

**EVALUATION OF:**

**HANGAR AND SUPPORT FACILITIES  
BUILDINGS 107 AND 121  
130<sup>TH</sup> AIR NATIONAL GUARD FACILITIES  
YEAGER AIRPORT  
CHARLESTON, WEST VIRGINIA**

**PERFORMED FOR:  
THE CENTRAL WEST VIRGINIA  
REGIONAL AIRPORT AUTHORITY**

**PERFORMED BY:**



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**June 13, 2005**



June 24, 2005

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Richard A. Atkinson, III  
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Rick,

From the information we have obtained regarding the "C" rating system utilized by the Air National Guard, we can find no direct correlation between the actual condition of the hangars at the 130<sup>th</sup> Air National Guard and the "C-4" rating used on the "Installation and Facilities Readiness Report".

Further, the rating system appears to not take into account the ability of these facilities to fulfill their intended purpose for the next 20 years.

From our research, it appears that the "C" rating system is primarily based on the cost of replacement of these structures. The ratio is based upon a numerator which is the cost to replace the facilities. The replacement cost is inflated to reflect the construction cost possibly 20 years from now, so this number is quite large. The denominator that this number is divided by represents the current "value" of the existing facilities which has been depreciated over the life of the structure; in this case 35 and 50 years. Therefore the bottom number is very low. This equates to a high number, which results in the C-4 rating.

Hypothetically, if two bases had identical facilities in identical shape and one was contemplating replacing their facilities in the next 20 years and the other was not, then the two identical facilities would receive drastically different "C" ratings.

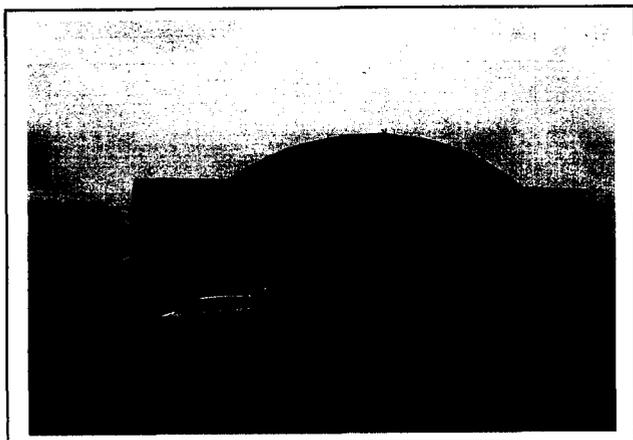
A more direct evaluation performed by the Air National Guard is their "Form 920-Space Use of Real Property" which lists the two hangars in the condition of 2 out of 5, which would indicate the facilities are in good working shape. A rating of 1 indicates the facilities are new and a rating of 5 indicates the facilities must be replaced.

Sincerely,

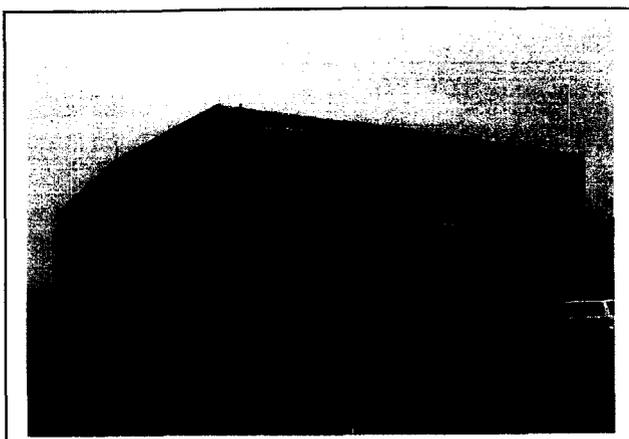
BUCHART-HORN, INC.

Michael M. Phillips, AIA

Project Architect



**Building 107- Maintenance Hangar**



**Building 121 – Fuel Cell Hangar**

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## I. INTRODUCTION

Buchart-Horn, Inc. was hired by the Central WV Regional Airport Authority to perform an independent evaluation of two hangar structures and the support facilities within those structures. The structures are located at the 130<sup>th</sup> Air National Guard Unit at Yeager Airport. The two structures are Building 107, the Maintenance Hangar, and Building 121, the Fuel Cell Hangar. The evaluation was to include a visual inspection of the facilities to determine their current existing physical condition and to report on items discovered that require remediation.

