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GIS-Based Capability Development to Support Pre- and Post-Event Analysis of Critical Infrastructure Disruption

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Los Alamos NATIONAL LABORATORY

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Acknowledgement

- The Fast Analysis Infrastructure Tool (FAIT) and FASTMap development efforts are tasks of the National Infrastructure Simulation and Analysis Center (NISAC).
- NISAC is
  - a program of the Assistant Secretary for Infrastructure Protection, Department of Homeland Security
  - a core partnership of Sandia National Laboratories and Los Alamos National Laboratory

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Overview

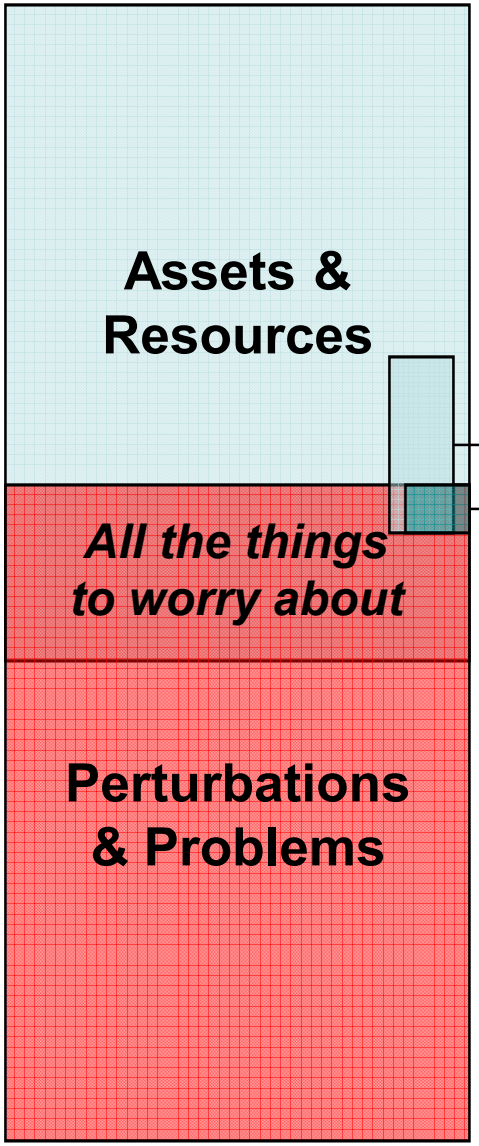
- Acknowledgement
- Philosophy of Fast Analysis Development
- Purpose of High-Risk Event Analysis
- Elements of High-Risk Event Analysis
  - Identifying the consequences on the problem space
  - Support information on assets of interest in the problem space
  - Using connectivity analysis to identify assets of importance in the problem space

Philosophy of Fast Analysis Development

- Time to respond is short…
  - …and growing shorter
- Automation of tasks should be used…
  - …to perform tasks which automation is useful for
    - always remembering
    - addition and multiplication
    - replicating past products for a common look and feel
  - …to free up analysts to be analysts rather than data processors
- We have developed capabilities to improve the quantity and quality of our fast response products, and coordinated development with analysts and (where possible) analysis consumers

