

**US Army Corps  
of Engineers.**

# ***VULNEARABILITY ASSESSMENTS: LESSONS LEARNED***

**By:**

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***Protective Design Center of Expertise***

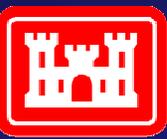
**Presented at:**

***FERC Security, Emergency Action Plan, and***

***Potential Failure Modes Analysis Workshop***

***27-30 January 2003***

***San Francisco, California***



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# *Agenda*

- **Overview of U.S. Army Corps of Engineers (USACE) and its missions**
- **USACE response after 9/11**
- **Vulnerability assessment process and lessons learned**



# *U.S. Army Corps of Engineers*

**US Army Corps  
of Engineers.**

*The world's premier public engineering organization  
responding to our Nation's needs in peace and war*

**A full spectrum engineer force of high quality,  
dedicated soldiers and civilians:**

- **Trained and Ready**
- **Vital Part of The Army**
- **Dedicated to Public Service**
- **Army Values-Based**





# National Presence

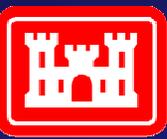
**US Army Corps of Engineers.**



	8 Divisions	
	41 Districts	
	2 Centers	
	ERDC	
	1 Engineer Battalion	

Districts outside the United States:  
 Europe (Germany)  
 Far East (Korea)  
 Japan

**South Atlantic Div (SOUTHCOM)**



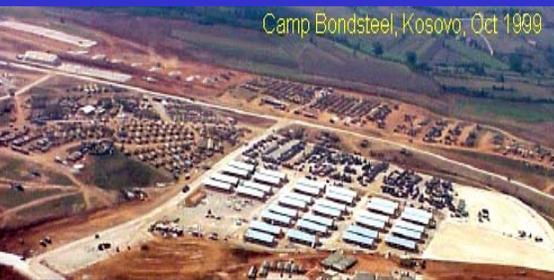
# USACE Missions

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## Military Programs

- Military construction
- Base operations
- Environmental restoration
- Geospatial Engineering

Camp Bondsteel, Kosovo, Oct 1999



## Homeland Security



- Critical Infrastructure
- Anti Terrorism Planner
- Infrastructure Security Partnership

## Research & Development

- Military engineering
- Terrain & Geospatial
- Structures
- Environment
- Water Resources



## Real Estate



- Acquire, manage & dispose
- DOD Recruiting facilities
- Contingency operations

## Interagency Support

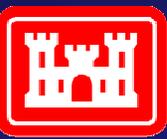
- DOD
- Federal
- State
- Local
- International



## Civil Works



- Navigation, Hydropower
- Flood control, Shore Protection
- Water Supply, Regulatory
- Recreation, Disaster response
- Environmental Restoration



# USACE Infrastructure

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**627 Shallow Draft  
Harbors**



