

# Identification and Assessment of Targets and Potential Consequences

## Threat and Risk Curriculum Module H

## Threat and Risk Concepts and Terminology

### Threat Assessment and Risk Informed Approach

Basis for Threat Assessment and Risk-Informed Approach

Intro to the Risk Informed Approach Cycle

Nuclear Security Risk Scenarios

Risk Assessment Methodologies

**Targets and Consequences**

Expert Elicitation

Threat Assessment Methodologies

Uncertainty & Sensitivity

Communicating Threat and Risk

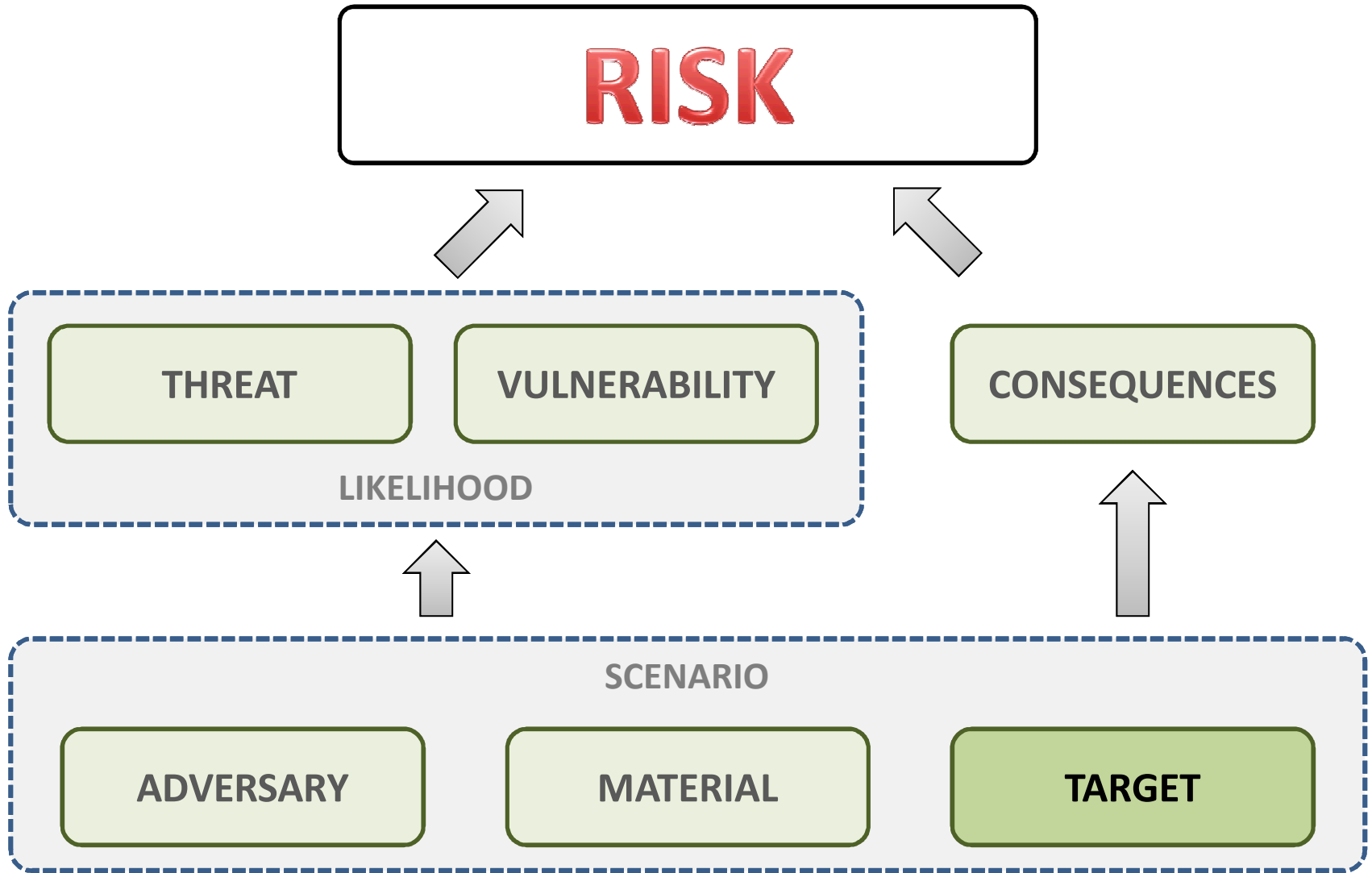
The Risk Informed Approach

## Applying the Risk Informed Approach to a Fictional State

# Module Objectives

Participants will understand how to identify and assess various targets, as well as the methods necessary to estimate the consequences related to a nuclear security event. Topics include:

- Identifying targets and assessing relative attractiveness to an adversary
- Estimating the health, economic, environmental, and societal (including political and psychological) consequences of nuclear security events



# What is a target?

A target can be anything an adversary can exploit or use a nuclear or radioactive device against:

