Fire Protection Evaluation

Building 330 - Corrosion Control/Fuel Cell Hangar

Tulsa International Airport

Inspect/Evaluate Hangar Fire Protection Systems
Project:
Contract:
Task Order:

11 March 2016

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prepared for

Tulsa International Airport
Inspect/Evaluate Hangar Fire Protection Systems
Tulsa, OK

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11 March 2016

prepared by

Burns & McDonnell Engineering Company, Inc.
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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
AF	Air Force
AFB	Air Force Base
AFCEC	Air Force Civil Engineering Center
AFF	Above Finished Floor
ANG	Air National Guard
AFFF	Aqueous Film Forming Foam
BMcD	Burns & McDonnell
ETL	Air Force Engineering Technical Letter
FACP	Fire Alarm Control Panel
FSCP	Fire System Control Panel (e.g. Releasing Panel)
HEF	High Expansion Foam
Hrs	Hours
LF	Linear Feet
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
ROM	Rough Order of Magnitude
SF	Square Feet
SOW	Scope of Work
T.O.	Technical Order
UFC	Unified Facilities Criteria
UFGS	Unified Facilities Guide Specifications

1.0 EXECUTIVE SUMMARY

1.1 Facility Evaluation

This document is a summary of the fire protection systems evaluated by Alan Moore, PE from Burns & McDonnell's Fire Protection Engineering Group on 13 August 2015 for Building 330 at Tulsa International Airport, Tulsa, OK.

This facility was constructed in 1996 and houses F-16 aircraft. The fire protection systems were installed in 2014. The total area of this facility is approximately 16,797 sq ft where approximately 10,468 sq ft is hangar bay area. There are two hangar bays in the facility (North - Fuel Cell, and South - Corrosion Control) with approximately 5,234 sq ft each. The hangar bays are protected with wet-pipe sprinkler systems and supplementary low level high expansion foam systems. A single wet-pipe sprinkler riser splits inside the South Hangar with separate feed mains with water flow switches extending to each individual hangar bay. Each hangar bay has a separate foam/water system. The foam/water system appears to be released by a dedicated releasing panel from manual releasing stations, waterflow from the overhead sprinkler system, or cross-zoned heat detectors. Support areas within this facility are provided with a wet-pipe sprinkler system and a fire alarm system.

Fire water is provided from a combined fire and domestic water supply provided by the city.

1.2 Reliability of Facility Systems

Table 1-1 shows the average reliability of the three fire protection systems in the facility. Further explanation on how the rankings are calculated can be found in the Base Report. In general, the scores in Table 1-1 should be interpreted as follows:

- 100 to 99 – The system and subsystems are reliable and expected to operate as intended.
- 98 to 80 – The system and subsystems will probably operate as intended, however there is an opportunity to increase system reliability.
- 79 to 51 – The system and subsystems may not operate as intended, or may inadvertently operate leading to a nuisance alarm or inconvenience.
- 50 to 0 – The system and subsystems will not operate as intended, may fail during operation, or may operate inadvertently leading to the release of the foam/water system.

Table 1-1: Reliability Score by Fire Protection System

Fire Suppression	Fire Alarm	Life Safety	Overall Building
Average: 83	Average: 61	Average: 91	Average: 78

1.3 Costs to Increase Reliability and Obtain Code Compliance

Three individual cost estimates were provided for this facility in Table 1-2. These are listed in order of priority: The hard broke cost; the reliability cost; and the code compliance cost. Hard broke costs are items which need corrective action for the system to operate as intended. Reliability costs include hard broke costs, recommended corrective actions to increase the system reliability, and reduce the occurrence and impact of inadvertent operation of systems. Code compliance costs include hard broke costs, reliability costs, and the cost to bring the facility's systems into compliance with current and forthcoming codes.

The estimates shown in Table 1-2 represent the combined estimates of fire suppression, fire alarm, and life safety system repairs recommended to address hard broke, reliability, or code compliant deficiencies. Estimates are based on RSMeans cost information, which includes the installers 10% overhead and profit on labor, equipment and materials. The estimates shown below have been modified for geographical location per RSMeans and increased for 10% for sub-contractors design, 20% for general contractor's overhead and profit, 12% for A/E design and commissioning, 20% contingency, and 30% anticipated escalation. For a full breakdown of ROM cost estimates, see Section 3.1.1. For a list of items not included in the cost estimate below, refer to Section 3.6.

Table 1-2: Facility ROM Cost Estimates

Cost to Repair Hard Broke Items	
Cost to Repair Hard Broke Items and Increase Reliability	
Cost to Repair Hard Broke Items, Increase Reliability, and Comply with Codes	

1.4 Hard Broke and Reliability Corrective Actions

During the evaluation, the facility was assessed for hard broke and reliability corrective actions. A hard broke corrective action is required to enable the fire protection system, or permit it to operate at full capacity. At the time of this assessment, there were no hard broke items that required corrective action.

In an effort to better protect the occupants, aircraft, and building, it is recommended that the foam/water releasing mechanisms be configured to activate automatically in addition to manual releasing stations. The releasing systems in this facility are currently in automatic mode and no corrective actions are required.

In an effort to reduce the occurrence of inadvertent operation of the foam systems, there are often times corrective actions that, when implemented, can reduce the likelihood of a false discharge. The following corrective actions are recommended to reduce the occurrence of inadvertent foam/water activations.

- Provide pressure relief valve on the hangar bay wet-pipe sprinkler riser
- Provide lock and signage on hangar inspectors test connection (connections located in the valve room) stating: 'Discharging water from this connection may release the foam system'
- Relocate hangar sprinkler system drain and test lines to areas not subject to freezing
- Provide tamper seals and signage on foam/water riser trim valve
- Cross-zone the foam system releasing mechanisms such that no single initiating device or zone can initiate foam release
- Revise the conduit such that it does not enter the top of the foam/water releasing panel
- Provide NEMA 4 foam system pull stations and backboxes with conduit looped into bottom of backbox with drain

In order for facility occupants to reduce the impact of inadvertent foam/water releases, a complete foam stop system that can halt the release of foam should be provided.

Reliability corrective actions are recommended to increase the overall reliability of the system including both the hangar bay and support areas as well as increase the level of aircraft protection. The following corrective actions are recommended to increase the reliability of the system and the level of aircraft protection.

- Provide a basket strainer upstream of the foam/water riser
- Provide 10 gallon hydraulic surge arrestors on hangar bay wet-pipe sprinkler riser and foam/water risers
- Re-pipe bladder tanks to the dry side of the foam system deluge valve to remove pressure from the bladders
- Remove or supervise the unsupervised valve on hydraulic ball valve line
- Provide Det-Tronics Eagle Quantum Premier releasing panel and optical flame detection such that no single initiating device or zone can initiate foam release

1.5 Inadvertent Foam/Water Releases

Base personnel were interviewed regarding inadvertent foam/water releases at the facility. Knowledge or documentation of an inadvertent foam/water system release at this facility was not available.

1.6 Testing and Maintenance Programs

The fire suppression, fire alarm, and life safety systems were inspected for signs of routine maintenance. When available, maintenance records were reviewed for conformance with UFC 3-601-02 regarding testing procedures and frequency. Base personnel were interviewed regarding general knowledge of the system's operation, testing procedures and qualifications of testing personnel, and preventative maintenance programs.