A team was assembled of the staff of Buchart-Horn, Inc. including:

Michael M. Phillips, Architect  
Jeffrey Kaminski, Structural Engineer  
Michael Miller, Mechanical Engineer  
Jeffrey Moreland, Electrical Engineer

The basis of review included general building industry standards, codes, life cycle information and cost information.

The team inspected the two facilities on June 10<sup>th</sup> and 11<sup>th</sup> of 2005 with the goal of delivering a report on June 13<sup>th</sup>. The inspection included viewing readily accessible areas, those areas that did not require demolition to view, as well as existing documentation of the two facilities. Given the time constraint and the magnitude of the facilities these inspections were not exhaustive and included only a partial viewing of similar areas to determine an average condition.

The following reports include the findings from these inspections.



## II. ARCHITECTURAL EVALUATIONS

### **BUILDING 107 - AIRCRAFT MAINTENANCE HANGAR circa 1949**

**Hangar - +/-26,437 s.f.**

**Shops/Offices/Support - +/- 15,000 s.f.**

- 1) Roof:
  - a) Hangar: The roof of the main hangar (arched trussed area) is of painted corrugated steel. It has been fully cleaned, prepared, painted and caulked in the last year. It was reported that there is some water infiltration during high volume rain storms. This apparently occurs at the joints where one corrugated panel overlaps another, which should be repaired by applying caulking to the joint from the inside. Having just been painted this roof does not appear to require additional major maintenance for 10+ years, only minor maintenance caulking of joints due to expansion/contraction of panels.
  - b) Shops/Offices/Support: The roofs of these areas are low slope asphaltic felt roofs. They appear to have been patched within the last 4 months and are in decent shape. These roofs, if maintained properly should not require replacement for 6 to 10 years.
  
- 2) Perimeter walls:
  - a) Hangar: Vertical clerestory areas are of corrugated metal and single pane windows. The windows and metal are in good shape as by design they are shed by an overhang. The Hangar doors, though noisy, operated without flaw to allow the bucket truck to enter the hangar.
  - b) Shops/Offices/Support: Exterior walls are of painted block and are of decent shape with single pane windows. The overhang of the roof and gutter is sufficient but could be extended to provide better weather protection. As long as the exterior walls are painted and maintained this should not be an issue. These apparently have been painted in the last year.
  
- 3) Interior walls:
  - a) For both the hangar and the support spaces the interior walls are painted block and are in good condition with no visible signs of settlement or cracking.
  
- 4) Interior floors:
  - a) For both the hangar and the support spaces; all interior floors are slab on grade and are in good shape. No noticeable signs of settlement or cracking were observed. In the former shower area there were signs of former leak problems with a floor drain, but this appears to have been resolved.



- 5) Means of egress (fire exit requirements):
  - a) Signage is reflective and posted in proper areas. Could be upgraded to lighted signage but as an existing condition is not required.
  - b) Doors separating areas are metal doors dating to the 1940's which while not carrying a rated label should meet the requirements of labeled doors today.
  - c) The hangar and all of the perimeter shops and support spaces appear to have sufficient means of egress to the exterior with outlined exit paths taped in reflective yellow on the floor.
  
- 6) Latrine facilities:
  - a) The latrine and shower facility show signs of disrepair and should be modernized and upgraded.
  - b) There are also no facilities for females and this should also be remedied\*\*.
  
- 7) ADA issues\*\*:
  - a) Hangar currently is accessible with no improvements required.
  - b) Shop/Offices/Support: ADA latrine facilities need to be provided. All other components appear to meet requirements.

\*\* If required for this military installation.

## **BUILDING 121 - FUEL CELL MAINTENANCE HANGAR**

**circa 1970**

**Hangar +/-20,397 s.f.**

**Shops/Offices/Support +/-25,130 s.f.**

- 1) Roof:
  - a) Hangar: The roof of the hangar is a low sloped fully adhered EPDM membrane roofing sloped or tapered to drain. The roof appears to have been installed in the last 5 years. This roof shows no visible signs of problems. There is one small lower area near the hangar doors where a roof drain is partially clogged requiring. Typically EPDM roofs have a 15+year warranty and if maintained will last 20+ years.
  - b) Shops/Offices/Support: The roof of these areas is a low sloped fully adhered EPDM membrane roofing sloped or tapered to drain. There are ample walking pads to the various mechanical systems to reduce wear and tear. The roof appears to have been installed in the last 5 years. This roof shows no visible signs of problems. Typically EPDM roofs have a 15+year warranty and if maintained will last 20+ years.
  
