



NAE GRAND CHALLENGES
FOR ENGINEERING
NATIONAL ACADEMY OF ENGINEERING



NAE Grand Challenge: Prevent Nuclear Terror

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14 Grand Challenges for
Engineering in the 21st
Century



Prevent Nuclear Terror Challenges:



1. how to secure the materials;
2. how to detect, especially at a distance;
3. how to render a potential device harmless;
4. emergency response, cleanup, and public communication after a nuclear explosion; and
5. determining who did it.

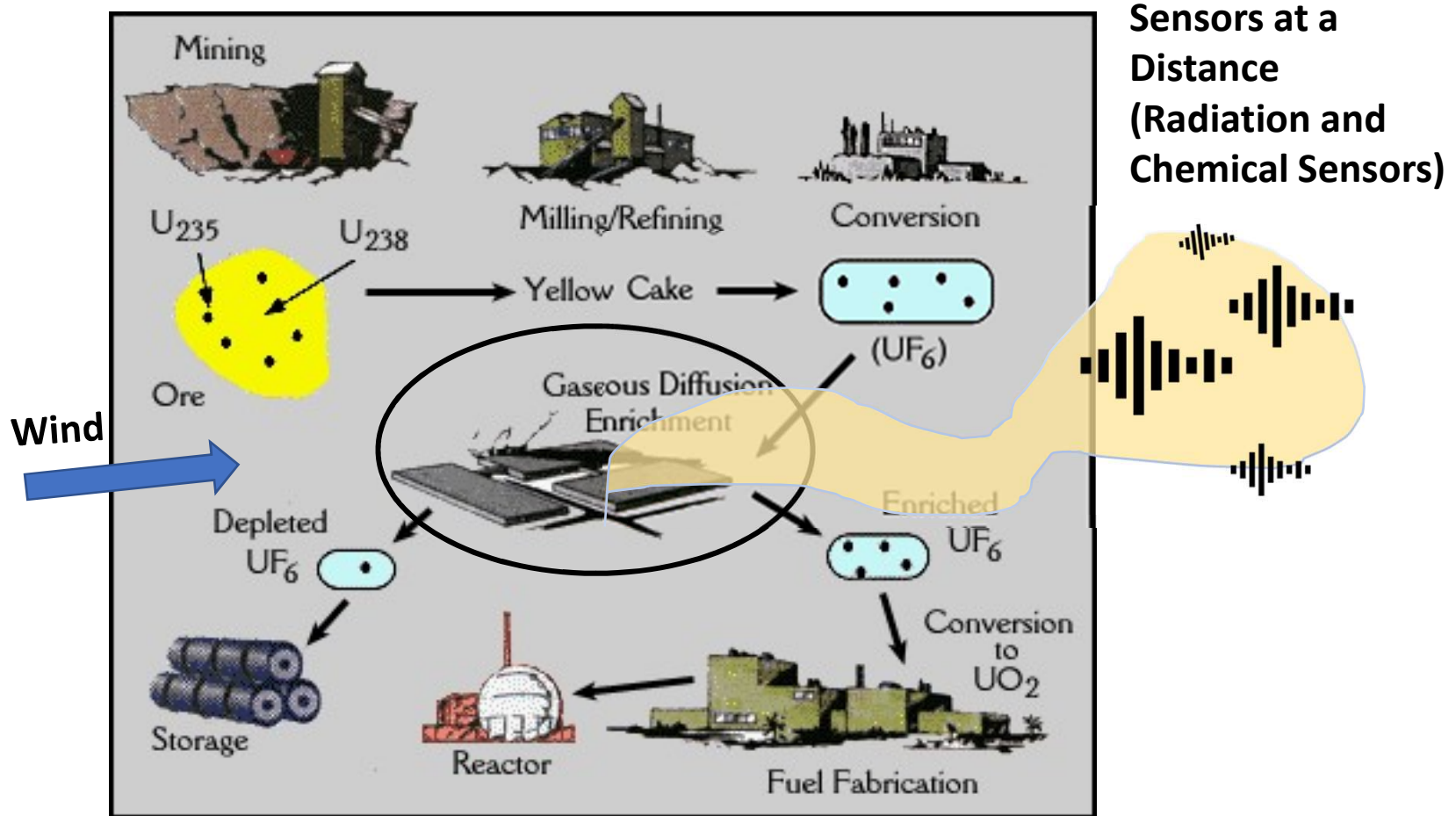
All of these have engineering components; some are purely technical and others are systems challenges.

