Health Risk Assessment of Air Toxics from Airports: "The State of the Science & Strategies for the Future"

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Overview

■Airport Growth & Air Quality Regulations

■Air Toxics and Human Health Risk Assessments

➡ Methods

➡ Limitations

➡ Risk Perception

■Available Studies

➡ SW Chicago Midway

➡ Chicago O'Hare

➡ SEATAC

➡ Southern California

■Risk Drivers

■Mitigation Options

■Recommendations

The Challenge:
Growth Projections for Air Travel

"The transition of air transport from an elite to a mass transport mode will be the most important development affecting regulatory practices in the coming years."

- Airports Council International

Air Quality:
Where Growth and Regulations Conflict!

Airport Emission Inventories are Going Up - Airports Expanding to Meet Demand

- Aircraft Operations
- Ground Support Equipment, Auxiliary Power Units
- Shuttles, Vans, Taxis
- Passenger Vehicles
- Cargo Trucks
- Construction Equipment

SIP Emission Inventory Budgets Are Going Down to allow States to Predict Timely Attainment of Standards

- Stationary Sources
- On-Road Mobile
- Off-Road Mobile
- Area Sources

A Further Complication:

Air Toxic Emissions from Airports

- Replacing/Adding to Noise as a Target for Local Opposition
- Human Health Risk Assessment Science
  - ➡ Unregulated
  - ➡ Uncertain; Over-conservative
  - ➡ Unproven ???

We Need Better Data!!

Airports Fall Through the Cracks in the Regulation of Air Toxic Emissions

■Not specifically addressed as “major” or “area” sources in Section 112 of the CAA

■Viewed as “mini-cities” generating numerous pollutants from multiple sources

■Complex mix of mobile and stationary sources

■Governed by many different authorities; housing many tenants

Nature of the Problem

■Urban areas struggle with air pollution issues

■Studies raise public concerns about air toxics from airports

■Regulators promulgate permit requirements for sources of air toxic emissions

➡HHRAs being included as part of air quality impact analyses in California

■Airports lack meaningful thresholds for analyzing impacts of air toxic emissions

Few Risk-Related Significance Criteria are Available

■CEQA Checklist is Vague - Significant impact = “Expose sensitive receptors to substantial pollutant concentrations”

■NEPA - also vague - “National policy… to prevent or eliminate damage to the environment…and stimulate the health and welfare of man”

It’s Not Going to Go Away

■Urban Air Toxics Initiatives on the Rise

■Public Perceptions/Environmental Justice Issues Heating Up

■Availability of Information (Check Out the Oppositions’ Web Sites)

This is Not a Problem

That Will Solve Itself

Human Health Risk Assessments - Predictions of Cancer, Chronic and Acute Health Effects in Neighboring Communities

■Emission Inventory (FAA EDMS and ARB Factors)

➡Airport Data (operations/day)

➡Emission Factors (lb/day/operation)

➡Speciation Factors (lb/lb, that is, lb of air toxic per lb of VOC or PM)

■Exposure Assessment and Risk Characterization

➡Emissions Dispersion and Risk Modeling ($\mu g/m^3$ exposure concentrations)

➡Toxicity Factors (excess lifetime cancer risk per $\mu g/m^3$ exposure concentration)

The Risk Assessment Process:
Key Improvements Needed

■Exposure - Monitoring vs. Modeling of Exposure Concentrations

■Dose Response - Agency Development of Toxicity Factors

The Big Issues Affecting HHRA

HHRA Results are Typically Conservative to an Extreme

■Estimate maximum "worst-case" emissions

■Estimate concentrations in air based on worst-case meteorological conditions

■Base risk estimates on a hypothetical maximum exposed individual

➡ Assumed to be located at the point where the highest pollutant concentrations will be found, 24 hours/day, 365 days/year, for a 70-year lifetime

Add Multiple Sources of Uncertainty

■Emission factors and speciation factors used to estimate toxic emissions from aircraft engines are based on limited emissions tests

■Toxicity factors derived from animal studies or epidemiological studies of exposed worker populations, extrapolated to low-level exposure, with additional safety factors

■Uncertainty occurs from the application of hypothetical risk estimates (the maximum exposed individual) to actual populations

Compare Overly Conservative Risk Estimates to Stringent Thresholds for Significance

■State of California - cancer risk thresholds:

➡1 in 1,000,000 ILCR at any individual w/o emission controls; 10 in 1,000,000 with TBACT

■Federal - based on benzene NESHAP:

➡100 in 1,000,000 at the MEI; 1 in 1,000,000 for an average member of the population

■Hazard index of 1 is the threshold for noncancer health effects:

➡HI's > 1 indicate "need for further study"

Available Studies:

What Are the Concerns?