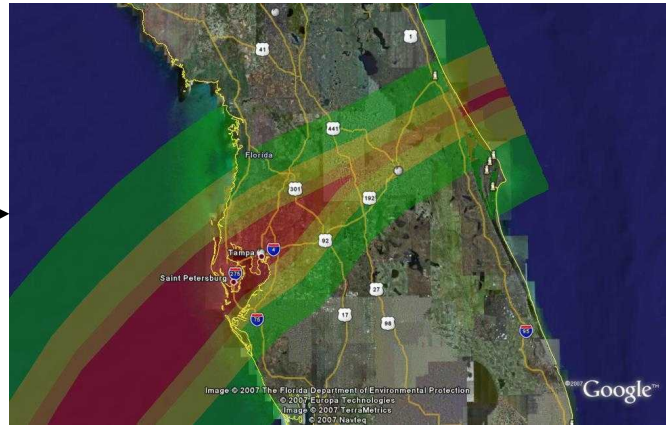
Purpose of High-Risk Event Analysis

Purpose of High-Risk Event Analysis



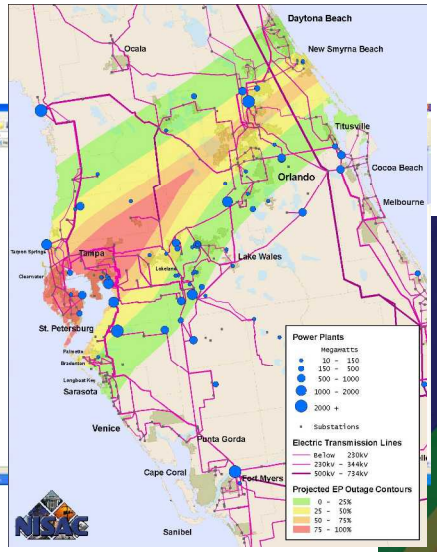
Sector-Specific Agency	Critical Infrastructure/Key Resources Sector
Department of Agriculture[1] Department of Health and Human Services[2]	Agriculture and Food
Department of Defense[3]	Defense Industrial Base
Department of Energy	Energy[4]
Department of Health and Human Services	Public Health and Healthcare
Department of the Interior	National Monuments and Icons
Department of the Treasury	Banking and Finance
Environmental Protection Agency	Drinking Water and Water Treatment Systems
Department of Homeland Security *Office of Infrastructure Protection*	Chemical Commercial Facilities Dams Emergency Services Commercial Nuclear Reactors, Materials, and Waste
Office of Cyber Security and Telecommunications	Information Technology Telecommunications
Transportation Security Administration	Postal and Shipping
Transportation Security Administration, United States Coast Guard[5]	Transportation Systems[6]
Immigration and Customs Enforcement, Federal Protective Service	Government Facilities

Assets Relevant to Public Interest and Impact in Question

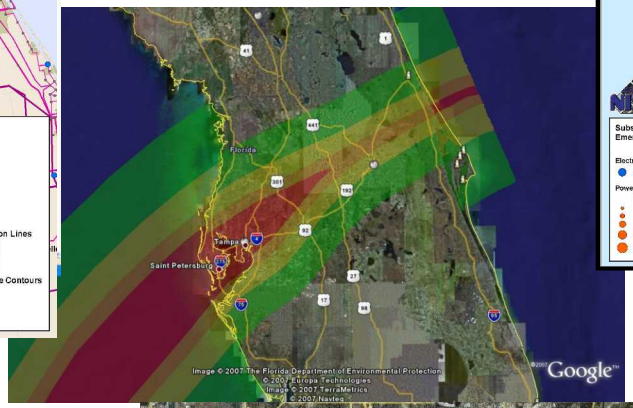


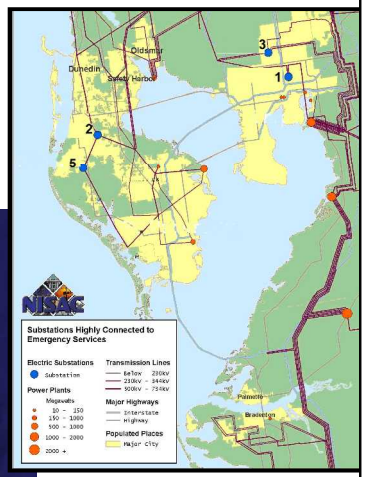
Area of Projected Impact

Elements of High-Risk Analysis



What's there?





Which facilities are critical to particular missions?

