Comparison of Risk Assessment Tools for the Water Sector

Kate Novick, P.E., C.S.P.
AWWA Management Standards

- “G Standards”

AWWA management standards “describe consensus requirements for utility management practices”

- Their use is “voluntary,” not a regulatory requirement

- “Intended to serve the water sector and improve overall operations and service”

- Establishes “formal management and operations guidelines”
Risk Assessments are Standard Practice in the Water Sector

- AWWA G430-14 Security Practices for Operation and Management
  - 4.4.1 The utility shall perform a risk assessment...
  - 4.4.2 The utility shall review and update its risk assessment as new hazards and threats emerge...
  - 4.4.3 The [review] schedule shall not exceed five years...

  - Same as above

- Both standards “define the minimum emergency preparedness requirements for water, wastewater, or reuse facilities to respond to emergencies and restore normal operations, minimizing the disruption of critical services while sustaining public health, protecting property, and maintaining consumer confidence.”
HOW DID WE GET HERE?
All water utilities servicing more than 3,300 people required to:

- Perform Vulnerability Assessments (VA)
- Update Emergency Response Plans to include the results of the VA
By December 2003...

  - Identifies 18 critical infrastructure and key resources (CIKR) sectors
  - Assigned EPA as the Sector-Specific Agency for the water and wastewater sector

Since 2003, a Lot Has Changed
Since 2003, a Lot Has Changed
Common risk management framework for all critical sectors

PPD-21 set forth a comprehensive risk management framework and clearly defines critical infrastructure protection roles and responsibilities.
Managing Risk is a Utility Responsibility (supported by public partnership)

PPD-21 states, “Critical infrastructure owners and operators are uniquely positioned to manage risks ... and to determine effective strategies to make them more secure and resilient.”
Utility risk assessments are one of the main topics of this plan:

“Utilities risk assessments prioritize security and emergency preparedness improvements by incorporating prevention, detection, response, and recovery concepts into their overall risk management strategy.”
Figure 3-2: Interdependencies with the Water Sector

(from Water Sector Specific Plan)
What is RAMCAP?

- Risk Analysis and Management for Critical Asset Protection (RAMCAP®) Standard

- “ANSI/ASME-ITI/AWWA J100-10”
By 2010, the VA process was retooled to respond to the needs of the nation to protect the water and wastewater infrastructure.

**Vulnerability Assessment ➔ Risk Assessment**

<table>
<thead>
<tr>
<th>Step</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Asset Characterization</td>
</tr>
<tr>
<td>2</td>
<td>Threat Characterization</td>
</tr>
<tr>
<td>3</td>
<td>Consequence Analysis</td>
</tr>
<tr>
<td>4</td>
<td>Vulnerability Analysis</td>
</tr>
<tr>
<td>5</td>
<td>Threat Analysis</td>
</tr>
<tr>
<td>6</td>
<td>Risk/Resilience Analysis</td>
</tr>
<tr>
<td>7</td>
<td>Risk/Resilience Management</td>
</tr>
</tbody>
</table>
Risk Analysis

- RAMCAP® is a process for analyzing and managing the risks associated with malevolent attacks and naturally occurring hazards against critical infrastructure.
Risk assessments in the water sector were performed long before 2001. They are useful for planning.
Benefits of Performing a Risk Assessment

- Standard practice across critical key infrastructure sectors
- Provide insights about water and wastewater system vulnerabilities, consequences and risks as support for internal decisions.
- Lower risks, increase resilience to attacks and natural hazards.
- Improve reliability of service.
- Improve ability to communicate risk.
- Assist in rate and fee setting to pay for reliability.
- May reduce insurance costs and/or improve credit ratings, etc.
Threats and Hazards in RAMCAP

- Specific reference threat scenarios are included in the Standard
  - **Natural events**
    - Flood, hurricane, tornado, wildfire, ice storm, earthquake
  - **Man-made events**
    - Contamination of product, process sabotage, diversion or theft, boat as weapon, plane as weapon, vehicle as weapon, assault teams
  - **Dependency and proximity hazards**
    - Other utilities, service interruptions of key suppliers, proximity to others’ assets that carry significant risk)
RAMCAP Risk Assessment Tools

**PARRE**
- Owned by AEM Corporation
- Buy annual license
- Web-based
- More user-friendly
- 1-hour of free technical support
- Been available for 2 years
- Been consistent with RAMCAP since its inception
- Good for any-size system