- Nuclear material, other radioactive material, and associated facilities
- Associated activities or other locations or objects of potential exploitation by a nuclear security threat
  - Major public events
  - Strategic locations
  - Sensitive locations
  - Sensitive information assets

**For the scope of this course, targets do not include authorized facilities and activities or materials under regulatory control**

# Identifying Targets

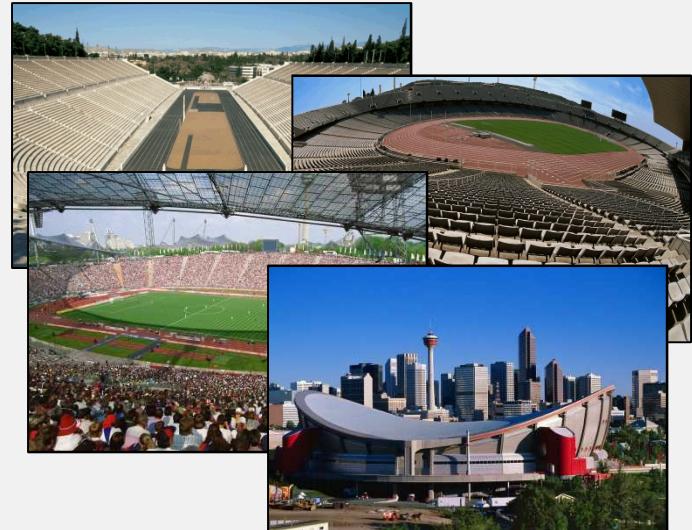
Targets can be considered *specific* or grouped as a *class*

## Example Specific Target



A particular stadium

## Example Target Class



All stadiums in a country

# Specific Target and Target Classes

- Assessing specific targets allows individual target attributes to be considered
- Assessing target classes is quicker, but attributes are generalized
- A list of specific targets will be much longer than target classes

**Considering a mix of specific targets and target classes may be appropriate**

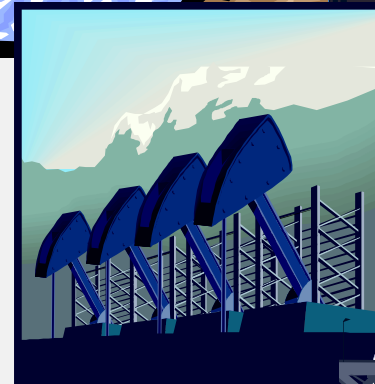
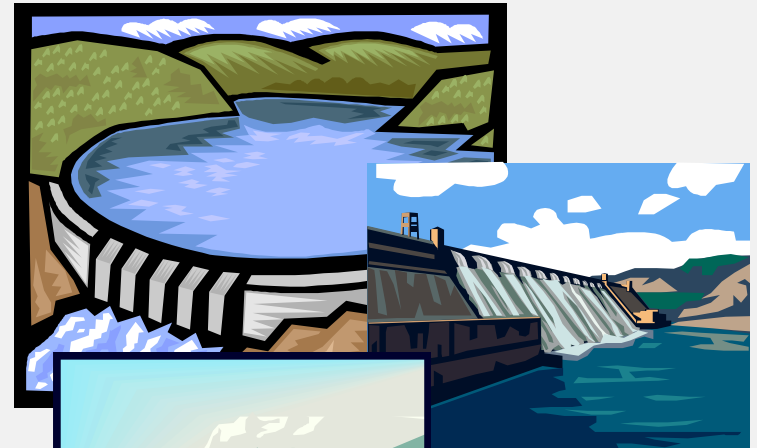
## Structures