- 2) Perimeter walls:
  - a) Hangar: Vertical areas above adjacent roofs are of block are in good shape, with only minor cracks. As long as the exterior walls are painted and maintained they should have many more years of life. They currently are in the process of being

- painted. The hangar doors reportedly operate without problems; day one they were closed and day two they were open.
- b) Shops/Offices/Support: Exterior walls are of painted block and painted metal over block and are of decent shape with single pane windows. These areas have sufficient drip flashing at the roof/parapet to allow sufficient weather protection as long as the walls are maintained and painted. These are in the process of being painted.
- 3) Interior walls:
- a) Hangar: Vertical areas above adjacent roofs are of block are in good shape.
  - b) Shops 1st floor: All walls are painted block and in excellent condition.
  - c) Offices/Classrooms 2nd floor: Most walls are painted drywall and in excellent condition the remaining walls are block and are in excellent condition.
- 4) Interior floors:
- a) Hangar: The floor is concrete slab on grade in excellent condition and the finish is a slip resistant urethane which is also in excellent condition.
  - b) Shops 1st floor: All floors are concrete slab on grade with various finishes from vinyl tile to sealed concrete. All are in excellent condition.
  - c) Offices/Classrooms 2nd floor: Floors are of concrete slab on metal decking with various finishes and are in excellent condition.
- 5) Means of egress (fire exit requirements):
- a) Signage is illuminated exit signage and posted in proper areas.
  - b) No visible deficiencies were noted for means of egress components from 1st or 2nd floor areas.
- 6) Latrine facilities:
- a) There are less female latrine facilities than male facilities on the first floor and second floor. Modern codes require equal to male facilities\*\*.
  - b) There appear to be no separate female showering facilities on the 1st floor\*\*.
- 7) ADA issues\*\*:
- a) The Hangar and all first floor areas utilized for aircraft maintenance are accessible except for modifications necessary to restroom and locker facilities.
  - b) The second floor is inaccessible. If required to be, an elevator and modified restrooms are required.

## ARCHITECTURAL SUMMARY

The only areas that appear to be non-compliant are latrine facilities and ADA issues both as they pertain to the latrines and the second floor of building 121. The latrine issues are addressed in Section IV Plumbing and Mechanical Systems, therefore the only additive architectural item for codes would be an elevator to access the second floor of building 121. If required this would cost approximately \$50,000.

### III. STRUCTURAL EVALUATIONS

#### **BUILDING 107 - AIRCRAFT MAINTENANCE HANGAR**

The structural inspection for this building was performed in the aforementioned cursory nature and focused on the primary structural components in order to identify any deficiencies. The main hangar was accessible by means of a bucket truck provided by National Guard staff. The perimeter 1-story rooms were visually accessible from the ground and were, for the majority, unobstructed from view with the exception of ceiling panels which were moved to examine the structure where this was present.

The main hangar consists of curved structural steel trusses that bear on a concrete system of columns and beams that provide for restraint of the vertical and thrusting loads induced by the trusses at their base. The perimeter rooms are also concrete framed with concrete block infill walls and act integrally with the main hangar concrete supports to support the previously explained forces. A few newer 1-story additions have been added to the perimeter of the hangar and consist of modern typical steel construction comprised of k-series joist, wide flange girders, and wide flange columns.

In general, the building is in good to very good condition.

The steel trusses show no signs of deterioration due to typical reasons such as water infiltration, impact from an exterior source, or age.

The curtain walls oriented on the East and West of the structure show signs of earlier water infiltration by means of rusting wall purlins, however, the deterioration is minor and of no current structural concern.

The lateral bracing that resists horizontal wind forces while appearing sound shows signs that 50 years of wind forces may have loosened the bolts that support threaded cross brace rods.

The concrete supporting both the trusses as well as in the perimeter rooms shows no signs of excessive stress by means cracking due to shear or bending forces. Also note that no sign of water infiltration or original improper reinforcement placement is evident by means of spalling or discoloration of any kind.

The concrete block exterior infill walls also showed no signs of excessive stress.

