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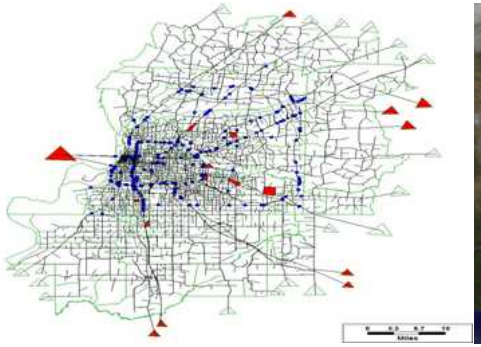

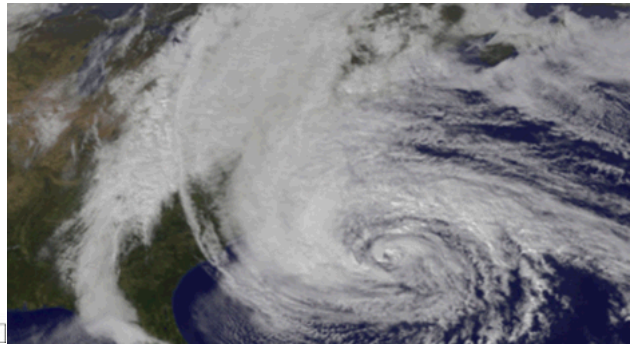

Transportation and Logistics Modeling

Sandia National Laboratories, May 2017

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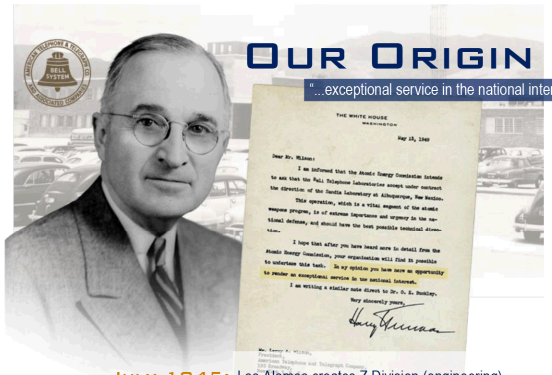
Sandia National Laboratories

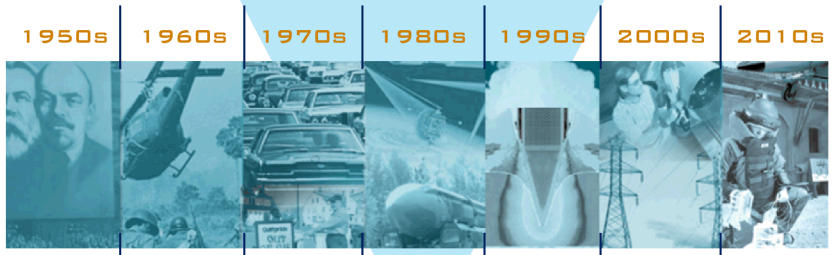
Our Origin



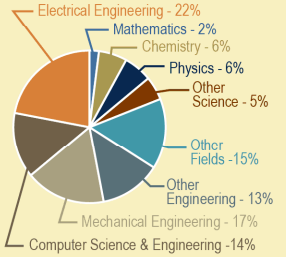
July 1945: Los Alamos creates Z Division (engineering)

November 1, 1949: President Truman establishes Sandia Laboratory as Engineering Lab from Z Division

Decades Addressing National Security Challenges



Our Workforce



12,609 Total workforce

10,307 Regular employees

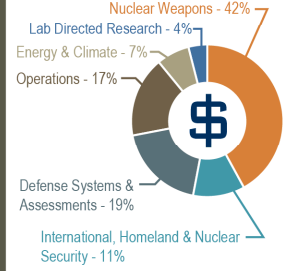
5,790 (56%) Advanced degrees

Our Budget

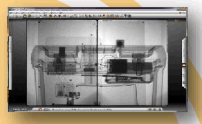
$3,165M FY15 Lab costs

$143M Lab directed R&D

$56.9M DHS work (S&T, NPPD, TSA, CBP, ICE, FEMA, DNDO...)



Our Successes



X-Ray Toolkit (XTK), image processing and analysis software, helps emergency responders perform effectively in the high-stress, time-critical act of **disabling IEDs** is **deployed to more than 20,000 users** in many of the 467 recognized non-military bomb squads across the U.S.

