

# Updated Site-Specific Biosafety and Biosecurity Mitigation Risk Assessment



February 2012  
Final Report

Executive Summary



**Homeland  
Security**

Science and Technology Directorate

Defending America Against Foreign Animal Diseases

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# Glossary of Acronyms and Terms

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AAALAC	Association for Assessment and Accreditation for Laboratory Animal Care
AAHL	Australian Animal Health Laboratory
ABSL	Animal Biosafety Level
APHIS	Animal and Plant Health Inspection Service
APHIS-VS	Animal and Plant Health Inspection Service – Veterinary Services
ARF	Aerosol Release Fraction
ARS	Agricultural Research Service
AUSVETPLAN	Australian Veterinary Emergency Plan
ACVP	American College of Veterinary Pathologists
BDM	Biotechnology Development Module
BEA	Bureau of Economic Analysis
BMBL	Biosafety in Microbiological and Biomedical Laboratories
BRI	Biosecurity Research Institute
BSAT	Biological Select Agents and Toxins
BSC	Biological Safety Cabinet
BSL	Biosafety Level
CAFO	Concentrated animal feeding operation
CDC	Center for Disease Control (aka CDCP)
CDCP	Center for Disease Control and Prevention (aka CDC)
CEAH	Centers for Epidemiology and Animal Health
CFSPH	The Center for Food Security and Public Health
cGMP	current Good Manufacturing Practices
CSCHAH	Canadian Science Centre for Human and Animal Health
CSIRO	Commonwealth Scientific and Industrial Research Organization
CUP	Central Utility Plant
cwt	Hundredweight
D&B	Dunn and Bradstreet
DADS	Davis Animal Disease Simulation
DEFRA	United Kingdom, Department of Environment, Food and Rural Affairs
DHS	Department of Homeland Security
DoD	Department of Defense
DOT	Department of Transportation
DSAT	Division of Select Agent and Toxins
DTRA	Defense Threat Reduction Agency
DVM	Doctor of Veterinary Medicine
EDS	Effluent Decontamination System
EIS	Environmental Impact Statement

EOPs	Emergency Operations Plans
EPA	Environmental Protection Agency
EPCRA	Emergency Planning Community Right-to-Know Act
ERA	European Centre for Medium-Range Weather Forecasts Re-Analysis
ERA-Interim	European Centre for Medium-Range Weather Forecasts Interim Re-Analysis
ERP	Emergency Response Plan
ERS	Economic Research Service
EU	European Union
FAD	Foreign Animal Disease
FADD	Foreign Animal Disease Diagnostician
FADDL	Foreign Animal Disease Diagnostic Laboratory
FADRU	Foreign Animal Disease Research Unit
FAZD Center	National Center for Foreign Animal and Zoonotic Disease Defense
FEMA	Federal Emergency Management Agency
FMD	Foot and Mouth Disease
FMDv	Foot and Mouth Disease virus
GAO	Government Accountability Office [of US Congress]
GMP	Good Manufacturing Practices
GNL	Galveston National Laboratory
GSF	Gross Square Feet
HEPA	High Efficiency Particulate Air
HeV	Hendra virus
HHS	Health and Human Services
HPAC	Hazard Prediction and Assessment Capability
HSPD	Homeland Security Presidential Directive
HVAC	Heating, Ventilation and Air Conditioning
IAH	Institute of Animal Health
IATA	International Air Transport Association
ICC	International Code Council
ID	Infectious Dose
IMPLAN	Impact Analysis for Planning
ISC	Interagency Security Commission
ISO	International Standards Organization
JEM	Joint Effects Model
K-State	Kansas State University
LAI	Laboratory Acquired Infection
LEPCs	Local Emergency Planning Committees
LMIC	Livestock Marketing Information Center
MAR	Material available for release
MESA	Multiscale Epidemiological/Economic Simulation and Analysis