Substations within the 75-100% outage area most highly connected to police stations

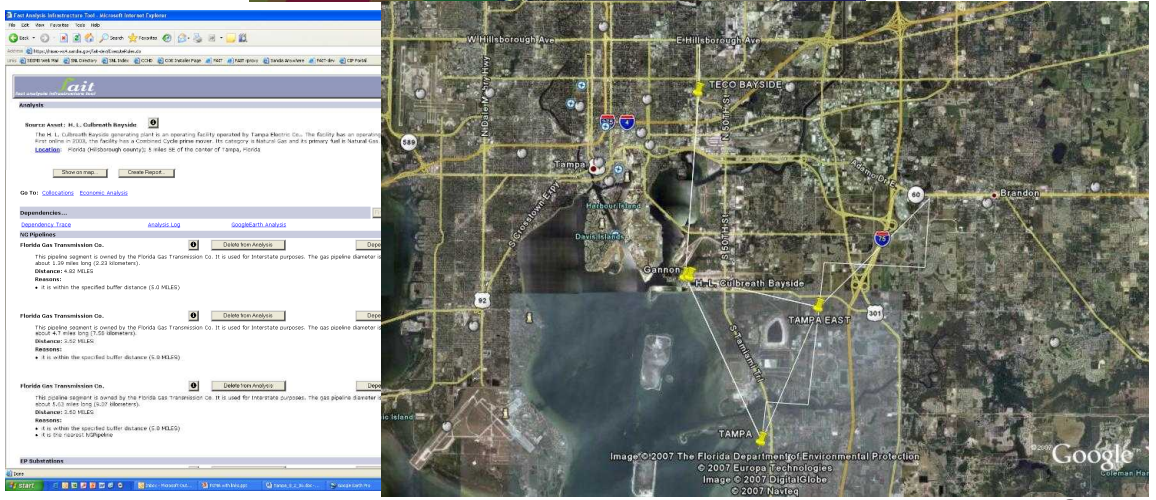
Substation	# Police Stations
1	8
2	4
3	3
4	3
5	3

Substations within the 75-100% outage area most highly connected to fire stations

Substation	# Fire Stations
1	12
5	10
3	7
6	7
2	6
7	6

Substations within the 75-100% outage area that are most highly connected to Hospitals

Sub-station	# of Hospitals
3	6
1	5
8	4
9	4
10	3



What more can we say about what's important?

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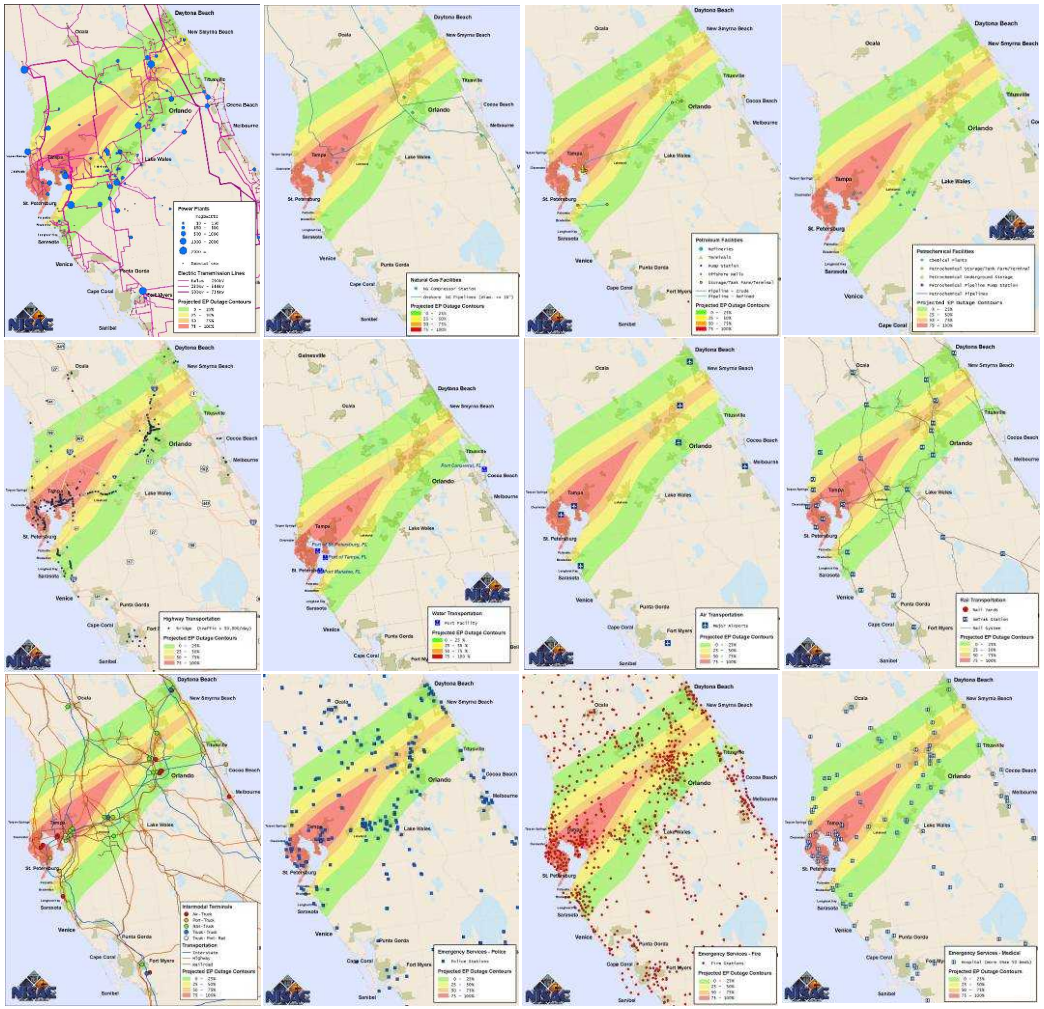
What's there?

