Aviation Hangar Fire Tank Replacement Project

Lenny Farello

Agenda

- **Problem**
- **Site Plans**
- **Original System Description**
- **Options**
- **Impairment Plan**
- **Construction**
- **Acceptance Testing**
- **Issue**
- **Eglin AFB HEF Fatality Summary**
- **Foam System Trip – Video**
- **Questions???**

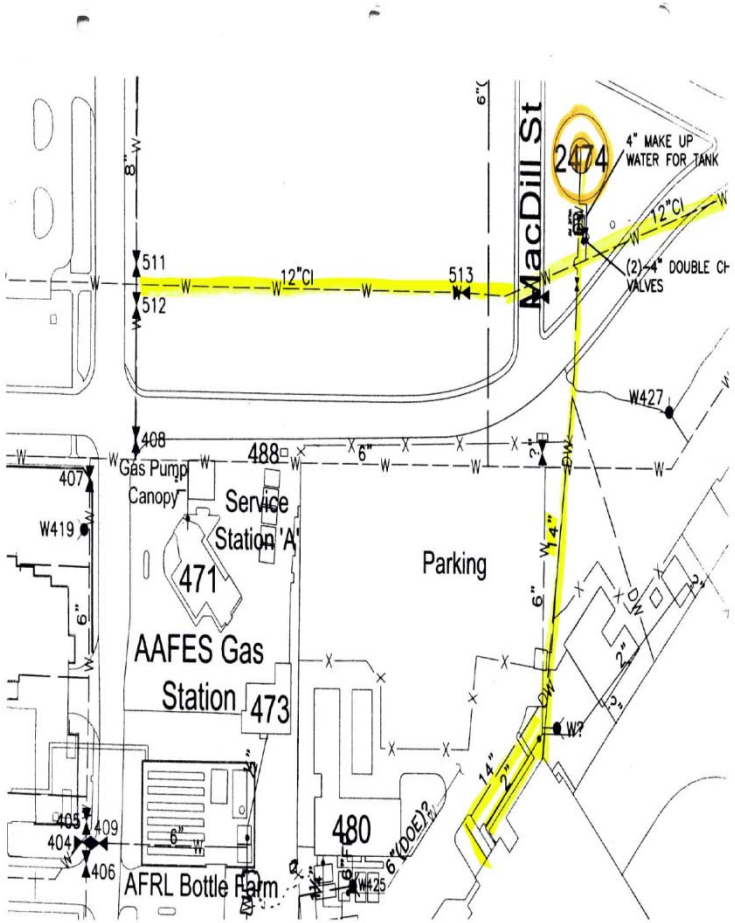
Problem

Problem

- Suspected structural concerns with original 500K gallon elevated dedicated fire water tank
- Internal inspections were not being performed as required
- KAFB trying to include 500K tank in the OST permit
- OST Management decision to replace dedicated fire water supply to hangar building versus accepting the risk

Site Plan

Site Water Utilities 1



Original Fire Systems in Hangar

- 34K square foot Aircraft Hangar – Now stores Two (2) 737's
- 500K elevated dedicated fire water tank (112' elevation to base of tank is about 48.5 psi suction to pumps)
- One (1) 2500 gpm @ 75 psi Electric Fire Pump for each Foam Deluge System for each Low Expansion Deluge Foam Sprinkler System (North & South)
- Four (4) UV/IR cross-zoned detectors positioned at aircraft wing level per deluge foam system
- Foam System Actuation via manual pull stations or cross-zoned UV/IR detectors
- Two (2) dead-man switches located in hangar (North & South)

Original Plan

- Re-connect original 14-inch hangar building feed main to the site domestic (KAFB) water supply
- Capacity of KAFB water supply was tested as Static=85psi with Residual=18psi Flowing=3664gpm
- Minimum required for 1 fire pump is 3750 (150%) at 20psi.
- Result – KAFB water supply is not adequate for hangar foam deluge systems
- No sprinkler system drawings or calculations available – As-builts created to determine design options
- System demand calculated at 6335gpm @ 128psi (both deluge LE foam systems operating)
- Result – Loss of Elevated Tank (48.5psi suction pressure) will require new fire pumps

Options

- Option 1: Install 2 new 120K gallon water tanks; Keep original Low Expansion Foam Deluge Systems; Upgrade to 2 new 350HP fire pumps; Keep original UV/IR Detection. $1.3M
- Option 2A: Upgrade to High Expansion foam system; 2 new 51K gallon fire water tanks; Upgrade to 2 new 250 HP fire pumps; Convert deluge systems to single wet-pipe system; Keep original UV/IR Detection. $1.5M
- Option 2B: Upgrade to High Expansion foam system (no tanks); Feed via KAFB water supply; Convert deluge systems to single wet-pipe system; Keep original UV/IR Detection. $1.1M (Waivers Req'd)

Aviation Fire Suppression Water Design Update w/ Estimates

Design Option	Cost	Pro	Con
#1: Install 2 new 120,000gal water tanks (~30' diameter each) •Use original foam system •Upgrade to 2 new 350HP pumps	$1.3M	•Reliable (dedicated tanks) •Minimal downtime in hangar •Project cost will result in some electrical improvements	•AF Exception Required (minimal risk) •Required 155psi exceeds ETL standard limit of 125 psi and will require AF AHJ approval •322 (AF) & Permit Modification for two new water tanks •Footprint taken off parking lot to accommodate tanks •Additional time and $ to design for upgraded electrical systems. Delay of final design.
#2A: Upgrade to High Expansion Foam system with dedicated water tanks •2 new 51,000gal each (21' diameter) •2 new 250HP pumps (only 1 operates at a time)	$1.5M	•No AF Exceptions needed. Meets all AF standards and code requirements •Reliable (dedicated tanks) with a smaller footprint for tanks •Cleaner, state of the art foam system •Original electrical has the capacity to support the new pumps	•Maximum downtime in hangar *(months)* •322 (AF) & Permit Modification for two new water tanks •Most expensive option
#2B:Upgrade to High Expansion Foam system (no tanks)	$1.1M	•Least expensive •Permit modifications not required •No tanks required •No upgrades to pumps required	•Unreliable water source. (DOE FPE Does not recommend) •AF Exception Required (higher risk) •ETL requirement for reduction in hose demand at 500gpm cannot be met (request 100gpm) •ETL deviation for backflow preventers location •All engineering solutions have been used to marginally provide enough flow. No wiggle room left in design to meet code. Further design may render this option N/A. •Maximum downtime in hangar *(months)*

Option 2A Chosen

- New ground-level fire tanks to provide dedicated fire water to Hangar building suppression systems
- New fire pumps, motors and controllers
- New jockey pump
- New high expansion foam system
- Convert 2 deluge pendant sprinkler systems to a single upright wet-pipe sprinkler system
- Use original fire alarm control panels and UV/IR detectors

Project Duration – 8 Months

- Project Notice to Proceed was issued 10/11/12
- System was placed in-service 4/3/2013
  - 2 Month Trial before acceptance test
- Foam System Acceptance Test was performed in June 2013

Impairment Plan

- **DOE NNSA OST B481 Fire System Impairment Plan**
  - **Developed detailed impairment plan approved by KAFB Fire Department**
  - **Followed detailed schedule**
  - **Dates of Impairment: 2/4/2013 – 4/3/2013**
  - **Implemented:**
    - **Red-Tag procedure**
    - **Hot Work procedure**
    - **Fire Watch program**
    - **Impaired fire hydrant map**
    - **Compensatory Measures**
      - **No Hot Work allowed in Hangar during impairment**
      - **UV/IR detectors remained in-service**
      - **Hourly fire watch and Log**
      - **24x7 Security Guard On-Site**