Buildings, monuments, or places with symbolic importance



## Critical Infrastructure

Assets that are critical for a society or economy to function



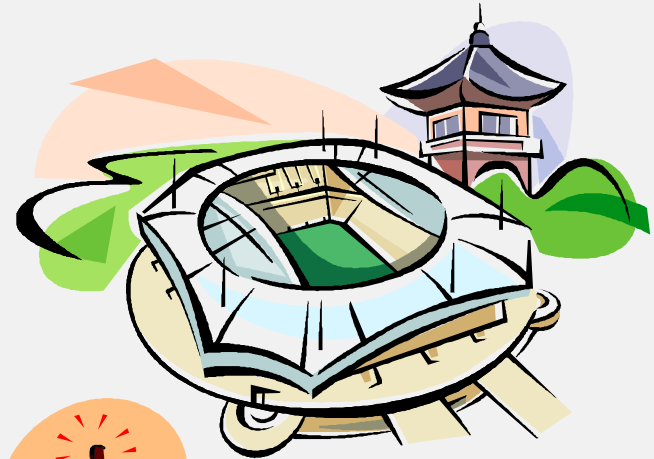
## Population Centers

Areas of dense population where or where people congregate



## Special Events

Gatherings of large numbers of people in a small area



# Prioritizing Targets

- Not all targets equal
  - Different vulnerabilities
  - Viewed differently by different adversaries
- Adversaries may select targets based on their objectives and capabilities
- Targets can be prioritized by estimating ***attractiveness*** to an adversary

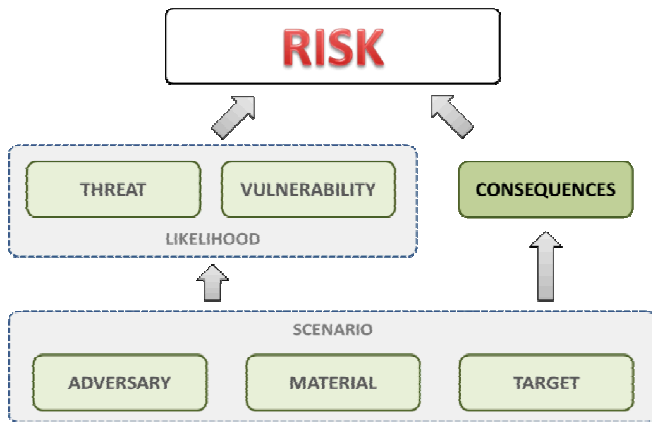
# Target Attractiveness

- Is specific to each adversary
  - Adversaries view targets differently
- May change over time
- Is commonly related to:
  - Target vulnerability
  - Impacted population
  - Economic impact of damages
  - Strategic value
  - Target symbolism

**CONSEQUENCES**

# Consequences

- Reflect the outcome of the scenario
- Include the initial direct impact and the impacts that follow
- Four types to be considered:
  - Health
  - Economic
  - Environmental
  - Societal