Identifying the consequences on the problem space with FASTMap

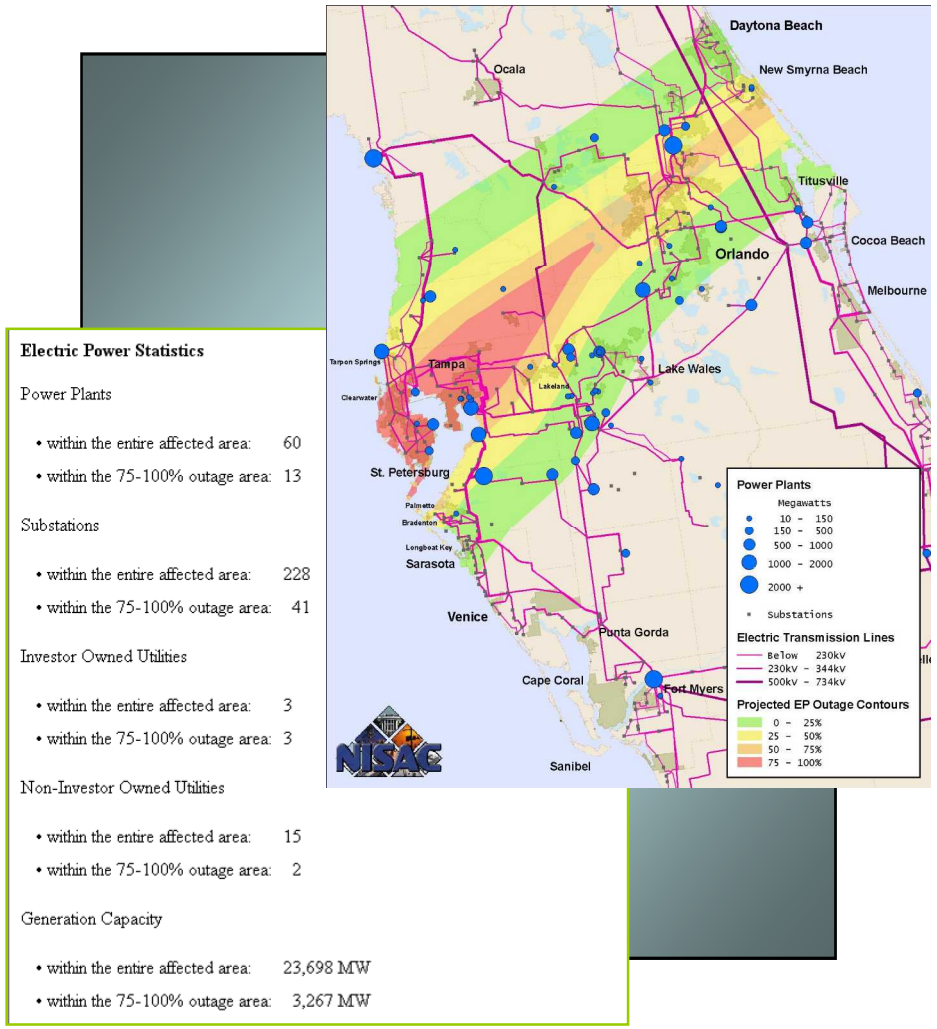
- Fast-turn analysis characterized by analysts…
  - …waiting for something to analyze
  - …busy with preliminary tasks better handled in an automated fashion
  - …having little time to process once something to analyze does arrive
- Core element to the delay: automation of map products and statistics associated with events



