



BSL 3-AG FACILITIES

2006 ChABSA Scientific Symposium
Fredrick, MD

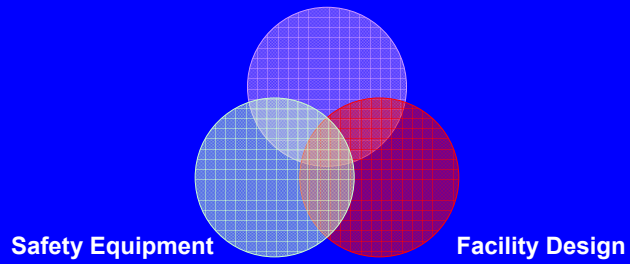
Dr. Robert A. Heckert, DVM, PhD
USDA Agriculture Research Service

Bio-Safety Level (BSL) Definition

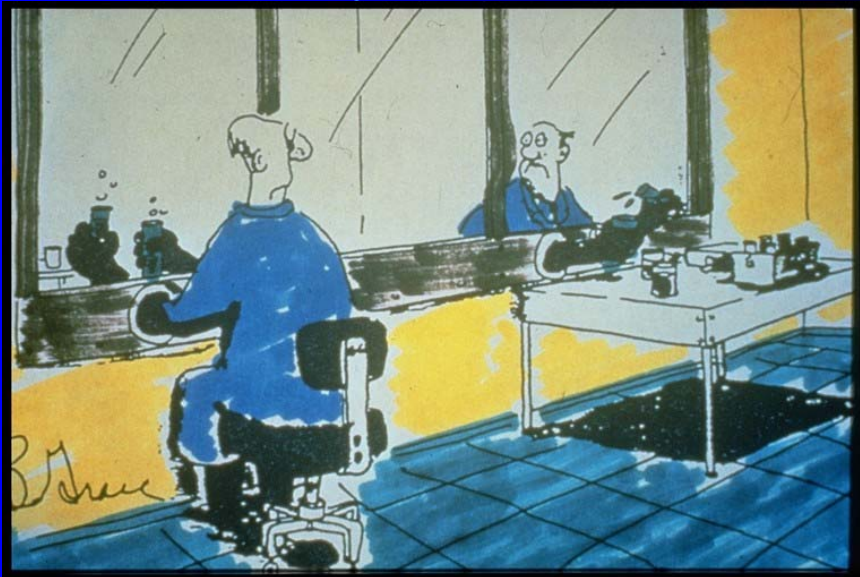
- A combination of work practices, primary containment devices, and construction technology to reduce the risk of laboratory infection or release of a microbe to the environment.
- The more pathogenic the microbe, the higher the BSL, and the stricter the containment requirements. BSL 4 is the highest level (BSL3-Ag).

Biosafety

Practices and Techniques



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BSL 3

- Agents cause serious or lethal consequences
- All work is done in Bio-Safety Cabinet
- Access is severely limited

Examples: *M. tuberculosis, Yellow Fever*

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BSL 3 Criteria

- BASIC
 - ✓ *Anteroom*
 - ✓ *Directional Airflow*
- Enhanced
 - ✓ *Air Treatment*
 - ✓ *Liquid Waste Treatment*
 - ✓ *Personnel Shower*
 - ✓ *Respiratory Protection*

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Special Problems

- 9/11/01 – *it's a new game!*
- Biosecurity vs. biosafety requirements
- Select agent requirements
- Construction details
 - Must build to suit the agent(s) with considerations of use (form follows function)
 - Flexibility
 - Validation (commissioning) + permitting

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Environmental Protection

Why is USDA and the
Agricultural Community so
concerned?