MFD	Manhattan Fire Department
MHK	Manhattan Regional Airport
MID	Minimum Infectious Dose
MOU	Memorandum of Understanding
MPH	Master of Public Health
MPH	Miles per hour
MPPS	Most Penetrating Particle Size
MRHC	Mercy Regional Health Clinic
MTV	Minute Tidal Volume
NAADSM	North American Animal Disease Spread Model
NAHLN	National Animal Health Laboratory Network
NAS	National Academy of Sciences
NASS	National Agricultural Statistics Service
NBACC	National Biodefense Analysis and Countermeasures Center
NBAF	National Bio and Agro-Defense Facility
NCAH	National Centers for Animal Health
NCAR	National Center for Atmospheric Research
NCEP	National Center for Environmental Prediction
NDP	NBAF Design Partnership
NEHRP	National Earthquake Hazards Reduction Program
NIH	National Institute of Health
NIMS	National Incident Management System
NiV	Nipah virus
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NRC	Nuclear Regulatory Commission
NSF	Net Square Feet
NVSL	National Veterinary Services Laboratories
O&M	Operation and Maintenance
OHS	Occupation Health Services
OIE	World Organisation for Animal Health
OSHA	Occupational Safety and Health Administration
OSTP	Office of Science and Technology Policy (White House)
PFU	plaque-forming units
PIADC	Plum Island Animal Disease Center
PMP	Probable Maximum Precipitation
PPE	Personal protective equipment
PReP	Preparedness and Response Plan
R&D	Research and Development
RCEM	Riley County Emergency Management

RIMS	Regional Input/Output Modeling System
RVF	Rift Valley Fever
RVFv	Rift Valley Fever virus
S&T	Science and Technology
SARA	Superfund Amendments and Reauthorization Act
SCIPUFF	Second-order Closure Integrated PUFF (model)
SME	Subject Matter Expert
SOMs	Self Organizing Maps
SOP	Standard Operating Procedure
SPC	Storm Prediction Center
SSO	Sanitary Sewer Overflow
SSRA	Site-Specific Risk Assessment
STAR	Science and Technology in Atmospheric Research (Institute)
TAD	Targeted Advanced Development
TCID	Tissue Culture Infectious Dose
U.S.	United States
UFC	Unified Facilities Criteria (Department of Defense)
UK	United Kingdom
USDA	United States Department of Agriculture
USDHHS	United States Department of Health and Human Services
USGS	U.S. Geological Survey
V.M.O.	Veterinary Medical Officer
WHO	World Health Organization
WWTP	Wastewater Treatment Plant

# Executive Summary

The National Bio and Agro-defense Facility (NBAF) in Manhattan, Kansas, will be used by U.S. Department of Homeland Security (DHS), U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) Veterinary Services (VS) Foreign Animal Disease Diagnostic Laboratory (FADDL), and the USDA



Agricultural Research Service (ARS) Foreign Animal Disease Research Unit (FADRU) for critical U.S. research, diagnostic, and training needs. An Updated Site-Specific Risk Assessment (Updated SSRA) for the NBAF, based on the 65% Design documents, was performed for DHS. The quantitative results from modeling potential infection-causing accidental releases of viable Foot and Mouth Disease virus (FMDv) from the NBAF and risks associated with research on large animals within the highest containment level (Biosafety Level 4, or BSL-4) were determined and assessed to inform DHS on potential facility design modifications that will be considered prior to finalizing the construction documents. In addition, recommendations on the continuing development of operational and accident response strategies were provided to facilitate the evolution of the safest and most effective protocols and procedures during the culmination of the design period and while construction is underway. ***This Updated SSRA assessment indicates that the NBAF 65% Design is sound and has no evident fundamental flaws or design features that would prohibit the implementation of the best and safest practices used in animal and zoonotic pathogen research facilities.***

The Updated SSRA was performed as part of the DHS commitment to NBAF safety and to satisfy the Congressional requirements stipulated in Public Law 112–10, §1647. As required by Congress, cumulative (NBAF project lifetime) calculations on the probability of an FMD outbreak caused by an accidental release of the virus from the NBAF were also performed. The calculations performed in this Updated SSRA indicate that ***the estimated expected probability that an accidental release of viable FMDv from the NBAF will occur and result in a subsequent outbreak during the NBAF’s nominal 50-year operating lifetime is less than 0.11% (including catastrophic events such as tornados and earthquakes) and less than 0.008% when catastrophic events are excluded.***