What's there?

Identifying the consequences on the problem space with FASTMap

- FASTMap
  - provides rapid situational awareness
    - Maps
      - Automated symbolization & labeling
    - Statistics
      - Sums
      - Counts
      - Lists
      - Complex collocations
  - reduces data gathering and preparation time
  - buys SMEs time to be analysts
  - facilitates rapid communication of dense data with policy makers and first responders

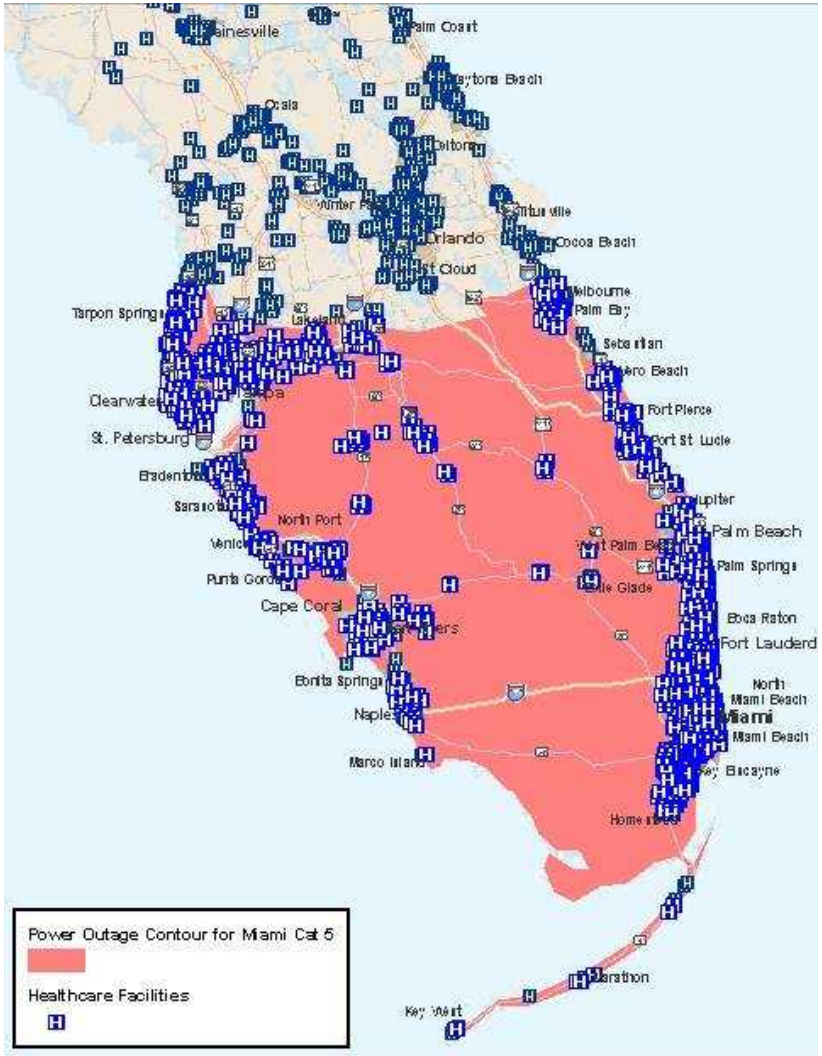


What's there?