Agriculture USA's Largest Industry

U.S. Farm Income Cash receipts to Producers

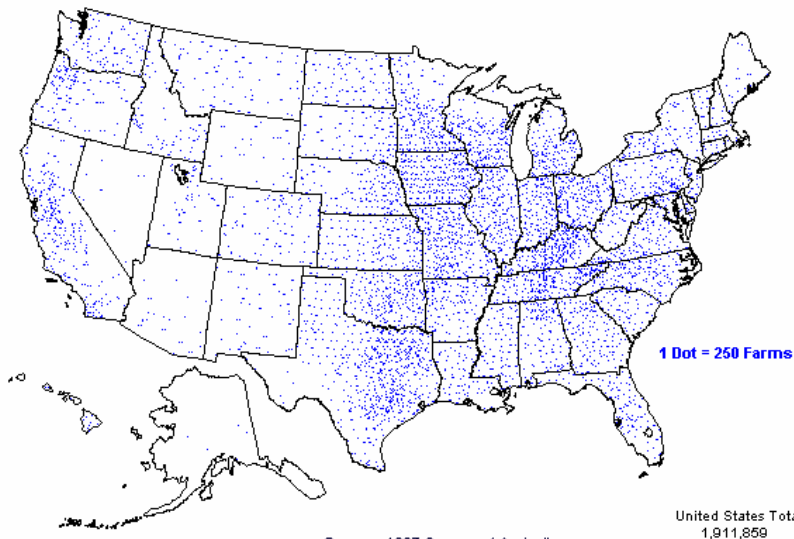
\$124 Billion - Animal

\$114 Billion - Crops

USDA/ERS, 2005

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Number of Farms: 1997



97-M01

Source: 1997 Census of Agriculture

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ECONOMIC IMPACT OF FOREIGN ANIMAL DISEASES



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ECONOMIC IMPACTS OF FADs

- Hypothetical
 - FMD in USA: \$27 Billion
 - CSF in USA: \$3.2 Billion
- Actual
 - HPAI 1983: \$349 Million
 - END in CA in 2003: \$ 360 Million
 - FMD UK 2001: \$15 Billion
 - CSF in Netherlands 1997: \$3.4 Billion

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WHY IS THE IMPACT SO LARGE?

- US National Herd
 - 90 M Beef Cattle
 - 10 M Dairy Cattle
 - 10 M Sheep
 - 60 M Hogs
 - 8 B Poultry
- Value of National Herds makes up 13% of Gross Domestic Product (GDP)
- Makes up about 17% of all employment in US

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FADs AFFECT ABILITY TO TRADE

- World trade has tripled in the last 20 years
 - \$2.4 Trillion in 1980 to \$8 Trillion in 2000
- US exports are climbing
 - 15% increase in chicken meat in last 30 years
 - 17% increase in dairy products in last 30 years
 - 2.25 million tons broiler meat in 2004

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Disease Control



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So what's BSL 3-AG?

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Unique issues arise in containment evaluation for agricultural animals

BSL 3 – AG Considerations

- **No Primary Containment (loose housed)**
- **Large Infected Species (any)**
- **Environmental Protection**
- **Potential Internal Transmission (room to room)**
- **What and how the agent will be used!!!**

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Laboratory Work with Ag Agents

- **All Agriculture pathogens can be worked with at BSL2, BSL3 or BSL3 with enhancements**
- **Reasons:**
 - the agent is not highly contagious,
 - a vector is needed for transmission,
 - there are various containment practices put in place

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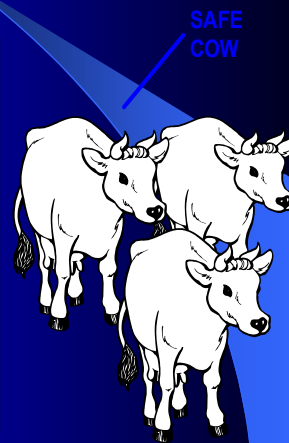
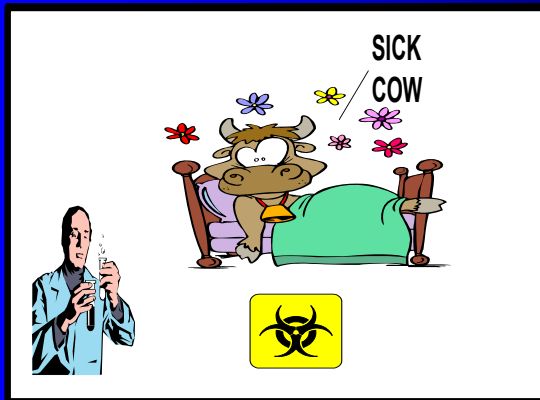
Biosafety Level Criteria (on-site risk assessment)

