Appendix B: Historic Structure Fire Protection System and Museum Collections Assessment Matrices, and Fire Protection Systems Information

HISTORIC STRUCTURE FIRE PROTECTION SYSTEM ASSESSMENT MATRIX

Not all NPS structures require the same level of fire protection. Use this chart to help establish criteria for selecting the level of protection appropriate to the significance and integrity of historic structures **not housing collections**. This chart serves as a reference guide only; it does not establish design criteria for historic structures.

Note: Determining the proper fire protection for each specific application should be a collaboration between the park IDT, resource manager, and the regional FCO. Depending on the complexity of the resource, the services of a fire protection engineer may be required by the team. All final plans must be reviewed and approved by the regional FCO. For structures

housing collections, follow the guidance and requirements in the *Museum Handbook*, Part I, Chapter 9, Museum Fire Protection. Also refer to NFPA 914, Code for the Protection of Historic Structures, for additional information and guidance

HOW TO USE THIS MATRIX

Rate each historic structure according to the 7 elements below, using a score of 1-5 (Levels 1-5).

For a total score of:	Scoring Recommendations	Score
1 – 14	Fire alarm system should be considered; however, a fire suppression system may not be needed for this structure.	
15 – 21	Fire alarm system required; park may want to install a fire suppression system in this structure.	
22 – 28	Fire alarm system required; park should install a fire suppression system in this structure.	
29 – 35	Fire alarm system required; suppression system required.	

HISTORIC STRUCTURE FIRE PROTECTION SYSTEM ASSESSMENT MATRIX

FACTOR	LEVEL 5 (Five Points)	LEVEL 4 (Four Points)	LEVEL 3 (Three Points)	LEVEL 2 (Two Points)	LEVEL 1 (One Point)
1. Significance	National Register Eligible or part of park's enabling legislation	Nationally Significant	Regionally Significant and/or a primary park theme	Locally Significant	Common; little or no local significance, associative, design, construction, or information value.
2. Integrity	Good	Fair	Poor	Reconstruction	Little remaining historic fabric
3. Use	Exhibit Building open to the public: Self-guided tours only; may include assembly, overnight accommodation, cooking facility	Open to the public: Staff-guided tours only; controlled access; storage	Mixed Use: Public access and offices, retail, and/or storage	NPS or partner offices	Storage only
. Location: Response	No fire department response available. No road access. Access difficulties. High visitation: large crowds may impede responders	Fire Department response > 30 minutes. Rural road; reasonable topo. Access without developed utility services. Seasonal road access difficulties	Rural road access with developed utility services	Fire Department response < 20 minutes. Urban access with minor vegetative or physical constraints	Fire Department response <10 minute. Urban access, no vegetative or physical constraints
5. Location: Accessibility	High crime area: Perimeter easily accessible after-hours	High crime area: Perimeter not easily accessible after-hours	Low crime area: Perimeter easily accessible	Low crime area: not easily accessible	Low crime area: Secured Perimeter 24/7 or difficult to access
. Construction Type (See *International Building Code (IBC)*, for additional information)	Type V: Wood Frame (Light Combustible Construction)	Type III: Masonry walls, wood floors (partial Combustible Construction)	Type IV: Heavy Timber (Heavy Combustible Construction, Non-combustible exterior walls)	Type II: Non-combustible (Non-combustible Construction)	Type I: Fire Resistive (Non-combustible Construction).
7. Fuel Load: Proximity	High: Adjacent, attached buildings not owned by NPS; Forest/ grasslands in fire-prone area	High: Adjacent, attached buildings owned by NPS; OR Forest/grasslands in fire-prone area	High: Adjacent, attached buildings not owned by NPS, OR Forest/ grasslands in fire-prone area	Adequate: Defensible space based on historic models	Not prone to fires
SCORE					

MUSEUM COLLECTIONS ASSESSMENT MATRIX

Not all NPS museum collections require the same level of fire protection. Use this chart to help establish criteria for selecting the level of protection appropriate to the significance, integrity, and physical durability of the collections, location of the facility, building use, etc. This chart serves as a reference guide only; it does not establish design criteria for historic structures or museum facilities.