My Related Projects/Research Areas

how to detect, especially at a distance;

Nuclear Enrichment: enriching power plant Uranium to weapons grade Uranium has some characteristic signature gases. A precise set of sensors would be able to detect these if one knew where to place them or point them (sensor detection is dependent on location, meteorology, topography, and concentration of the signature gases).

How to Detect at a Distance



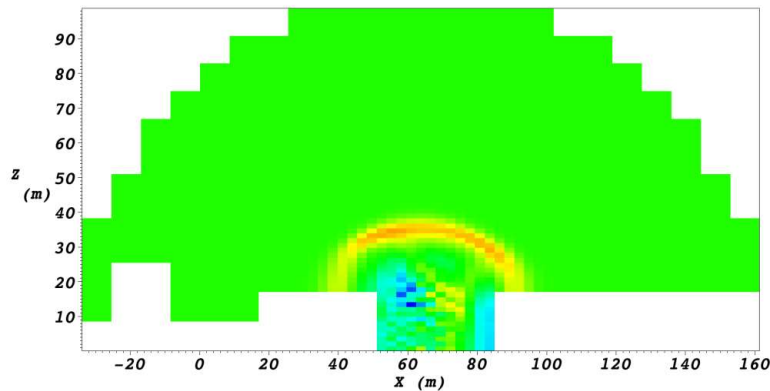
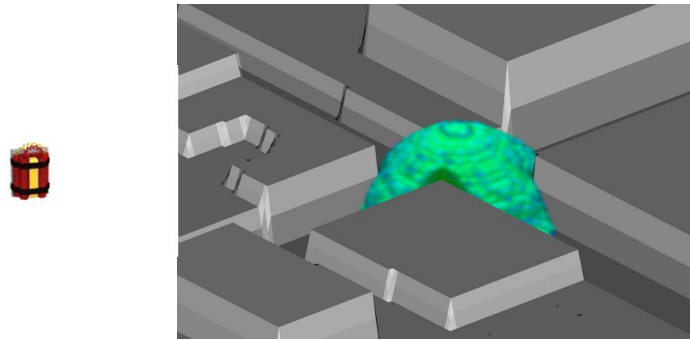
My Related Projects/Research Areas

emergency response, cleanup, and public communication after a nuclear explosion

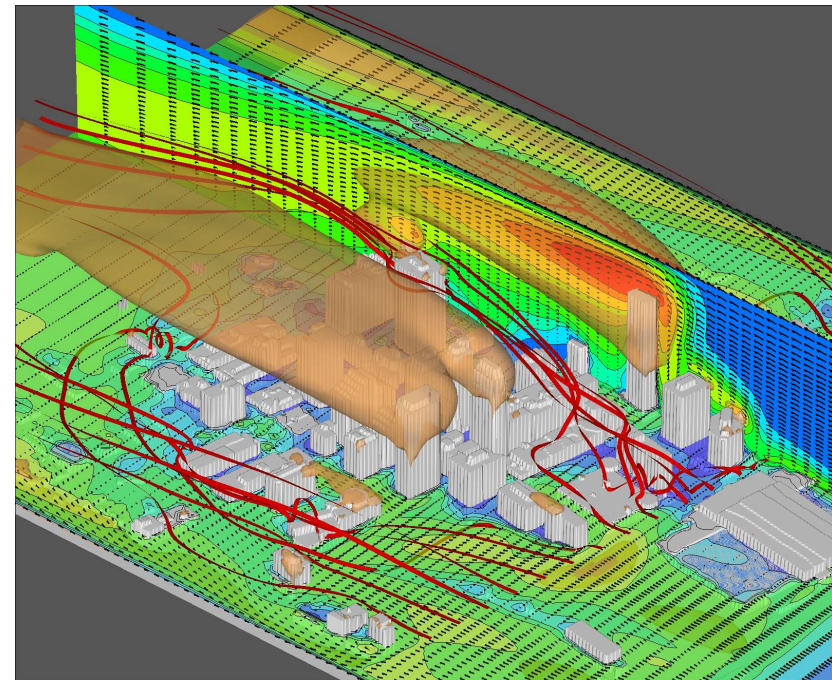
Building a full-scale bomb would not be easy, so terrorists might attempt instead to cause other forms of nuclear chaos, possibly using conventional explosives to blast and scatter radioactive material around a city.

