



# AN EXAMPLE OF DISASTER VULNERABILITY:

Risk and Policy Institute

**THE CONSEQUENCES OF AN INTENTIONAL ATTACK ON THE  
RANCHO LPG STORAGE FACILITY IN SAN PEDRO, CALIFORNIA**



**CARL SOUTHWELL  
FEBRUARY 23, 2013**

# RANCHO LPG STORAGE FACILITY

**The demand for an LPG receiving facility in Southern California:**



- **LPG is an efficient fuel source for heating and cooking.**
- **Butane and propane are byproducts of refining oil.**
- **Used in calibrating the RVP of gasoline for summer blends.**
- **The Rancho LPG facility is probably the largest aboveground storage tank facility in the United States.**

# RANCHO LPG STORAGE FACILITY



**The primary risks to an LPG storage facility in Southern California:**

- **Earthquake**
- **Tsunami**
- **Industrial accidents**
- **Terrorist act**

**The primary hazards of interest to an LPG storage facility are:**

- **Asphyxiation**
- **Fires-pool, vapor, BLEVE**

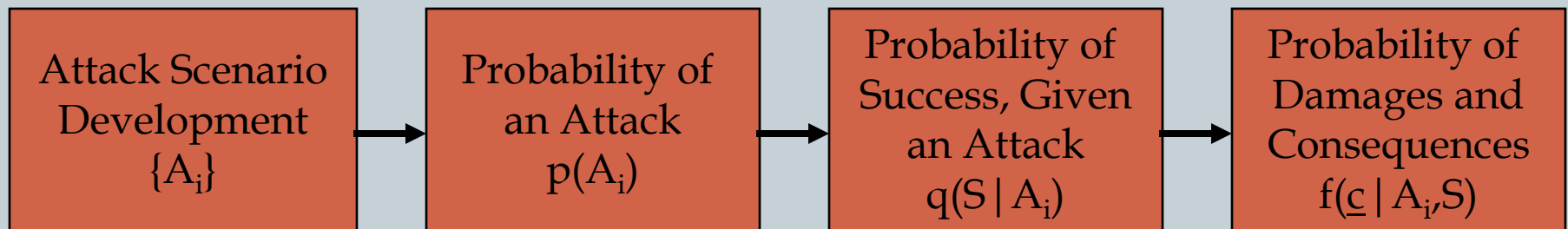
# RANCHO LPG STORAGE FACILITY TERRORIST ATTACK

## Risk Analysis Task – Evaluate a Terrorist Event causing a Flash Fire

### Threat Analysis

### Vulnerability

### Consequences



# RANCHO LPG STORAGE FACILITY TERRORIST ATTACK

## Assumptions:



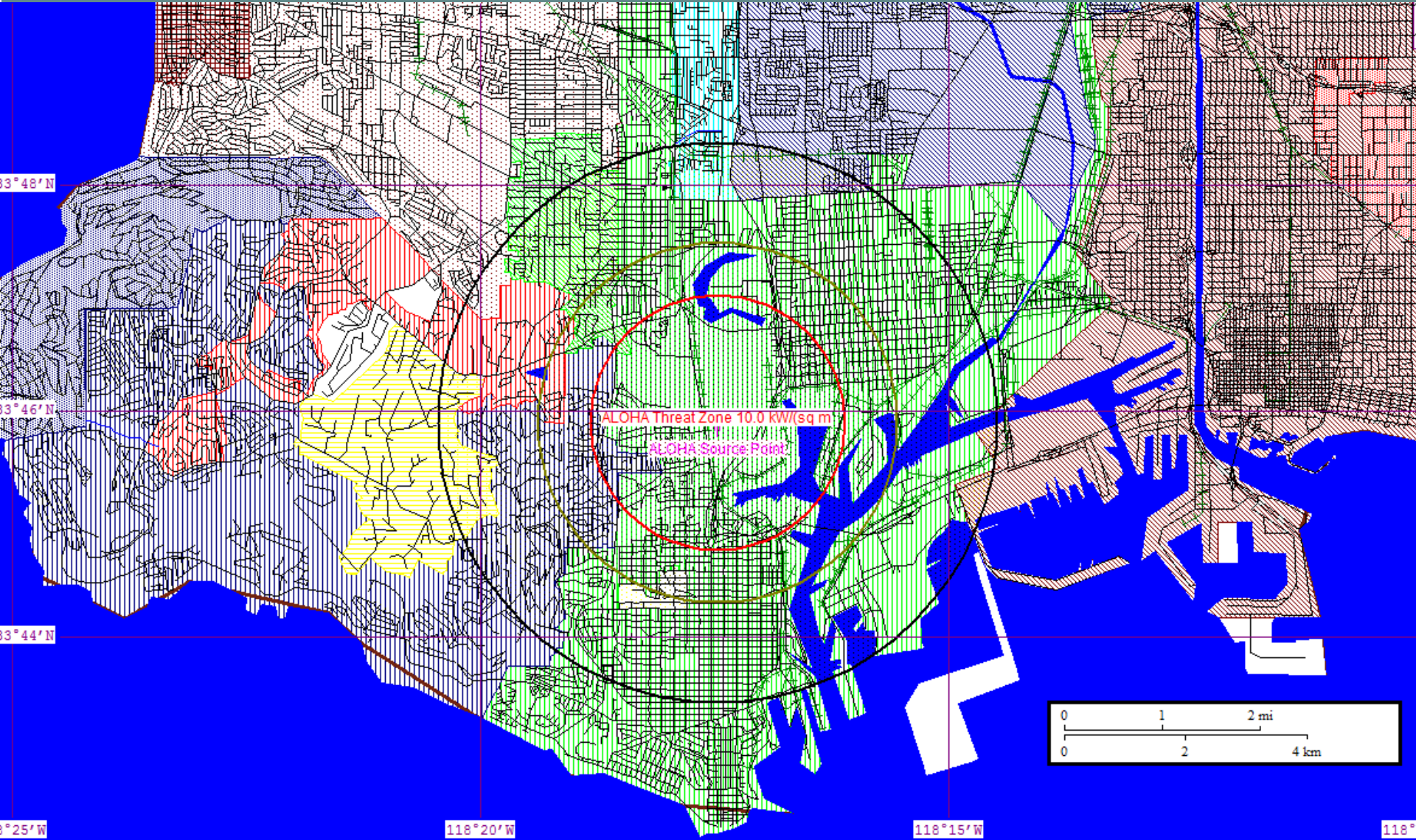
- **Two 12.5 million gallon butane storage tanks**
- **Terrorist attack—jet suicide attack or thermobaric RPG**
- **Full breach of one tank—approx. 10 foot diameter hole**
- **Phase I: 0.4 mile radius pool fire (5 kW/sq m zone)**
- **Phase II: adjacent tank internal pressure causes BLEVE, 1.86 mile radius pool fire/BLEVE (5 kW/sq m zone)**
- **Selected, estimated one-year chance of attempt—1 in 1150 (ranging from 1 in 100 to 1 in 100,000)**