Note: Determining the proper fire protection for each specific application should be a collaboration between the park Interdisciplinary Team (IDT), resource manager, and the regional FCO. Depending on the complexity of the resource, the services of a fire protection engineer may be required by the team. All final plans must be reviewed and approved by the regional FCO. For structures housing collections, follow the guidance and requirements in the *Museum Handbook*, Part I, Chapter 9, Museum Fire Protection. Also refer to NFPA 914: *Code for the Protection of Historic Structures*, for additional information and guidance.

HOW TO USE THIS MATRIX

Rate each collections facility according to the 8 elements below, using a score of 1-5 (Levels 1-5).

For a total score of:	Scoring Recommendations	Score
1 – 14	Fire alarm system should be considered; however, Fire Suppression System May Not Be Needed for this Structure *(Record of the Superintendent's Decision Regarding Installation of Automatic Fire Protection Systems and Consolidation of Collection would be required if no system installed).*	
15 – 21	Fire alarm system required; Park may Want to Install a Fire Suppression System in this Structure *(Record of the Superintendent's Decision Regarding Installation of Automatic Fire Protection Systems and Consolidation of Collection would be required if no system installed).*	
22 – 28	Fire alarm system required; Park should Install a Fire Suppression System in this Structure *(Record of the Superintendent's Decision Regarding Installation of Automatic Fire Protection Systems and Consolidation of Collection would be required if no system installed).*	
29 – 35	Fire alarm system required; Suppression System Required *(Record of the Superintendent's Decision Regarding Installation of Automatic Fire Protection Systems and Consolidation of Collection would be required if no system installed).*	

Record of the Superintendent's Decision Regarding Installation of Automatic Fire Protection Systems and Consolidation of Collection is available in the *Museum Handbook, Part I, Chapter 9, Museum Fire Protection, Figure 9.3a*

MUSEUM COLLECTIONS ASSESSMENT MATRIX

FACTOR	LEVEL 5 (Five Points)	LEVEL 4 (Four Points)	LEVEL 3 (Three Points)	LEVEL 2 (Two Points)	LEVEL 1 (One Point)
1. Significance	Scientific Type Specimen, Threatened or Endangered Species, related to a World Heritage Site, National Historic Landmark, or part of park's enabling legislation	Nationally Significant	Regionally Significant and/or a primary park theme	Locally Significant	Common; little or no local significance, associative, scientific, or information value
2. Condition	Excellent	Good	Fair	Poor	Little or no remaining historic fabric or scientific integrity
3. Physical Properties/ Durability of Item/Specimen	Fragile, water-soluble, low-temperature items and/or flammable	Combustible and/or extremely sensitive to heat, smoke and water	Sensitive to smoke, heat and water	Highly Durable and relatively unaffected by limited exposure to smoke, heat and water	Fire-Resistant or contained within a fire-resistant cabinet, exhibit case, vault, etc.
4. Use of Building	Exhibit Building open to the public: limited staff supervision	Open to the public: guided tours only or sizable staff presence	Mixed Use: Public access and offices, retail, and/or storage	'S or partner offices	Storage only
5. Building Location: Response	No brigade response available. No road access; developed utility service w/ topo. Access difficulties. High visitation: large crowds may impede responders.	Brigade response > 30 minutes. Rural road; reasonable topo. Access without developed utility services. Seasonal road access difficulties	Rural road access with developed utility services	Brigade response < 20 minutes. Urban access with minor vegetative or physical constraints	Brigade response <10 minute. Urban access, no vegetative or physical constraints
6. Location: Accessibility	High crime area: Perimeter easily accessible after-hours	High crime area: Perimeter not easily accessible after-hours	Low crime area: Perimeter easily accessible	ow crime area: not easily accessible	Low crime area: Secured Perimeter 24/7 or difficult to access
7. Construction Type of Building and/or room that Houses the Collection (See *International Building Code (IBC)*, for additional information)	Type V: Wood Frame (Light Combustible Construction)	Type IV: Heavy Timber (Heavy Combustible Construction)	Type III: Masonry walls, wood floors (partial Combustible Construction)	Type II: Non-combustible (Non-combustible Construction)	Type I: Fire Resistive (Non-combustible Construction)
8. Fuel Load: Proximity	High: Adjacent, attached buildings not owned by NPS; Forest/ grasslands in fire-prone area	High: Adjacent, attached buildings owned by NPS; OR Forest/grasslands in fire-prone area	High: Adjacent, attached buildings not owned by NPS, OR Forest/ grasslands in fire-prone area	Adequate: Defensible space based on historic models	Not prone to fires
SCORE					