Sandia lab-directed **research** in decontamination foam used in 2001 anthrax clean ups and **transitioned to commercial sector.**

2016: **Small business** developing explosive detectors **teams with Sandia** experts to improve the machine's speed, distance and accuracy for market launch.

Sandia National Laboratories

Working With Us

- Federally Funded Research and Development Center **(FFRDC)** subject to Federal Acquisition Regulation (FAR) Requirements
- Broadly **prohibited from competing with industry**, and primarily work with DHS through Interagency Agreements (IAAs) via DOE
- Homeland Security Act of 2002 **authorizes DHS special access** to Sandia to assist any component in accomplishing its mission.

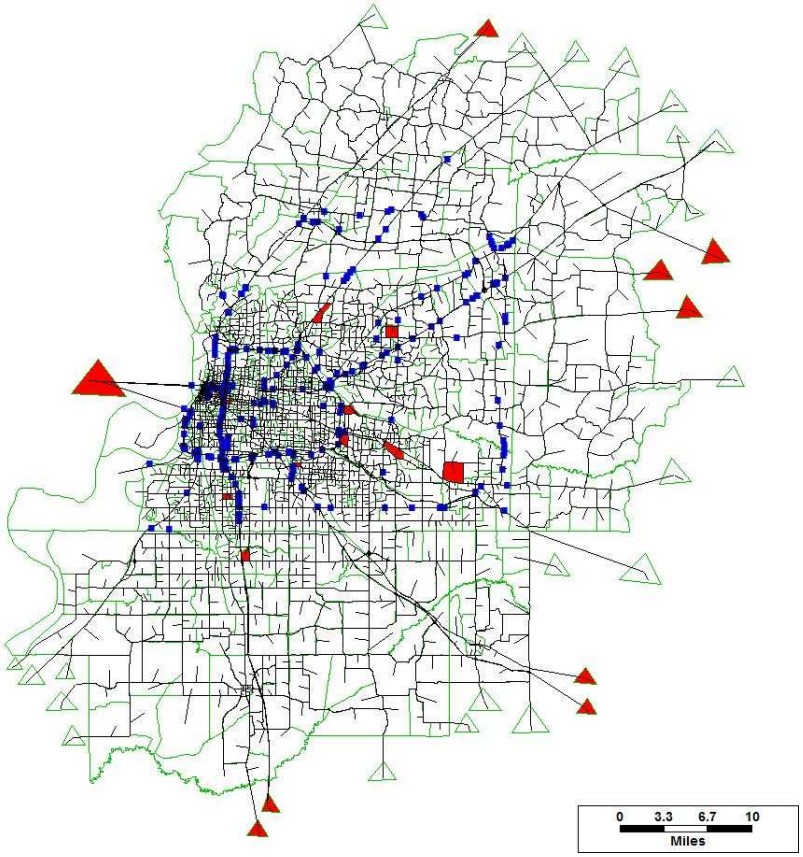
Our Facilities

- Albuquerque, NM
- Livermore, CA
- Kauai, HI
- Carlsbad, NM
- Pantex & Amarillo, TX
- Tonopah, NV