In general, there is room for improvement regarding the testing and maintenance at the Base. The fire systems are one year old and therefore have not been through a full maintenance cycle. The existing testing procedures and frequency should be expanded to align better with the requirements of UFC 3-601-02. Base personnel would benefit from additional training regarding the specifics of the system operation, testing procedures, and periodic maintenance requirements. For specific recommendations, refer to Section 4.0.

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2.0 OPERATIONAL RELIABILITY ANALYSIS

2.1 Operational Reliability Overview

In order to provide a benchmark on which to evaluate the reliability of the fire protection systems in a facility, the following operational reliability score was created. This reliability score weights the likelihood the system will operate as intend, and only when intended. The more unreliable the system is and greater the consequences upon system failure, the lower the reliability score. For additional information regarding how the reliability is calculated, refer to the Base Report.

The operational reliability score is based on a scale of 100 to 0 where:

- 100 to 99 – Indicates the system is reliable and expected to operate as intended.
- 98 to 80 – Indicates the system will probably operate as intended, however there is an opportunity to increase system reliability.
- 79 to 51 – Indicates the system may not operate as intended, or may inadvertently operate leading to a nuisance alarm or inconvenience.
- 50 to 0 – Indicates the system will not operate as intended, or may operate inadvertently leading to a release of the foam/water system.

2.2 Operational Reliability Scores

The average operational reliability score for each of the three fire protection systems and the overall facility score are shown below in Table 2-1. For a more detailed breakdown of the reliability scores, refer to the individual assessment points in Appendix B. For additional information on reliability weighting and how this facility compares to other facilities on the Base, refer to the Base Report.

Table 2-1: Reliability Score by Fire Protection System

Fire Suppression	Fire Alarm	Life Safety	Overall Building
Average: 83	Average: 61	Average: 91	Average: 78

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3.0 EVALUATION OF ASSESSMENT POINTS

3.1 Purpose of the Assessment

The scope of this evaluation included an assessment of fire suppression, fire alarm, and life safety systems installed within each facility. Each system was assessed for three main objectives: The ability to reduce inadvertent discharges of the foam/water system; the ability to operate reliably as intended and designed; and the system's compliance with current and forthcoming codes.

3.1.1 Determination of ROM Cost Estimations

A cost estimate is included in Appendix B for each deficiency noted except as excluded in Section 3.6. These estimates were determined using RSMeans data which includes the installers 10% overhead and profit on labor, equipment, and materials.

In Section 1.3, Section 3.4, and Section 3.5, the RSMeans costs estimates were further modified to estimate an overall ROM. The overall estimate includes an adjustment for location, 10% for sub-contractors design, 20% for general contractor's overhead and profit, 10% for A/E services, 20% contingency, and 30% anticipated escalation. These percentages were based on RSMeans, industry standard rates, previous project costs, and engineering judgment.

3.1.2 Evaluation of Reliability and Inadvertent Discharge Mitigation

In evaluating the existing system, each assessment point was reviewed to determine if it will operate as intended during a fire event. Additionally, each assessment point was reviewed to verify it will not inadvertently activate or release the foam/water system when not intended. For further information on guidance used in evaluation the fire protection system reliability, refer to the Base Report.

3.1.3 Evaluation of Compliance with Current Codes and Standards

The evaluation also assessed the extent of modifications needed to bring the existing fire protection systems in the facility up to current codes and standards. For this portion of the evaluation to be the most effective, the facility was evaluated against the most recent draft versions of UFC 3-600-01, UFC 4-211-01, and the most current published editions, as of August 2014, of applicable NFPA standards.

3.2 Assessment Points and Evaluation System

The assessments were broken into three main systems: Fire Suppression, Fire Alarm, and Life Safety. For each of these points, the evaluator was given a comprehensive list of the common and uncommon deficiencies found with the associated system. Each point was checked for these deficiencies, and a deficiency was removed where not found. For additional information regarding the systems and subsystems evaluated, refer to the Base Report.

3.3 Assessment Points Not Evaluated

The following assessment points in Table 3-1 were not evaluated as part of this assessment.

Table 3-1: Assessment Points Not Evaluated

Assessment ID	Assessment Point	Reason for Exclusion
FS-2	Fire Pump House	The facility is not a Fire Pump House
FS-3	Fire Water Storage	The facility does not have dedicated fire water storage
FS-8	Fire Pump	Located in Fire Pump House
FS-9	Fire Pump Controller	Located in Fire Pump House
FS-10	Fire Pump Piping	Located in Fire Pump House
FS-21	Hangar Bay AFFF Foam/Water Distribution System	AFFF not provided in this facility

3.4 Corrective Actions to Reduce Inadvertent Discharges and Increase Reliability

Where the assessment point contains deficiencies that impact the functionality of the system, corrective actions are recommended to increase the reliability of the system to operate as intended and reduce the potential for inadvertent discharges. The following paragraphs include facility-specific corrective actions in five priority levels.

When applying the corrective actions indicated in this report, the priority of execution should follow the outline as shown below from highest to lowest priority. Refer to Section 3.7 of the Base Report for details and examples.

- Actions to remedy hard broke items that affect system performance.
- Actions that allow the fire suppression system to be switched from manual to automatic mode.
- Actions that would reduce inadvertent releases of the existing foam/water suppression system.
- Actions that would reduce the impact of inadvertent releases of the existing foam/water suppression system.

- Actions that increase the operational reliability of the existing system as currently installed.
- Actions to increase the effectiveness of the fire protection systems to protect the aircraft.
- Actions to bring the fire protection systems up to current codes and standards.

It should be noted proper maintenance of the fire suppression, fire alarm, and life safety systems also contribute to increasing the operational reliability. Routine inspections and testing of the systems will create familiarity with the systems as well as allow for detection of system deficiencies as they arise.

Table 3-2: Corrective Actions to Fix Hard Broke Items

Assessment ID	Corrective Action	RSMeans Estimate
-	No hard broke corrective actions are required for this facility	

Table 3-3: Corrective Actions to Convert System from Manual to Automatic Mode

Assessment ID	Corrective Action	RSMeans Estimate
-	No corrective actions are required to convert the system from manual to automatic mode	

Table 3-4: Corrective Actions to Reduce Inadvertent Discharges

Assessment ID	Corrective Action	RSMeans Estimate
FS-15	Provide pressure relief valve on the hangar bay wet-pipe sprinkler riser	
FS-15 FS-16	Provide lock and signage on hangar inspectors test connection (connections located in the valve room) stating: 'Discharging water from this connection may release the foam system'	
FS-16	Relocate hangar sprinkler system drain and test lines to areas not subject to freezing	
FS-17	Provide tamper seals and signage on foam/water riser trim valve	
FA-1	Cross-zone the foam system releasing mechanisms such that no single initiating device or zone can initiate foam release	
FA-1	Revise the conduit such that it does not enter the top of the foam/water releasing panel	
FA-2	Provide NEMA 4 foam system pull stations and backboxes with conduit looped into bottom of backbox with drain	