Note that while foundation concerns are much harder to determine with a cursory inspection, we were unable to notice any discernable foundation problems from typical tell-tale signs on the superstructure by means of noticeable settlement, cracking, or frost-heaving.

The only immediate structural concern occurs in the newer steel joist roof framed areas around the perimeter of the hangar. We performed structural calculations due to a suspicion that the joists were under-designed and determined that the current 10K1 joists provided in a few of these areas are under-designed by approximately 50% based on current building code required snow drift loading. This is easily remedied with the addition of new joists in-between the existing joists to add additional capacity to the structure.

### **BUILDING 121 - FUEL CELL MAINTENANCE HANGAR**

The structural inspection for this building was performed in the aforementioned cursory nature and focused on the primary structure in order to identify any deficiencies. The main hangar was accessible by means of a bucket truck provided by National Guard staff. The perimeter 1-story rooms were visually accessible from the ground and were, for the majority, unobstructed from view with the exception of ceiling panels which were moved to examine the structure where this was present.

The main hangar consists of structural steel trusses that are supported by steel wide flange columns. Lateral bracing for the structural consists of steel angle cross braces that in turn transmit the wind force loading to the cmu walls around the perimeter of the structure. The perimeter rooms are steel framed consisting of wide flange beams, girders, and columns. A few newer 1-story additions including an exterior canopy has been added to the perimeter of the hangar and consist of a modernly typical steel construction comprised of k-series joist, wide flange girders, and wide flange columns.

In general, the building is in good to very good condition.

The steel trusses, curtain walls, and lateral braces show no signs of deterioration due to typical reasons such as water infiltration, impact from an exterior source, or age.

The concrete block exterior shear walls also showed no signs of excessive stress with the exception occurring along the top course in multiple areas by means of block that has started to crush due to the constant deflection of the structural frame over time without any original allowance for normal service life deflections typical to steel structures. This is however of no immediate structural concern.

Note that while foundation concerns are much harder to determine with cursory inspection, we were unable to notice any discernable foundation problems from typical tell-tale signs on the superstructure by means of noticeable settlement, cracking, or frost-heaving.



The only immediate structural concern occurs in the newer steel joist roof framed areas around the perimeter of the hangar. We performed structural calculations due to a suspicion that the joists were under-designed and determined that the current 10K1 joists provided in a few of these areas are under-designed by approximately 50% based on current building code required snow drift loading.

### **SUMMARY**

Both buildings are in good to very good condition and are completely sound structurally. As long as they are maintained properly, which they have been, they should be able to fulfill their function for at least another 20 years.

#### **Code and immediate upgrade issues**

1. Tighten and tack weld threaded cross brace to bolts (107) \$500
2. Snow loading additional steel to design and construct fifteen new 10K1 joists for under-designed areas of new perimeter room (107 & 121) \$5000

#### **Maintenance/Life cycle issues**

3. Sandblast and epoxy paint rusted curtain wall purlins (107) \$2500



#### IV. PLUMBING AND MECHANICAL EVALUATION

##### BUILDING 107 - AIRCRAFT MAINTENANCE HANGAR

- 1) Plumbing
  - a) Water Service and Distribution
    - i) 155 psig pumped service with backup from Yeager Airport system
    - ii) Cast iron water pipe in fair condition without back flow prevention piped to fixtures and equipment. No reported flow inadequacies.  
**(1) Recommendation #1 – insert back flow preventor \$10,000**
    - iii) A few isolated valves and elbows are covered with suspect hazardous materials, which appears to be decades old.  
**(1) Recommendation #2 – test material & remove any found to be hazardous. \$5,000**
    - iv) Summary -Appears to be in fair condition, operating, and fulfilling current needs.
  - b) Domestic Hot Water
    - i) Residential type water heater in fair condition.
    - ii) Appears to be in fair condition, operating, and fulfilling current needs.
  - c) Sanitary Sewer
    - i) Under ground cast iron piping and fittings discharging to under ground collection.
    - ii) Portions of piping developed leaks and floor opened and the pipe replaced.
  - d) Storm Water
    - i) Gutter and down spout collected in underground boots discharging through piping to grade.
    - ii) Appears to be in good condition, operating, and fulfilling current needs.
  - e) Natural Gas Service and Distribution
    - i) Underground service extended in 1989 to regulators.
    - ii) Steel piping serving radiant heaters.
    - iii) Appears to be in good condition, operating, and fulfilling current needs.
  - f) Compressed Air
    - i) Galvanized steel piping with regulators, hose reels, and quick connection fittings.
    - ii) Two electrically driven air compressors, one old and one a few years old.
    - iii) Appears to be in fair condition, operating, and fulfilling current needs.