**1/4 of Nation's  
Hydropower  
Production**



**383 Major Lakes  
&  
Reservoirs  
376 M Visitors/yr**

**11,000 miles  
Inland  
Waterways**

**299 Deep Draft  
Harbors**



**400 miles  
Coastal  
Structures**



**11.7 Million Acres  
Public Land**

**4,340  
Recreation  
Areas**



**276 Locks**

**8,500 Miles of  
Levees**



**\$500M Annual  
Dredging Costs**

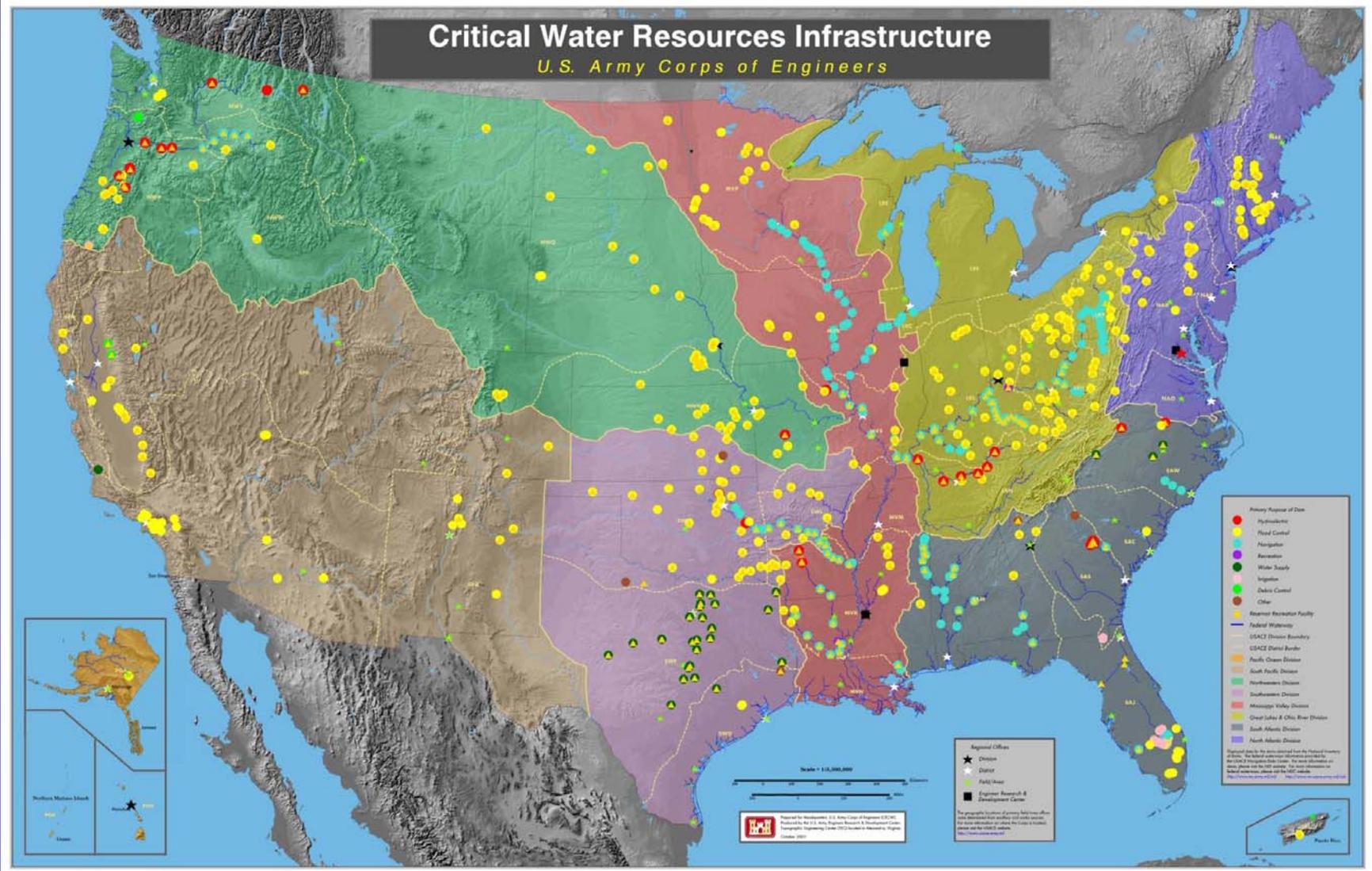




US Army Corps of Engineers.

# USACE Infrastructure

## Critical Water Resources Infrastructure U.S. Army Corps of Engineers



- Primary Purpose of Dam**
- Hydroelectric
  - Flood Control
  - Navigation
  - Recreation
  - Water Supply
  - Irrigation
  - Debris Control
  - Other
  - Reservoir Reception Facility
- Regional Offices**
- Division
  - District
  - Field/Over
  - Engineer Research & Development Center
- Primary Purpose of Dam**
- Mississippi Valley Division
  - Great Lakes & Ohio River Division
  - South Atlantic Division
  - North Atlantic Division
  - Northwestern Division
  - South Pacific Division
  - Pacific Ocean Division
  - USACE District Boundary
  - USACE District Border
  - Federal Waterway

Scale 1:10,000,000

Prepared by the Hydrographic, U.S. Army Corps of Engineers, 2010.  
 Prepared for the U.S. Army Engineer Research & Development Center  
 by the Army Corps of Engineers, 2010. All rights reserved. No part of this publication may be reproduced without permission in writing from the copyright owner.

The geographic information system data used in this map was derived from the National Inventory of Dams (NID) and the National Inventory of Dam Safety (NIDS) data. The data was obtained from the USACE Hydrographic Data Center. The data was obtained from the USACE Hydrographic Data Center. The data was obtained from the USACE Hydrographic Data Center.

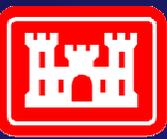




# September 11<sup>th</sup> Attacks

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# *Infrastructure Vulnerability Assessment Program*

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- **Establish objectives**
- **Set milestones**
- **Conduct vulnerability assessments**
- **Design security improvements**
- **Construct security improvements**
- **Revisit objectives, funding and priorities**



# *Infrastructure Vulnerability Assessment Program*

US Army Corps  
of Engineers.

## Intent and Objectives:

- Improve security to “basic” protection standards
- Conduct 300+ physical security risk assessments using RAM-D methodology
- Develop project risk management plan
- Recommend prioritized physical security improvements

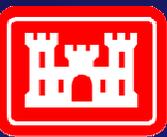


# *Infrastructure Vulnerability Assessment Program*

US Army Corps  
of Engineers.

## Milestones:

- Pre-Screened all USACE Projects - Oct/Nov 2001
- Train 30+ Districts on RAM-D – Nov/Dec 2001
- RAM-D Assessments – Nov 2001 / Apr 2002
- 300+ RAM-D Reports completed - 22 Apr 2002
- Reprioritized projects – May 2002
  - 306 Projects considered priority projects
- Initiate design on 83 projects – Jun 2002
- Construction – **complete by Dec 2003!**



# *Infrastructure Vulnerability Assessment Program*

US Army Corps  
of Engineers.