New 8-inch path from KAFB (12-inch) Water Supply

New 8-inch installation

New 8-inch Installation

New 8-inch

New 8-inch w/ thrust-block

New
8-inch buried with asphalt

Path of New 14-inch from Tanks to Pump Room

New 14-inch + Electrical to Pump Room

Covered New 14-inch to Pump Room

New 14-inch Connection to Pump Room via original PIV

Original Pump Room PIV

Excavated Pump Room PIV

14-inch Feed Main into Pump Room

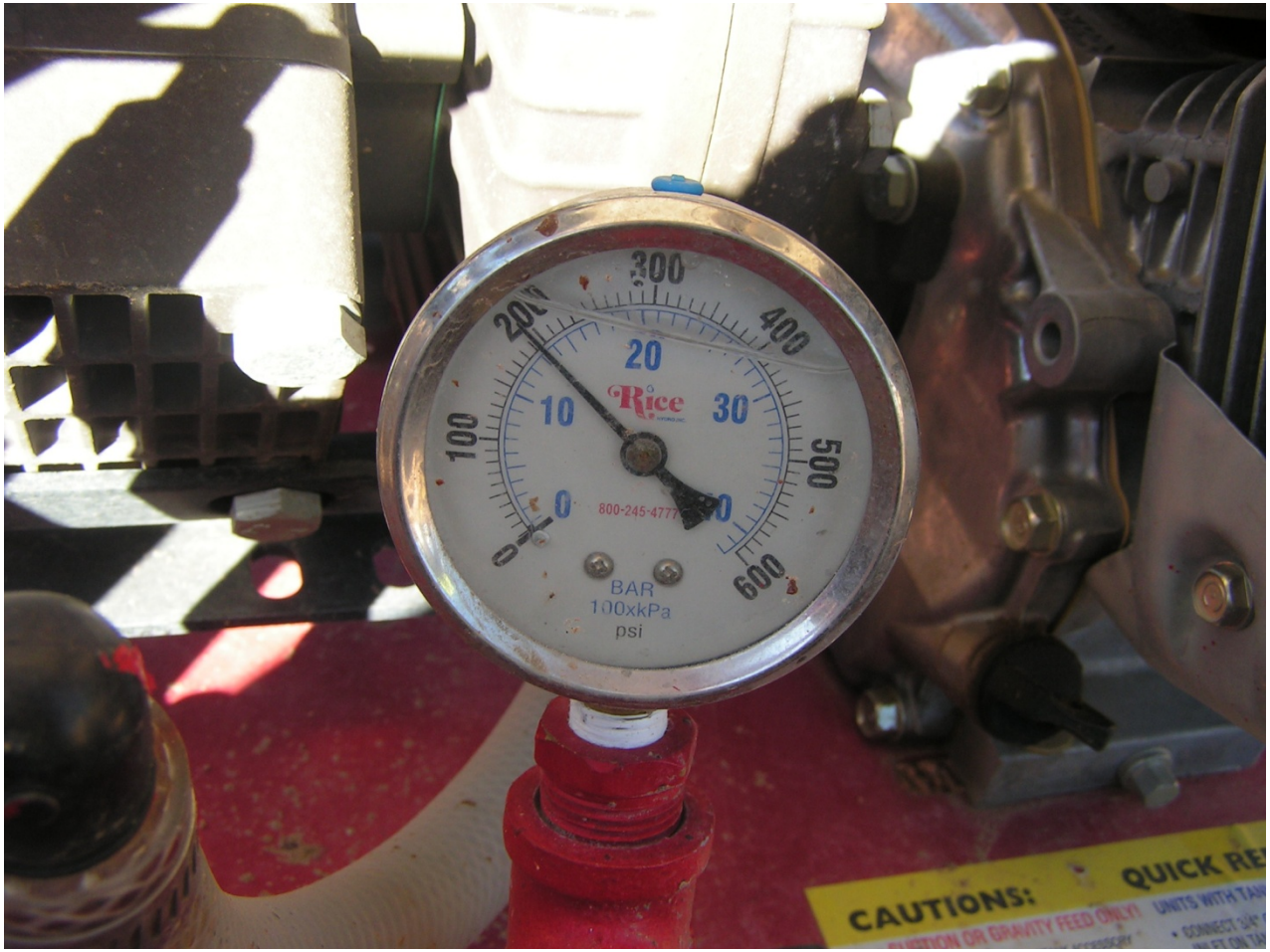
New PIV to Pump Room

New Covered PIV to Pump Room