- g) Plumbing Fixtures and Equipment
  - i) Emergency Eye washers in hangar area Appears to be in fair condition, operating, and fulfilling current needs.
  - ii) Emergency shower in battery area which is elevated in a shower enclosure that is. Appears to be in poor condition, not easily accessible but operating, and not fulfilling current needs.  
**(1) Recommendation #3 – replace with current standard device. \$2,000**
  - iii) Plumbing fixtures are currently non-compliant and showing wear.  
**(1) Recommendation #4 – upgrade Latrines \$15,000**
- 2) Fire Protection
  - a) Water Supply
    - i) 200,000 gallon storage supplemented by 330,000 gallon storage from Yeager.
    - ii) Storage replenished by treated municipal water pumps at a rate greater than peak flow demand
    - iii) Appears to be in good condition, operating, and fulfilling current needs.
  - b) Fire Service
    - i) Underground through Post Indicator Valves PIV
    - ii) Yard Hydrant adjacent to Fire Department connection.
    - iii) Appears to be in good condition, operating, and fulfilling current needs.
    - iv) Automatic Sprinklers –None  
**(1) Recommendation #5 – provide sprinklers in storage rooms greater than 100 Square foot in area. \$5,000**
  - c) Fire Hose
    - i) Local valve and hose connections spaced at perimeter of hangar.
    - ii) Appears to be in fair condition, operating, and fulfilling current needs.
  - d) Foam Fire Suppressing System
    - i) Newer system installed approximate 1989.
    - ii) Foam equipment in remote room interlocked to rate of heat detectors.
    - iii) Four Automated oscillating foam nozzles around aircraft location.
    - iv) Not total flooding type.
    - v) Appears to be in good condition, operating, and fulfilling current needs.
- 3) Heating, Ventilating, and Air Conditioning
  - a) Building heating
    - i) Gas fired radiant tubes and deflector system in hangar and adjacent spaces.
    - ii) A few fire tubes are oxidized.
    - iii) Appears to be in fair condition, operating, and fulfilling current needs.



- b) Exhaust
  - i) None in latrine area
    - (1) **Recommendation #6 – provide make-up and exhaust fans and ductwork \$7,500**
  
- c) Ventilation
  - i) None in Hangar area
    - (1) **Recommendation #7 – provide make-up air units and ducted low exhaust \$100,000**
  
- d) Fume Exhaust
  - i) Fume Hood in Battery area.
  - ii) Appears to be in fair condition, operating, and fulfilling current needs.
  
- e) Air Conditioning
  - i) Window air conditioners in support areas such as shops and offices.
    - (1) **Recommendation # 8 – replace with ducted HVAC system \$ 15,000**
  - ii) Appears to be in fair condition, operating, and fulfilling current needs.
  
- f) Fire Alarm Interface
  - i) Interlocked to remote fire station.
  - ii) Appears to be in good condition, operating, and fulfilling current needs.

## **BUILDING 121 - FUEL CELL MAINTENANCE HANGAR**

- 1) Plumbing
  - a) Water Service and Distribution
    - i) 155 psig pumped service with backup from Yeager Airport system
    - ii) Cast iron water pipe in good condition without back flow prevention piped to fixtures and equipment. No reported flow inadequacies.
      - (1) **Recommendation #9 – insert back flow preventor \$10,000.**
    - iii) Appears to be in good condition, operating, and fulfilling current needs.
  
  - b) Domestic Hot Water
    - i) Residential type water heater in good condition.
    - ii) Appears to be in good condition, operating, and fulfilling current needs.
  
  - c) Sanitary Sewer
    - i) Under ground cast iron piping and fittings discharging to under ground collection.
    - ii) Appears to be in good condition, operating, and fulfilling current needs.
  
  - d) Storm Water
    - i) Roof Drains collected in underground boots discharging through piping to grade.