## Milestones:

- Pre-Screened Projects - Oct/Nov 2001
- Train 38 Districts on RAM-D – Nov/Dec 2001
- RAM-D Assessments – Nov 2001 / Apr 2002
- 300+ RAM-D Reports completed - 22 Apr 2002
- Reprioritized projects – May 2002
  - 306 Projects considered priority projects
- Initiate design on 83 projects – Jun 2002
- Construction – complete by Dec 2003!
- **Reprioritized projects – Mar 2003**
  - 263 Projects considered priority projects
- **Construction 83 projects complete by Dec 2004!**



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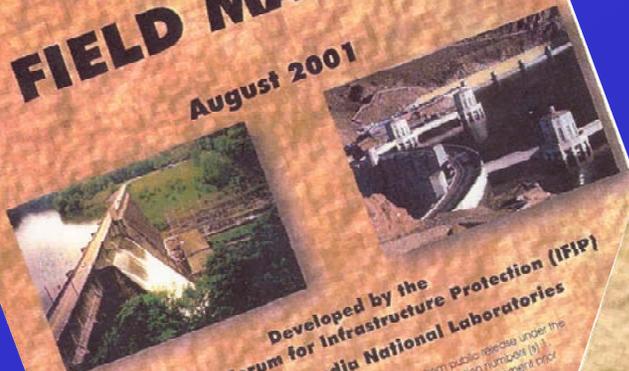
# *Vulnerability Assessments Utilizing RAM-D<sup>SM</sup>*

**Proprietary - Official Use Only**

**Risk Assessment  
Methodology for Dams (RAM-D<sup>SM</sup>)**

**FIELD MANUAL**

**August 2001**



**Developed by the  
Interagency Forum for Infrastructure Protection (IFIP)  
Prepared by Sandia National Laboratories**

Contains information which may be exempt from public release under the Freedom of Information Act (5 USC 552), exemption numbers (b) (1) and (b) (7) (C).  
Approval by the Department of Energy, Department Element prior to public release is required.  
Originator: R. V. Mersoloco, Date: August 20, 2001  
Further dissemination authorized to U.S. Government agencies and their contractors.  
Other requests shall be approved by the originating facility or high DOE programmatic authority.

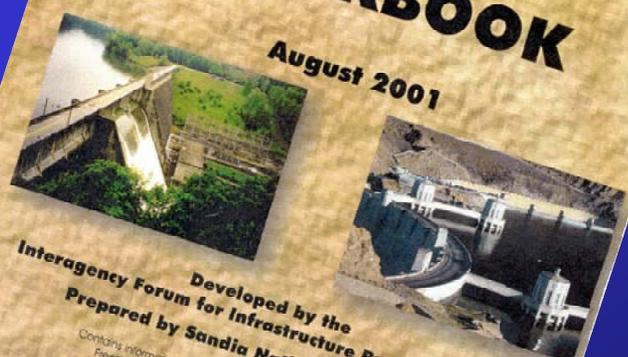
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**Risk Assessment  
Methodology for Dams (RAM-D<sup>SM</sup>)**

**WORKBOOK**

**August 2001**



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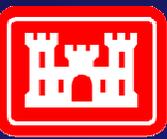


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# *RAM-D<sup>SM</sup> Risk Formula*