Underground Hydro-Testing

Underground Hydro-Testing

Underground Hydro-Testing



New Tank Locations

Tank Foundation Prep

Tank Foundation Prep

Tank Foundation Rebar

Tank Grounding

Tank Grounding

Tank Concrete

Tank Concrete

Tank Concrete

Tank Pads

Tank Installation

Tank Installation

Tank Installation

Tank Installation

Tank Installation

Tank Installation

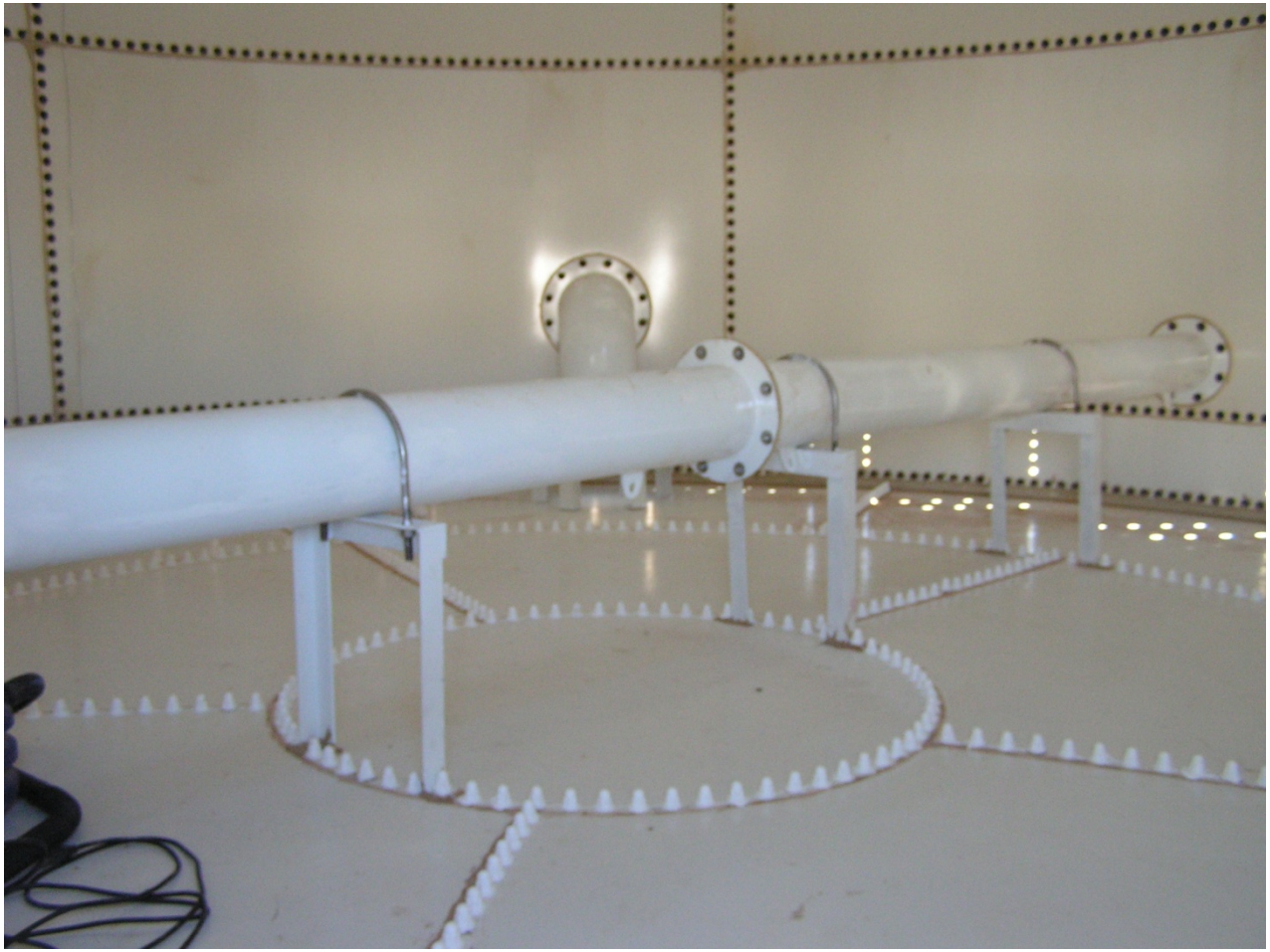
Tank Installation

Tank Installation

Tank Installation

USA Tanks Installation