Identifying the consequences on the problem space with FASTMap

Example: Category 5 Hurricane on Miami Health Care Sector and Supporting Infrastructures

- Significant Extended Power Outages Likely
- Assisted Living Centers, Hospices, Nursing Homes unlikely to have backup power
  - Over 2,150 such facilities in shaded area at right
  - Over 95,000 beds in these facilities
  - Nearly 1,000 of these facilities have fewer than 10 beds
  - Many in these facilities will likely require EMS vehicle evacuation
    - Likely at least 10,000 vehicles
- Questions
  - Do you have enough
    - vehicles?
    - drivers?
    - fuel?
  - How far do you have to move these people to find available facilities and support?

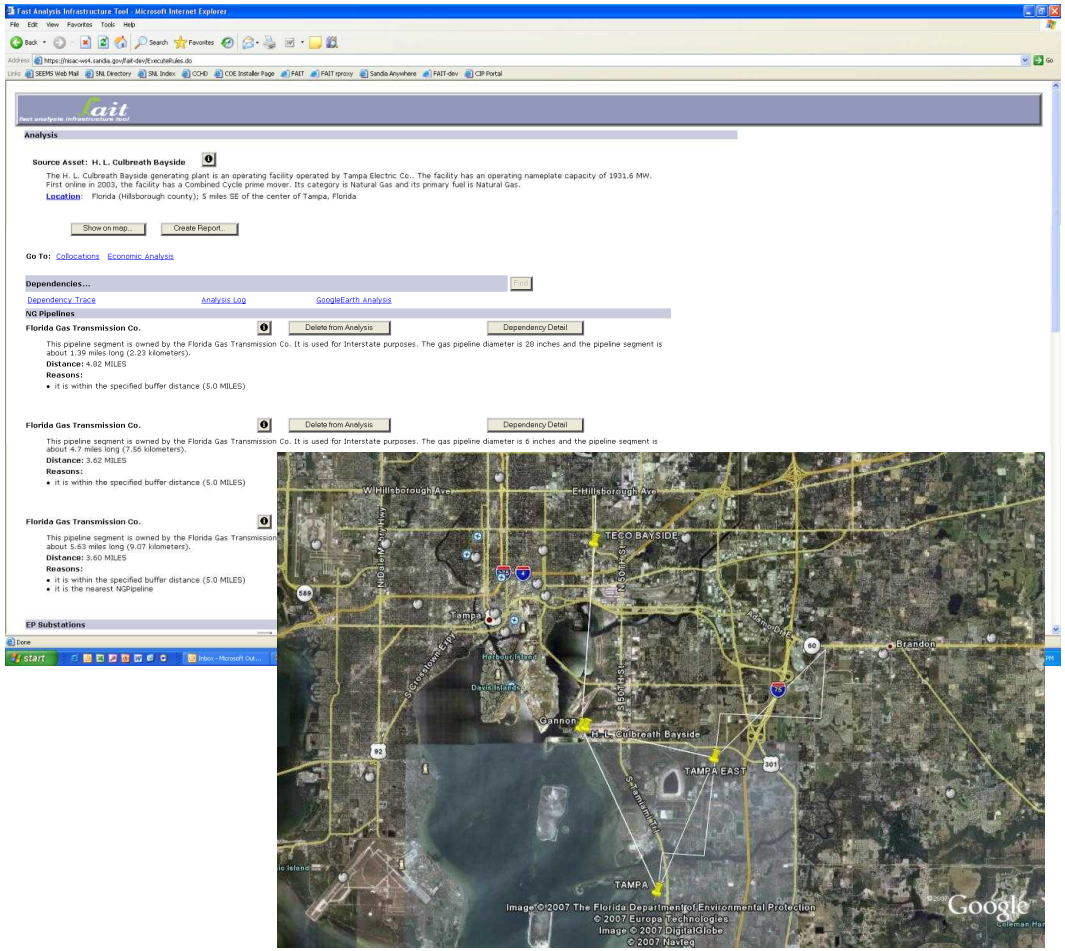


What more can we say about what's important?