$$R = Pa * C * (1-Pe)$$

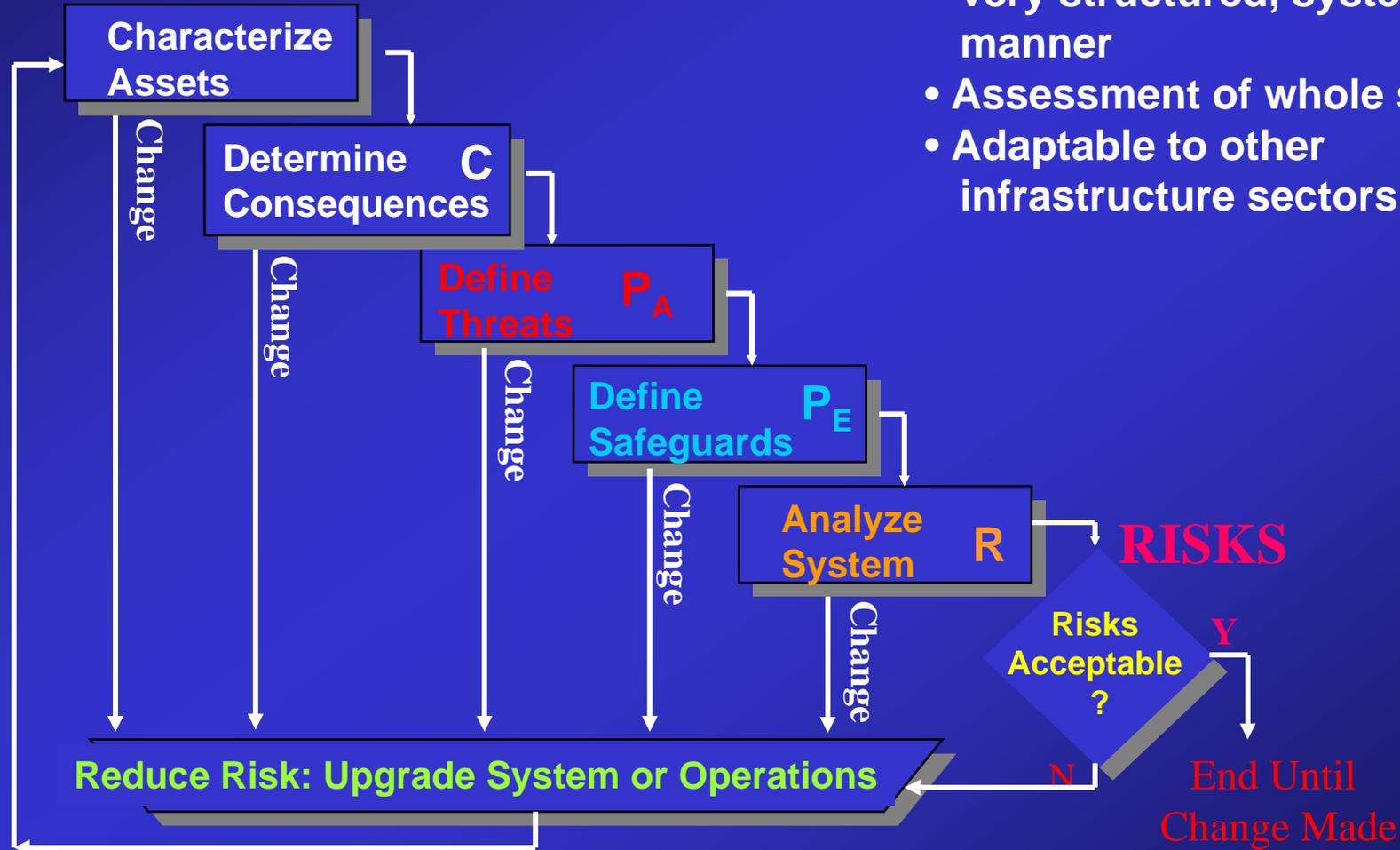
- **R:** Risk
- **Pa:** Likelihood of attack
- **C:** Consequence
- **Pe:** System Effectiveness



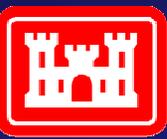
# RAM-D<sup>SM</sup> Flow Diagram

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## Screening Process



- RAM-D<sup>SM</sup> assesses risk in a very structured, systematic manner
- Assessment of whole system
- Adaptable to other infrastructure sectors

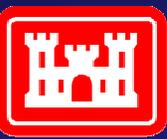


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# *Generic Table of Consequences*

Reference Table of Consequences

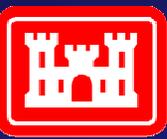
Undesired Event	Measures of Consequence	High	Medium	Low
Loss of Flood Control	Economic loss:	>\$50 million	\$10-50 million	<\$10 million
	Deaths	>100	10-100	0-10
Loss of Hydroelectric generation	Economic loss	>\$10 million	\$1-10 million	<\$1 million
Loss of water supply	Economic loss	>\$50 million	\$10-50 million	<\$10 million
Loss of Commercial Navigation	Operational Impact on other facilities	> 5 projects	3-5 projects	< 3 projects
	Economic loss	>\$50 million	\$10-50 million	<\$10 million
Environmental/ Ecological loss -Habitat/wildlife - Water Quality	Economic loss	>\$10 million	\$1-10 million	<\$1 million
	Number of fish lost	>100 thousand	50-100 thousand	<50 thousand
Loss of Symbol of US Way of Life	Level of public knowledge/ fame	International Recognition	National recognition	Regional Recognition



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# *Consequences*

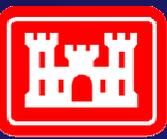
- **AGENCY SPECIFIC!!**
  - Reservoir elevation
    - “average annual maximum operating pool”
  - “Undesired Events” – Loss of:
    - Flood Control, Hydropower, Water Supply, Navigation and. . .
    - Environmental/Ecological – **difficult to determine**
  - Thresholds for undesired events
    - \$1M, \$10M, \$100M, \$1B
    - Loss of life (deaths) – **difficult to determine**
    - Population at risk
  - “System” verses “individual” dam failure scenario
  - Electricity cost to consumer or supplier?
  - Gather available information – **dated!!**



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# ***Threat Assessment: Aggressors***

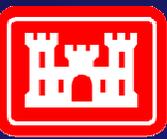
- **Vandals**
- **Insider**
- **Ecological Terrorists**
- **Paramilitary/Militia Groups**
- **Visitors**
  - Accommodating “visitors” and securing facility is extremely costly.