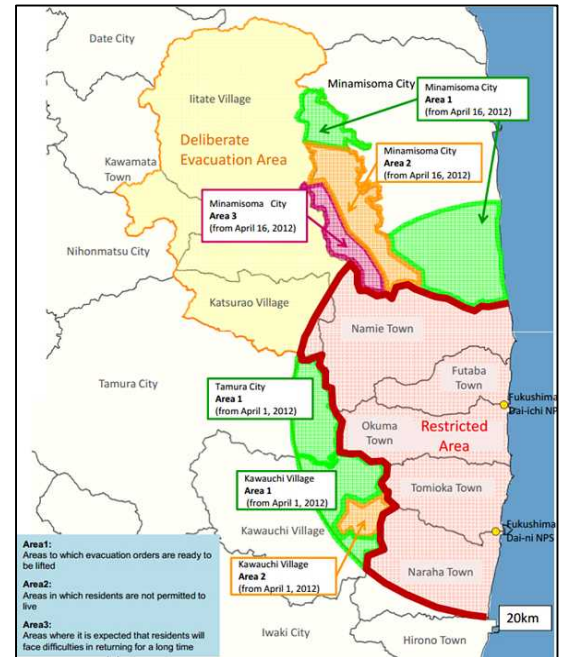
# Health Consequences

- Can occur from the device blast as well as from radiation exposure
- Deterministic
  - Immediate injuries and fatalities
  - Effects seen in hours to weeks
  - Requires specialized treatment
- Stochastic
  - Cancers and genetic effects that appear in later years



# Economic Consequences

- Can arise from many aspects of a nuclear security event:
  - Treating those who become ill
  - Decontamination
  - Evacuation and relocation
  - Business disruption
- Indirect costs may also impact a State's economy