**VSAT**
- Owned by EPA
- Free
- Not web-based
- Online tutorial videos
- Used more often than PARRE
- No technical support
- Latest version (6.02) is consistent with RAMCAP
- Good for small and some medium-sized systems
Getting the Tools

**PARRE**

**PARRE Professional** by AEM Corporation

- **Price**: $499.00
- **Buy Now**

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**Conduct a Drinking Water or Wastewater Assessment**

**Vulnerability Self-Assessment Tool (VSAT) 6.0**

Drinking water and wastewater utilities of all sizes can use VSAT to enhance and resiliency. Utilities can:

- Identify the highest risks to mission-critical operations
- Find the most cost-effective measures to reduce those risks

VSAT Version 6.0 complies with the water sector risk assessment standard under the Department of Homeland Security’s Support Anti-Terrorism by Fostering Effective Technology (SAFETY) Act program. EPA strongly encourages drinking water and wastewater utilities to use VSAT 6.0 to conduct or update an all-hazards risk assessment.

Download VSAT 6.0

VSAT 6.0 Training Video
Home Screens

PARRE™

Home
VSAT is a risk assessment application for water, wastewater, and combined utilities of all sizes. It allows utilities to develop a risk assessment by guiding them through a series of steps.

Setup
VSAT captures a variety of information about your utility, including site and location. You can also specify other data used during analysis.

Assets
VSAT provides a standardized list of assets. You can modify the asset inventory to reflect your specific facility (wastewater, water, or water/wastewater).

Countermeasures
VSAT provides a template of commonly used countermeasures and users can develop new countermeasures and assign to assets. Assign countermeasures to the assets they protect. During analysis, they are evaluated for the protection they provide.

Threats
The water sector has defined a common framework to assess terrorist and natural hazards to water utilities. Select the threats that apply and define facility-specific threats.

Baseline
After establishing the baseline risk level associated with currently in place.

Improvement
After conducting a baseline, ways to lower the risk are identified.

Cost/Risk
Use the cost/risk model to determine the cost to reduce the risk.

Results & Reports
Generate reports of the results and define facility-specific outcomes.

Threat/Asset Identification

Asset Characterization
Threat Characterization
Asset/Threat Characterization

Data Documentation

Consequence Analysis
Vulnerability Analysis
Threat Analysis
Natural Threat Analysis
Dependency Threat Analysis

Data Analysis

Risk/Resilience Analysis
Risk/Resilience Management
Reports

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Additional Features of PARRE

- Two levels of prioritization and screening to refine scope of assessment
  - One at asset level and one at asset-threat pair level

- Vulnerability Analysis of Malevolent Threats has 4 built-in methods to choose:
  1. Direct expert elicitation
  2. Path analysis
  3. Vulnerability logic diagram
  4. Event tree

- Threat Analysis of Malevolent Threats has 3 built-in methods to choose:
  1. Conditional probability
  2. Best estimate
  3. Proxy indicator
Additional Features of PARRE

- Natural Threat Analysis has built-in calculators for hurricane, earthquake, tornado, floods, and ice storms to evaluate natural threats or you can manually input values.
## Baseline Results for Both