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# ***Threat Assessment: Aggressor Tactics***

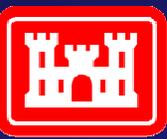
- **Ballistic**
- **Insider compromise**
- **Vehicle bomb**
- **Forced entry**



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# *Threat Assessment: Tools, Weapons and Explosives*

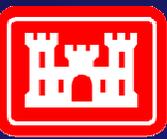
- **Vehicle**
  - Size and speed
    - Large perimeters very costly
- **Small arms**
  - Caliber and number of rounds
    - “Ballistic resistant” very costly
- **Hand tools**
  - Rocks, hammers, power tools, etc
- **Explosives**
  - number of pounds (5, 50, . . . 60,000#s)
    - Hardening very costly



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# *Threat Assessment: “Critical Assets”*

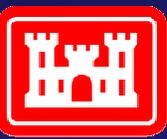
- Experience and composition of assessment team **VERY IMPORTANT!**
- Major Categories of Critical Assets
  - Embankment, Powerhouse, Inlet/Outlet Works, Spillway, Navigation Lock and Switchyard
- Tools:
  - Army Technical Manual 5-853 Vols. 1 thru 4 “Security Engineering” (FOUO)
  - RAM-D<sup>SM</sup> Fault Tree (Proprietary-OUO)
  - DAMSVR (Contains Energy Critical Infrastructure Information)



# *Vulnerability Assessment: Inspection Team*

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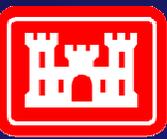
- **Assessment Team**
  - Limit number of teams - USACE 38 Districts
  - Trained and Experienced
  - 3 to 5 Optimum - **Diversified background!**
    - Security Officer
    - Engineers
      - Dam safety
      - Structural
      - Electrical
      - Security
  
- **Others attendees**
  - Operations personnel - “customer buy-in”
  - Local, State and Federal law enforcement
  - Coordinate with other “stakeholders”



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# ***Vulnerability Assessment: When?***

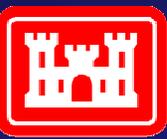
- **Day and Night inspection**
  - Doors
  - Lighting
  - CCTV quality
  - Routine of guards/personnel. . .predictable?
  - Interview everybody and anybody
    - Especially the person nobody wants you to talk to!
- Visit project the day/night before or after scheduled inspection date



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# ***Vulnerability Assessment: Detect, Delay, Assess and . . .***

- **Detect**
  - Sensors
  - Test existing systems!
- **Delay**
  - Doesn't start until detection occurs
  - Tactics, tools and weapons!
  - Delay  $\geq$  Response time
- **Assess**
  - Cameras



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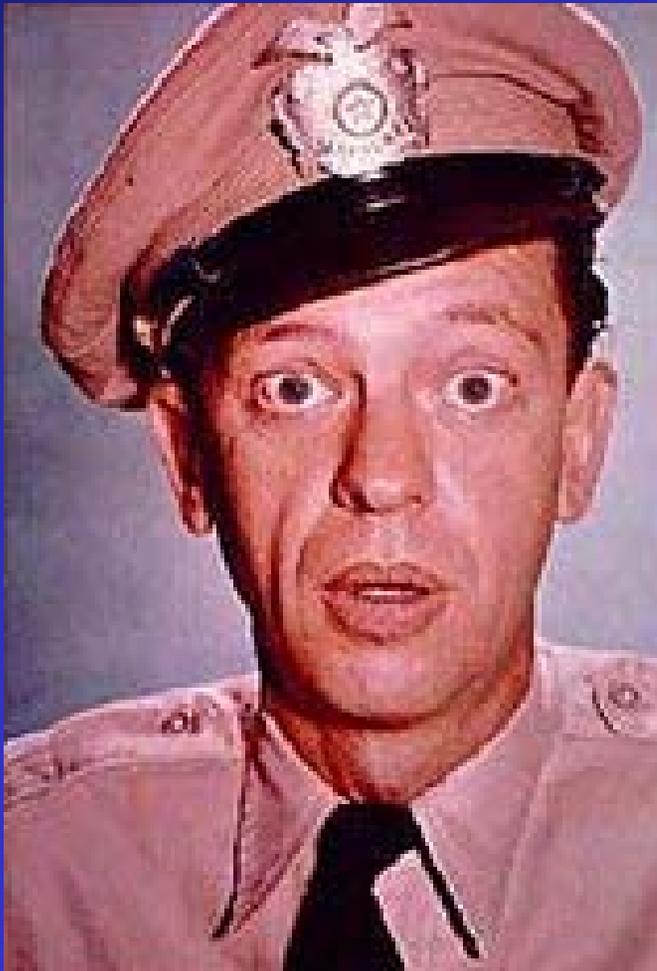
# *Vulnerability Assessment: Response*

- **Response**
  - Projects often remote
    - Days and hours –vs- minutes
  - Delay <<<<<<<<< Response!
- **Response –vs- “Effective Response”**
  - Law enforcement unfamiliar with:
    - Project and “critical assets”
  - Ill-equipped to handle “determined adversary”
    - Side arm –vs- automatic weapons/explosives
  - “Shoot to kill” –vs- “hurry up and wait” or “negotiate a peaceful solution”
  - Ask law enforcement what they would do if an attack occurred!