Tanks Bolted & Sealed



Tank 8-inch Fill Line

Tank Ladder

Finished Tanks

Trench for 8-inch Feed to Tanks

8-inch Feed to Tanks and 14-inch Feed to Pump Room

Tank Temperature Sensor

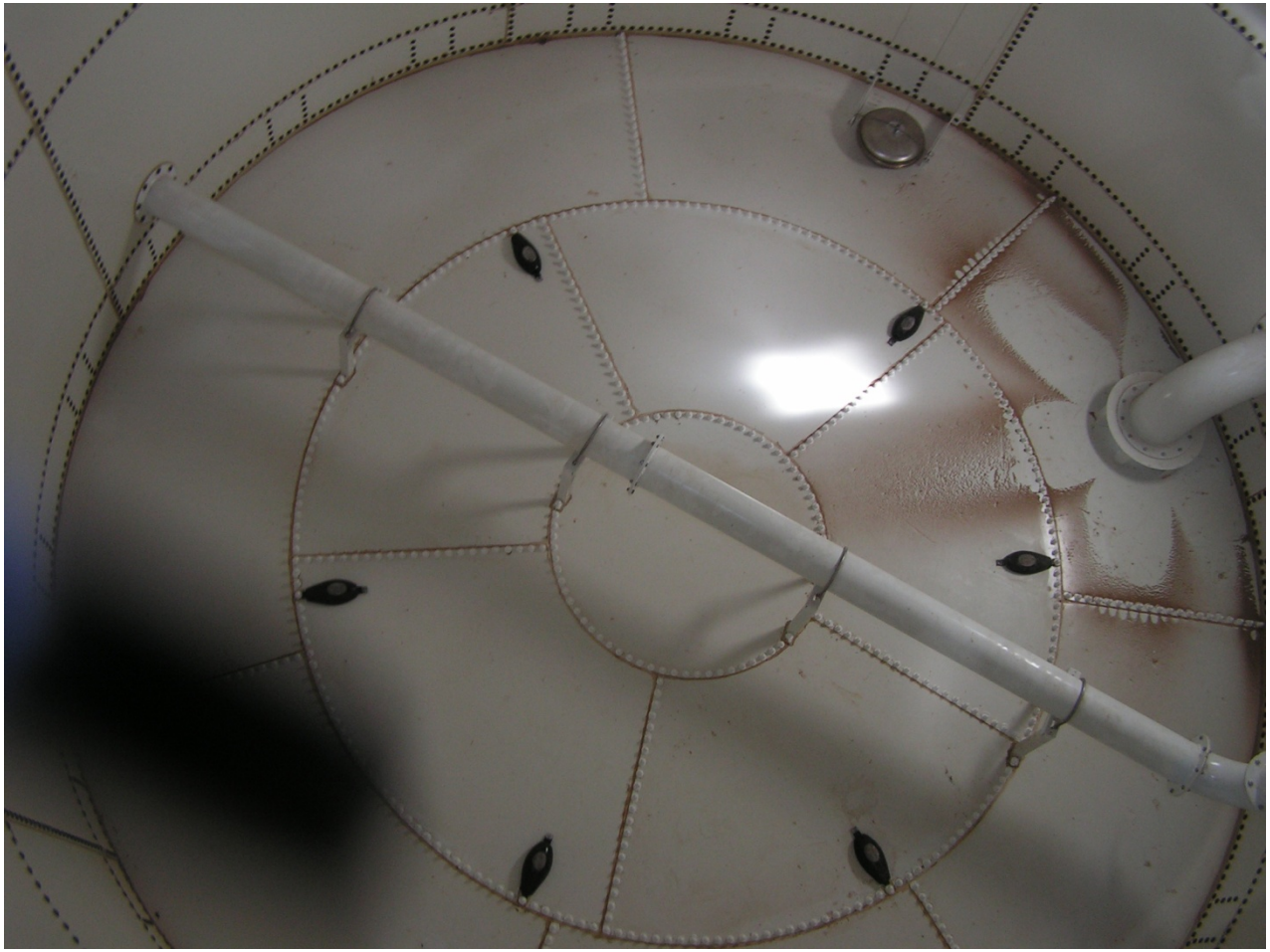
8-inch Feed Tee to Tanks

14-inch Tee from Tank to Pump Room

14-inch Feeds from Tanks to Pump Room

14-inch Suction from Tank

Tank Cathodic Protection



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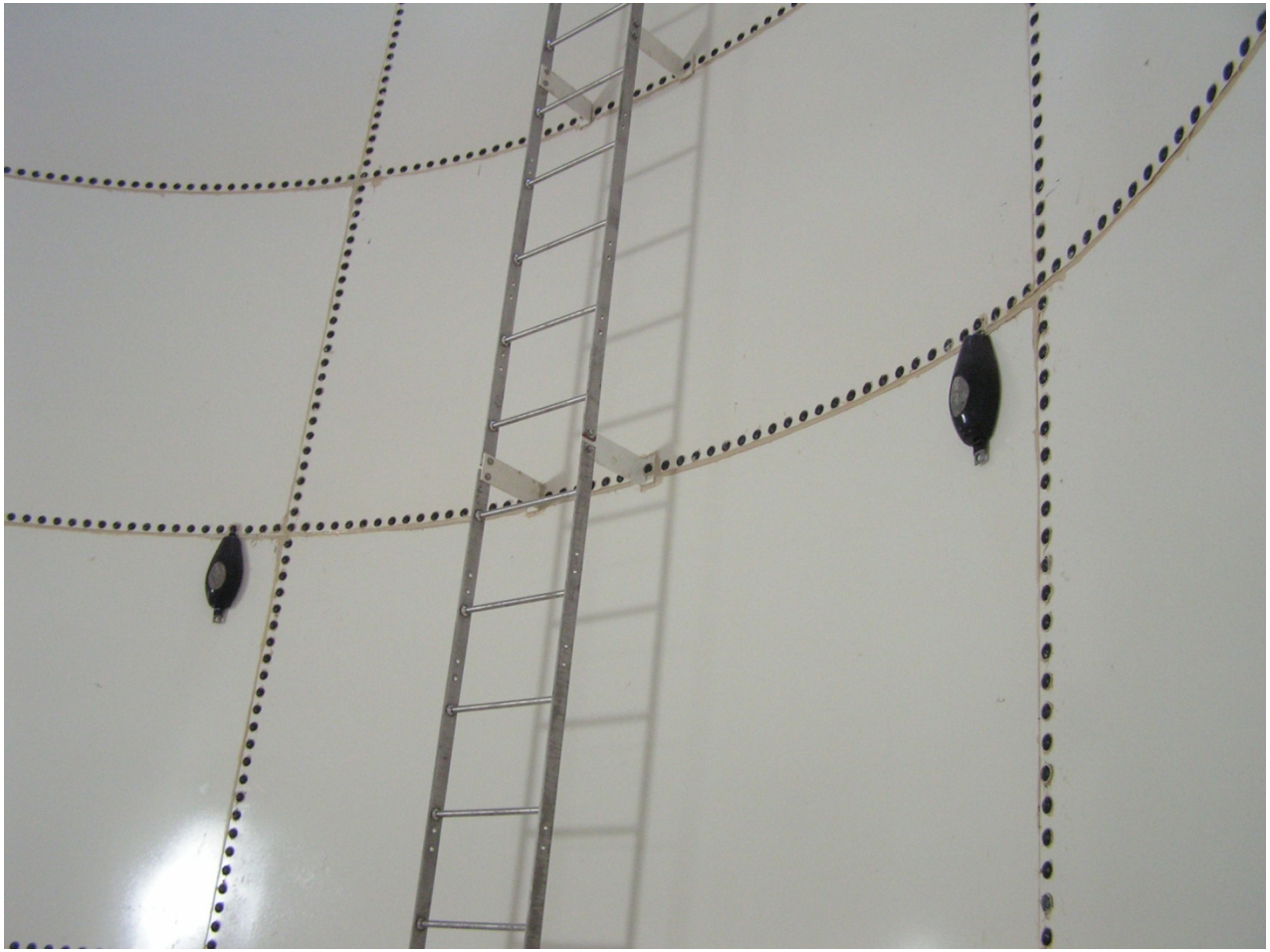
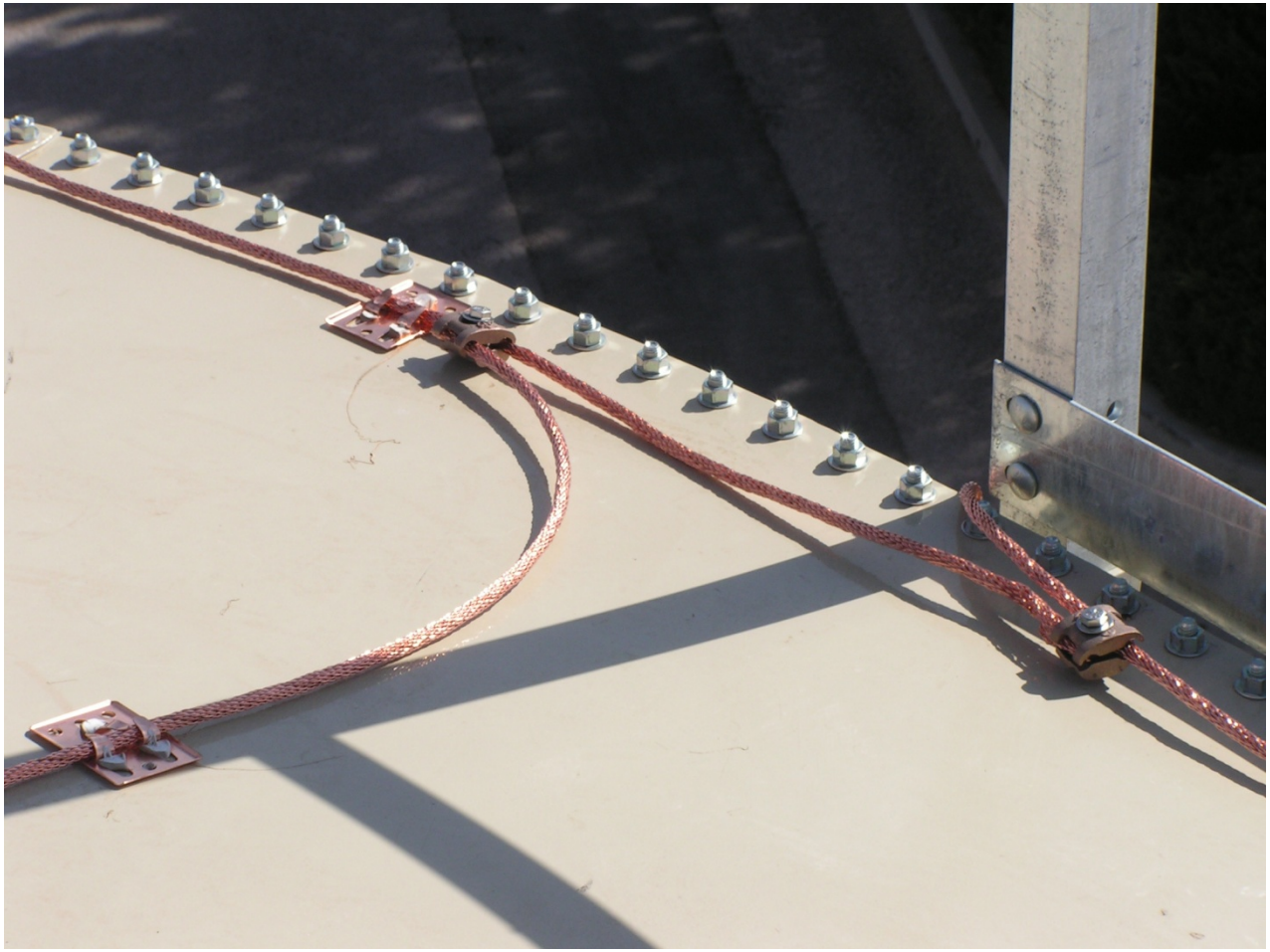