<table>
<thead>
<tr>
<th>Asset</th>
<th>Threat</th>
<th>Number of Fatalities</th>
<th>Number of Injuries</th>
<th>Fatalities ($)</th>
<th>Injuries ($)</th>
<th>Utility Financial Impact</th>
<th>Regional Economic Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment Facility</td>
<td>S(PI) - Process Sabotage-Physical Insider</td>
<td>50</td>
<td>2000</td>
<td>$390,000,000</td>
<td>$156,000,000</td>
<td>$100,000,000</td>
<td>$1,000,000,000</td>
</tr>
<tr>
<td>Treatment Facility</td>
<td>AT1 - Assault Team 1</td>
<td>50</td>
<td>2000</td>
<td>$390,000,000</td>
<td>$156,000,000</td>
<td>$100,000,000</td>
<td>$1,000,000,000</td>
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<tr>
<td>Treatment Facility</td>
<td>V1 - Car Bomb</td>
<td>50</td>
<td>2000</td>
<td>$390,000,000</td>
<td>$156,000,000</td>
<td>$10,000,000</td>
<td>$100,000,000</td>
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<tr>
<td>Lake</td>
<td>C(C) – Contamination</td>
<td>50</td>
<td>2000</td>
<td>$390,000,000</td>
<td>$156,000,000</td>
<td>$11,000,000</td>
<td>$110,000,000</td>
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<tr>
<td>Street Offices</td>
<td>Active Shooter</td>
<td>8</td>
<td>20</td>
<td>$62,400,000</td>
<td>$1,560,000</td>
<td>$1,000,000</td>
<td>$10,000,000</td>
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<tr>
<td>Treatment Facility</td>
<td>Active Shooter</td>
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<td>10</td>
<td>$31,200,000</td>
<td>$780,000</td>
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<tr>
<td>Storage</td>
<td>C(C) – Contamination</td>
<td>4</td>
<td>8</td>
<td>$31,200,000</td>
<td>$624,000</td>
<td>$2,000,000</td>
<td>$20,000,000</td>
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<tr>
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<td>2</td>
<td>$15,600,000</td>
<td>$156,000</td>
<td>$10,000,000</td>
<td>$0</td>
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<tr>
<td>Transmission Mains</td>
<td>F2 - 500-year flood</td>
<td>2</td>
<td>2</td>
<td>$15,600,000</td>
<td>$156,000</td>
<td>$5,000,000</td>
<td>$2,000,000</td>
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<tr>
<td>Distribution Mains</td>
<td>F2 - 500-year flood</td>
<td>2</td>
<td>2</td>
<td>$15,600,000</td>
<td>$156,000</td>
<td>$500,000</td>
<td>$100,000</td>
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<tr>
<td>Storage</td>
<td>T1 - Fujita 1</td>
<td>2</td>
<td>4</td>
<td>$15,600,000</td>
<td>$312,000</td>
<td>$2,000,000</td>
<td>$0</td>
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<tr>
<td>Storage</td>
<td>C(C) – Contamination</td>
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<td>Storage</td>
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<td>4</td>
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<td>$312,000</td>
<td>$5,000,000</td>
<td>$50,000,000</td>
</tr>
</tbody>
</table>

Continued...
## Baseline Results for Both

<table>
<thead>
<tr>
<th>Asset</th>
<th>Threat</th>
<th>Likelihood of Damage</th>
<th>Likelihood of Threat</th>
<th>Total Monetized Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment Facility</td>
<td>S(PI) - Process Sabotage-Physical Insider</td>
<td>0.3</td>
<td>0.0001</td>
<td>$49,380</td>
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<tr>
<td>Treatment Facility</td>
<td>AT1 - Assault Team 1</td>
<td>0.3</td>
<td>0.000000001</td>
<td>$0</td>
</tr>
<tr>
<td>Treatment Facility</td>
<td>V1 - Car Bomb</td>
<td>0.3</td>
<td>0.000000001</td>
<td>$0</td>
</tr>
<tr>
<td>Lake</td>
<td>C(C) – Contamination</td>
<td>0.15</td>
<td>1E-10</td>
<td>$0</td>
</tr>
<tr>
<td>Street Offices</td>
<td>Active Shooter</td>
<td>0.03</td>
<td>0.0001</td>
<td>$225</td>
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<tr>
<td>Treatment Facility</td>
<td>Active Shooter</td>
<td>0.3</td>
<td>0.00001</td>
<td>$129</td>
</tr>
<tr>
<td>Storage</td>
<td>C(C) – Contamination</td>
<td>0.05</td>
<td>1E-10</td>
<td>$0</td>
</tr>
<tr>
<td>Street Offices</td>
<td>H1 - Category 1</td>
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<td>0.0233</td>
<td>$18,003</td>
</tr>
<tr>
<td>Transmission Mains</td>
<td>F2 - 500-year flood</td>
<td>0.25</td>
<td>0.002</td>
<td>$11,378</td>
</tr>
<tr>
<td>Distribution Mains</td>
<td>F2 - 500-year flood</td>
<td>0.25</td>
<td>0.002</td>
<td>$8,178</td>
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<tr>
<td>Storage</td>
<td>T1 - Fujita 1</td>
<td>0.2</td>
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<tr>
<td>Storage</td>
<td>C(C) – Contamination</td>
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<td>1E-10</td>
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<tr>
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<td>C(C) – Contamination</td>
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<td>1E-10</td>
<td>$0</td>
</tr>
</tbody>
</table>

Continued…
RAMCAP Risk Assessment Report

- Top threats
- Asset-threat pair risks prioritized
- Risk reduction options prioritized
- And more...