## NBAF Background

The research infrastructure that will be provided by the NBAF is necessary for continuing protection of the U.S. food and agriculture industry. This highly integrated, global, and complex industry is inherently vulnerable to foreign animal, emerging, and zoonotic disease outbreaks that could threaten the stability of the economy, food security, and the Nation’s public health. DHS has the responsibility and the

national stewardship mandate to detect, prevent, protect against, and respond to terrorist attacks within the U.S. (Homeland Security Act of 2002, 6 U.S.C 182). DHS shares these responsibilities, as they apply to the defense of animal agriculture, with the U.S. Department of Agriculture (USDA); hence, a coordinated agricultural research strategy (as called for in the Homeland Security Act of 2002 and Homeland Security Presidential Directive 9 (HSPD-9), “Defense of U.S. Agriculture and Food,” January 30, 2004) has been developed. HSPD-9 also specifically identified the need for “safe, secure, and state-of-the-art agriculture biocontainment laboratories that support research and develop diagnostic capabilities for foreign animal and zoonotic diseases.” The NBAF will provide the infrastructure needed to satisfy the need for these modern biocontainment laboratories.

The White House Office of Science and Technology Policy (OSTP) organized a Blue Ribbon Panel in 2003 to examine research and development requirements to support efforts to mitigate the potential threat of bioterrorism directed against agricultural livestock. This panel presented a series of recommendations, including a prioritization of pathogens requiring study [Kelly, 2003]. Subsequently, DHS and USDA partnered on the development of the list of high-consequence diseases that threaten the U.S. and will be researched in the NBAF: Foot-and-Mouth Disease, African Swine Fever, Classical Swine Fever, Japanese Encephalitis, Rift Valley Fever, and Contagious Bovine Pleuropneumonia. These diseases were identified for study based on the threats and consequences of their introduction into the U.S. In addition, the NBAF will be the first facility of its kind in the U.S. to conduct critical studies on Nipah and Hendra and other emerging zoonotic viruses in large animal models (*e.g.*, cattle and swine) in the highest containment level.

Foreign animal diseases (FADs) affect livestock, poultry, and wildlife and are not indigenous to the U.S. For the past 50 years, much of the Nation’s FAD research has been conducted off the coast of Long Island, New York, at the Plum Island Animal Disease Center (PIADC). Because the food and agriculture industries are significant contributors to U.S. economic prosperity, any disruptions from a deliberate or natural FAD introduction that caused a significant loss in the agro business chain would have significant economic consequences. In addition, FADs that also result in zoonoses (transmission from animals to humans) may cause a human health crisis. The NBAF will replace the PIADC and expand the research that is currently available. Facilities at the PIADC have limited laboratory space, antiquated infrastructure, and do not include Biosafety Level 4 (BSL-4) laboratories, which are required to safely conduct research on emerging and high-threat exotic pathogens such as the Nipah and Hendra viruses.

When operational, the NBAF will enable DHS and USDA to conduct comprehensive research of high-threat foreign animal and zoonotic diseases within the U.S. and will therefore serve to protect the Nation’s animal agriculture and public health against numerous foreign animal and emerging diseases. Specifically, the NBAF will provide:

- Capabilities to perform basic and advanced research;
- Enhanced means to perform laboratory diagnostic detection and response;

- Expanded capabilities for development of new vaccines against high-threat foreign animal diseases; and
- Facilities for training veterinarians in preparedness and response to high-consequence foreign animal disease outbreaks.