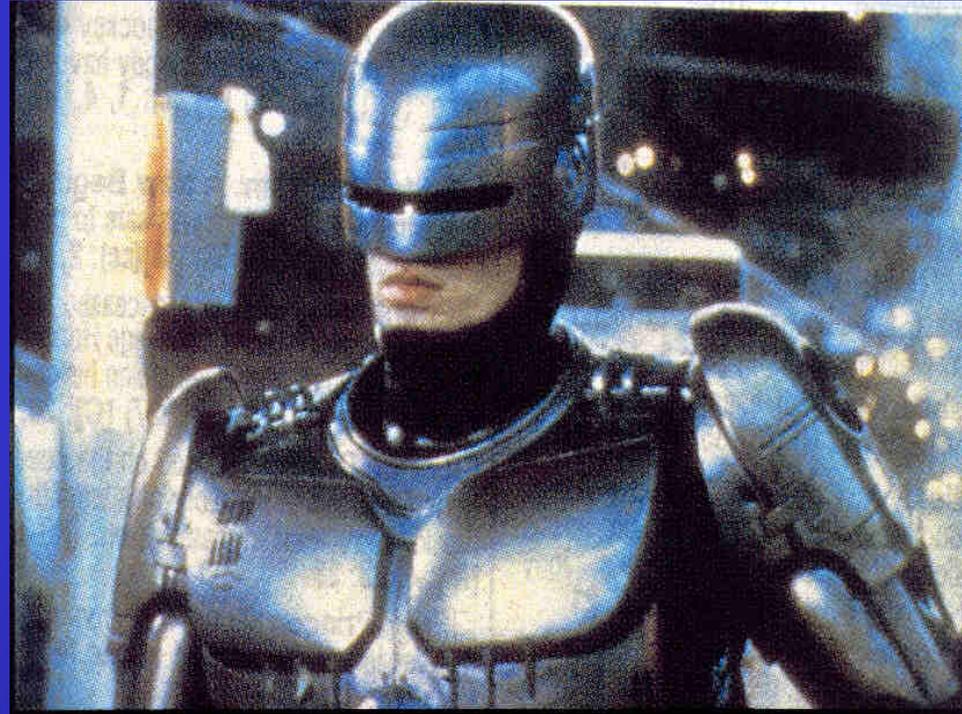


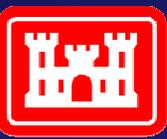
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# *Vulnerability Assessment: Response*



**- VS -**



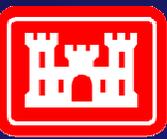


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# *Vulnerability Assessment: What about Deterrence?*



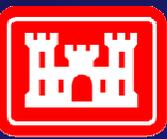
- **Cannot quantify!**
- **Cannot predict accurately!**