LPS Air Terminal Connections

Tank Grounding



Grounding Connections

Tank Grounding System Check

14-inch Suction from Tank

Altitude Valve Installation w/ Pressure Sensing Line for Tank Refill

Tank Fill

Tank Level Indicator

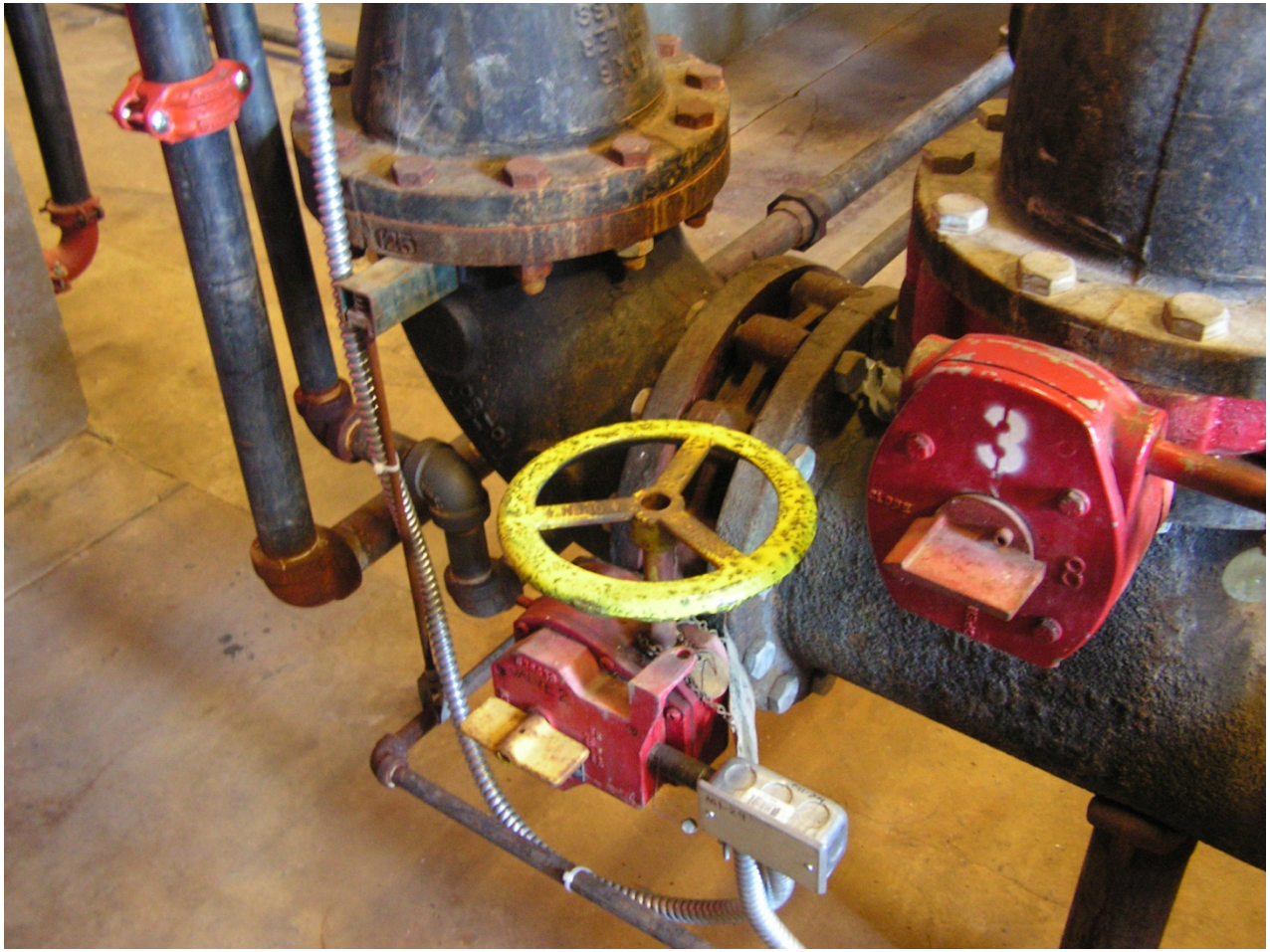
Tank Overflow

Completed Tanks with 8-inch Refill Line and 14-inch Suction Lines

Original Fire Pump Room

Door & Frame Removed from Pump Room

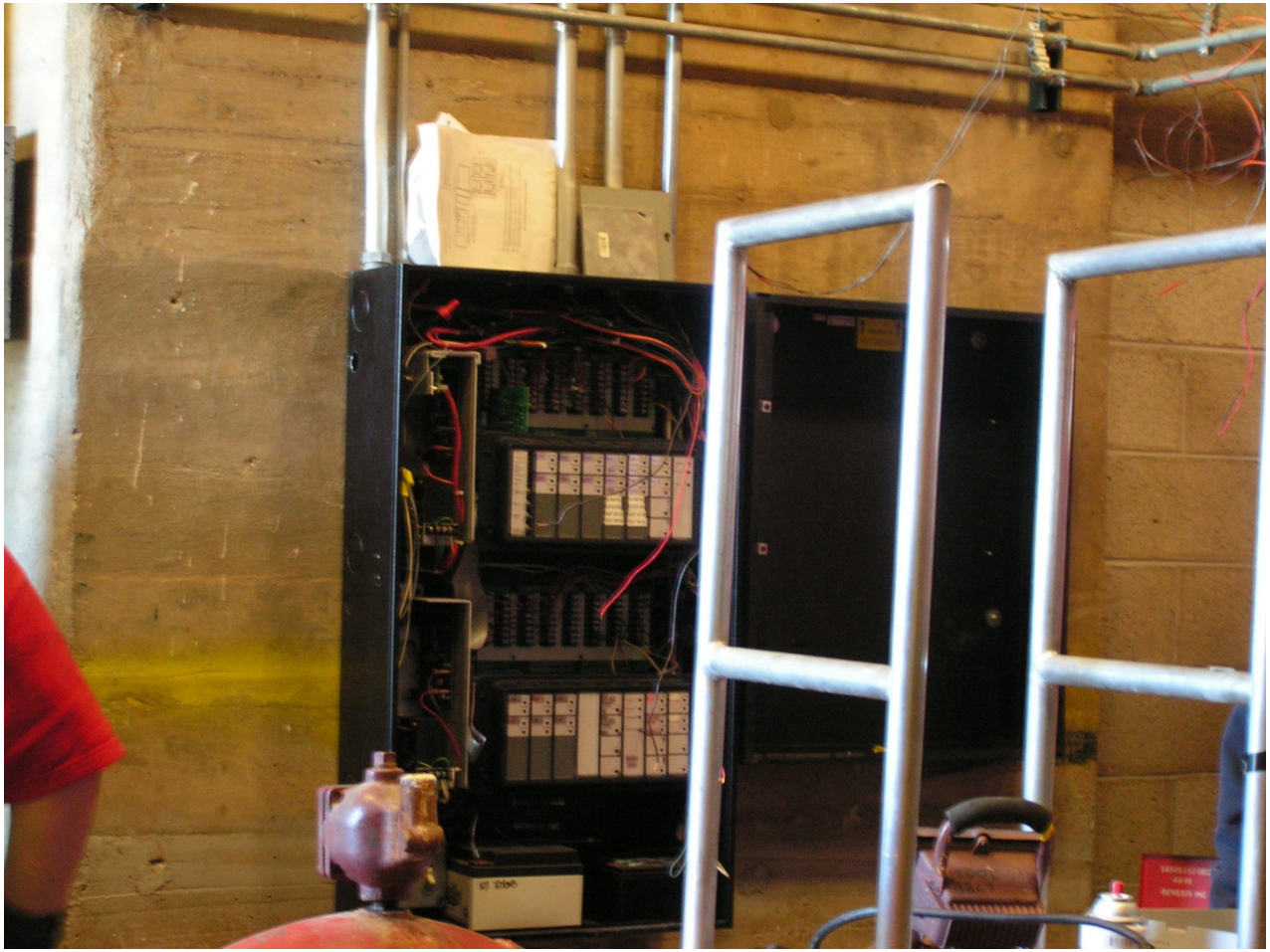
Original Discharge Piping in Pump Room



Original Sylvania Fire Pump Controller - Replaced

Original Foam Tank

Fire Alarm Control Panel in Pump Room – Not replaced



Pumps and Piping Removed

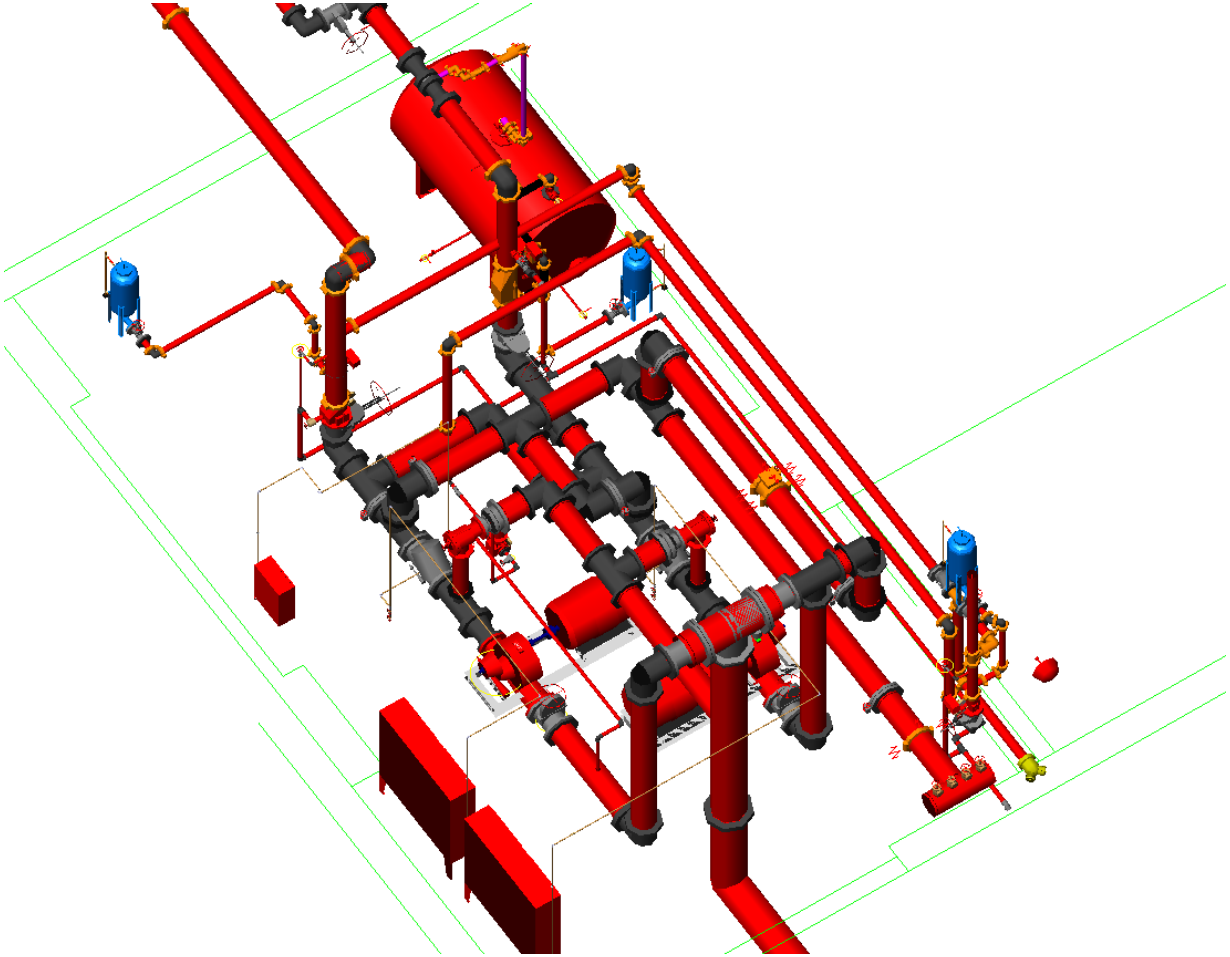
Original Low-Expansion Foam donated to KAFB Fire Department