- Virulence
- Pathogenicity
- Biological Stability
- Route of Spread
- Communicability
- Laboratory Function
- Practice and Procedures
- Quantity/Concentration of Organism
- Endemicity of Agent
- Availability of Effective Vaccine or Therapy

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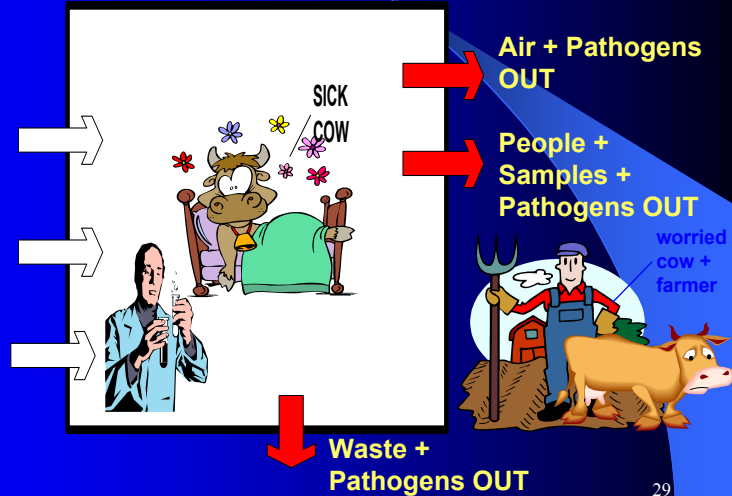
Contain the Hazard:

The pathogen in the animal
The animal room becomes primary containment



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A sealed airtight box achieves our objective but isn't ideal from the animal's perspective. Through necessity, the barrier is compromised.



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AIR
BIO-WASTE
PEOPLE
CONSTRUCTION



- **HEPA filter treatment of exhaust and/or supply air**
- **Sealed windows**
- **Sealed utility penetrations**
- **Door closures**
- **Controlled air movement**
- **Air pressure negative with respect to adjacent areas**

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AIR
BIO-WASTE
PEOPLE
CONSTRUCTION



- Sealed utility penetrations
- Procedures for consumables IN
- Decontamination/sterilization of liquid effluent
- Solid waste incineration/safe disposal

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AIR
BIO-WASTE
PEOPLE
CONSTRUCTION



- Access control
- Personnel shower OUT
- Samples OUT
- Procedures for removal of samples
- Respiratory protection
- Restriction on contact with domestic animals

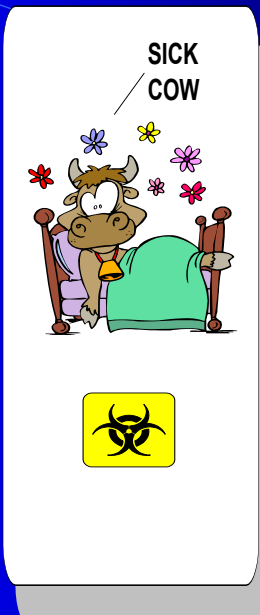
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AIR

BIO-WASTE

PEOPLE

CONSTRUCTION



- *Surface impervious to liquids*
- *Sealed windows*
- *Sealed utility penetrations*
- *Airlock doors*

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BSL 3 – AG

- **APPLIES TO LOOSE HOUSED ANIMALS INFECTED WITH SOME AGENTS**
- Decontamination/sterilization of liquid effluent
- HEPA Filter treatment of exhaust and/or supply air
- Provision for personnel “**Shower Out**” capability
- Some restriction on contact with domestic animals
- **PRESURE DECAY TESTING OF WALLS IN ANIMAL ROOMS ONLY (new construction)**