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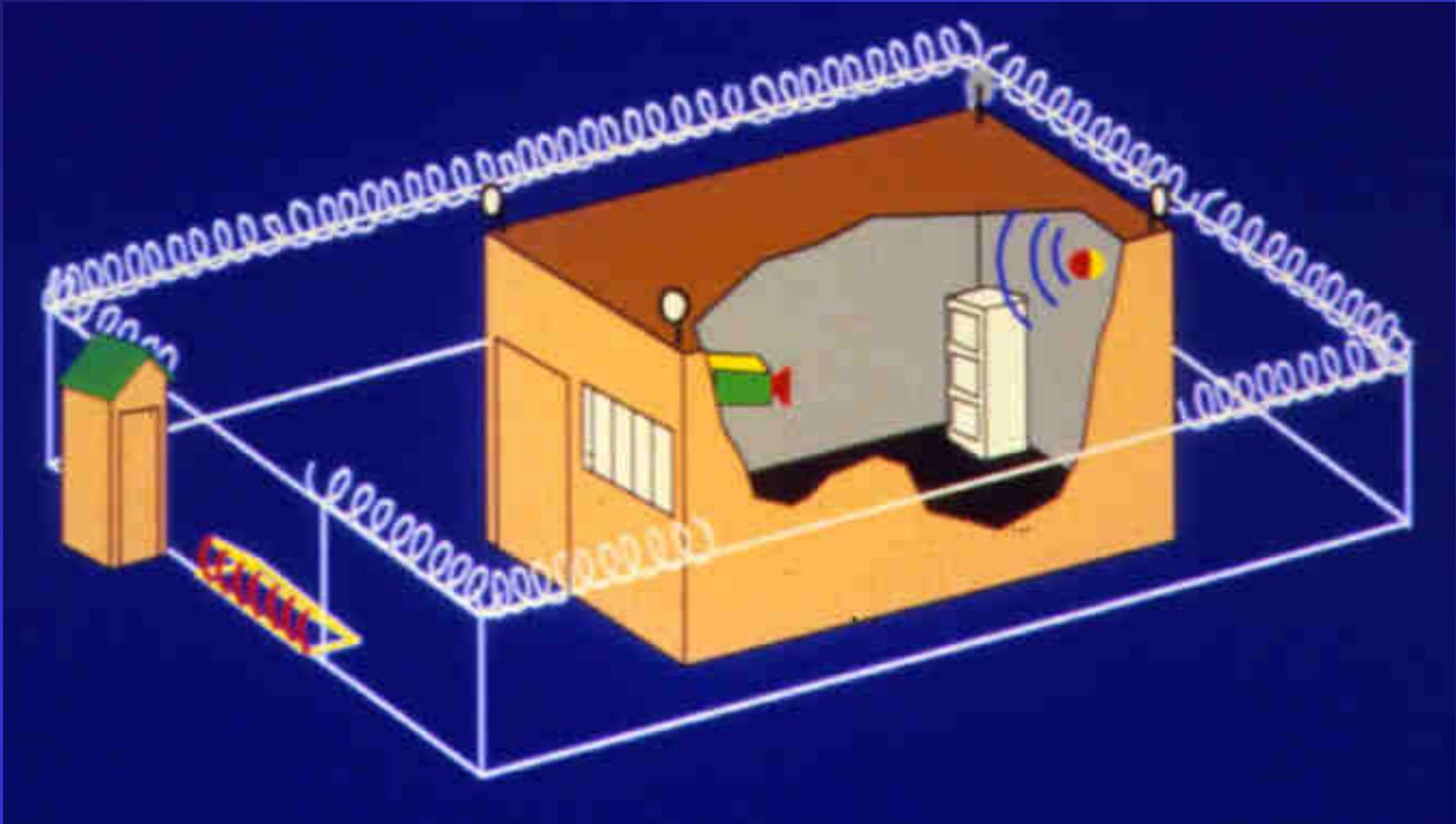
# ***Vulnerability Assessment: Attack Scenarios***

- **Very time consuming!**
- **“Sophisticated” attack**
  - Attacking more than one asset
- **Use specific threat information**
- **Calculate all delay times. . .**
  - Success: Delay  $\geq$  Response time
  - Failure: Delay  $<$  Response time



# *Army's Protective System*

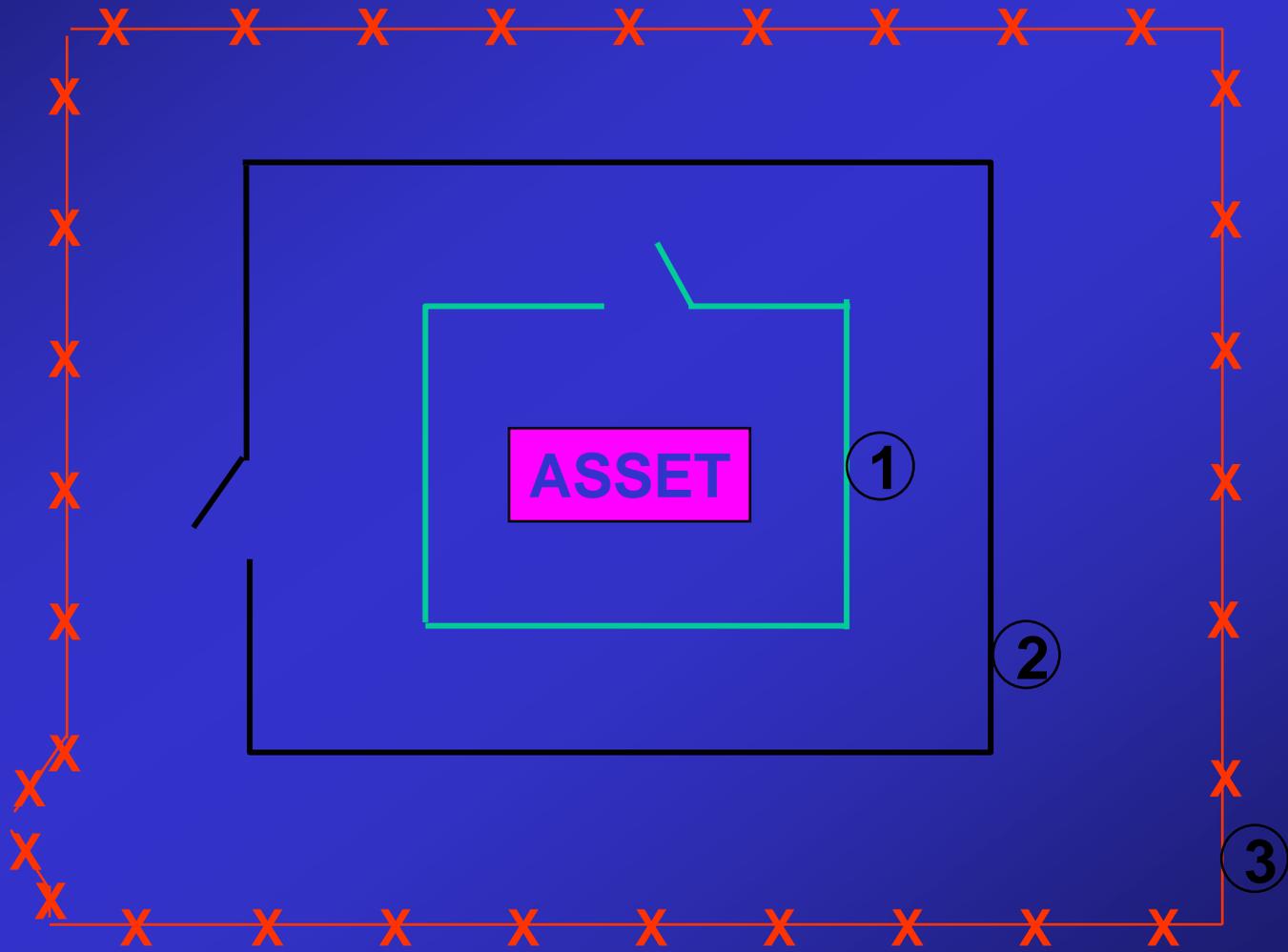
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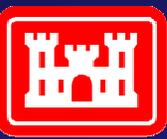