National Nuclear Security Administration

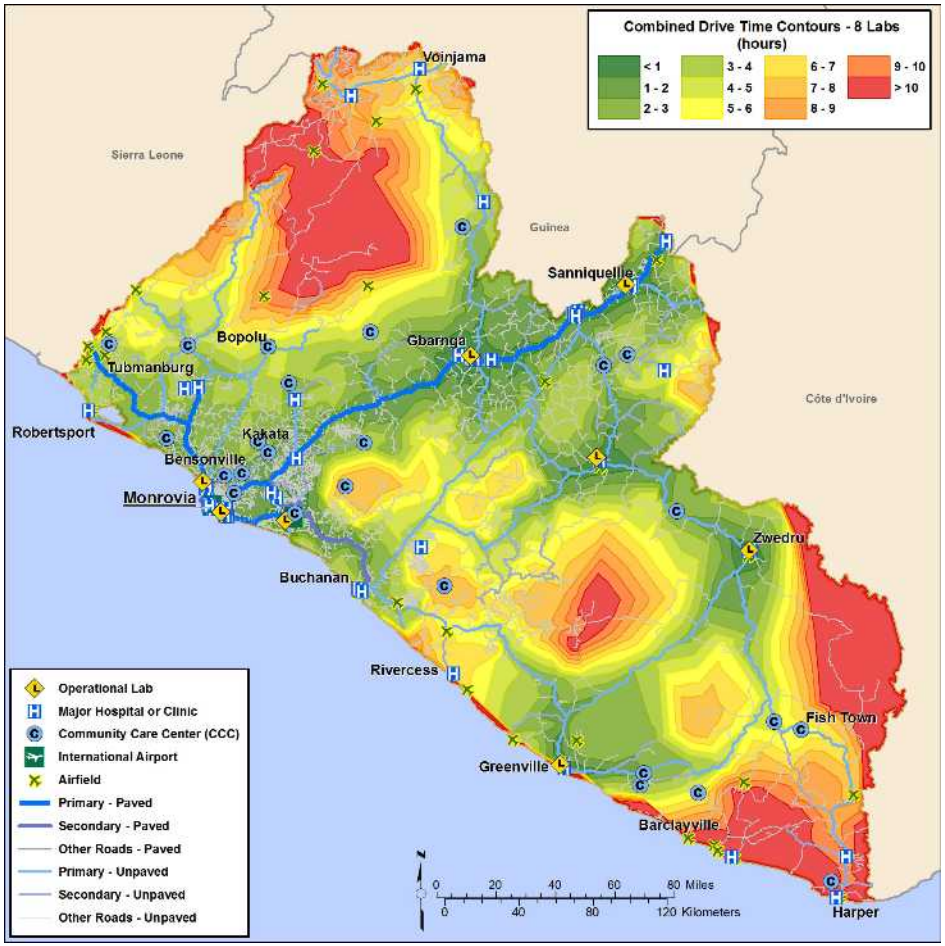
Multi-hazard planning

- Consider a decision maker who wants to ensure the population of a city (e.g., Memphis, TN) can reach hospital services within a specified amount of time
- Hazards
  - Seismic threat to bridges
  - Terrorism threat to hospitals
- Mitigations
  - Seismically reinforce bridges
    - 286 bridges
    - 10^{86} combinations
  - Security upgrades to hospitals
- Model traffic flow on roadway network



Ebola sample transport

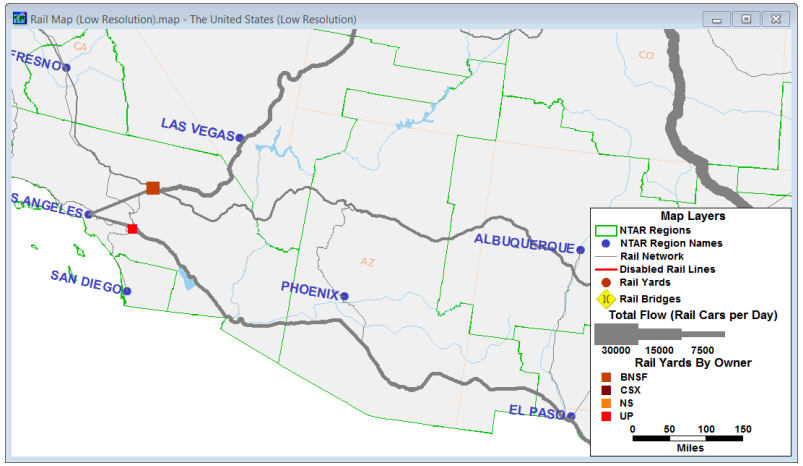
- Goal: determine the optimal locations for labs and the best transportation routes, while accounting for such obstacles as:
  - national curfew
  - poor infrastructure
  - lack of laboratory capacity