Pumps and Piping removed

Tank Removal

Tank Removal

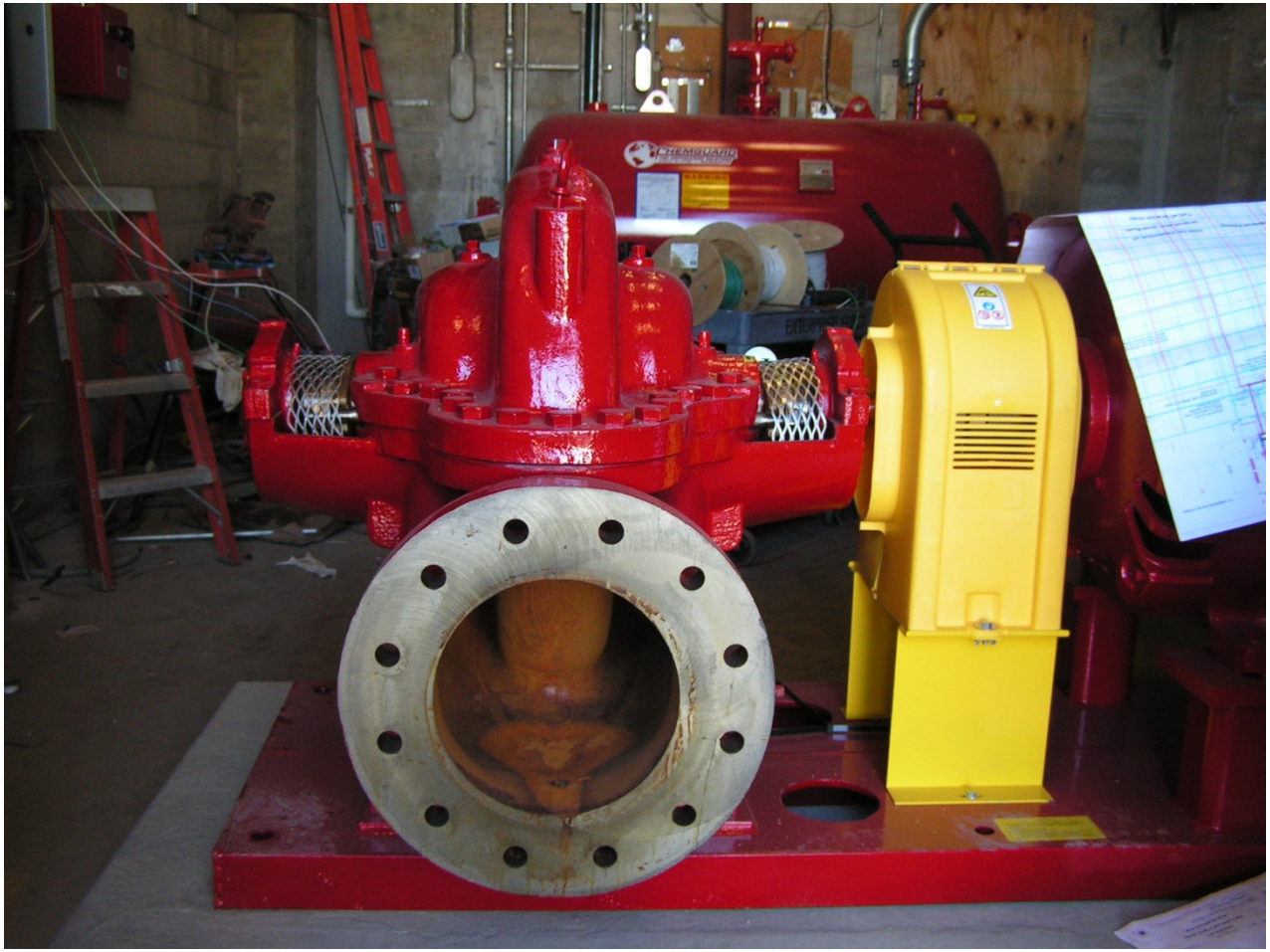
Revised Pump Room Layout



New Foam Tank – Chemguard C2 – 2% HE Foam

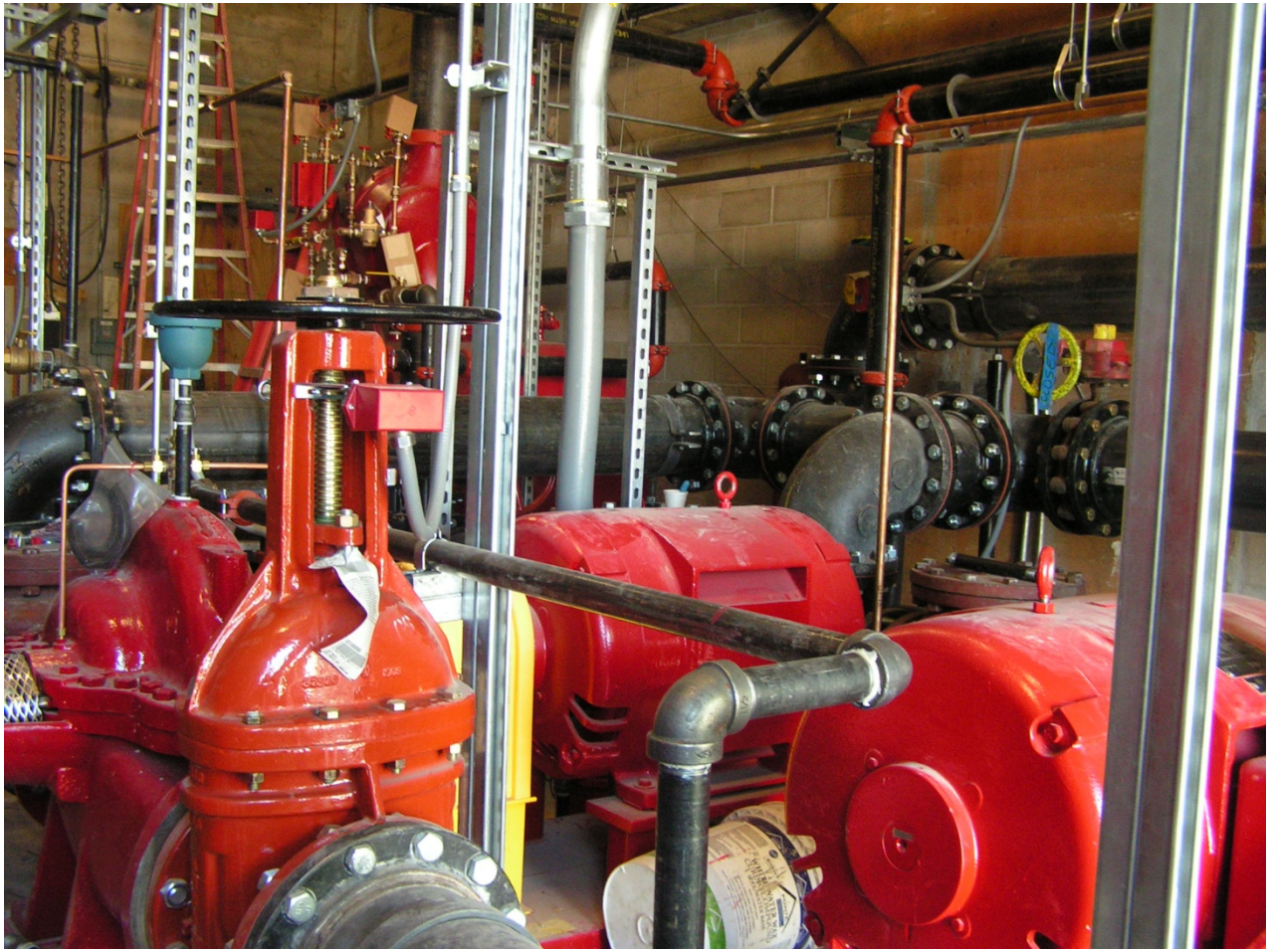
New Fire Pump

New Fire Pump and Motor



New Piping in Pump Room

New Pumps, Motors and Piping



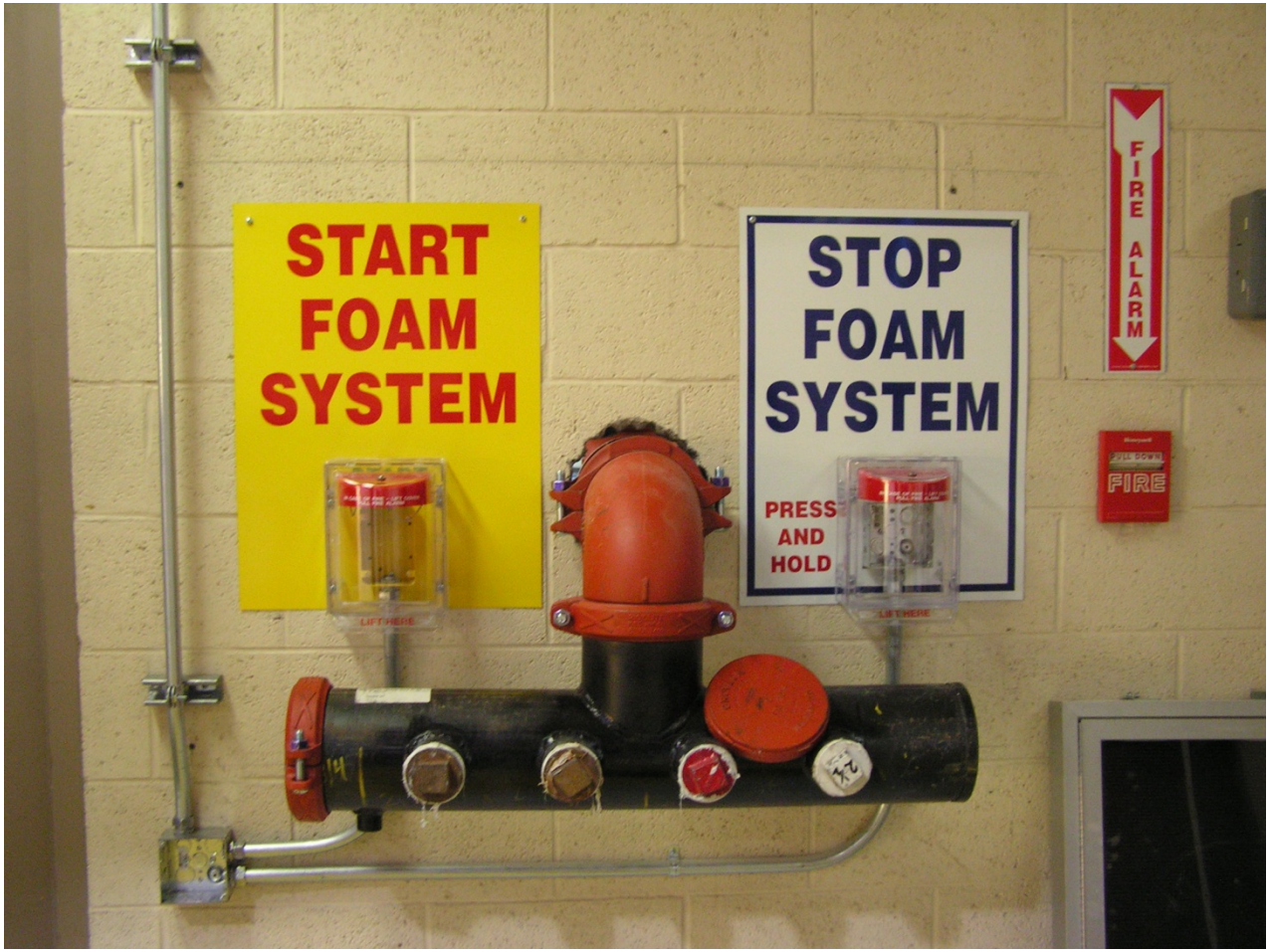
New Foam Tank and Riser

New Master Fire Pump Controller

New Electrical Main Distribution Panel (MDP) installed to meet new fire pump demand

Original LE Deluge System Pull Station and Dead-man

New HE Foam Pull Station and Dead-man and Foam System Test Header



Hangar Pipe being converted to Upright Wet-pipe

Distance from ceiling to deflector (Reqt. <12-inches)