Safety and security are of paramount importance in the planning, design, construction, and operations of the NBAF. From selection of the site to the design of the facility and, finally, the operation of the NBAF, DHS is committed to understanding the associated safety and security risks and mitigating those risks through the necessary design, engineering, operational protocols, and response planning efforts. To date, DHS has completed an Environmental Impact Statement (EIS), including a Health and Safety Chapter [DHS, 2008], a Threat and Risk Assessment (December 2008), a Site-Specific Threat and Risk Assessment (intentional acts) [Sandia, 2010], and a Site-Specific Risk Assessment (SSRA) [DHS, 2010].

Since the 15% Design phase and completion of the 2010 SSRA, DHS has incorporated recommendations to include additional mitigation measures for carcass disposal systems, liquid waste treatment and management, fully redundant dual-HEPA exhaust systems, and tornado hardening. In addition, DHS has continued to advance operations and response plans that also reduce risks. ***The relatively low risk observed across the various potential release events evaluated in this Updated SSRA are the result of the design, operational plans, and response practices that have been adopted or improved upon since the 15% Design.***

### Risk Assessment Process Summary

The Updated SSRA is part of the overall DHS risk management effort for the NBAF and is based on the 65% Design. This update satisfies Congressional requirements (Public Law 112–10, §1647), addresses feedback provided by the NAS SSRA Committee, incorporates additional data collected on the selected site (Manhattan, Kansas), uses the most up-to-date modeling tools, and integrates updated design, operations, and accident response strategies into the assessment. DHS has completed the 50% and 65% Designs, thus satisfying the requirements of §1647(b)(1). The Updated SSRA satisfies the Congressional requirements for demonstrating how calculated risks have been significantly reduced by incorporating mitigations into the risk assessment and addressing shortcomings identified by the NAS SSRA Committee (§1647(b)(2), §1647(c)(1)) through the application of the following enhancements, and others, to the risk assessment process:

- Providing a more systematic approach to the assessment of potential accident events including the use of fault tree and event tree analyses;
- Characterizing uncertainties in calculated results based on standard deviations, unknowns, assumptions, and stochastic variability associated with inputs that are modeled in the assessment;
- Incorporating the use of a published tornado return period methodology;

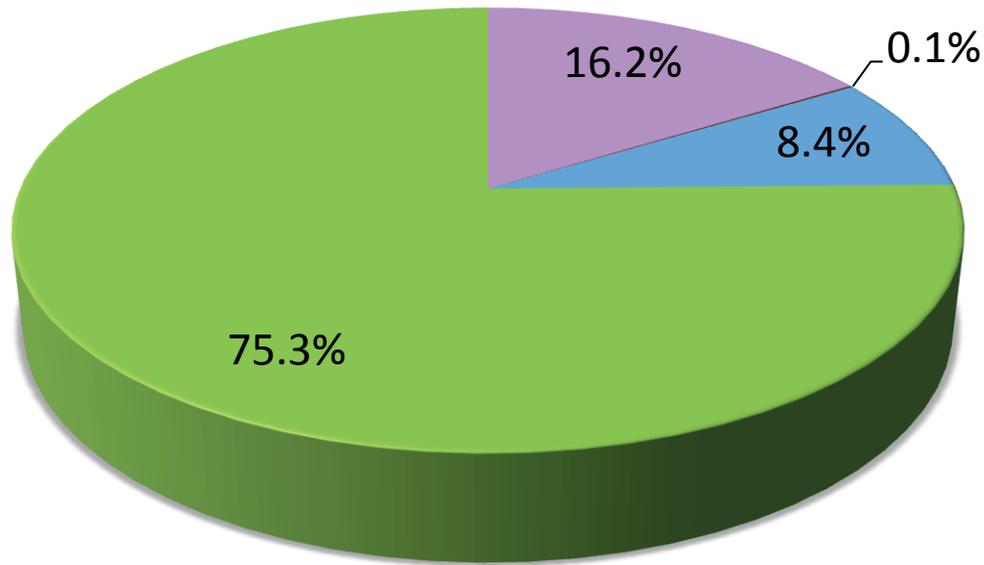
- Providing additional knowledge and data collected for the NBAF location (e.g., susceptible populations, outbreak control measure resources, etc.) that were used in the predictive epidemiological modeling; and
- Developing and using a methodology to estimate the cumulative risk of an FMD infection that would result from an accidental release from the laboratory over the anticipated operating lifetime of the facility.