Table 3-5: Corrective Actions to Reduce the Impact of Inadvertent Discharges

Assessment ID	Corrective Action	RSMeans Estimate
Provide a complete foam stop system that can halt the release of foam. At a minimum, the following components are required:		
FA-3	Provide NEMA 4 dead-man stop stations and backboxes, conduit loop into bottom of backbox with drain, and dedicated distinct signage	
FS-17	Provide flow control valve for foam/water riser with brass trim package for electric releasing, remote resetting, and adjustable opening/closing speed control	
Upon final design, The following components may also be required:		
FS-17	Provide new fire pumps to account for pressure loss caused by adding flow control valves	
FS-13 FS-15 FS-17	Provide new PRV on all risers due to the addition of new pumps	

Table 3-6: Corrective Actions to Increase System Reliability and Aircraft Protection

Assessment ID	Corrective Action	RSMeans Estimate
FS-11	Provide a basket strainer upstream of the foam/water riser	
FS-15 FS-17	Provide 10 gallon hydraulic surge arrestors on hangar bay wet-pipe sprinkler riser and foam/water risers	
FS-18	Re-pipe bladder tanks to the dry side of the foam system deluge valve to remove pressure from the bladders	
FS-19	Remove or supervise the unsupervised valve on hydraulic ball valve line	
FA-1 FA-4	Provide Det-Tronics Eagle Quantum Premier releasing panel and optical flame detection such that no single initiating device or zone can initiate foam release	

Table 3-7: Summary of Corrective Action ROM Cost Estimates for Building 330

Sub-Total	
RSMeans Location Modifier	
Adjusted Sub-Total	
Increase for Sub-Contractor Design Documents	
Increase for General Contractor Overhead and Profit	
Increase for Architecture/Engineering Services and Commissioning	
Increase for Additional Contingency	
Increase for Anticipated Escalation	
Total ROM Estimate	

3.5 Corrective Actions to Obtain Code Compliance

The ROM cost estimates for code compliance are summarized in Table 3-8. These costs estimates include the corrective actions indicated in section 3.4, and the additional requirements to obtain conformance with current and forthcoming codes. For a list of all deficiencies and recommended corrective actions, refer to assessment points in Appendix B.

Table 3-8: Summary of ROM Cost Estimate for Code Compliance for Building 330

Reliability Score	Summary of Corrective Actions	RSMeans Estimate
83	Fire Suppression Systems	
61	Fire Alarm Systems	
91	Life Safety Systems	
	Sub-Total	
	RSMeans Location Modifier	
	Adjusted Sub-Total	
	Increase for Sub-Contractor Design Documents	
	Increase for General Contractor Overhead and Profit	
	Increase for Architecture/Engineering Services and Commissioning	
	Increase for Additional Contingency	
	Increase for Anticipated Escalation	
	Total ROM Estimate	

3.6 Corrective Actions Not Included in the Cost Estimate

For many of the assessment points, the corrective actions are straight forward (e.g. Pull station has an incorrect NEMA rating; replace manual foam/water releasing stations with NEMA 4 rated device.) However, in some cases there is more than one solution (e.g. Releasing panel is operating outside it's recommend temperature; provide an A/C split system, duct A/C into the room to provide cooling, or relocate the panel to a conditioned room.) In these cases, only one of the possible corrective actions is included in the cost estimates.

Then there are corrective actions which are not provided within the cost estimates because of the large degree unknown, or additional design required to establish an acceptable solution. This level of exploratory service and design is outside the scope of this evaluation.

Items which are technically not correct per the current or forthcoming codes, but have little impact on the overall system operation were not included.

- Replacement of stranded wire with solid wire for all fire alarm circuits. This corrective action for code compliance does not provide a benefit, where crimped connections have been installed.
- Replacement of 18 AWG or smaller wiring with 16 AWG wiring. This corrective action for code compliance does not provide a benefit, where voltage drop calculations can support a small gauge conductor.

3.7 Humidity and Temperature Requirements

Fire alarm systems are required to comply with the humidity and temperature limitations of NFPA 72, UL 864, or FM 3010 requirements as shown in Table 3-9. Where fire alarm panels or devices have been installed in locations that exceed these limitations, the effect of a malfunctioning device is typically only a nuisance alarm.

However, for releasing systems this is not the case. Where these devices have malfunctioned, the result has varied from a nuisance alarm to the inadvertent release of a foam/water system. Since the potential for damage is greater from a malfunctioning releasing system, as part of this evaluation the releasing systems have been assessed for compliance with NFPA 72, UL 864, FM 3010, the current draft version of UFC 4-211-01, and the recommendations of AFCEC.

Table 3-9: Temperature and Humidity Limitations

Reference	Applicable System	Temperature Limitation	Humidity Limitation
NFPA 72	Both	32 to 120°F	85% RH at 86°F (159 gr/lb)
UL 864	Both	32 to 120°F	93% RH at 90°F (200 gr/lb)
FM 3010	Both	32 to 120°F	90% RH at 100°F (260 gr/lb)
UFC 4-211-01	Releasing Only	60 to 80°F	85% RH at 86°F (159 gr/lb)
AFCEC	Releasing Only	Design – 60 to 80°F Equipment - 32 to 120°F	Design – Less than 85% RH Equipment – Less than 93% RH

3.7.1 Humidity and Temperature Results and Recommendations

For this location the fire alarm panel is required to be located in a heated area, and the releasing panel and addressable releasing devices are required to be located in a heated and conditioned area to comply with Table 3-9. Refer to the Base Report for additional information regarding Air Force Engineering Weather Data and the humidity and temperature analysis. For specific equipment evaluations and recommendations, refer to section 3.4 and the assessment points in Appendix B.

3.8 Seismic Protection Requirements

The current draft of the UFC 4-211-01 requires foam/water systems to be seismically braced per NFPA 13 regardless of geographical location. UFC 3-600-01 requires seismic bracing of non-foam systems in

accordance with NFPA 13 when required by ASCE 7-10. Only locations with a Seismic Design Category of C or higher require seismic bracing of the non-foam systems.

3.8.1 Seismic Protection Results and Recommendations

For this location the most restrictive Seismic Design Category is B and therefore seismic bracing installed in accordance with NFPA 13 is not required on non-foam fire suppression systems. Refer to the Base Report for additional information regarding the seismic protection analysis. Refer assessment points in Appendix B for specific equipment evaluations and recommendations.

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4.0 FIRE PROTECTION SYSTEM TESTING AND MAINTENANCE

4.1 Testing and Maintenance Overview

The testing and maintenance systems and subsystems reviewed at this facility are provided in Table 4-1. For a more detailed list, refer to Assessment Points FS-22, FA-10, and LS-8 in Appendix B.

Table 4-1: Systems and Components Reviewed

Systems	Subsystems
Fire Suppression	Hydrants, Wet-pipe Sprinklers, and Foam/Water Systems
Fire Alarm	Fire Alarm Control Panel, Foam/Water Releasing Panel, and Associated Devices
Life Safety	Exit Signage, Emergency Lighting, Passive Fire Protection Integrity, and Portable Fire Extinguishers

As part of the testing and maintenance evaluation, the following were assessed for fire suppression, fire alarm, and life safety systems.

- Reviewed testing procedures and maintenance records at each facility.
- Interviewed Base personnel responsible for performing or supervising testing and maintenance for each system. Refer to the Base Report for a list of personnel interviewed during the evaluation.
- Assessed the qualifications of the personnel testing and maintaining the systems at each facility.
- Reviewed the preventative maintenance programs in place to verify conformance with the requirements of UFC 3-601-02.