New High Expansion Foam system piping

7 HEF Generators installed in Hangar Ceiling

Hydro-testing system piping

Multiple leaks from original deluge piping

Flushing original deluge system piping

Flushed original deluge piping at several locations

Very corroded piping

Clogged Sprinkler Tee's

Totally clogged branch-line

Totally clogged branch-line

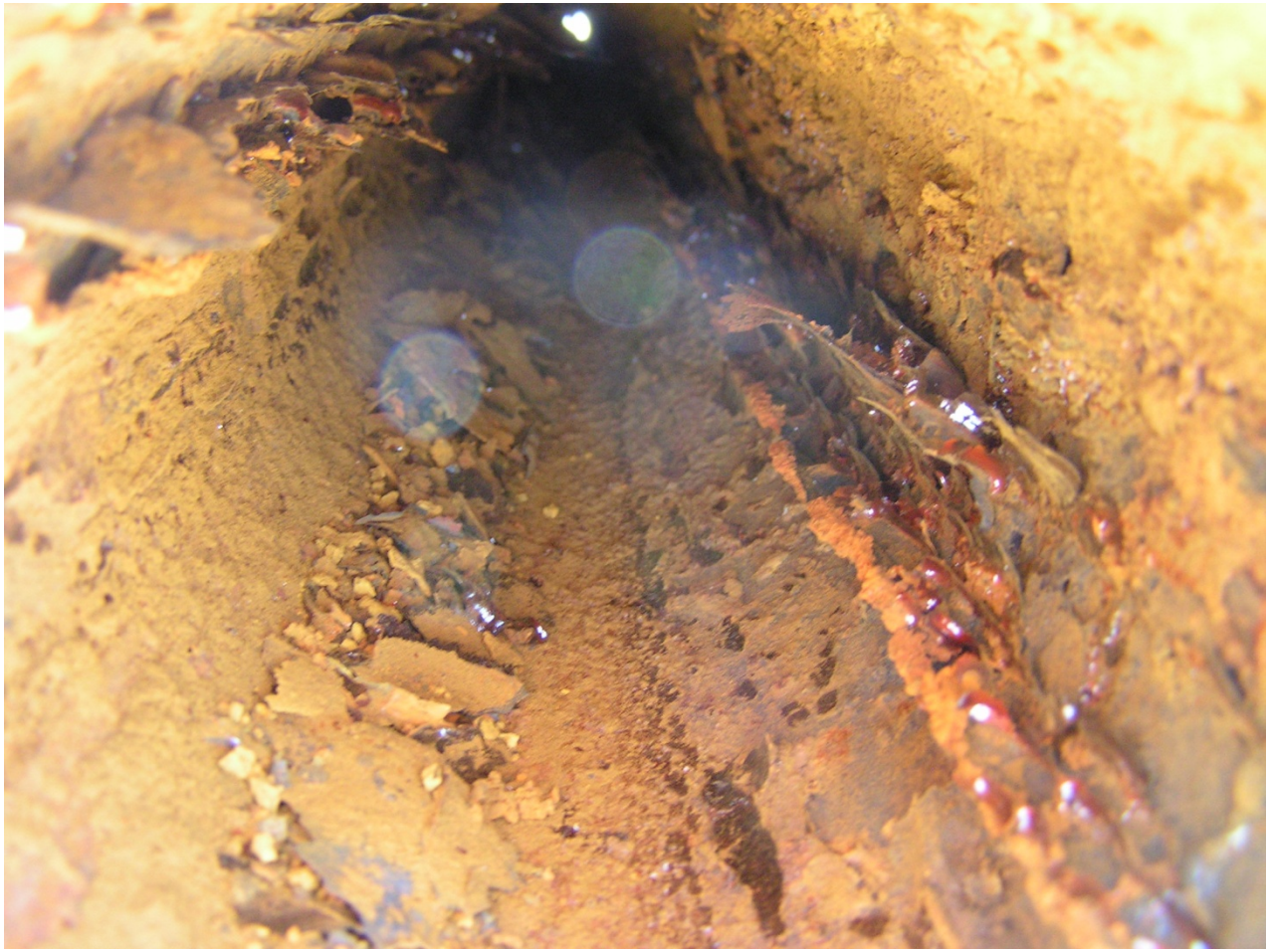
Totally clogged branch-line

Clogged sprinkler head

Clogged sprinkler heads

Dried corrosion debris from deluge pendant sprinkler heads

Corroded Piping



Drainage Issue in Pump Room

Clogged floor drain pipe from Pump Room - replaced

Surprise - New 6-inch feed required to Hangar Vehicle Maintenance Facility B-480

New 6-inch Feed to B-480 Hangar Vehicle Maintenance Facility

Fire Pump Testing

Fire Pump Testing

Project Issues

- Configuration Management
- Fire Protection Program
- Maintenance
- Other
- Logistics – New HEF System

Configuration Management Issues

- KAFB Water Utility drawing incorrect
  - Building 480 and other buildings found being serviced from 500K Tank – potable water
    - Had to re-feed these buildings from KAFB water supplies
- No fire sprinkler drawings, calculations or design basis for OST B481 Hangar

Maintenance Issues

- 500K Tank was not being maintained – needed internal and structural inspection
- Broken altitude valve feeding 500K Tank that required Manual refilling Quarterly
- “Sub-Contracted” ITM not being performed per NFPA
- Piping not flushed as required after several accidental LE Foam system trips
- Many pinhole leaks in deluge piping
- Clogged piping and heads – System would not have operated as designed
- Existing Foam Bladder found compromised – Not testing foam concentrate
- Broken PIV – Not being exercised

Fire Protection Program Issues

- No formal fire system impairment process being implemented by OST, Contractor or Sub-Contractor
- Several times throughout the scope, design and project – foam system solenoids were found removed
  - Resulted in ORPS Report NA--OST-OST-OSTBOP-2012-0001
  - Root-Cause Analysis and Lessons Learned
- Inadequate training on fire system, operations, response and ITM

Other Issues

- AHJ not clear throughout project – Air force HQ, Local KAFB FM, Local KAFB Contractor, or NNSA
- Took 2 months to perform acceptance test and place system in-service
- Existing electrical transformer would not support both pumps running and complex service simultaneously – installed electrical shunt trip to complex
- Hard time meeting 12-inch requirement converting pendant deluge sprinklers to upright wet-pipe
- Replaced clogged floor drain in fire pump room
- Replaced broken oil/water separator in hangar
- Resurfaced hangar floor after foam acceptance testing

Logistics Issues – New HEF System

- New Inspection, Testing & Maintenance Procedures for new system
- Train occupants on new system features and operations (electrical shunt trip)
- New response protocols for occupants, security and fire department
- New system impairment process
- Other

Eglin AFB HEF Fatality Summary - 1/8/2014

- Jan 2014 Polar Vortex (Low Temp 17 deg. F) – Freezing in Gulf – Frozen sprinkler ITV that burst and tripped sprinkler flow switch – HE Foam accidental system trip
- Hangar personnel called into Maintenance leaking ITV twice before it burst
- 90,600 square foot hangar
- Foam filled hangar to 17-feet
- Four Contractors working in adjacent office building were helping fire department clear building – got curious about foam and took elevator from 3rd floor down into hangar where foam over-came elevator car against FD Direction.
  - 2nd & 3rd Contractor found a way out
  - 4th Contractor rescued after 5 minutes
  - 1st Contractor rescued after 1Hr-19Mins – fatality
- Workers were not familiar with Hangar building and hazards of foam
- They had no business entering 1st floor of hangar after told by fire department
- Training required for building occupants, system operation, response protocols, fire department rescue after actuation
- Issues with HEF system trip delay with automatic flow switch actuation
- Previous AF Spec – Wet-pipe sprinklers and HE Foam Activated: manually, flow switch OR UV/IR detectors.
- Current AF Spec – Wet-pipe sprinklers and HE Foam Activated: manually, flow switch AND UV/IR detectors

NW Camera - Hangar

SE Camera - Hangar

Foam System Acceptance Test Criteria

- Air Force ETL 98-8
  - A3.5.2. High expansion foam systems must deliver sufficient foam to cover the aircraft servicing area and adjacent accessible areas to a depth of 1 meter (3 feet) in 4 minutes or less.
  - A3.5.2.1. Concentrate and water supply must permit continuous operation of the system to generate four times the submergence volume (A3.5.2) for not less than 15 minutes. No additional foam is required for maintenance of the submergence volume beyond this 15 minutes.
  - Similar to NFPA 11 requirements.

High Expansion Foam System Trip Video

Questions????