# RANCHO LPG STORAGE FACILITY TERRORIST ATTACK: PHASE I





# RANCHO LPG STORAGE FACILITY TERRORIST ATTACK: PHASE II



# RANCHO LPG STORAGE FACILITY TERRORIST ATTACK: CONSEQUENCES

	Phase I – Pool Fire of Tank A			Phase II – BLEVE of Tank B caused by Pool Fire			Mean Annual Unconditional Expected Loss
	<i>0.3-mile Radius</i>	<i>0.41-mile Radius</i>	<i>0.63-mile Radius</i>	<i>1.33-mile Radius</i>	<i>1.86-mile Radius</i>	<i>2.95-mile Radius</i>	
	Pool fire - 524 yards - (10.0 kW/(sq m) = potentially lethal within 60 sec)	Pool fire - 722 yards - (5.0 kW/(sq m) = 2nd degree burns within 60 sec)	Pool fire - 1103 yards - (2.0 kW/(sq m) = pain within 60 sec)	BLEVE - (10.0 kW/(sq m) = potentially lethal within 60 sec)	BLEVE - (5.0 kW/(sq m) = 2nd degree burns within 60 sec)	BLEVE - (2.0 kW/(sq m) = pain within 60 sec)	BLEVE - (2.0 kW/(sq m) = pain within 60 sec)
<b>Total Population</b>	0	451	4808	26,105	65,430	162,606	162,606
<b>Total Households</b>	n/a		1634	9934	22,751	56,900	56,900
<b>Total Estimated Fatalities from Attack (% Population)</b>			n/a			2,500 (1.5%)	2 (0.001%)
<b>Total Estimated Injuries from Attack (% Population)</b>			n/a			12,500 (7.7%)	11 (0.007%)
<b>Total Estimated Economic Losses from Attack (excluding Fatalities and Injuries)</b>			n/a			\$12.0 billion	\$10.4 million



# RANCHO LPG STORAGE FACILITY TERRORIST ATTACK: POLICY IMPLICATIONS

- **There is a significant difference in the risk management of planned versus existing hazardous facilities. The rationale for grandfathering is that significant, sudden regulatory change hurts existing facilities and discourages future investment. Arguments centering on “fairness” and “economic feasibility” (e.g., it is less expensive to implement pollution controls at the time of new construction rather than as a retrofit) were generally developed to favor the owners of infrastructure rather than neighbors.**
- **Siting of aboveground LPG storage facilities near other critical infrastructure or near population centers should be avoided.**
- **Hardening (e.g., full containment tanks) and additional security can be very effective tools in reducing expected losses.**
- **Siting of aboveground LPG storage facilities in areas with low densities at least four miles from population centers and at least two miles from other significant commercial enterprises to minimize the exposure of people and property to potential harm should be strongly preferred.**
- **The persistency of Rancho LPG may also be due to its significant sunk costs. Political decisions often consider sunk costs, and avoidance of this consideration can only be accomplished absolutely by use of prospective analysis of proposed sites rather than retroactive analysis of existing sites.**