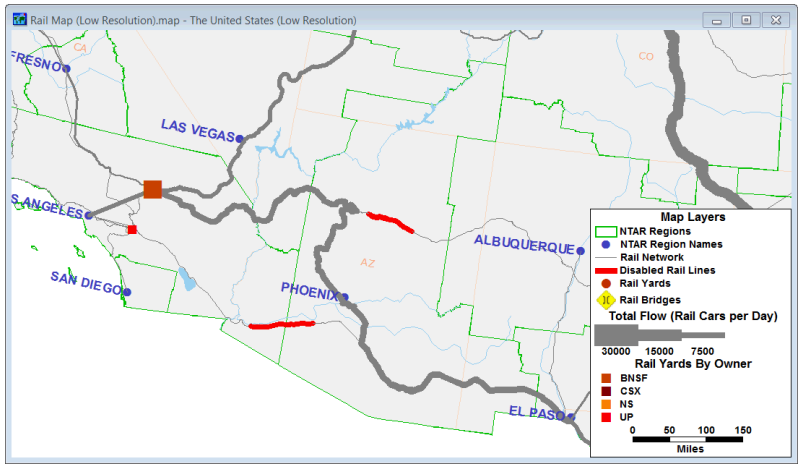
Rail Network Analysis System (R-NAS)

- Example analysis questions
  - How would the loss of one or more major assets in the rail network affect its ability to maintain service?
  - Which commodities (and in what quantity) could not be shipped or received?
  - How would transportation costs increase if rerouting rail traffic were required?

Pre-Event Traffic Flow



Post-Event Traffic Flow



Office of Cyber and Infrastructure Analysis
National Protection and Programs Directorate
U.S. Department of Homeland Security

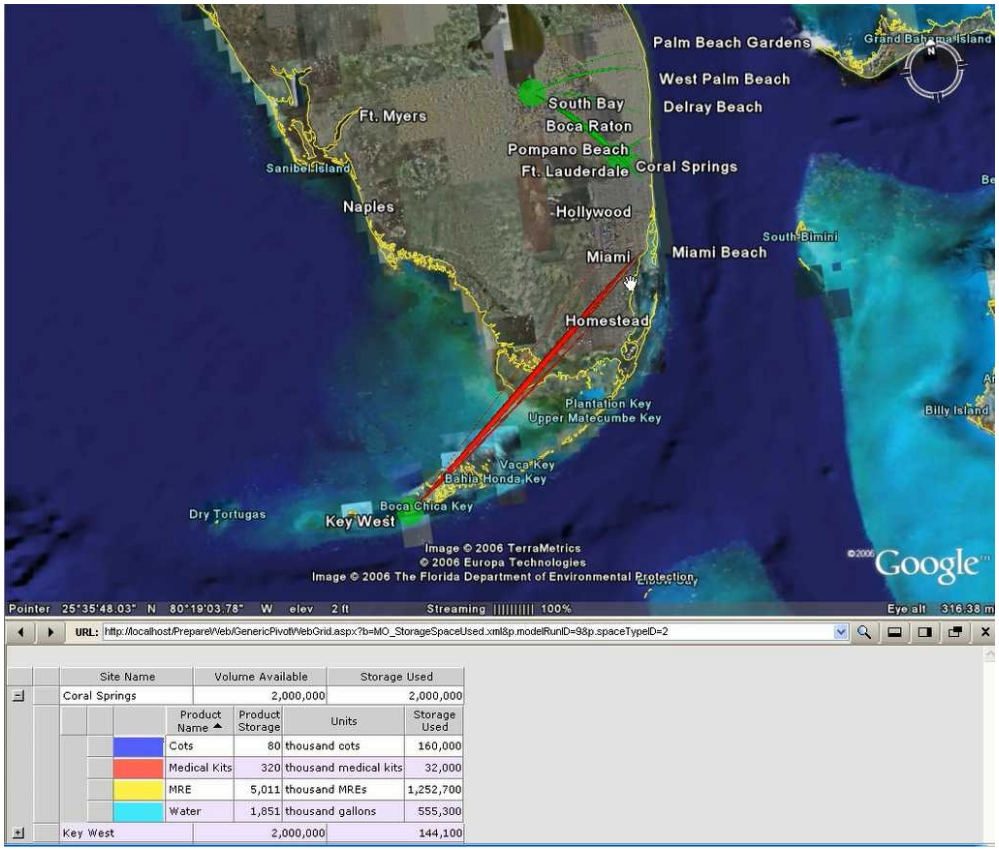
Routing of spent fuel

- Created an optimization tool for use by DOE for investment planning (e.g. fleet size over time) around transportation assets for moving spent nuclear fuel to Yucca Mountain
- Mixed-Integer Linear Program
- Could also be used to analyze:
  - impacts of storage site restrictions
  - changes in loading rules
  - impacts of security measures
- Web based application