Other enhanced risk assessment methodologies used in the Updated SSRA comprise the use of updated epidemiological modeling and sensitivity analyses, higher-fidelity meteorological modeling, and advanced economic modeling of potential outbreaks.

In addition, this Updated SSRA satisfies §§1647(c)(2) and (3) by assessing the impact of surveillance, response, and mitigation plans, and providing an assessment of the overall risks associated with research involving large animal models in BSL-4 containment to assist the government in evaluation of the effectiveness of control measures and inform stakeholders on the feasibility of implementation.

## Conclusions

The quantitative modeling of infrequent FMD outbreaks caused by unintentional pathogen release from the NBAF (excluding catastrophic earthquake and tornado events) indicated that human error and the associated transfer of virus from the laboratory by human vectors or fomites are the most likely causes of an accident that would result in an outbreak. The potential for the release of pathogenic material (viable FMDv) from the NBAF was assessed by modeling each accident event by the mechanism of virus transfer or pathway. The four transport pathways used to characterize all accident events were aerosol, solid waste, liquid waste, and transference (which includes human vectors and fomites). Among all non-catastrophic FMDv events, the transference pathway occupied approximately 75.3% of the overall risk (the product of frequency and consequences) space, as illustrated in Figure ES-1. The assessed risks for the aerosol, solid waste, and liquid waste pathways represent approximately 16.2%, 0.1%, and 8.4% of the risk space, respectively.



■ Aerosol 
 ■ Solid Waste 
 ■ Liquid Waste 
 ■ Transference

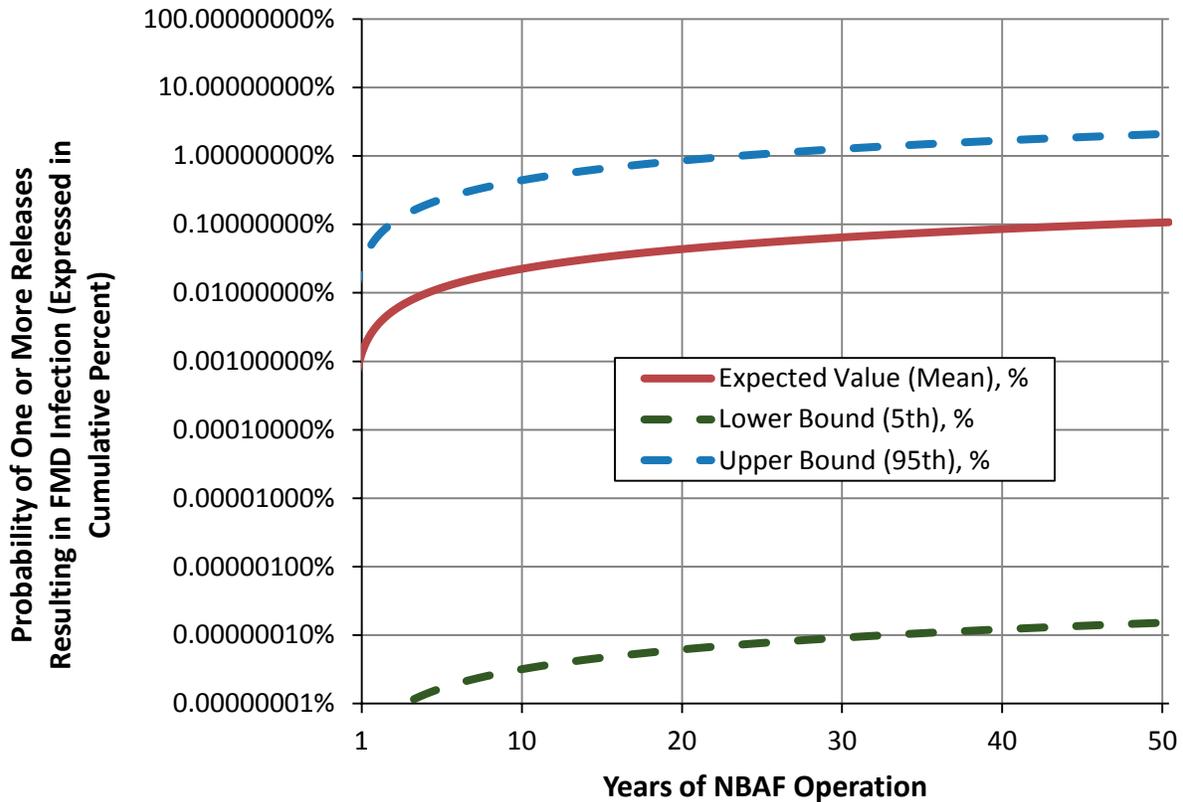
**Figure ES-1: Proportion of Risk Space by Pathway for FMD**