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Ag Agents of Concern

- African horse sickness ^{1,2}
- African swine fever virus ^{1,2,3}
- Akabane virus ²
- Avian influenza virus (highly pathogenic) ^{1,2,3}
- Bacillus anthracis ^{1,2}
- Beasnoitia besnoiti
- Bluetongue virus (exotic) ^{1,2}
- Borna disease virus
- Bovine infectious petechial fever agent
- Bovine spongiform encephalopathy ²
- Brucella abortus ^{1,2}
- Brucella melitensis ^{1,2}
- Brucella suis ^{1,2}
- Burkholderia mallei (Pseudomonas mallei - Glanders) ^{1,2}
- Burkholderia pseudomallei ^{1,2}
- Camelpox virus ²
- Classical swine fever ^{1,2,3}
- Coccidioides immitis ²
- Coeliomyia hominivorax (Screwworm)
- Cowdria ruminantium (heartwater) ²
- Coxiella burnetii (Q fever) ²
- Epizootic fever virus fever agent
- Eastern equine encephalitis ^{1,2}
- Foot and mouth disease virus ^{1,2,3}
- Francisella tularensis ²
- Goat pox ^{1,2}
- Hendra virus ^{1,2,4}
- Histoplasma (Zygometa) farciminosum
- Infectious salmon anemia virus
- Japanese encephalitis virus ^{1,2}
- Leptospira
- Lumpy skin disease virus ^{1,2,3}
- Malignant catarrhal fever virus (exotic strains or alcelaphine herpesvirus type 1) ²
- Menangle virus ²
- Mycobacterium bovis
- Mycoplasma agalactiae
- Mycoplasma mycoides subsp. mycoides, (small colony type) ^{1,2,3}
- Mycoplasma capricolum ^{1,2,3}
- Nairobi sheep disease virus (Ganjam virus)
- Newcastle disease virus (velogenic strains) ^{1,2,3}
- Nipah virus ^{1,2,4}
- Peste des petits ruminants (plague of small ruminants) ^{1,2,3}
- Rift Valley fever virus ^{1,2,3}
- Rinderpest virus ^{1,2,3}
- Sheep pox ^{1,2}
- Spring Viremia of Carp virus
- Swine vesicular disease virus ²
- Teschen disease virus¹
- Theileria annulata
- Theileria lawrencei
- Theileria bovis
- Theileria hirci
- Trypanosoma brucei
- Trypanosoma congolense
- Trypanosoma equiperdum (dourine)
- Trypanosoma evansi
- Trypanosoma vivax
- Venezuelan equine encephalomyelitis ^{1,2}
- Vesicular exanthema virus
- Vesicular stomatitis (exotic) ^{1,2}
- Viral hemorrhagic disease of rabbits Wesselsbron disease virus

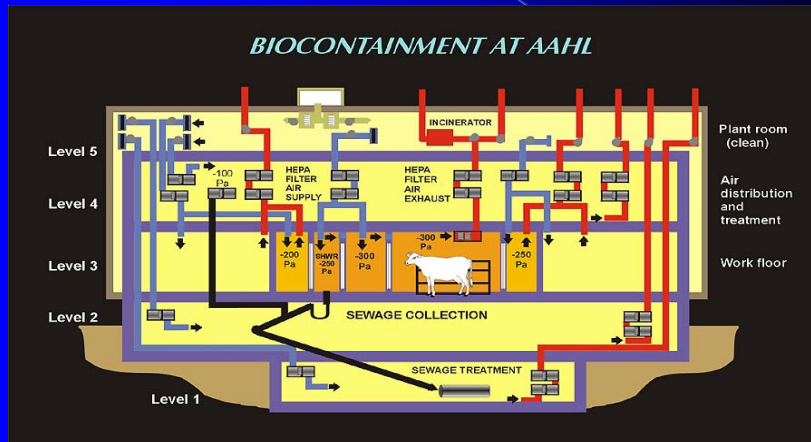
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BSL3-Ag Agents

- African swine fever virus
- Avian influenza virus (highly pathogenic)
- Classical swine fever
- Foot and mouth disease virus
- Lumpy skin disease virus
- Contagious bovine pleuropneumonia
- Contagious caprine pleuropneumonia
- Newcastle disease virus
- Peste des petits ruminants
- Rift Valley fever virus
- Rinderpest virus

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BSL 3 Ag Facility



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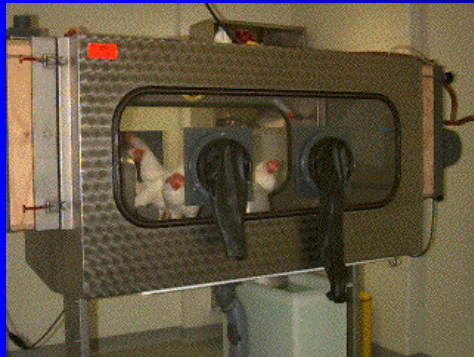
Avian Influenza