Image courtesy: www.iaea.org

Supply pre-positioning

- Optimization goals:
  - Minimize the amount of unsatisfied demand
  - Minimize commodity delivery time from pre-positioning sites to demand sites
- Considerations:
  - Accessibility of storage sites under each damage scenario
  - Commodity cost
  - Transit time constraints
  - Budget available for establishing sites and purchasing supplies



Site Name	Volume Available	Storage Used
Coral Springs	2,000,000	2,000,000

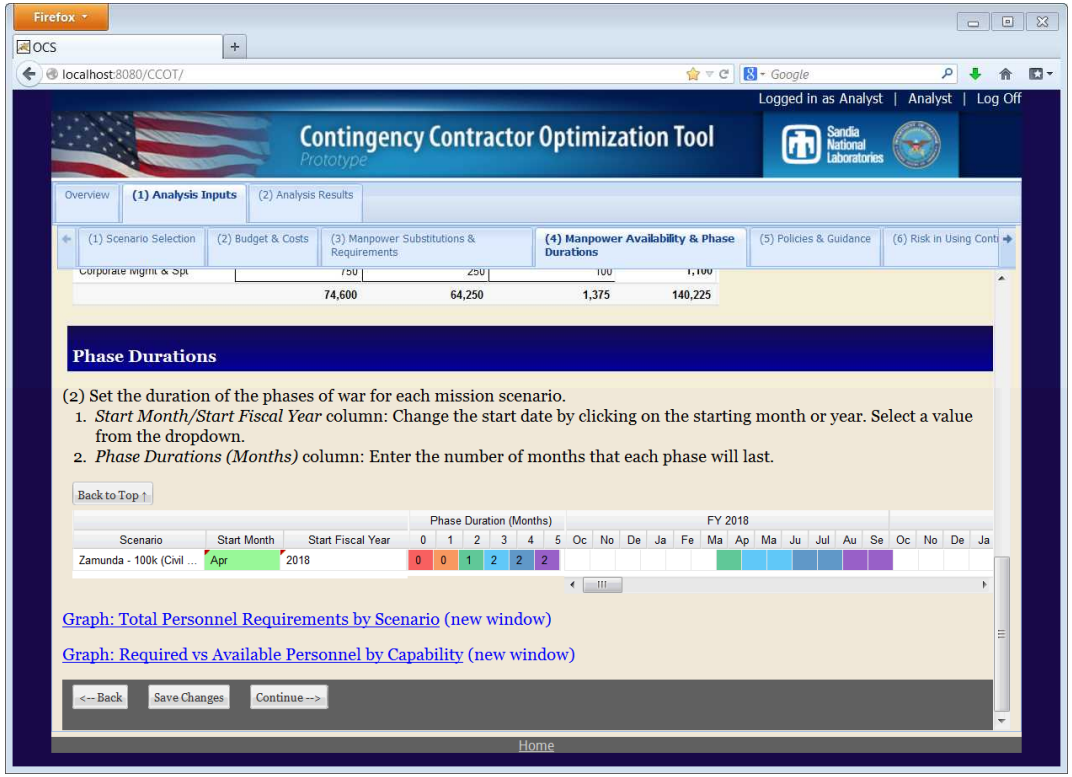
Product Name	Product Storage	Units	Storage Used
Cots	80	thousand cots	160,000
Medical Kits	320	thousand medical kits	32,000
MRE	5,011	thousand MREs	1,252,700
Water	1,851	thousand gallons	555,300