FIRE PROTECTION SYSTEMS

This document is developed to act as a quick reference guide only, and not to establish design criteria for historic structures. Rather each building will be evaluated on its own merit. It is assumed that all structures have changed their usage from originally designed, and changes to fire protection systems are necessary to ensure safe public access and resource protection. The proper fire protection for specific application must be designed by a fire protection engineer or others as approved by the regional FCO. All final plans must be reviewed and approved by the regional FCO. ***(For a comprehensive description of the system types, reference NFPA 914: Code for the Protection of Historic Structures)***.

FIRE PROTECTION SYSTEM COMPARISONS (Systems 1-3)

Element	System 1	System 2	System 3
FIRE PROTECTION SYSTEMS	**No Fire Suppression System** Relies on Fire Brigade/Public Fire Department response	**Passive Fire Protection** (controlling doors through fire alarm system for smoke and fire containment)	**Fuel Reduction,** such as a change in approach to building usage: increase use of flame-retardant material; minimize use of heating or cooking sources; reduce ignition sources and use of electricity; and implement a WUI plan
DESCRIPTION	ALL	Typically fire walls, doors	Good housekeeping practices. Removing transient combustibles.
PROTECTION ADVANTAGE	Suppression to minimize exposure to surrounding environment	Life Safety and Resource Protection	Minimizing risk
PROTECTION DISADVANTAGE	Dependent on response time, equipment, training, and if mutual aid agreements are in place with local jurisdiction	May require additional equipment (door closures) and construction features	Dependent on occupants' vigilance and does not provide protection or notification
DISADVANTAGE	Firefighting techniques are not sensitive to historic fabric and may create a considerable amount of collateral damage to the resource during firefighting process	More equipment to install and maintain with associated costs	Impact to facility operations and possibly interpretation
RESOURCE ADVANTAGE	Short response time by an appropriately equipped and properly trained brigade may allow for the structure and/or collections to be saved from major damage or total loss	Limits the size of the fire and the effects of a fire	Potential to reduce threats from wildfires, lightning, accidents, and inappropriate activities
RESOURCE DISADVANTAGE *See Notes #1 and #2 Below	Damage to historic fabric from entry, attack, force of water, soaking of items, etc. Slow brigade response may result in a total loss	Not applicable for most historic structures; can disrupt historic fabric; increased ITM costs	May not be feasible in some historic structures
TYPICAL APPLICATION	ALL	ALL	Can and should be used anywhere
WATERFLOW RATES (Collateral Water Damage)	VERY HIGH	May be very high. Relies on Fire Department response	May be very high. Relies on Fire Department response

FIRE PROTECTION SYSTEM COMPARISONS (Systems 4-6)