Information on assets of interest in the problem space with FAIT

- Geospatial (and associated) data
  - provides a useable frame of reference for associating information with
    - Individual assets
    - Classes of assets
    - Infrastructure and geospatial grouping

  but it requires
  - translation to plain language
  - a platform for associating elements of infrastructure based on SME knowledge
- FAIT's development path has enabled progress in answering questions and synthesizing information in a platform which is used by SNL analysts in support of DHS fast analysis questions



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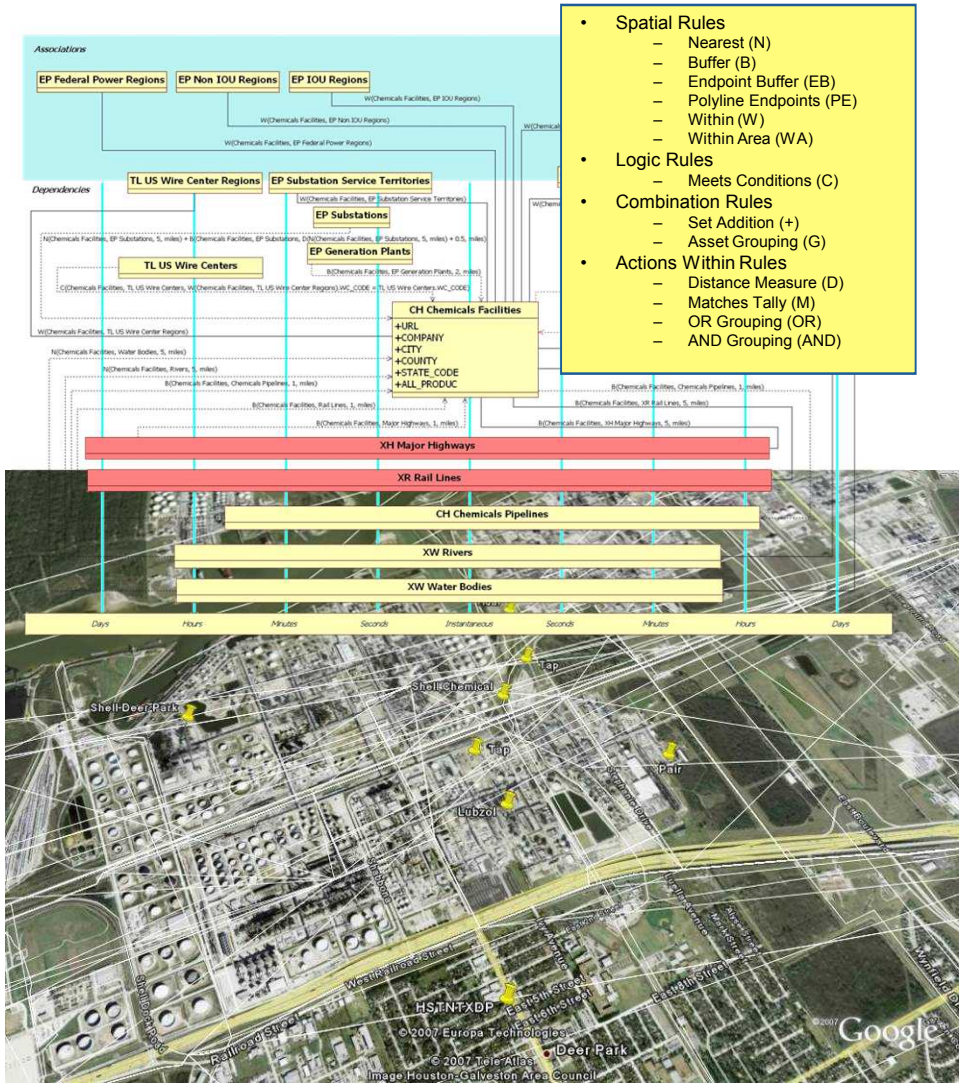