■Southwest Chicago (Midway)

■Chicago O'Hare

■SeaTac

■HHRAs as part of CEQA analyses

➡LAX

➡ Proposed OCX

➡ SDIA

Southwest Chicago HHRA
(1993)

■Study requested by
US Congressman

■Average to maximum cancer risks - 200 to 800 in 1,000,000

■Mobile sources (25% of predicted risks)

■1,3-Butadiene most significant contributor to predicted cancer risks

Chicago O'Hare HHRA
(1999)

■Initiated by communities surrounding airport in response to perceived inaction by state and federal agencies

■Modeled risks from emissions estimates generated by the airport

■Monitored ambient concentrations at the fenceline

■Based on modeling:

➡ Maximum risk at the fenceline - 100 in 1,000,000

➡ Risk exceeded 10 in 1,000,000 over an approximate 40 square mile area

➡ Risk exceeded 1 in 1,000,000 over an approximate 1,000 square mile area

■Air monitoring downwind could detect slightly elevated concentrations of Formaldehyde and Benzene, however:

➡ values generally indistinguishable from ambient concentrations typically present in urban air in the U.S.

➡ Downwind monitoring stations were located at the fenceline, adjacent to a runway

Chicago O'Hare HHRA - Implications?

■Would concentrations in air associated with airport operations be distinguishable from "background" levels even a few blocks away?

■What are airport-related risks if concentrations resemble urban background?

SEATAC

■Air monitoring study only (in 1993)

■Some VOCs above State ASILs (Acceptable Source Impact Levels)

■Concentrations resemble typical urban background

■Insufficient data for HHRA

■$4M monitoring study - status???

HHRAs as Part of CEQA

■California has an aggressive air toxics program

■HHRAs part of analysis for LAX, proposed OCX (El Toro), and SDIA

➡ More extensive analysis of mobile sources

➡ Diesel PM and Acrolein have been identified as significant drivers

■Experience has highlighted limitations with existing HHRA approaches

Putting Airport Emissions and Risks into Perspective: MATES

■SCAQMD Study in 1987; Updated in 1998/1999

■MATES II - HHRA based on Air Toxics in Ambient Urban Air - 1,400 In 1,000,000 Cancer Risk, Primary Driver - Diesel PM

■Conclusion - Mobile Source Emissions are Primary Contributors to Estimated Risks

But What Are the Drivers, Really?

Acrolein

■Agency RELs (Reference Exposure Levels) resemble typical ambient concentrations

■California's Acute REL is based on 40-year old data, includes numerous "safety" factors

➡ Reflects uncertainty, not toxic potency

➡ Result: Acrolein is easily judged to pose significant impacts.

➡ Now proposed by California to be one of five air toxics of particular concern to children and infants (Children's Environmental Health Protection Act).

1,3-Butadiene

■Recently determined to be a known human carcinogen, but

■Highly reactive in the atmosphere -
half life in air of several hours

➡Wasn't detected in Mostardi Platt samples taken near Chicago O'Hare

➡Modeled in risk assessments as non-reactive in air; is risk over-stated?

Diesel PM

■Risk driver in several risk assessments

■Judged by EPA as likely to be a human carcinogen, but EPA has not assigned a cancer unit risk factor

■California has assigned a cancer unit risk factor and implemented an aggressive statewide Diesel PM10 Risk Reduction Plan

■EPA's Science Advisory Board has expressed concerns about calculating cancer risks from diesel exposure

Agree There is a Problem?

- Is it just a perception?
- Does that matter?

The Solution?

- Mitigated Projects
- Cleaner Airports
- Educated, Involved “Public”

Learn to Accept What You Cannot Change?

- Accept that you need to find mitigation in nearly every step of regulatory approval process
- If you don’t have a big SIP budget, or toxics are a big issue, the smartest approach may be a mitigated project
- Get lots of positive PR for your hard work

Why Mitigate?

■Reduce Air Toxics Impacts

■Be Green

■Build Trust in the Community

■Spread the Good News!

Is Technology Available?

■CNG Shuttles, Vans

■LPG Trucks

■Electric Vehicles

■Electric Baggage Tugs
and Belt Loaders

■Terminal/Gate Electrification (400 Hz Power, Pre-Conditioned Air)

Support Infrastructure

■CNG Fueling Station

■LPG Fueling Station

■Photo-Voltaic Arrays

■Fast Chargers for GSE

■Vehicle Chargers for Public and Fleet

■Electrical Supply

Recommendations for Future Study

It Pays to Plan Ahead

■Do Air Quality and Environmental Constraints Analysis as You Proceed With Master Planning

■Improve Data and Methods You Have to Work With

- Conduct Tests to Improve Emission/Speciation Factors
- Monitor Ambient Air to Verify Modeling Results
- Lobby for Better Toxicity Factors
- Develop a Standardized Risk Assessment Approach

■Plan/Budget for Mitigation; Apply for Funding

■Involve the Public