4.2 Reliability of Testing and Maintenance and Records Obtained

The reliability scores for testing and maintenance at this facility are provided in Table 4-2. Further explanation on how these rankings are calculated can be found in the Base Report. In general, the scores in Table 4-2 should be interpreted as follows:

- 100 to 99 – In general, the system and subsystems are provided with regular testing and maintenance in conformance with UFC 3-601-02.
- 98 to 51 – The systems and subsystems are provided with infrequent testing and maintenance, or the procedures do not align with the requirements of UFC 3-601-02.
- 50 to 0 – The system is currently not tested or maintained.

Where testing and maintenance records were available, the systems were assessed against the requirements of UFC 3-601-02. Maintenance records for the fire suppression, fire alarm, and life safety systems are compiled and Maintenance records for the fire suppression, fire alarm, and life safety systems are compiled and stored in AEIS..

Table 4-2: Reliability of Testing and Maintenance and Records Obtained

System	Reliability Scored	Testing and Maintenance Records Obtained and Reviewed
Fire Suppression	93	No Records Available (system is one year old)
Fire Alarm	93	No Records Available (system is one year old)
Life Safety	65	Partial Set of Records Obtained

4.3 Testing Personnel and Qualifications

A summary of the testing personnel for each system and their qualifications are provided in Table 4-3.

Table 4-3: Testing Personnel and Qualifications

System	Testing Personnel	Personnel Qualifications
Fire Suppression	Fire Suppression Contractor Simplex/Grinnell	Testing personnel have acquired a minimum NICET Level III in Inspection and Testing of Water-Based Systems
Fire Alarm	Fire Suppression Contractor Simplex/Grinnell	Testing personnel have acquired a minimum NICET Level III in Inpection and testing of Fire Alarm Systems
Life Safety	Base Fire Department	The qualifications of the testing personnel could not be verified

4.4 Testing and Maintenance Results and Recommendations

The fire suppression, fire alarm, and life safety systems were inspected for signs of routine maintenance. When available, maintenance records were reviewed for conformance with UFC 3-601-02 regarding testing procedures and frequency. Base personnel were interviewed regarding general knowledge of the system's operation, testing procedures and qualifications of testing personnel, and preventative maintenance programs.

In general, there is room for improvement regarding the testing and maintenance at the Base. The fire systems are one year old and therefore have not been through a full maintenance cycle. The existing testing procedures and frequency should be expanded to align better with the requirements of UFC 3-601-02. Base personnel would benefit from additional training regarding the specifics of the system operation, testing procedures, and periodic maintenance requirements.

Since most foam/water releasing systems have a degree of complexity and often the personnel who maintain these systems are not familiar with the specifics of the system, it would be advantageous to post instructions next to each foam/water riser explaining: How the system operates; how to disable the releasing function when testing; how to manually release the system in emergency situations; and how to shut the system down after an event.

It should be noted proper maintenance of the fire suppression, fire alarm, and life safety systems also contribute to increasing the operational reliability. Routine inspections and testing of the systems will create familiarity with the systems as well as allow for the detection of system deficiencies as they arise.

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5.0 BUILDER DIRECT CONDITIONAL RATINGS

5.1 Direct Conditional Rating Overview

As part of the report of findings, each assessment point is given a direct conditional rating and added to the Builder database. This rating is an assessment of the system and subcomponents current condition in regards to wear and tear or the ability for the system to perform as required. A general overview of each direct conditional rating is shown below in Table 5-1. The direct conditional rating for each assessment point is indicated in Appendix B. For more information regarding direct conditional ratings refer to the Base Report.

Table 5-1: Direct Conditional Ratings Scale

Rating	Deterioration	Maintenance and Repair Requirements
Green	Fully Operational - Minimal wear or system defects	Routine maintenance or minor repair
Amber	Reduced Operation - Moderate wear or system defects which may impair the system from operating effectively.	Significant repair, modification, or replacement of one or more subcomponents of the system
Red	Loss of Operation - Significant wear, system component failure, or missing component which impairs the system from operating effectively.	Major repair, full system modification, or system replacement

When comparing Direct Conditional Ratings with Reliability Scores some components may be scored with a low direct conditional rating while scoring a high reliability score or vice versa. This is due to the different criteria used to assign the scores. As an example, a foam/water releasing panel may receive a direct conditional rating of green, but score a low reliability score because of the probability and magnitude of the system operating inadvertently. Additionally, a foam/water riser may score a relatively high reliability score but a red direct conditional rating because of the full system modification required to upgrade the system to comply with current codes and standards.

APPENDIX A – APPLICABLE CODES AND STANDARDS

UFC 3-230-02	Operation and Maintenance: Water Supply Systems, 10-Jul-2001
UFC 3-400-02	Design: Engineering Weather Data, 28-Feb- 2003
UFC 3-600-01	Fire Protection Engineering for Facilities, 90% Draft 06-Oct-2014
UFC 3-601-02	Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection systems, 8-Sep-2010
UFC 4-021-01	Design and O&M: Mass Notification Systems, Change 1, Jan-2010
UFC 4-211-01	Unified Facilities Criteria 95% Draft copy 09-Oct-2014
UFC 3-520-01	Interior Electrical Systems, Change 2, 01-Jul-2012
UFC 3-550-01	Exterior Power Distribution Systems, Change 1, 01-Jul-2012
UFC 3-501-01	Electrical Engineering Preliminary Considerations, Change 2, 01-Jul-2012
UFC 3-560-01	Electrical Safety, O & M, 6 December 2006, Change 4, 01-May-2012
ETL 01-1-1	Air National Guard Design Policy, Mar-2004
ETL 02-15	Fire Protection Engineering Criteria – New Aircraft Facilities, 03-Dec-2002
ETL 98-8	Fire Protection Engineering Criteria – Existing Aircraft Facilities, 25-Jun-1998
AFCEC	Department of the Air Force Memorandum for ALMAJCOM/A7, FOAs, DRUs, Subject: Protecting Aircraft Hangars – Reducing Inappropriate Fire System Activations, 2010
AFCEC	Department of the Air Force Memorandum for ALMAJCOM/A70s, Subject: Preventing Inappropriate Aircraft Hangar Fire Protection System Activations, 2011
AFCEC	Department of the Air Force Memorandum, Inadvertent Foam Lessons Learned Attachments 1-5, 2012
AFCEC	Process for Location Fire System Control Panels in Accordance and Humidity Limits
AFCEC	Hangar Foam Fire Suppression System Manual Start Stop Control Locations
NFPA 11	Standard for Low-, Medium-, and High-Expansion Foam – 2010