- Spatial Rules
  - Nearest (N)
  - Buffer (B)
  - Endpoint Buffer (EB)
  - Polyline Endpoints (PE)
  - Within (W)
  - Within Area (WA)
- Logic Rules
  - Meets Conditions (C)
- Combination Rules
  - Set Addition (+)
  - Asset Grouping (G)
- Actions Within Rules
  - Distance Measure (D)
  - Matches Tally (M)
  - OR Grouping (OR)
  - AND Grouping (AND)

- Subject Matter Experts help to define
  - classes of assets available
  - relationships between assets
    - Same asset class (supply chains)
    - Same infrastructure
    - Across infrastructures
- Rules used to define relationships incorporate spatial and logical concepts based on properties of the data
- Result is an ability to identify candidate interdependencies and associations between assets, which can be applied to data
  - Flexible Network Development

Which facilities are critical to particular missions?

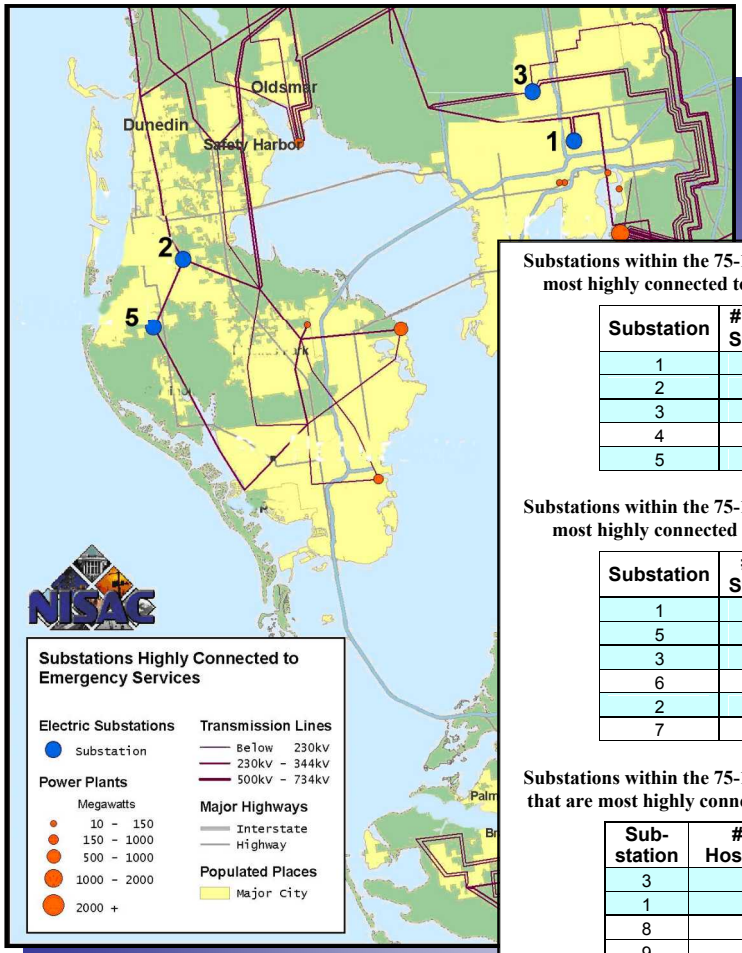
Using FAIT area analysis to identify assets of importance in the problem space

- Which infrastructure facilities are 'critical'?
  - Answer often depends on who is asking the question
- Our process
  - Established a series of generic service rules regarding infrastructure service to any location
  - Apply rules en masse to elements of 'demand infrastructures'
    - Fire stations
    - Police stations
    - Hospitals

    within a defined 'area'
    - Hurricane swath

    to identify elements of 'supply infrastructures'
    - Electric Power
    - Telecommunications

    which serve the largest number/quantity of 'demand infrastructure' elements



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