2004
www.phac-aspc.gc.ca/ols-bsl/lbiq-ldmbi
geo.international.gc.ca/cip-pic/library/biological-en.aspx (Russian version)

*Laboratory Biorisk Management Standard.* CEN Workshop Agreement 15793. 2007
(available in Russian)

“*Biosafety 101*” Instructional DVD
Module 6: Risk Communication

Objectives

- Explain what is meant by risk communication
- Describe the challenges in communicating crisis information to the public
- Outline examples of how communication of laboratory accidents and breaches of containment influenced the media and the public

Training Tools and Reference Material

*Emergency and Risk Communication.* Centres for Disease Control. www.bt.cdc.gov/erc


Objectives

- Describe the progression of building a new biocontainment laboratory from conceptualization through to certification
- Outline the concepts to be addressed during the laboratory programming phase
- Understand key architectural and engineering biocontainment features
- Describe key security features and control systems
- Describe the commissioning and certification process and understand the difference between them

Training Tools and Reference Material

*Anthology of Biosafety VII – Biosafety Level 3.* American Biological Safety Association. 2004 (available in Russian)

*Laboratory Biosafety Manual.* World Health Organization. 2004


*Laboratory Biosafety Guidelines.* Public Health Agency of Canada. 2004


“*Containment Level 3 Laboratories*”. Instructional DVD (available in Russian)

“*Containment Level 2 Laboratories*”. Instructional DVD

Tour of BSL3 Laboratory and Mechanical Support Systems

Review of Architectural/Mechanical Drawings for Mock Laboratory
Module 8: Operational Biosafety Practices & Procedures

Objectives

- Describe the general biosafety practices and procedures applicable to all laboratories handling infectious agents
- Describe the biosafety practices and procedures applicable to BSL2 laboratories
- Describe the biosafety practices and procedures applicable to BSL3 laboratories
- Understand the characteristics of aerosols and how they are generated in the laboratory
- Explain good microbiological technique and methods to minimize the creation of aerosols

Training Tools and Reference Material

*Anthology of Biosafety VII – Biosafety Level 3.* American Biological Safety Association. 2004 (available in Russian)

*Laboratory Biosafety Manual.* World Health Organization. 2004
geo.international.gc.ca/cip-pic/library/biological-en.aspx (Russian version)

*Laboratory Biosafety Guidelines.* Public Health Agency of Canada. 2004
www.phac-aspc.gc.ca/ols-bsl/lbg-lldmb/l
geo.international.gc.ca/cip-pic/library/biological-en.aspx (Russian version)

"Containment Level 3 Laboratories". Instructional DVD (available in Russian)

"Containment Level 2 Laboratories". Instructional DVD

"Biosafety 101" Instructional DVD

Demonstration of Personal Protective Equipment
Module 9: Biological Safety Cabinets

Objectives

- Describe the classes and types of biological safety cabinets (BSC)
- Understand the principles of HEPA filtration
- Explain the practices for safely working in a BSC
- Identify other laminar flow devices and their limitations for use with microorganisms
- Outline the certification process for BSCs
- Describe the NSF 49 standard and its application

Training Tools and Reference Material

www.cdc.gov/od/ohs


www.eagleson.org

“*Biological Safety Cabinets: Safe Use and Operation*”. Poster to be distributed to participants
geo.international.gc.ca/cip-pic/library/biological-en.aspx (English & Russian version)

“*Containment Level 3 Laboratories*”. Instructional DVD (available in Russian)

Demonstration of Airflow Patterns in a Biological Safety Cabinet
Objectives

- Outline the risk assessment and planning process for work with experimental animals
- Identify the guidelines and standards applicable to laboratory animal facilities
- Understand the differences in primary and secondary containment when working with small vs large animals
- Describe the general concepts in animal facility design
- Explain the containment caging options for working with small animals
- Describe the unique architectural and engineering biocontainment features for large animal facilities
- Describe the range of hazards unique to working with animals in the laboratory

Training Tools and Reference Material


“Overview of Risk Assessment and Risk Management in Laboratory Animal Biosafety.” Instructional video. [www.absa.org/restraining.html](http://www.absa.org/restraining.html)

“Working at Animal Biosafety Levels 1, 2, and 3”. Instructional video. [www.absa.org/restraining.html](http://www.absa.org/restraining.html)
Objectives

- Outline the components of a maintenance program for containment laboratories
- Understand the differences between routine, preventive and proactive maintenance
- Explain the concepts of continuity and reliability of services in support of the laboratory program
- Identify maintenance issues for key architectural, mechanical and security systems
- Describe the skilled trades involved in effectively implementing a maintenance program

Training Tools and Reference Material


*Working Safely in a BL3 Laboratory - Guidance for Service and Maintenance Employees.* Instructional Video. Office of Environmental Health & Safety, Yale University.  
www.yale.edu/oehs/biomoreinfo.htm
Objectives

- Define disinfection, germicide, sanitizer, virucide, sterilant and other applicable terms used to describe decontaminants
- Describe the factors affecting the efficacy of disinfectants
- Outline the classes of disinfectants and their advantages and disadvantages
- Describe methods to test the efficacy of disinfectants
- Describe the methods used for the decontamination of rooms and other spaces

Training Tools and Reference Material


Objectives

- Outline the types of infectious waste generated in the laboratory
- Describe the treatment methods for infectious waste
- Understand the principles and practices for steam sterilization
- Explain the strategies for treating liquid effluent from the laboratory

Training Tools and Reference Material

Module 14: Bioethics

Objectives

- Describe the ethical responsibilities for individuals working with infectious disease agents in the laboratory
- Outline the ethical issues that concern biosafety and biosecurity
- Discuss codes of conduct for scientists
- Identify key international codes and conventions in relation to the safe and ethical use of biological sciences

Training Tools and Reference Material


www.unog.ch/bwc
www.opbw.org
Module 15: Transportation of Infectious Substances

Objectives

- Outline the regulatory framework governing the transportation of infectious substances
- Describe the classification, packaging, labeling, documentation and shipping requirements for infectious substances and diagnostic specimens
- Describe the responsibilities of the consignor, carrier, and consignee

Training Tools and Reference Material

Guidance on Regulations for the Transport of Infectious Substances. World Health Organization. 2007
www.who.int/csr/resources/publications/biosafety/WHO_CDS_EPR_2007_2 (available in Russian)

Infectious Substances Shipping Guidelines. International Air Transport Association. 2006
www.iata.org/ps/publications/issg.htm

Copies of Guidance document to be distributed to participants

Demonstration of packaging, labeling and documentation
Objectives

- Outline the procedures for responding to spill of infectious materials and other accidents in the laboratory
- Describe how to handle medical emergencies in a containment facility setting
- Describe the components of an effective occupational health program
- Outline the procedures for management of occupational exposures to infectious agents

Training Tools and Reference Material

Demonstration of mock spill remediation using fluorescent tracer powder