ACRP Problem No. 12-04-17

*Chemical and Biological Attack Readiness Planning for Airports and Airliners*

**ACRP Staff Comments:** The proposed research could complement that presented in ACRP Report 12: An Airport Guide for Regional Emergency Planning for CBRNE Events.

**TRB Aviation Group Committees Comments:** AVIATION SECURITY & EMERGENCY MGT CMTE: Not Recommended. Although this is a very well structured problem statement, there are vast differentials associated with physical infrastructure elements of airports around the world, environmental factors such as humidity or wind direction, the security/risk profile of the locale, and the remotest possible chance that anyone other than a highly trained WMD support unit could identify a specific agent. Research dollars should not be used for market development.

**Review Panel Comments:** Not recommended — There are already a lot of resources and information available. ACRP Report 12, An Airport Guide for Regional Emergency Planning for CBRNE Events, addresses the coordination issues.

**AOC Disposition:** No funds allocated. No discussion.
I. PROBLEM TITLE

Chemical and Biological Attack Readiness Planning for Airports and Airliners

II. RESEARCH PROBLEM STATEMENT

In spite of the 1995 Arum Shinrikyo attack in the Tokyo subway, where Sarin gas was released which resulted in 13 deaths, 50 severely injured travelers and disruption to thousands of others, the air transportation system remains vulnerable to chemical agent attacks. The 2001 anthrax spore distributed through the US mail system and the 2004 ricin toxin found in the U.S. Senate Office Building demonstrate that terrorists can also secure biological threat agents that have a slower time-scale to detection. Airport could also be vulnerable to biological threats introduced via the air intake. Unlike chemical warfare attacks, a biological attack could go undetected for many days until symptomatology of travelers point to the occurrence of a bioattack.

Prior studies by the National Research Council (NRC) highlighted the need to protect the air transportation network against both chemical and biological agent attacks [1]. This NRC study realized that the time-scale for a chemical agent attack would be close to real-time, therefore prior recommendations discouraged the exclusive use of detect-to-alarm sensing systems. Rather, protective and preventive steps such as enhanced visual security, the use of separate air supply for critical spaces within the airport, and the use of continuous air neutralization systems to remove contaminants were recommended. In spite of the difference in time-scale between a chemical- and biological-agent attack, the NRC offered the same recommendations for biological threats in part because biosensor performance was insufficient back in 2006 and would have resulted in high false alarm rates, not tolerable by the flying public.

Collectively, the suggestions put forth by the National Research Council [1] are particularly appropriate for new construction. However, existing airports may require significant resources to modify their existing ventilation systems. Furthermore, although the Department of Homeland Security (DHS) has jurisdiction over secured areas at large international airports, fresh air intakes need not be physically located in restricted areas. Therefore, should chemical vapor or biological attacks be introduced by conveyances located in shared space, multiple government agencies would be involved, and the airport operations could be largely affected. A holistic assessment of vapor-phase chemical and aerosolized biological agent vulnerabilities at large international airports would be highly beneficial to airport operators, government agencies that would be involved in response, and the travelling public.

III. OBJECTIVE

Quantitatively assess the risk to human health should a vapor-based chemical threat (e.g., Sarin) or biological agents (e.g., inhalation anthrax spores) be introduced into the ventilation system of a large airport. This research should result in a generalizable model that can compute spatial and temporal contaminant concentrations based on chemical properties, dose, and ventilation flow rates in order to identify highest risk areas in airport. A menu of chemical decontamination measures should also be identified.

IV. RESEARCH PROPOSED

(1) Develop a high-fidelity computational fluid dynamics (or equivalent) model that would accurately predict the spatial and temporal concentration of vapor-phase chemical (and biological threat) agents introduced at fresh air intakes in a large international airport (e.g., Dulles International Airport). The parameters of this model should be taken from actual ventilation systems at the participating airport. Chemical (or biological) characteristics to be used by the model should also be based on accurate data about the agent in question (e.g., Sarin for chemical threat and anthrax spores for biological threat). The
model should be flexible enough to simulate other chemical (and biological agents) and a variety of ventilation conditions. In addition, the model should be adjustable using typical environmental parameters including for example relative humidity, temperature, and ambient particulate levels which may lead to changes in physical properties (e.g., particle agglomeration). The output of the model should be the spatial and temporal concentration of agents in all phases (e.g., vapor and/or deposited onto surface) and biochemical byproducts where appropriate.

(2) Based on the outcome in (1), compare the steady-state and highest concentrations from affected areas to known safety levels (e.g., OSHA’s TWA and IDLH levels, EPA guidelines for environmental restoration) for the agents being modeled. Identify whether a risk in fact exists. Describe the method employed to execute the risk assessment.

(3) Develop mitigation strategies for areas where there are the highest risks. Strategies may include the use of detectors, filters, air neutralizers, or increased ventilation.

(4) Based on (1)-(3) above, develop a limited field test to check the accuracy of the model using surrogates (e.g., SF6 for chemical threat and fluorescent polystyrene beads for biological threat). A cost-benefit analysis for different scenarios would be appropriate. The results should be documented.

(5) Prepare a guidebook on best practices for chemical (and biological) decontamination along with the model.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD. 400K. 18 months

VI. URGENCY AND PAYOFF POTENTIAL
While the threat of a terrorist attack on our nation’s aviation system is ever present, and the nature of such an attack can take many forms, chemical and biological attack is one of the hardest to defend against. There is much that is not known about the potential for success of such an attack and what means, if any, would be effective to interdict an attack once launched. The threat is real and the degree of vulnerability of our nation’s airports is unknown. The payoff of this study would be a greater understanding of the risk and vulnerability that our nation's airports face regarding chemical and biological attack, as well as identifying potential mitigation measures to lessen or eliminate the effects of any attack.

VII. RELATED RESEARCH
MITRE’s Systems Engineering and Development Institute (SEDI) is sponsored by DHS on a study of Advanced Chemical Vapor Detection System

VIII. PERSON(S) DEVELOPING THE PROBLEM
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IX. PROCESS USED TO DEVELOP PROBLEM STATEMENT
This problem statement was developed by Grace M. Hwang and Matthew D. Crosman. G. Hwang solicited inputs from colleagues at MITRE SEDI.

X. DATE AND SUBMITTED BY
Grace Mei-Hua Hwang, Ph.D. 10 March 2011

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