The catastrophic events, earthquakes and tornados, potentially involve multiple transport pathways. The most current NBAF design provides for maintaining laboratory containment even in tornado events with winds up to ~228 mph. However, the catastrophic events comprise approximately 81% of the total risk space when included in the calculations with the accident events. More than 99% of this 81% is attributed to the modeled risk from an earthquake (catastrophic tornado events comprise the remaining risk space). The large contribution to risk presented by earthquakes is a function of the modeled values for the frequency of an earthquake that could potentially compromise the containment integrity of the NBAF and possibly lead to an infection event. These frequencies are likely overestimated because the containment area modifications incorporated in the latest NBAF design that address the high wind and tornado risks will also provide benefit to the containment performance characteristics during an earthquake event, but these benefits have not yet been characterized. The detailed dynamic structural modeling that will characterize the present earthquake performance characteristics is currently being performed. When catastrophic events are included, the aerosol, solid waste, liquid waste, and transference events represent approximately 3.1%, 0.02%, 1.6%, and 14.3% of the risk, respectively. As modeled, the expected return period for the catastrophic earthquake is 2,500 years and for a catastrophic tornado the expected return frequency is 14.2 million years.

As required, cumulative risk estimates associated with the release and subsequent infection of susceptible species with FMD were estimated for the projected 50-year lifecycle of the NBAF. The risks assessed in the Updated SSRA were based on the projected research activities that are scheduled to begin around 2020. The uncertainties, assumptions, and unknowns associated with modeled research activities increase with time. For example, it is reasonable to assume that FMD research will still be a high priority in 2020, but it is more difficult to make the same assertion for 2070. The practice of numerically estimating risk over such a long period is not recommended (but required by Public Law 112–10, §1647), and care should be taken to avoid over-interpreting the cumulative risk estimates developed in the Updated SSRA. Also, the uncertainty associated with the estimates comprising the cumulative risk values are, in many cases, large relative to the estimated risks.

With these caveats, the estimated probability that a release of viable FMDv from the NBAF will occur and cause an infection was calculated for a single year (the first year) of NBAF operation and across the 50-year operating lifetime of the facility. For a single year of NBAF operation, when all events are considered (including catastrophic), the expected probability of at least one release resulting in an infection in a given year is  $2.16 \times 10^{-5}$  and the estimated range is approximately  $3.07 \times 10^{-11}$  to  $4.23 \times 10^{-4}$ . When catastrophic events are excluded, the probability of at least one release resulting in an infection in a given year is estimated to be between  $3.07 \times 10^{-11}$  and  $2.33 \times 10^{-5}$  with an expected value of  $1.52 \times 10^{-6}$ . The risk over all events for one year was \$0.70M when all events were included and \$0.13M when the catastrophic events were excluded.

