

# Development of a Security Manual for Historic Covered Bridges

National Center for Wood  
Transportation Structures

# Acknowledgement

- Federal Highway Administration
- USDA Forest Products Laboratory

# All But a Lost Art

- Design, construction of covered bridges.
- Many existing bridges are preserved only because of their status on the National Registry.
- Or, due to diligent maintenance and care by owners and other interested parties.
- Arson, vandalism, neglect, natural disasters...



# Objective

- Provide covered bridge engineers with tools to quickly and efficiently design and implement security measures.
  - Usable
  - Flexible
  - Practical
  - Adaptive
  - Low-tech to high-tech

# Approach

- In-depth analysis of options ranging from control of terrain to installation of automated systems.
- Consideration of needed expertise, value, limitations, practicality.
- Also reviewed maintenance needs, power requirements, expertise needed, etc.

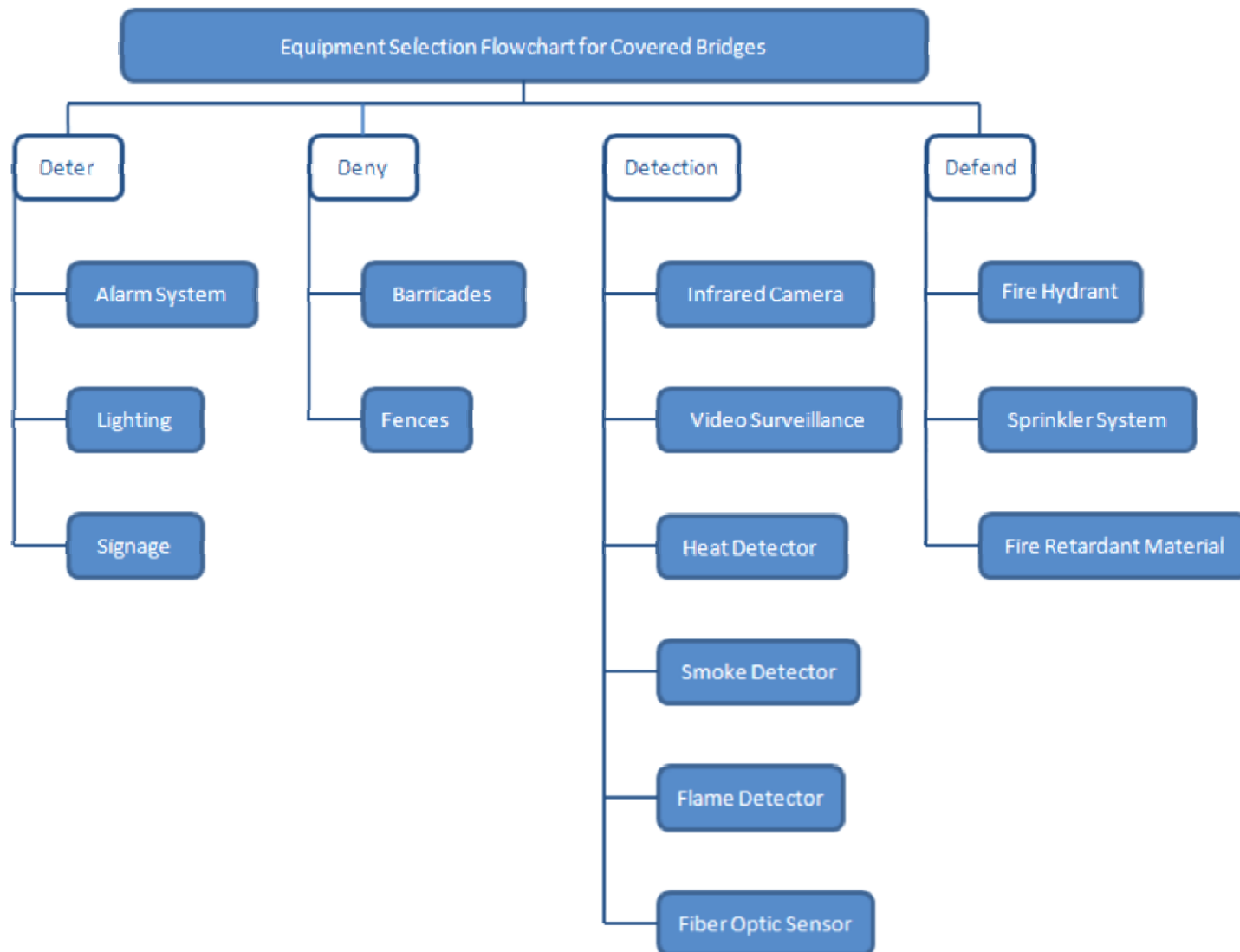
# Case Studies

- Detailed information on systems installed at multiple locations.
- Fictitious cases where multiple options (and costs) are considered.