Element	System 4	System 5	System 6
FIRE PROTECTION SYSTEMS	**Wet Pipe** *ITM – Annually; Visual inspection requirements weekly/monthly/ quarterly*	**Dry Pipe** *ITM – Annually; Visual inspection requirements weekly/monthly/ quarterly (Slight increase in costs due to additional equipment associated with dry system*	**Antifreeze System** *ITM – Annually; Visual inspection requirements weekly/monthly/quarterly (Slight increase in costs due to additional equipment associated with antifreeze system.)*
DESCRIPTION	Closed heads; piping is filled with water	Closed heads; piping is filled with compressed air, which holds back water.	Closed heads. Piping is filled with a glycol/water solution.
PROTECTION ADVANTAGE	Life Safety and Resource Protection	Life Safety/building protection	Life Safety/building protection
PROTECTION DISADVANTAGE	Must be installed in climate-controlled space above 40 degrees Fahrenheit	Delay in initial response in dry system (code allows up to 60 seconds)	None
DISADVANTAGE	Staining, black steel pipe deteriorates more quickly than other pipe materials (such as copper, stainless galvanized)	Staining, Increased installation and ITM costs. Susceptible to inline corrosion; design requires adequate drainage of in-pipe condensation to prevent corrosion and low point drains. Is susceptible to MIC. Requires reliable power to maintain inline pressure	Cost of antifreeze; increased costs of ITM; specialized components
RESOURCE ADVANTAGE	Relatively easy and economical to maintain; ITM more likely to be carried out	Can be used to protect historic structures and museum buildings lacking HVAC and/or utilities	Can be used to protect historic structures and museum buildings lacking HVAC and/or utilities
RESOURCE DISADVANTAGE *See Notes #1 and #2 Below	Water may damage fragile historic fabric or collections. Some installations have been unsightly and insensitive to historic/interpretive setting due to poor design and construction oversight. See note 2 below	Water may damage fragile historic fabric or collections. Some installations have been unsightly and insensitive to historic/interpretive setting due to poor design. See note 2 below	Water and antifreeze discharge damage to fragile historic buildings, fabrics, or collections
TYPICAL APPLICATION	ALL	Northern climates, historic buildings, unheated attics and concealed spaces, outbuildings, Pole building, storage buildings, and other non-climate controlled buildings	Northern climates, historic buildings, unheated attics and concealed spaces, outbuildings, Pole building, storage buildings, and other non-climate controlled buildings, where electricity for air compressor is not available
WATERFLOW RATES (Collateral Water Damage)	Low to moderate	Moderate/ high	Moderate

FIRE PROTECTION SYSTEM COMPARISONS (Systems 7-9)

Element	System 7	System 8	System 9
FIRE PROTECTION SYSTEMS	**Preaction** *ITM – Annually; Visual inspection requirements weekly/monthly/ quarterly (*potential 100% increase in costs due to the maintenance requirements of the required fire alarm system)*	**Performance Based** *ITM will be based on the proposed design*	**Deluge** *ITM – Annually; Visual inspection requirements weekly/monthly/quarterly (*potential 100% increase costs due to the maintenance requirements of the required fire alarm system)*
DESCRIPTION	Closed heads; no water is in the piping; Detection system opens a valve to allow water in the pipe	Any type of system which is based on the unique situation and requires the services of a fire protection engineer	Same as pre-action, but with open heads
PROTECTION ADVANTAGE	Life Safety/building protection	Designed to meet the intended needs	Special application system
PROTECTION DISADVANTAGE	None	Protection based on specific use. Requires specific FCO approval.	All sprinklers operate at once, resulting in considerable water damage. Special purpose only
DISADVANTAGE	Cost of antifreeze; increased costs of ITM; specialized components	Deviates from prescriptive code	Loss of fire alarm system will compromise all protection
RESOURCE ADVANTAGE	Can be used to protect historic structures and museum buildings lacking HVAC and/or utilities	System specifically tailored to the preservation needs of the collection and/or historic structure	Special, specific circumstances, such as to minimize damage to historic fabric while still protecting visitors and staff
RESOURCE DISADVANTAGE *See Notes #1 and #2 Below	Water and antifreeze discharge damage to fragile historic buildings, fabrics, or collections		Extensive water damage to collections and/or historic fabric, including items not directly affected by flames and smoke
TYPICAL APPLICATION	Northern climates, historic buildings, unheated attics and concealed spaces, outbuildings, Pole building, storage buildings, and other non-climate controlled buildings, where electricity for air compressor is not available	Protection of the historic building where utilities are available	Extremely fast burning fires and exposure protection
WATERFLOW RATES (Collateral Water Damage)	Moderate	Varies based on proposed design	Moderate/high