NFPA 13	Standard for the Installation of Sprinkler Systems, 2013
NFPA 16	Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems – 2015
NFPA 20	Standard for the Installation of Stationary Fire Pumps, 2013
NFPA 24	Standard for the Installation of Private Fire Service Mains and Their Appurtenances – 2013
NFPA 70	National Electrical Code – 2014
NFPA 72	National Fire Alarm and Signaling Code – 2013
NFPA 101	Life Safety Code – 2015
NFPA 409	Standard on Aircraft Hangars – 2011
ASCE 7-10	Minimum Design Loads for Buildings and Other Structures, 2010
NEMA 250	Enclosures for Electrical Equipment, 2014
BUILDER	Data Collection Guide for Air Force Aircraft Hangar Evaluation and Assessment (Appendix B),
UL 864	Standard for Control Units and Accessories for Fire Alarm Systems, 01-Dec-2014
AWWA	American Water Works Association Standards for Water Distribution and Storage Systems for Potable and Non-potable Applications.
RSMeans	Site Work & Landscape Cost Data – 2013
RSMeans	Plumbing Cost Data – 2013
RSMeans	Electrical Cost Data – 2013
RSMeans	Mechanical Cost Data – 2013
RSMeans	Square Foot Costs – 2013

APPENDIX B – ASSESSMENT POINTS

Air National Guard Fire Protection Systems Assessment Report

Burns & McDonnell
Fire Protection Engineering Group
Aviation & Federal Global Practice

8201 Norman Center Drive
Suite 300
Bloomington, MN 55437

Tulsa International Airport

Building 330
Corrosion Control Hangar

Assessment Performed by:
Al Moore
13 August 2015

Operational Reliability Scores by System

Fire Alarm	Fire Suppression	Life Safety
61	83	91

Code Compliance Cost Estimates by System

Fire Alarm	Fire Suppression	Life Safety

Hangar - Overhead

Hangar - Airside

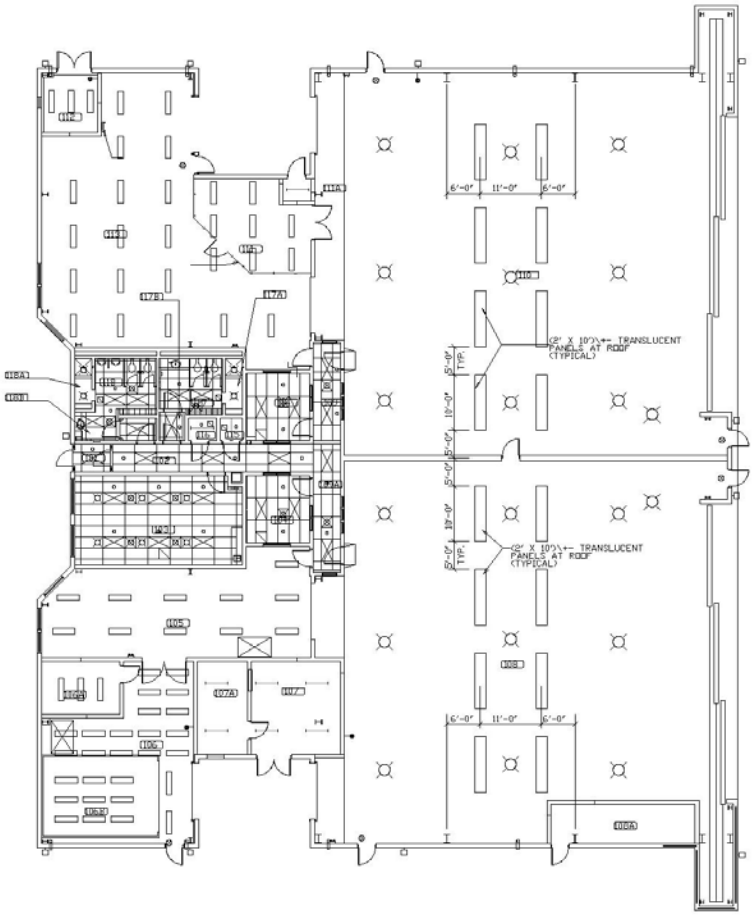
Hangar - Landside

Hangar - Landside

Tulsa International Airport

Building 330

Corrosion Control Hangar



Notes

FS-5 **Underground Fire Water Main**

Area: Exterior

D40 - FIRE PROTECTION

D4020 - FIRE SUPP WATER SUPPLY/ EQUIP

D402001 - FIRE PROTECTION WATER PIPING AND EQUIPMENT

Reliability Score	BUILDER Rating
93	Red

Item	QTY		Rate	
Entrance Pit with Grating	1	Items	Per Item	
8" Underground Ductile Iron Pipe	30	LF	Per LF	
Demoliton of Floor Slab and Foundation	1	Items	Per Item	
Remove Elec Supervision, add Lock	1	Items	Per Item	
Labor to Relocate PIV	40	Hrs	Per Hr	
Equipment Rental	1	Items	Per Item	
			Total:	

Equipment Details

8 inch underground fire main with PIV. Enters the building below grade through the slab.

Observations

The underground piping and control valve are generally in good condition and meets the requirements except as noted below:

- PIV supervision is not provided with a lock or tamper seal. UFC 3-600-01 para 3-7.2.2
- The PIV is not located more than 40 ft from building or is not at least as far from the building as the height of the wall facing the post indicator valve (collapse zone) per NFPA 24 para 6.2.11. UFC 3-600-01 para 3-7.1.5
- Where the fire piping is routed under the slab, it is not a continuous welded stainless steel pipe. UFC 4-211-01 para 3-5.4.3
- Where the piping is routed through the floor slab, it is not provided with a sleeve. UFC 3-600-01 para 4-2.4.11
- Fire water piping does not enter the building through a pit. UFC 4-211-01 para 3-5.4.3

FS-6 **Fire Protection Room**

Area: Fire Protection Equipment Room

D40 - FIRE PROTECTION

D4090 - OTHER FIRE PROTECTION SYSTEMS

D409090 - OTHER SPECIAL FIRE PROTECTION SYSTEMS

Reliability Score	BUILDER Rating
93	Red

Item	QTY		Rate	
Adding Fire Sealant, Labor & Mat.	40	Hrs	Per Hr	
Painting and Labeling, Labor & Mat.	4	Hrs	Per HR	
Labor	40	Hrs	Per HR	
Valves with Chain Operators	4	Items	Per Item	
			Total:	

Equipment Details

Fire protection room housing two wet-pipe risers, two foam/water risers, foam concentrate tank and proportioner.

Observations

The fire protection room is generally in good condition and meets the requirements except as noted below:

- Openings and penetrations in the fire rated wall assembly are not adequately sealed with a UL listed assembly. There is a 2 foot square opening and a 2 inch by 4 foot opening where piping penetrates the roof of the room. There is also a large roof hatch for bladder tank removal that may not be rated. NFPA 101 para 8.3.4
- The door is not adequate to allow for the removal of the tank and or pumps. A roof hatch is provided for tank removal. UFC 4-211-01 para 3-5.5.1
- Four valves are located more than 8 ft above the floor and not provided with chain operators. UFC 4-211-01 para 3-5.5.1
- All the piping in the fire protection room is not adequately labeled (e.g. Fire protection water, FDC, Test Header, fire sprinkler, foam system). UFC 4-211-01 para 3-5.5.2

FS-13.1 **Support Area Wet-Pipe Sprinkler Riser**

Area: Fire Protection Equipment Room

D40 - FIRE PROTECTION

D4040 - SPRINKLERS

D404001 - SPRINKLER AND RELEASING DEVICES

Reliability Score	BUILDER Rating
97	Red

Item	QTY		Rate	
Pressure Relief Valve with Drain Pipe	1	Items	Per Item	
10 Gallon Surge Tank, Valve, Tamp	1	Items	Per Item	
Hanger	1	Items	Per Item	
Water Gauge	1	Items	Per Item	
EMT Conduit with Circuit	25	LF	Per LF	
Riser PRV due to Fire Pump Addition	1	Items	Per Item	
			Total:	

Equipment Details

2 1/2 inch wet-pipe sprinkler riser for administrative & shops. Riser is designed for [undetermined] for a total demand of [undetermined] serving a total 6,329 sf. Flow switch manufacturer: Potter, model: VSR.