# Structural Security

- Blue Ribbon Panel on Bridge and Tunnel Security.
  - Five levels of security for bridges
    - Deterrence, deny access, detect presence, defend the facility, and design structural hardening





# Deter

- Discourage action by means of fear or doubt.
- Fear/doubt is that you would be caught and prosecuted.
- Equipment
  - Alarm system: audible or silent, detect-transmit-alert-react
  - Lighting: eliminate/reduce the cover of darkness; perimeter, area, flood, gatehouse
  - Signage: effective at causing doubt

# Deny

- Limit or eliminate access to the bridge.
- One of the more difficult security options.
- Equipment
  - Barricades: natural (rivers, brush, etc.), man-made (planters, bollards, k-rail, guard rails, berms)
  - Fences: chain link, barbed wire, wrought iron, wood, block wall

# Detection

- Detection of threats can be an invaluable portion of a security system design.
- Facilitates alerting of authorities.
- Equipment
  - Camera: CCTV, infrared
  - Heat detector: fixed temperature or rate of rise
  - Smoke detector: vulnerable to dust, etc.
  - Flame detector: detect heat and flicker rate

# Defend

- Ability to react to an attack.
- Different from hardening in that defend mechanism are not structural in nature.
- Equipment
  - Fire hydrant
  - Sprinkler system: dry-pipe systems are preferred
  - Fire retardant materials: reduce the ability of wood to burn
  - Intumescent coatings: chemically bound water is released when exposed to heat

# Considerations

- Infrastructure placement: aesthetics, line of sight, functional.
- Enclosures: aesthetics, environmental protection.
- Power: grid power, renewable (wind, solar), storage

# Madison County Case Study

- Covered bridges are an important economic draw to Madison County
  - Made famous by the book and movie.
- Madison County received a grant to upgrade security of all bridges following arson of the Cedar Bridge and Francesca's house.

# Components

- Internal communication equipment
- Video camera
- IR camera
- Flame detectors
- Renewable energy source
- 3G internet access
- On-site data processing
- Text/page/email alerts in the event of a trigger
  - Sherriff, fire department, police chief