Element	System 10	System 11
FIRE PROTECTION SYSTEMS	**Residential** *ITM – Annually; Visual inspection requirements weekly/monthly/ quarterly (Slight increase in costs if supported by a pressure tank; significant if using a pump)*	**Water Mist System** ITM – Quarterly & Annually; *Visual inspection requirements each shift (valves, controllers) weekly/monthly/ quarterly (potential 100% increase in costs due to available qualified service contractors)*
DESCRIPTION	Closed head wet pipe or antifreeze system	A higher pressure, low water system that discharges extremely small water particles
PROTECTION ADVANTAGE	Provide safe egress path from residence	Protects resource with minimum wetting of resource. Self-contained suppression system that can provide suppression for a designed period of response time. Low water requirement can be serviced with water storage tank
PROTECTION DISADVANTAGE	Primarily a life safety system	Currently only tested (FM) for light hazard plication. Expanded applications require services of Fire Protection Engineer
DISADVANTAGE	System is based on small fire of short duration	Requires specialized installers, new technology in US = high installation costs due to lack of certified installers. Systems require intensive design and installation oversight to limit impact to historic resources
RESOURCE ADVANTAGE	Relatively inexpensive to install and maintain	Reduces potential for water damage to collections and historic fabric, as less water used than a typical wet or dry pipe system. Can be used to protect structures which lack water and reliable utility service
RESOURCE DISADVANTAGE *See Notes #1 and #2 Below	May not be adequate to thoroughly protect the resources	ew technology; ITM minimum once installed
TYPICAL APPLICATION	Residential using domestic water or pressurized storage tank	Special application system; Special applications where water damage or lack of reliable power and/or water pressure and supply are issues
WATERFLOW RATES (Collateral Water Damage)		Low

Element	System 12	System 13
FIRE PROTECTION SYSTEMS	**Gaseous (Clean) Agent Systems**	**High Expansion Foam Suppression** *ITM quarterly, semi- annual, and annual; visual inspection requirements weekly/monthly/quarterly (considerable increase in costs due to additional equipment associated with foam system*
DESCRIPTION	A "deluge-type" system that discharges a fire extinguishing gas rather than water	A fixed extinguishing system that generates a foam agent for total flooding
PROTECTION ADVANTAGE	Protects contents and resources, and doesn't not drench the resource	Special application system for confined spaces
PROTECTION DISADVANTAGE	Generally, not applicable for deep seated fires	When properly designed, used in conjunction with water sprinklers, will provide more positive control and extinguishment than either extinguishment system used independently. Use to extend water sources
DISADVANTAGE	Some gases require tightly sealed compartments for effective operation. Gas discharges with high pressure and can disturb fragile artifacts. High associated costs with ITM and replacement	The discharge of large amounts of high-expansion foam can inundate personnel, blocking vision, making hearing difficult, and creating some discomfort in breathing
RESOURCE ADVANTAGE	Eliminates potential for smoke, flame and water damage to collections and historic fabric.	Foam used to extinguish alcohol fires in collections rooms with fluid-preserved scientific specimens (primarily in ethanol)
RESOURCE DISADVANTAGE *See Notes #1 and #2 Below	Some clean agents may compromise research value of certain scientific specimens.	Foam ingredients may damage collections not stored within closed cabinets and historic fabric.
TYPICAL APPLICATION	Collection rooms, computer rooms, telephone rooms. Etc.	Collections rooms housing specimens in alcohol, computer, telephone, archival rooms, compact storage shelves, exhibit cases, etc.
WATERFLOW RATES (Collateral Water Damage)	NA	

AUTOMATIC FIRE DETECTION SYSTEMS (Systems 14-16)