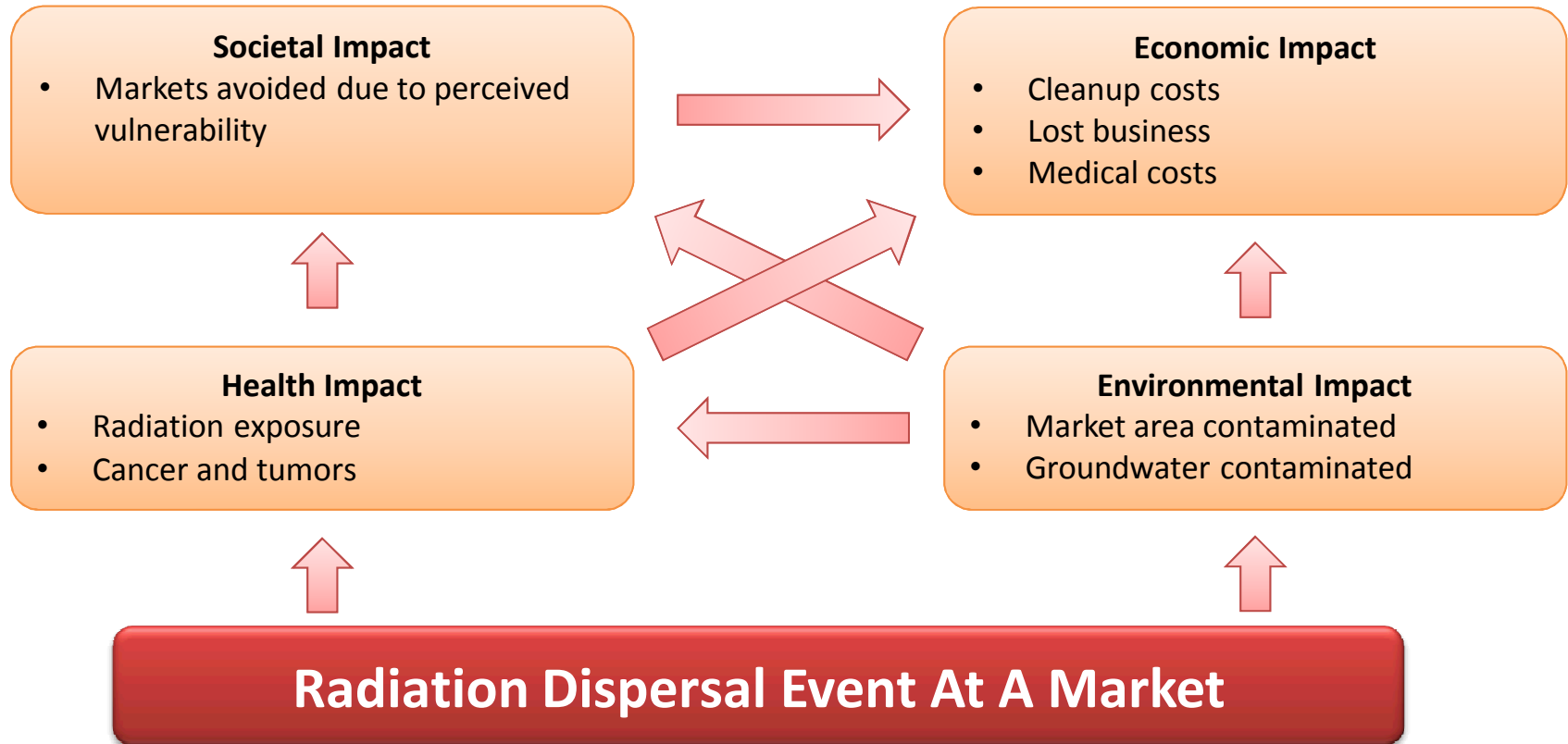
# Environmental Consequences

- Some radionuclides can contaminate areas for several hundred years
- Impacts include:
  - Abandonment of surrounding areas
  - Contamination of soil and groundwater
  - Disruption of fragile ecosystems
  - Avoidance of agricultural products from region



# Societal Consequences

- Can impact a State, a region, or the world
- Occur when people modify behavior such as:
  - Avoiding areas similar to the target
  - Displaying outrage and anxiety
  - Acting out of an abundance of caution
- Includes political consequences
  - Disrupting elections
  - Change in leadership



**Consequences are often related**

# Estimating Consequences

- All consequences of a nuclear security event should be estimated
- Several methods for estimation, including:
  - Qualitative ranking
  - Detailed consequence modeling

# Qualitative Ranking

- Subject matter experts are used to rank consequences
- Rankings are typically broad
  - For example: minimal, moderate, or severe
  - Can also mix quantitative impacts and qualitative impacts
- Can be represented as a matrix

# Qualitative Consequence Matrix

Impacts	Negligible	Minor	Moderate	Significant	Catastrophic
<b>Health</b>	Likely to produce no casualties	Likely to cause less than 100 casualties	Likely to cause greater than 100 casualties	Likely to cause greater than 1000 casualties	10,000 casualties
<b>Economic</b>	Costs equal to replacement of a building	Costs significant at the city district level	Costs significant at the city level	Costs between 1% -10% GDP	Costs in excess of 10% of GDP
<b>Environmental</b>	No significant contamination	Small area or temporary contamination	Significant contamination in a small area	Large area measurable contamination or critical area uninhabitable	Extremely important resources unavailable due to contamination
<b>Societal</b>	No major change in population behavior, or effects on social functioning locally or nationally	Occasional or minor loss of nonessential social functions in a circumscribed geographical area	Loss of many nonessential social functions in a circumscribed geographical area	Dysfunctional behavior and disruption of important social functions for a sustained period	Loss of belief in government and institutions; widespread disregard for official instructions; widespread looting and civil unrest