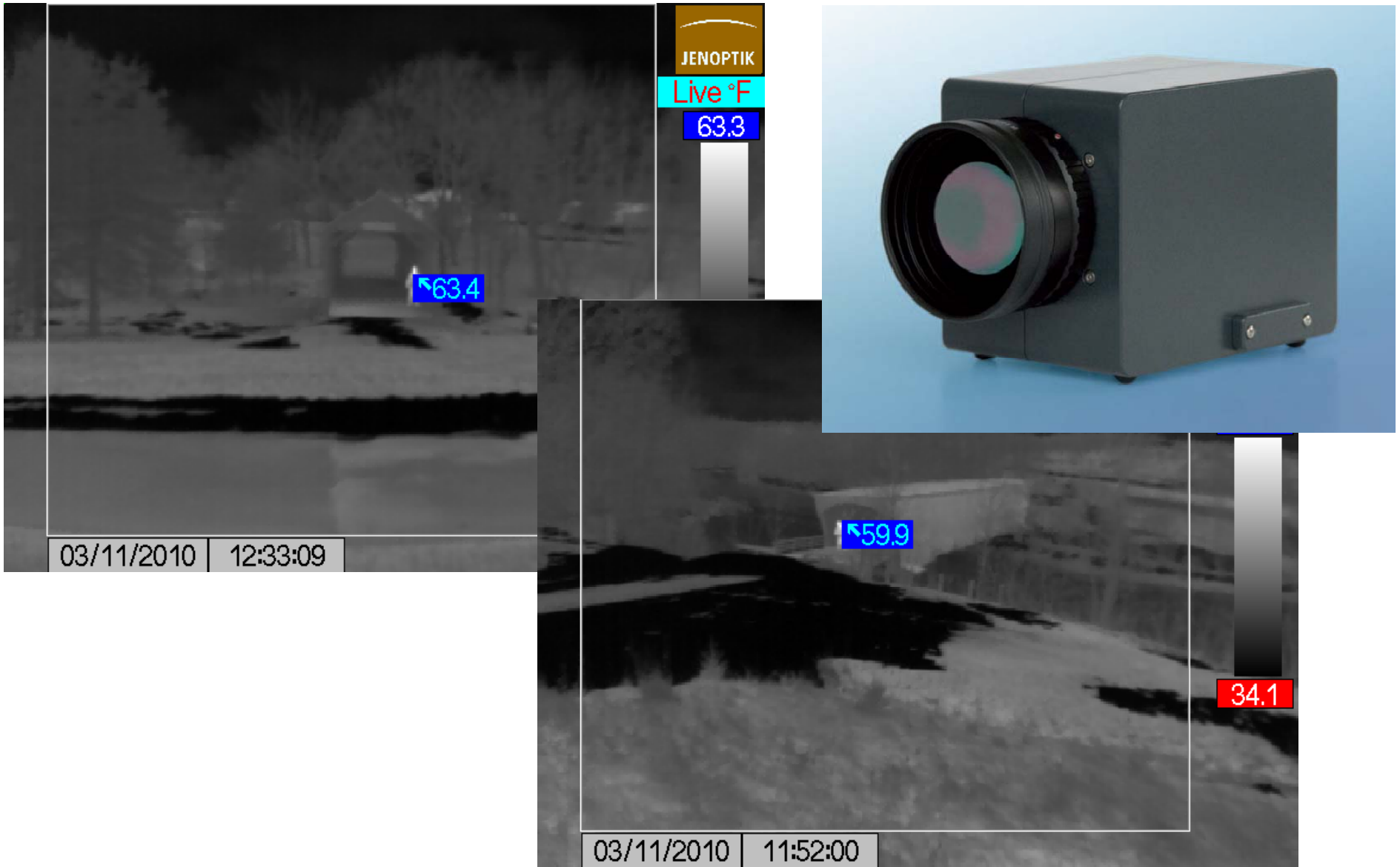
# Communication and Processing



# Video Camera



# IR Camera



# Flame Detector





# Storage



# Power



# Slaughter House Bridge Hypothetical

- Option 1 – Intumescent coating plus signage
  - Cost: Low
  - Protection: Moderate
  - Maintenance: Low-Moderate
  - Goal: Provide some protection and minimize damage.
  - Reason: Proximity to medium sized-city with fire-department felt to provide good safety net as long as threats can be quickly identified.

# Slaughter House Bridge Hypothetical

- Option 2 – Lighting plus flame detectors
  - Cost: Moderate
  - Protection: Moderate-High
  - Maintenance: Moderate
  - Goal: Deter trespassers
  - Reason: Proximity to major highway and residential area provides significant deterrence. These technologies upgrade the security to include detection.



# Slaughter House Bridge Hypothetical

- Option 3 – Lighting plus sprinkler system
  - Cost: High
  - Protection: High
  - Maintenance: Moderate
  - Goal: Ensure survival of bridge by protecting middle of span.
  - Reason: Relatively easy access to water source reduces cost of sprinkler system.

# Other Case Studies

- Union County Covered Bridges – linear heat detection cable with alarming plus LED lights
- Knecht's Covered Bridge – alarm system with strobes and horns connected to linear heat detection plus dry sprinkler system.
- Pomeroy-Academia Covered Bridge – Eight cameras plus fire retardant.
- Red Covered Bridge – Internal lights controlled by photocells plus five cameras.

# Concluding Remarks

- A tool does exist to help covered bridge engineers improve/upgrade security.
- Tools range from low-cost to high-tech.
- Tools help engineers match budget limitations with the best security value.

**Thank You!**  
**Questions?**

Brent Phares  
(515) 294-5879  
bphares@iastate.edu