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# *Layers of Defense*

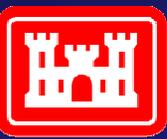




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# ***Vulnerability Inspection: Security Improvements***

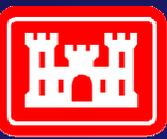
- **Guidance on “package” design**
  - Threat based
    - Define Design Basis Threat
  - Priority based
  - Consequence based
  - Other
  - Combination of the above
  
- **Build on one another**
  - Package A (ex. Vandals)
  - Package B (ex. Eco. Terrorists), includes A
  - Package C (ex. OCONUS Terrorist), includes A and B



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# ***Vulnerability Inspection: Security Improvements***

- **Can't neglect or forget. . .**
  - Operational Constraints
  - Response Plans
  - Operation and Maintenance “tail”
  
- **USACE Security Improvements**
  - Fences
  - Gates
  - Locks
  - Lights
  - Cameras
  - Sensors
  - Alarms
  - Structural Hardening

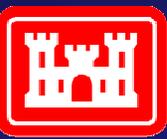


# *Vulnerability Assessment: Cost Estimate*

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- **“Parametric” cost estimate**
  - Actual construction costs for “final design” security improvements are far surpassing “preliminary” security design defined in vulnerability assessment reports!

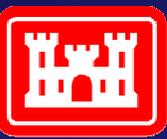




# *Vulnerability Assessment: Final Report*

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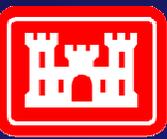
- **Define report format requirements.**
  - Executive summary, TOC, list of drawings, forms, appendices, etc.
- **“For Official Use Only” (FOUO)**
  - Vulnerabilities
  - Attack scenarios
  - Security design
- **Freedom of Information Act (FOIA)**



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# *Vulnerability Assessment: Learned any Lessons?*

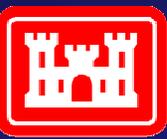
- Document YOUR Lessons Learned!
  - After Action Report (AAR)



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# *Closing Remarks*

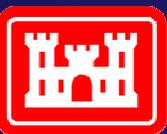
- **Some dams are easily considered Weapons of Mass Destruction (WMD) due to their potential destructive power.**
- **A very sophisticated and determined aggressor is EXTREMELY costly to overcome and is probably going to succeed in an attack despite what security improvements are constructed. . .just hope you are not the first one attacked and are not an example for the rest of the nation and/or world.**
- **“Guys with Guns” on-site is the only way to win the battle but is not a practical, long term solution.**



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# ***Infrastructure Security Truths***

- **Today's terrorist can strike any place, any time, and with virtually any weapon**
- **Securing the infrastructure is a challenge of monumental scale and complexity**
- **This is an exceedingly complex mission that requires coordinated and focused effort from our entire society – Federal Government, State and Local Governments, the private sector and the American People**
- **The U.S. Government has no more important mission.**



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# *USACE Challenge*



# Questions?

**USACE - Omaha District  
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