**Consequence Rankings**

**Quantitative Impact**

**Qualitative Impact**

**Consequence Categories**

# Using the Consequence Matrix

1

1. Develop scenarios
2. Develop consequence matrix

2

Ask SMEs to rate the consequences of each scenario

3

Aggregate and compare results

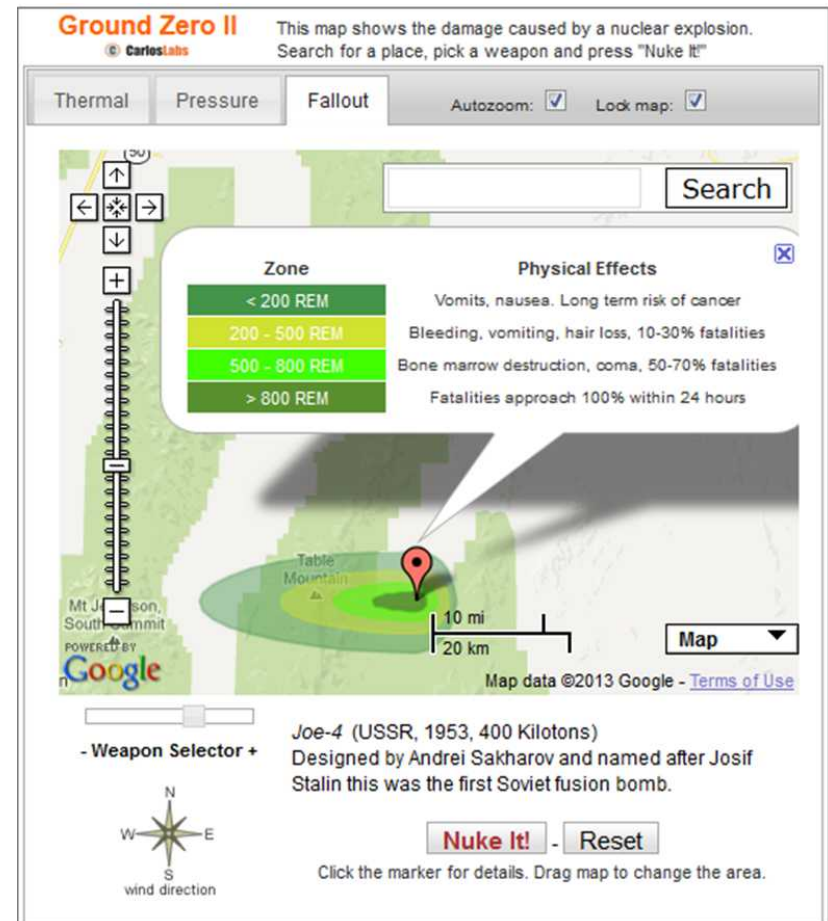
Scenario	Health	Economic	Environmental	Society
A	Negligible	Negligible	Minor	Moderate
B	Catastrophic	Catastrophic	Moderate	Significant
C	Minor	Minor	Significant	Moderate

# Detailed Consequence Modeling

- Quantitative and computational approach for calculating effects from physical models
  - Blast radius
  - Distribution of radiation doses
  - Contamination level
  - Extent of contamination
- Common consequence assessments include number of casualties and economic costs

# Modeling Nuclear Security Events

- Typically require computational resources to perform
- Vary in complexity
  - Simple: Wind direction
  - Complex: Fluid dynamic models of airflow
- Typically have significant margins of error



Model output from: <http://www.carloslabs.com/node/20>

# Utilizing Outputs

For a simple analysis values for consequences can be combined into a “Normalized Consequence Rating” (NCR)

- All values must be unit-less or in the same units
- Rating can be used to rank scenarios

**ALL VALUES ARE NOTIONAL AND DO NOT REFLECT ACTUAL ESTIMATES**

Scenario	Health	Economic	Environmental	Societal	Combined Value	NCR
A	$5 \cdot 10^3$	$10^{11}$	$5 \cdot 10^{10}$	$5 \cdot 10^9$	$2.05 \cdot 10^{10}$	100
B	$5 \cdot 10^1$	$5 \cdot 10^{10}$	$5 \cdot 10^9$	$5 \cdot 10^8$	$5.6 \cdot 10^{10}$	27
C	$5 \cdot 10^2$	$5 \cdot 10^9$	$5 \cdot 10^8$	$5 \cdot 10^9$	$1.55 \cdot 10^{10}$	8

Value = Health \* 10,000,000 + Economic + Environmental + Societal

$$NCR = 100 * \frac{Value}{Max(Value)}$$

# Module Summary

## TARGET

- All targets within a State should be considered
- Can use a mixture of specific targets and target classes
- Different adversaries may find different targets attractive

Example Specific Target



Example Target Class



## CONSEQUENCE

- For each scenario, consider:
  - Health consequences
  - Economic consequences
  - Environmental consequences
  - Societal consequences
- Consequences can be complex and related
- Both qualitative and quantitative methods exist for estimating cons

Scenario	Health	Economic	Environmental	Society
A	Negligible	Negligible	Minor	Moderate
B	Catastrophic	Catastrophic	Moderate	Significant
C	Minor	Minor	Significant	Moderate