Observations

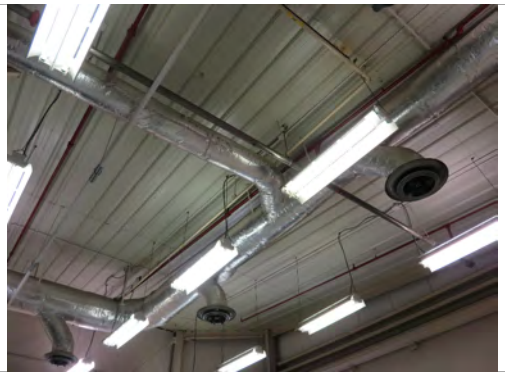
The wet-pipe sprinkler riser is generally in good condition and meets the requirements except as noted below:

- The riser is not provided with a gauge below the check valve. UFC 3-600-01 para 4-2.4.19
- Piping risers are not adequately supported within 24 inches of the riser. NFPA 13 para 9.2
- A pressure relief valve is not provided downstream of the check valve. NFPA 13 para 7.1.2.1
- 10 gal surge arrestor is not provided. UFC 4-211-01 para 3-5.4.4
- A pressure regulating valve is required in riser due to the addition of fire pumps to support the foam flow control valve and inductor. See assessment point FS-17.1

FS-14 **Support Area Wet-Pipe Sprinkler System**

Area: Support Area
D40 - FIRE PROTECTION
D4040 - SPRINKLERS
D404001 - SPRINKLER AND RELEASING DEVICES

Reliability Score	BUILDER Rating
93	Red



Item	QTY		Rate	
Replace Sprinklers with Quick Response	75	Items		Per Item
Add sprinklers under ductwork	5	Items		Per Item
Drain Down and Refill System	1	Items		Per Item
			Total:	

Equipment Details

Wet-pipe sprinkler systems for administrative & shops. Utilizing standard response 165 degree F, K=5.6 pendent and upright sprinkler manufacturer: Reliable Model: G

Observations

The support area wet-pipe sprinkler distribution system is generally in good condition and meets the requirements except as noted below:

- Quick response sprinklers are not used throughout the wet-pipe system. UFC 3-600-01 para 4-2.3.4
- Sprinkler pattern development for several sprinklers are obstructed by ductwork and HVAC equipment. NFPA 13 para 8.6.5
- Undetermined if the waterflow switch delay or retard chamber is equivalent to 60 seconds or greater. UFC 4-211-01 para 3.5.11.12

FS-15.1 **Hangar Bay Wet-Pipe Sprinkler Riser**

Area: Fire Protection Equipment Room

D40 - FIRE PROTECTION

D4040 - SPRINKLERS

D404001 - SPRINKLER AND RELEASING DEVICES

Reliability Score	BUILDER Rating
47	Red

Item	QTY		Rate	
Signage at Inspectors Test	2	Hrs		Per Hr
Pressure Relief Valve with Drain Pipe	1	Items		Per Item
10 Gallon Surge Tank, Valve, Tamp	1	Items		Per Item
Hanger	1	Items		Per Item
Splash Block	1	Items		Per Item
Water Gauge	1	Items		Per Item
Riser PRV due to Pump Addition	1	Items		Per Item
				Total:

Equipment Details

6 inch wet-pipe sprinkler riser for the hangar bay. Riser is designed for 0.2 gpm/sf over 5,000 sf for a total demand of 1590 gpm at 91 psi serving a total 10,468 sf. Flow switch manufacturer: Potter, model: VSR. Mechanical clapper check valve manufacturer; Tyco, model: CV-1F. The sprinkler riser splits inside the hangar and has a two separate feed mains, check valves and waterflow switches for the North and South Hangars.

Observations

The wet-pipe sprinkler riser is generally in good condition and meets the requirements except as noted below:

- The riser gauge above the check valve reads zero pressure. The gauge appears to be in need of replacement. UFC 3-600-01 para 4-2.4.19
- Piping riser is not adequately supported within 24 inches of the riser. NFPA 13 para 9.2
- A pressure relief valve is not provided downstream of the check valve. NFPA 13 para 7.1.2.1
- 10 gal surge arrestor is not provided. UFC 4-211-01 para 3-5.4.4
- The activation of the wet-pipe riser flow switch will release the foam system, and signage is not provided at the inspector test connection and remote drainage points indicating "Discharging water from this connection may release the foam system". AF Lessons Learned
- A pressure regulating valve is required in riser due to the addition of fire pumps to support the foam flow control valve and inductor. See assessment point FS-17.1

FS-16 **Hangar Bay Wet-Pipe Sprinkler System**

Area: Hangar Bay

D40 - FIRE PROTECTION

D4040 - SPRINKLERS

D401001 - FIRE ALARM DISTRIBUTION

Reliability Score	BUILDER Rating
35	Red

Item	QTY		Rate	
Lift Rental	2	Items	Per Item	
Painting and Labeling, Labor and Mat'ls	32	Hrs	Per Hr	
Pipe Inspectors Test to the Exterior	20	LF	Per LF	
Labor	85	Hrs	Per Hr	
Automatic air vent	8	Items	Per Item	
Splash Block	2	Items	Per Item	
Remove Two Inspector's Test Connections fr	8	Hrs	Per Hr	
Revise waterflow delay		Hrs	Per Hr	
			Total:	

Equipment Details

Wet-pipe sprinkler systems for hangar bay. Utilizing quick-response, 170 degree F, K=8.0 upright sprinklers. Sprinkler Manufacturer: Tyco Model: TY4131. The sprinkler riser splits inside the hangar and has a separate feed main and waterflow switch for each the North and south Hangar.

Observations

The hangar bay wet-pipe sprinkler distribution system is generally in good condition and meets the requirements except as noted below:

- Automatic air vents are not provided at the high point(s) of the wet-pipe sprinkler system. UFC 4-211-01 para 3-5.8
- 99.6% dry bulb temperature is less than 32 degrees F per UFC 3-400-02 Engineering Weather Data, and an inspectors test connection is located in the hangar bay (inspectors test connections are located in the hangar bay and also at the riser). UFC 4-211-01 para 3-5.8
- Inspector test connection does not discharge to a paved or concrete surface, or splash block. UFC 4-211-01 para 3-5.5.2
- The Inspector's drain is not routed to the exterior. UFC 4-211-01 para 3-5.5.2
- Piping is not adequately labeled (e.g. Hangar bay sprinkler system). UFC 4-211-01 para 3-5.5.2
- Undetermined if the waterflow switch delay or retard chamber is not equivalent to 60 seconds or greater. UFC 4-211-01 para 3.5.11.12