- Highly contagious disease of birds caused by type A strains of influenza
- Waterfowl are the natural reservoir and most resistant to avian influenza, but can be asymptomatic carriers
- Birds shed virus through saliva, nasal secretions and feces
- First human case of avian influenza documented in Hong Kong in 1997, caused by influenza A H5N1
- Humans have little immunity
- No human to human transmission



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Poultry Isolator



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Loose-housed poultry



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Summary

- There is a lot at stake – US Ag is big
- Special design and construction requirements are necessary for BSL 3 with enhancements and BSL 3-AG facilities because of the nature of the microbes to be studied.
- Not all agriculture agents of concern require BSL3-Ag (W5 dependent).

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Summary

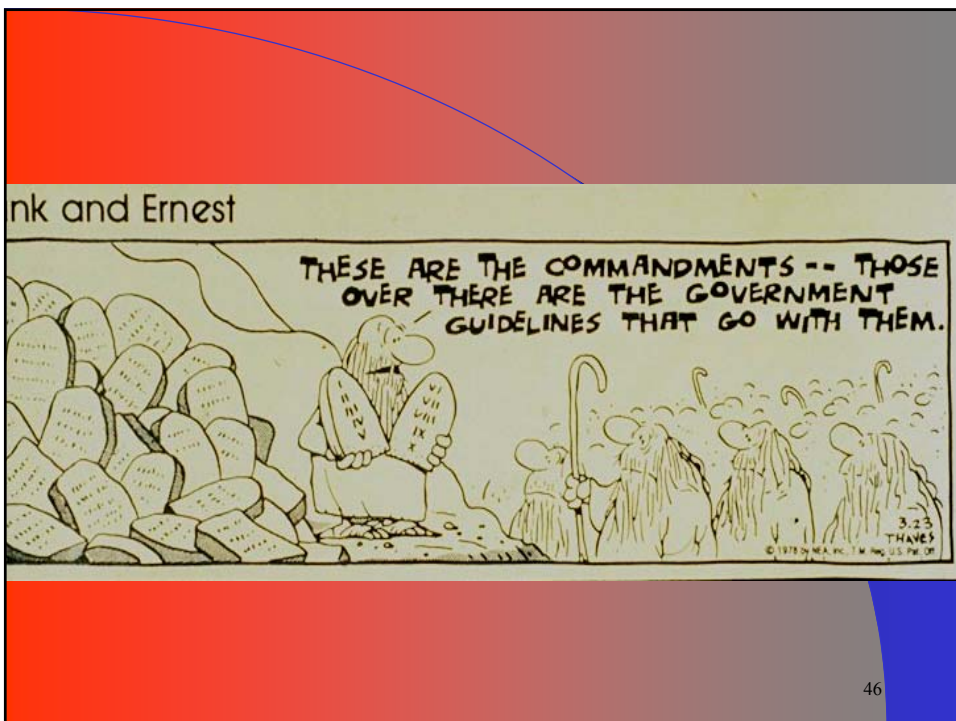
- Work with Ag agents of concern in the laboratory does NOT require BSL3-Ag
- Work with loose-housed animals with some (11) Ag agents requires BSL3-Ag
- An onsite risk assessment is vital to determining the level of containment required to work with Agriculture agents of concern.

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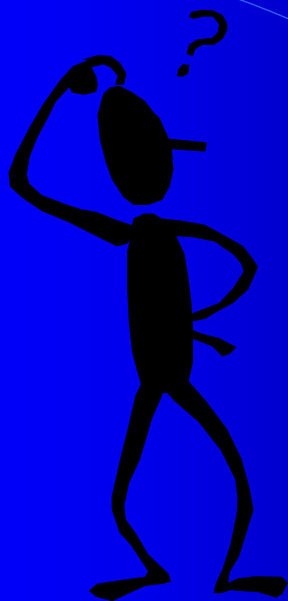
Take home message

Loose housed animals +
Agent (11) =
BSL3-AG

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Thank you to the
BSL-3AG committee