The 50-year cumulative probability estimate for an FMD event is  $1.08 \times 10^{-3}$  (ranging from  $1.54 \times 10^{-9}$  to  $2.35 \times 10^{-2}$ ) when all events were included and  $7.61 \times 10^{-5}$  (ranging from  $1.54 \times 10^{-9}$  to  $1.17 \times 10^{-3}$ ) when catastrophic events were excluded. In other words, when all events (all causes) are considered, the probability of at least one release resulting in an FMD infection over the 50-year NBAF operating lifetime is estimated to be less than 0.11%, as illustrated in Figure ES-2. (The upper bound (95<sup>th</sup> percentile) and lower bound (5<sup>th</sup> percentile) are also illustrated in this figure. When catastrophic events are excluded, the probability of at least one release resulting in an infection over the 50-year NBAF operating lifetime is estimated to be less than 0.008%. The cumulative risk over the 50-year operating lifetime of the NBAF was \$35M when all events were included and \$7M when the catastrophic events were omitted. The uncertainty (standard deviation) in the 50-year cumulative risk was found to be approximately \$15B, regardless of whether catastrophic events are included.



**Figure ES-2: Cumulative Probability of FMD Infection over the 50-Year Operating Lifetime of the NBAF**

*The estimated probability (with the stipulated caveats) that an accidental release of viable FMDv from the NBAF will occur and result in a subsequent outbreak during the NBAF's nominal 50-year operating lifetime is less than 0.11%.*

The Updated SSRA concludes that the NBAF 65% Design incorporates the most current validated biocontainment techniques and meets or exceeds required and recommended design and construction standards, and human factors (errors) again dominate the risk space, as was determined in the 2010 SSRA. Architectural features and engineered systems included in the design support the application of best operational biosafety and biocontainment practices, but sufficient personnel training will be required, as planned, to minimize the potential for an accidental pathogen release. Facility features and systems that were identified as being associated with elevated risks in the 2010 SSRA were addressed in the most current design by adding or changing appropriate facility features and systems. Compared to the 2010 SSRA, fewer recommendations that have risk-mitigating potential were made as a result of the Updated SSRA because of the addition of several mitigation measures in the maturing design and response strategies.

## Large Animal BSL-4 Assessment

This Updated SSRA also provides an assessment of the risks associated with research on high-consequence zoonotic pathogens (Nipah and Hendra) with large animal models in BSL-4 laboratories.

Again, the risks were defined as the product of event frequency and consequences but the consequences were modeled with less fidelity since there is a lack of applicable and validated modeling tools for these pathogens. This assessment used the same transport pathways as the FMD assessment but the modeled events differed. The transference pathway for the BSL-4 events also dominated the risk space—more than 99.999% of the risk space was attributed to transference events for both Nipah and Hendra viruses. The recommendations derived from this assessment were aggregated with recommendations from the FMD assessment and are summarized below.

## Recommendations

The recommendations for consideration by DHS, USDA, and other stakeholders presented in Table ES-1 are intended to inform NBAF planning processes on design features, operations-related concepts, and response strategies that may help further reduce risks associated with animal and zoonotic pathogen research. Recommendations have been derived from the quantitative assessment of FMD-related research in BSL-3Ag and BSL-3E facilities (including the Special Procedure areas) and the assessment of zoonotic pathogen research in the large animal BSL-4 facilities. Also considered in this assessment and the development of recommendations are the most current risk mitigation and planning efforts of DHS and USDA and all design modifications that have been implemented since the performance of the 2010 SSRA. As the design nears completion, DHS will intensify the operational and response planning efforts. Specifically, DHS has initiated or continued the following activities to further advance operational and response planning:

- Continued to engage the Plum Island Animal Disease Center (PIADC) to leverage 60 years of operating experience, knowledge, and planning documents;
- Leveraged and applied information from a highly successful CDC/USDA inspection of the National Biodefense and Countermeasures Center (NBACC) laboratory to support planning efforts;
- Engaged local and regional emergency responders to initiate Memorandums of Understanding (MOUs) for needed response capabilities;
- Established the Research and Transition Working Group to begin formulating training requirements;
- Continued stakeholder engagements to ensure full understanding by local and regional community of the NBAF mission; and
- Established appropriate baseline biosafety guidelines for incorporation into design basis and standard operating procedures.