FS-17.1 **Hangar Bay Foam/Water Riser - North Hangar Bay**

Area: Fire Protection Equipment Room
D40 - FIRE PROTECTION
D4090 - OTHER FIRE PROTECTION SYSTEMS
D409002 - FOAM GENERATING EQUIPMENT

Reliability Score	BUILDER Rating
43	Red

Item	QTY		Rate	
6" Flow-Control Riser, Surge, Tamp	1	Items	Per Item	
Water Gauge & Signage	1	Items	Per Item	
Riser PRV due to Pump Addition	1	Items	Per Item	
Labor	16	Hrs	Per Hr	
Lateral Brace	2	Items	Per Item	
10 Gallon Surge Tank, Valve, Tamp	1	Items	Per Item	
Replace 4" Coupling	1	Items	Per Item	
Add Pumps to Support Flow Control Valve	2	Items	Per Item	
			Total:	

Equipment Details

4 inch foam/water riser for approximately 5,234 sq ft of the hangar bay (1/2 of hangar bay). One of two foam risers feeding four generators (two in the South Bay and two in the North Bay) for a total demand of 1988 gpm at 95 psi. Flow switch manufacturer: Potter, model: PS10-2. Flat diaphragm deluge valve manufacturer; Tyco, model:DV504FS3. Releasing solenoid manufacturer: Parker, model: 73218BN4UNLVN0C111C2.

Observations

The foam riser is generally in good condition and meets the requirements except as noted below:
- A remote resetting flow control valve with re-reclosing feature, speed control settings, and field adjustable pressure reducing trim is not provided. UFC 4-211-01 para 3-5.5.4
- The riser is not provided with a gauges above the flow control valve. UFC 3-600-01 para 4-2.4.19
- Couplings are not from the same manufacturer (one location). UFC 3-600-01 para 4-2.4.8
- Foam/water solution piping is not seismically braced with 4-way laterally bracing at the top of risers. UFC 4-211-01 para 4-5.3
- 10 gal surge arrestor is not provided. UFC 4-211-01 para 3-5.4.4
- Test valve is not provided with permanent identification. NFPA 13 para 6.7.4
- Trim valving which could release the system or render it inoperative is not locked or provided with tamper seal, in addition to signage indicating its normal operating position. UFC 4-211-01 para 3-5.11.14

- A pressure regulating valve is required in riser due to the addition of fire pumps to support the foam flow control valve and inductor.

FS-17.2 **Hangar Bay Foam/Water Riser - South Hangar Bay**

Area: Fire Protection Equipment Room
D40 - FIRE PROTECTION
D4090 - OTHER FIRE PROTECTION SYSTEMS
D409002 - FOAM GENERATING EQUIPMENT

Reliability Score	BUILDER Rating
43	Red

Item	QTY		Rate	
6" Flow-Control Riser, Surge, Tamp	1	Items	Per Item	
Water Gauge	1	Items	Per Item	
Signage	1	Items	Per Item	
Labor	16	Hrs	Per HR	
Lateral Brace	2	Items	Per Item	
10 Gallon Surge Tank, Valve, Tamp	1	Items	Per Item	
Riser PRV due to Pump Addition	1	Items	Per Item	
Seal and Sign on Trim Valve	2	Items	Per Item	
			Total:	

Equipment Details

4 inch foam/water riser for approximately 5,234 sq ft of the hangar bay (1/2 of hangar bay). One of two foam risers feeding four generators (two in the South Bay and two in the North Bay) for a total demand of 1988 gpm at 95 psi. Flow switch manufacturer: Potter, model: PS10-2. Flat diaphragm deluge valve manufacturer; Tyco, model:DV504FS3. Releasing solenoid manufacturer: Parker, model: 73218BN4UNLVN0C111C2.

Observations

The foam riser is generally in good condition and meets the requirements except as noted below:
- A remote resetting flow control valve with re-reclosing feature, speed control settings, and field adjustable pressure reducing trim is not provided. UFC 4-211-01 para 3-5.5.4
- The riser is not provided with a gauges above the flow control valve. UFC 3-600-01 para 4-2.4.19
- Foam/water solution piping is not seismically braced with 4-way laterally bracing at the top of risers. UFC 4-211-01 para 4-5.3
- 10 gal surge arrestor is not provided. UFC 4-211-01 para 3-5.4.4
- Test valve is not provided with permanent identification. NFPA 13 para 6.7.4
- Trim valving which could release the system or render it inoperative is not locked or provided with tamper seal, in addition to signage indicating its normal operating position. UFC 4-211-01 para 3-5.11.14
- A pressure regulating valve is required in riser due to the addition of fire pumps to support the

foam/water system. The fire suppression systems are one year old and have not been through a full maintenance cycle.
- System maintenance and testing documents were not available for the hydrants, wet-pipe sprinkler system, foam/water system. Simplex/Grinnell has not performed their first tests of the fire systems.
- Maintenance records for the fire suppression, fire alarm, and life safety systems are compiled and stored in AEIS. Work orders are recorded in the ANG Integrated Engineering Management System (iEMS).

HYDRANTS
- Inspections for accessibility, leaks and worn threads has not been performed every 2 years. UFC 3-601-02 Table 2-14
- Lubrication to ensure ease of operation has not been performed every 2 years. UFC 3-601-02 Table 2-14
- Operation of not less than 5 full cycles with caps on all outlets in ensure porper function and lubrication has not been performed every 2 years. UFC 3-601-02 Table 2-14

WET-PIPE FIRE SPRINKLER
- The valve position of control valves that are sealed, locked or electrically supervised, have not been checked annually. UFC 3-601-02 Table 2-2
- Waterflow alarm devices have not been operated annually to verify initiation and receipt of alarm. UFC 3-601-02 Table 2-2
- The alarm test valve alignment and tamper switch (if sealed or electrically supervised) have not been verified. UFC 3-601-02 Table 2-2
- The exterior of the alarm valve and trim, valves, gauges, trim alignment, pressure, hydraulic name plate have not been checked annually. UFC 3-601-02 Table 2-2
- A main drain test to verify supply has not been performed annually, and static and residual pressure readings have not been documented on a 3" x 5" tag secured at the system pressure gauge. The main drain test results have not been verified to determine if they are within acceptable limits. UFC 3-601-02 Table 2-2
- The fire department connection accessibility and condition (caps removed or missing and obstructions) has not been checked annually. UFC 3-601-02 Table 2-2

HIGH EXPANSION FOAM FIRE SUPPRESSION
- Foam concentrate has not been tested annually. UFC 3-601-02 Table 2-12
- Foam concentrate supply amount has not been verified annually. UFC 3-601-02 Table 2-12
- Foam generator has not been inspected to verify condition and valve alignment annually. UFC 3-601-02 Table 2-12
- Foam suppression system pipe hangers, generators for obstructions, generator nozzles for obstruction, generator screens for damage,detectors unblocked/uncovered, panels secured and indicator lamps functional, notification appliances in place, manual stations in place and unobstructed and piping and riser condition have not been visually checked as a part of building inspection. UFC 3-601-02 Table 2-12

foam/water system. UFC 4-211-01 para 3-5.11.5
- Releasing panel is fed from a dedicated fire alarm circuit not red in color, and lockable. UFC 3-520-01 para 3-2.4
- The releasing panel has conduit entering the top of the enclosure. UFC 4-211-01 para 3-5.11.1