Responding to a “dirty bomb” attack would also involve engineering challenges ranging from monitoring to cleanup, of both people and places.

Radiological Dispersion Device (RDD) Modeling for Cleanup



Modeling the Initial Blast Waves that Spread Materials



Model Radioactive particle dispersion (spread): Improve the Particle Models



Better Response and Cleanup!

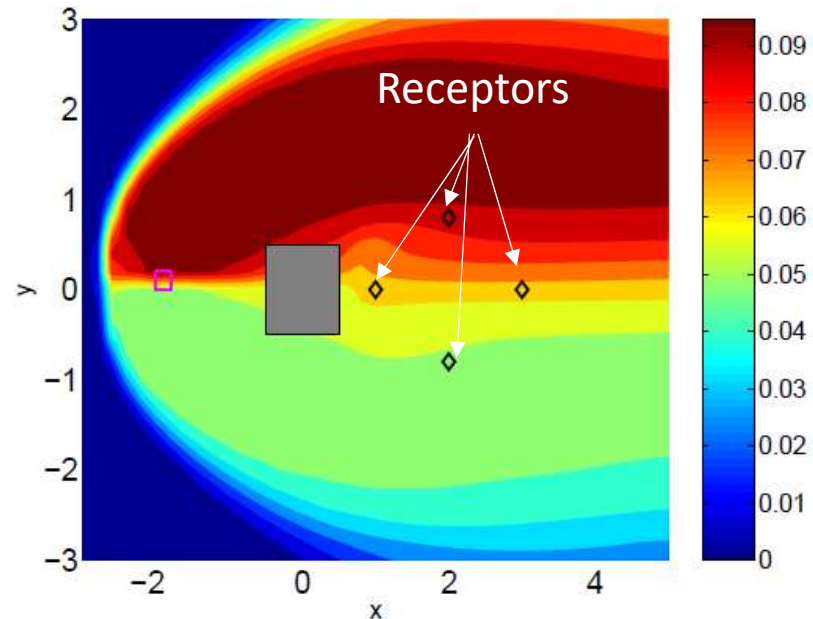
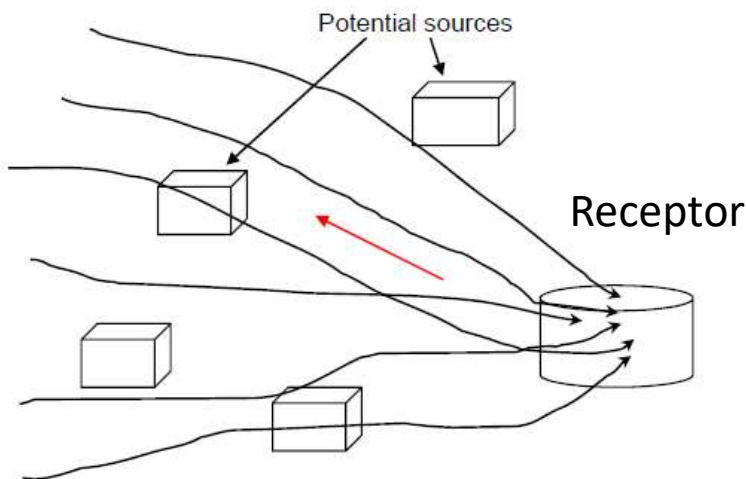
My Related Projects/Research Areas

determining who did it.

Nuclear forensics is the investigation of nuclear materials to find evidence for the source, the trafficking, and the enrichment of the material. The material can be recovered from various sources including dust from the vicinity of a nuclear facility, or from the radioactive debris following a nuclear explosion.

Reconstructing a RDD Source through Computer Algorithm

For receptor-oriented modeling, the sign of the time step is reversed and trajectories are run backward.



Using individual Receptors (Sensors) to model the potential location of the source through Monte Carlo Simulation

Multiple Receptors give higher probability of the initial source location



**Location of Detonation
Backtrack could lead to Clues**