Element	System 14	System 15	System 16
FIRE PROTECTION SYSTEMS	***Monitored Automatic Fire Alarm System** *ITM – Monthly, Quarterly, Annually; Visual inspection requirements monthly/quarterly and semiannually*	**Incipient Sampling Detectors (Air Aspiration or Air Sampling)** *ITM – Annually; Visual inspection requirements semiannually (slight increase in cost due to operating characteristics)*	**Single Station Smoke Detection** *Test monthly; 9vdc battery replacement semiannually*
DESCRIPTION	Smoke detectors, manual pulls, and horn/strobes in all areas, remotely monitored. May include heat detectors in some areas (attic, dusty locations).	A piping network that is connected to a high efficiency aspirator.	Residential
PROTECTION ADVANTAGE	Early warning and Life Safety	Life Safety and resource protection with a Fire Protection System. Very early detection of smoke and fire	Life Safety/occupant warning
PROTECTION DISADVANTAGE	Provides early warning; however, does not offer suppression	Very sensitive and may be subject to nuisance signals if not properly installed and maintained	Provides early warning to residents at specific location; however, does not offer suppression or building notification
DISADVANTAGE	Requires 110 vac for operation	More equipment to install and maintain with associated costs	Reoccurring costs of 9vdc batteries
RESOURCE ADVANTAGE	Can quickly alert brigade and park staff during a fire's incipient stage	Early warning system for specialized applications, such as a sterilized environment for extremely sensitive collections	Inexpensive means of alerting staff while on duty
RESOURCE DISADVANTAGE *See Notes #1 and #2 Below	Must be integrated into a suppression system to help provide the most effective resource protection	System acclimation may result in equipment nuisance alarms during initial installation.	Not applicable for buildings without staff; no protection possible during non-staffed hours
TYPICAL APPLICATION	ALL	Special applications	Residential
WATERFLOW RATES (Collateral Water Damage)	May be very high. Relies on Fire Department response	May be very high. Relies on Fire Department response	May be very high. Relies on Fire Department response

Additional cost estimate is based on a fire alarm system being installed for the sole purpose of preaction/deluge system control.

DETECTORS

The fire alarm industry provides a wide variety of options to provide adequate protection with minimum impact to the historic fabric and facilitates any design operating criteria through systems programming.

Criteria	Protection
Projected Beam Detectors	Beam detectors consist of a transmitter and receiver which are connected to the fire alarm circuit and are a type of photoelectric light obscuration smoke detector wherein the beam spans the protected area. Typically, these are used for open space protection (e.g., open atriums, large assembly halls).
Laser Detectors	Spot type wired detectors which utilize laser technology to provide very early warning to an incipient fire condition.
Line Type Heat Detection	A linear cable (approximately 1/8" thickness) that is routed through attics, crawl spaces, etc., and initiates an alarm condition upon a thermal activation within the protected environment.
Ionization Smoke Detector	Spot type wired smoke detectors that use ionization technology to detect incipient smoke in the early stages of a fire event. Ionization detectors are more responsive to invisible particles produced by most flaming fires. It is less responsive to larger particles typical of most smoldering fires.
Photoelectric Smoke Detector	Spot type wired smoke detectors that use photoelectric technology to detect incipient smoke in the early stages of a fire event. Photoelectric detectors are more responsive to larger particles typical of most smoldering fires.
Single Station Smoke Detector	Typically approved for residential environments. It is a detector comprising an assembly that incorporates a sensor, control components, and an alarm notification appliance in one unit operated from a power supply (9vdc battery).
Multiple-Station Alarm Device	Typically, these are approved for residential environments. Two or more single station alarm devices that can be interconnected so that actuation of one causes all integral or separate audible alarms to operate.

Comments:

Note #1: <u>All</u> fire suppression technologies and systems can adversely impact historic fabric, historic landscapes, or collections. All work should proceed in close collaboration between park maintenance, cultural resources, and protection (fire and LE) staff to minimize impacts while still ensuring life safety, resource protection, and code equivalency.

Note 2: Visual impact is always an important consideration. Concealed installations, while not visually intrusive, typically and irreversibly damage historic fabric. Periodic repairs or system replacement further damages historic fabric. Exposed systems, while visually unattractive, are more reversible and have less physical impact on a historic structure. Planning for fire detection and suppression on a case-by-case basis needs to address this issue.