DHS has also started the development of the initial operating capability (IOC) of the NBAF in preparation for the migration of personnel, equipment, and operations from the PIADC facility. In collaboration with USDA, DHS is in the beginning stages of developing the NBAF Emergency Response Plan (ERP). The NBAF ERP will provide guidance and direction to assure an integrated and coordinated response to emergency situations at the NBAF. The ERP will include the delineated steps and actions needed for mitigation, preparedness, response, and recovery and will provide guidance and direction to assure an integrated and coordinated response to emergencies at the NBAF.

While DHS has started the development of operational and response plans, it has been purposefully slow to publish protocols, practices, and strategies. With laboratory commissioning and operations still several (7-8) years away, there is adequate time to develop, review, and inculcate scientific users, personnel, and response stakeholders without the risk of prematurely developing plans that may not be relevant when the facility is finally constructed. As research priorities and technology advance, it is important to have practices and procedures that represent the best available at the time of commissioning and operation. In addition, there may be some concerns about the enhancement of strategic risks related to public disclosure of sensitive information on U.S. countermeasure programs. However, as described above, the collaborative process is underway.

In summary, new recommendations for the NBAF program are presented (Table ES-1) as part of the continuing effort to make the NBAF among the safest containment laboratories in the world, while providing infrastructure and facilities necessary to minimize the risks to U.S. agriculture.

**Table ES 1: Updated SSRA Recommendations Summary**

No.	Description	Status
1	Add permanent disinfection fixtures to the design in shower (water) areas between containment levels.	<b>Accepted</b>
2	Incorporate time-interlocked doors in shower area between the BSL-3E containment area and non-containment.	<b>Accepted</b>
3	Assess the enhanced earthquake performance that may be derived from the structural hardening and containment penetration specifications added for the high-wind and tornado design mitigations for the benefit of future risk assessments.	<b>Accepted</b>
4	Perform additional analyses, as needed, prior to incorporating beneficial reuse into designs and plans.	<b>Accepted</b>
5	Continue to include outside emergency and incident response stakeholders in the operational planning cycle and distribute plans (upon completion) for review and additional contributions.	<b>Accepted</b>
6	Begin periodic training on newly developed and evolving NBAF SOPs, plans, and practices.	<b>Accepted</b>

**Table ES 1: Updated SSRA Recommendations Summary**

No.	Description	Status
7	Develop practices and procedures that reduce handling of and exposure to potentially infectious packages outside of containment.	<b>Accepted</b>
8	Accelerate response planning efforts while including emergency and incident response stakeholders (Recommendation 5) and appropriate interested entities.	<b>Accepted</b>
9	To the extent possible, make vaccination response plans publicly available.	<b>Accepted</b>
10	Publish a high-level description of the cooperative arrangements and roles of public and veterinary health providers.	<b>Accepted</b>
11	Develop and implement a producer education program for livestock producers in the NBAF region.	<b>Accepted</b>

# Acknowledgements

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The Updated SSRA comprised a broad collaborative team that combined the experience, talents, and effort of a variety of domestic and international experts. Expertise was provided by individuals and consultants from private industry; academia; and international, national, state and local government entities, selected for their detailed knowledge of Department of Homeland Security (DHS) and United States Department of Agriculture (USDA) foreign animal disease programs or specific technical expertise. Below is a list of the individuals whose combined expertise and efforts performed the Updated SSRA and produced this Final Report. Some of these contributors were asked only to provide input and comments for subsections of the Updated SSRA. In such cases the reviewers and experts provided valuable input and suggestions and made substantive contributions to the Updated SSRA, but they were not asked to endorse the product in its entirety.

## Contractors

This section lists the individuals who were compensated for their contributions to the Updated SSRA including the Prime Contractor, Signature Science, LLC's, key personnel and key personnel from subcontractors Gryphon Scientific, LLC, STAR Institute and SES Inc. This section also lists consultants who were paid under agreement with Signature Science, LLC or a subcontractor.

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