FA-2 **Foam/Water Releasing Panel - Manual Releasing Station**

Area: Hangar Bay
D40 - FIRE PROTECTION
D4010 - FIRE ALARM AND DETECTION SYSTEMS
D401002 - FIRE ALARM DEVICES

Reliability Score	BUILDER Rating
47	Red

Item	QTY		Rate	
Manual Release Station, Audible Cover & Bre	8	Items	Per Item	
			Total:	

Equipment Details

Manual releasing stations are provided throughout the hangar bay to release the foam/water system. Manufacturer: Harrington Model: HSPS-1TKL

Observations

The manual foam releasing stations are generally in good condition and meet the requirements except as noted below:

- Clear covers do not emit an audible alarm when removed. UFC 4-211-01 para 3-5.11.7
- Manual releasing stations are not a minimum NEMA 4. UFC 4-211-01 para 3-5.11.7
- A minimum separation distance of 5 ft is not maintained between manual releasing stations and manual pull stations for general fire alarm. UFC 4-211-01 para 3-5.11.7
- A breather/automatic drain are not placed at the low point in the conduits. UFC 4-211-01 para 3-5.11.7

FA-3 **Foam/Water Releasing Panel - Stop Station**

Area: Hangar Bay

D40 - FIRE PROTECTION

D4010 - FIRE ALARM AND DETECTION SYSTEMS

D401002 - FIRE ALARM DEVICES

Reliability Score	BUILDER Rating
0	Red

Item	QTY		Rate	
Manual Stop Station, Cover, Sign & Breather/	8	Items		Per Item
EMT Conduit with Circuit	800	LF		Per LF
Flow control valve at riser (see FS-17)	0	Items		Per Item
			Total:	

Equipment Details

Observations

Foam stop stations are not provided. UFC 4-211-01 para 3-5.11.8

FA-4 **Foam/Water Releasing Panel - Optical Flame Detectors**

Area: Hangar Bay

D40 - FIRE PROTECTION

D4010 - FIRE ALARM AND DETECTION SYSTEMS

D401002 - FIRE ALARM DEVICES

Reliability Score	BUILDER Rating
0	Red

Item	QTY		Rate	
Det-Tronics Optical Flame Detector	6	Items	Per Item	
EMT Conduit with Circuit	800	LF	Per LF	
			Total:	

Equipment Details

Observations

Optical flame detectors are not provided. UFC 4-211-01 para 4-5.6

- Optical flame detectors are not provided such that a fire in any position within the hangar bay is within range and the cone-of-vision of at least three optical detectors. UFC 4-211-01 para 4-5.6

FA-8 **Fire Alarm Control Panel - Initiation Devices**

Area: Facility

D40 - FIRE PROTECTION

D4010 - FIRE ALARM AND DETECTION SYSTEMS

D401002 - FIRE ALARM DEVICES

Reliability Score	BUILDER Rating
85	Red

Item	QTY		Rate	
EMT Conduit with Circuit	50	LF		Per LF	
Manual Pull Station - Non-addressable, NEM	6	Items		Per Item	
Remove Heat Detectors	2	Items		Per Item	
Duct smoke remote test switch and LED	4	Items		Per Item	
				Total:	

Equipment Details

Initiating devices are provided throughout the facility including: pull stations, smoke detectors, duct detectors, flow switches and tamper switches

Observations

The fire alarm initiating devices are generally in good condition and meet the requirements except as noted below:

- The building is provided with a sprinkler system and automatic initiating devices (two heat detectors in the bathrooms) are provided which exceed the code or UFC minimum requirements. UFC 3-600-01 para 5-4.1
- Manual pull stations are not NEMA 4 where installed in the hangar bay. UFC 4-211-01 para 3-5.11.6
- Duct smoke detectors are not provided with remote test switches and remote light emitting diodes. UFC 3-600-01 para 5-6.5

LS-3 **Facility - Fire Fighting Accessibility Hangar Bay Door**

Area: Hangar Bay

D40 - FIRE PROTECTION

D4090 - OTHER FIRE PROTECTION SYSTEMS

D409090 - OTHER SPECIAL FIRE PROTECTION SYSTEMS

Reliability Score	BUILDER Rating
93	Red

Item	QTY		Rate	
Door Track Heater	140	LF	Per LF	
Labor	20	Hrs	Per Hr	
		Items	Per Item	
Key-Operated access control switch	2	Items	Per Item	
EMT Conduit with Circuit	200	LF	Per LF	
Electrical Service - Below Grd	400	LF	Per LF	
Disconnect at Transformer	1	Items	Per Item	
Cut and Patch Concrete	150	LF	Per LF	
			Total:	

Equipment Details

Horizontal sliding hangar doors.

Observations

The fire fighting accessibility through the hangar bay door is generally in good condition and meets the requirements except as noted below:

- The power to the hangar door is not tapped ahead of the main building disconnect. UFC 4-211-01 para 3-9.3
- Door track heaters with drainage are not provided for the horizontal sliding hangar door in areas subject to freezing. UFC 4-211-01 para 3-2.1.8
- A key-operated or other access-control switch is not provided on the exterior of the facility to open the hangar door in the event of an emergency. UFC 4-211-01 para 3-2.1.8

LS-4 **Electrical Hazard Classifications - Hangar Bay**

Area: Hangar Bay

D40 - FIRE PROTECTION

D4090 - OTHER FIRE PROTECTION SYSTEMS

D409090 - OTHER SPECIAL FIRE PROTECTION SYSTEMS

Reliability Score	BUILDER Rating
93	Red

Item	QTY		Rate	
Intrinsically Safe Door Sensor	2	Items		Per Item
			Total:	

Equipment Details

The hangar bay has the following electrical hazard classifications: Class I Division I below grade, Class I Division II up to 18 inches above the hangar floor and within 5 ft of the aircraft [Class I Division II to the top of the hangar door].

Observations

The installation of electrical equipment in the hangar bay is generally compliant with the electrical hazard classifications except as noted below:

- Non-intrinsically safe equipment including electrical boxes and door sensors are installed in the electrically hazardous area in the Corrossion Control hangar bay. UFC 4-211-01 para 3-6.1
- Non-intrinsically safe equipment including computers and refrigerators are installed in the electrically hazardous areas outside the hangar bay where not suitable cut-off. UFC 4-211-01 para 3-6.1
- Areas outside the hangar bay are not suitable cutoff by two self-closing doors (three doors are propped open). UFC 4-211-01 para 3-2.1.2

LS-5 **Facility - Portable Fire Extinguishers**

Area: Facility

D40 - FIRE PROTECTION

D4050 - FIRE PROTECTION SPECIALTIES

D405001 - PORTABLE EXTINGUISHERS

Reliability Score	BUILDER Rating
93	Red

Item	QTY		Rate	
Fire Extinguisher with Cabinet	8	Items		Per Item	
				Total:	

Equipment Details

Support Areas are provided with 4-A:80-B:C Dry-Chemical portable fire extinguishers. Hangar Bays are not provided with Fire extinguishers.

Observations

The portable fire extinguishers are generally in good condition and meets the requirements except as noted below:

- For Class B fires, a fire extinguisher is not located with 50 ft of travel (extinguishers are not provided in the hangar bays). UFC 3-600-01 para 4-9

BURNS McDONNELL

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