Key West	2,000,000	144,100

Resource constrained optimization

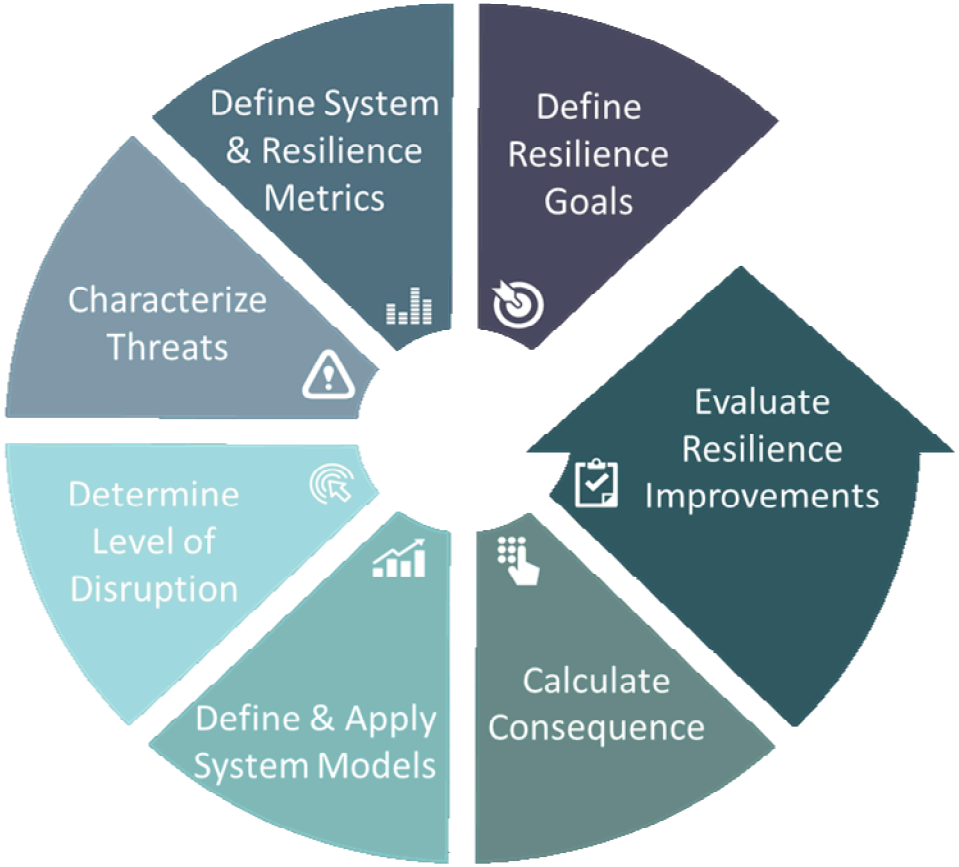
Optimize use of available resources for mission scenario tasks while honoring use rules, resource limits, budget, etc.

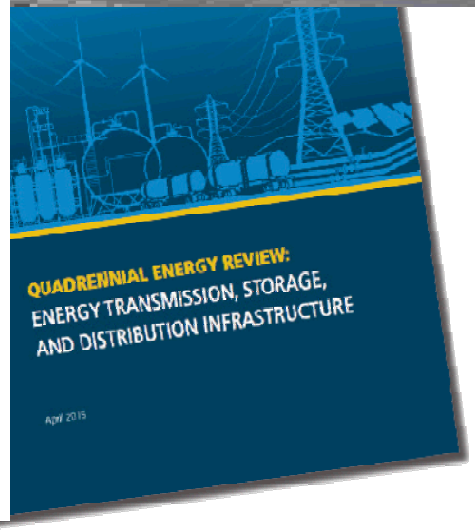
- Created for the Office of the Secretary of Defense
- Focused on personnel, but mathematical approach could support other resource types
- Example constraints:
  - Resource demand
  - Resource availability
  - Resource use rules
  - Budget limitations



Sandia Resilience Analysis Framework

A framework for deploying metrics that can be ... frastructure planning, ... olicy changes





Federally Funded Research and Development Centers (FFRDCs) Characteristics

Sandia National Laboratories

- Defined in Federal Acquisition Regulation (FAR) 35.017
- FFRDCs were instituted in the early 1940s to mobilize the country's scientific and engineering talent.
- An FFRDC **meets some special long-term research or development need** which cannot be met as effectively by existing in-house or contractor resources.
- Has access, **beyond that which is common to the normal contractual relationship**, to Government and supplier data, including sensitive and proprietary data, and to employees and installations equipment and real property.
- To operate in the public interest with **objectivity and independence**, to be free from organizational conflicts of interest, and to have full disclosure of its affairs to the sponsoring agency.
- It is **not the Government's intent** that an FFRDC use its privileged information or access to installations equipment and real property to **compete with the private sector**.

Source: FAR 35.017 https://www.acquisition.gov/far/html/Subpart%2035_0.html, Accessed 2/14/2017