- ii) Appears to be in good condition, operating, and fulfilling current needs.
- e) Natural Gas Service and Distribution
  - i) Underground service
  - ii) Steel piping serving roof top heaters.
  - iii) Appears to be in good condition, operating, and fulfilling current needs.
- f) Compressed Air
  - i) Galvanized steel piping with regulators, hose reels, and quick connection fittings.
  - ii) Two small electrically driven air compressors,
  - iii) Appears to be in good condition, operating, and fulfilling current needs.
- g) Plumbing Fixtures and Equipment
  - i) Emergency Eye washers in hangar area
  - ii) Appears to be in good condition, operating, and fulfilling current needs.
- h) Plumbing fixtures in adjacent support area
  - i) Appears to be in good condition, operating, and fulfilling current needs.
- i) Fire Protection
  - i) Water Supply
  - ii) 200,000 gallon storage supplemented by 330,000 gallon storage from Yeager.
  - iii) Storage replenished by treated municipal water pumps at a rate greater than peak flow demand
  - iv) Appears to be in good condition, operating, and fulfilling current needs.
- j) Fire Service
  - i) Underground through Post Indicator Valves PIV
  - ii) Yard Hydrant adjacent to Fire Department connection.
  - iii) Appears to be in good condition, operating, and fulfilling current needs.
- k) Automatic Sprinklers
  - i) N/A
- l) Fire Hose
  - i) Local valve and hose connections spaced at perimeter of hangar.
  - ii) Appears to be in good condition, operating, and fulfilling current needs.
- m) Foam Fire Suppressing System
  - i) Foam equipment in remote room interlocked to rate of heat detectors.
  - ii) Four Automate occilating foam nozzles around aircraft location.
  - iii) Not total flooding type.
  - iv) Appears to be in good condition, operating, and fulfilling current needs.



- 2) Heating, Ventilating, and Air Conditioning
  - a) Building heating
    - i) Gas fired roof top air handling units with ducted supply high in Hangar. Appears to be in good condition, operating, and fulfilling current needs.
  - b) Exhaust
    - i) In Hangar and adjacent support areas.
    - ii) Appears to be in good condition, operating, and fulfilling current needs.
  - c) Ventilation
    - i) Low floor-skimming type in Hangar area for general exhaust.
    - ii) Appears to be in good condition, operating, and fulfilling current needs.
  - d) Fume Exhaust
    - i) Flexible ducts and exhaust system for fume ventilation of fuel cells.
    - ii) Appears to be in good condition, operating, and fulfilling current needs.
  - e) Air Conditioning
    - i) Roof top DX air handling type in support areas such as Latrines, lockers, shops and offices.
    - ii) Appears to be in good condition, operating, and fulfilling current needs
  - f) Fire Alarm Interface
    - i) Interlocked to remote fire station.
    - ii) Appears to be in good condition, operating, and fulfilling current needs.

### SUMMARY

The plumbing, fire protection and hvac systems (with preventative maintenance) have the potential to perform for at least an additional 15 years.

#### Code and immediate upgrade issues

#1	Backflow Bldg 107	\$10,000
#2	Asbestos Bldg 107	\$5,000
#3	Emerg. Shower Bldg 107	\$2,000
#5	Storage Rm Sprinkler Bldg 107	\$5,000
#7	Hangar makeup air Bldg 107	\$100,000
#9	Backflow Bldg 121	\$10,000

#### Maintenance/Life Cycle issues

#4	Upgrade latrines Bldg 107	\$15,000
#6	Latrine exhausts Bldg 107	\$7,500

#### Convenience

#8	Ducted A/C in shops Bldg 107	\$15,000
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## V. ELECTRICAL EVALUATION

### WEST VIRGINIA AIR NATIONAL GUARD HANGAR FACILITIES ELECTRICAL SYSTEMS EVALUATION

The evaluation was limited to the electrical systems associated with the Maintenance Hangar (Bldg. 107) and the Fuel Cell Hangar (Bldg. 121). The following criteria and scope served as the basis of the evaluation:

#### Basis of Evaluation

- Visual Inspection (equipment condition, nameplate information, circuit and equipment labels, etc.)
- Interview of maintenance and supervisory personnel
- Review of drawings from original design and subsequent renovations
- Review of facility master planning and related documents
- Review of 2003 and d 2004 facilities assessment reports (Installation Readiness Reports) and related documents

#### Evaluation did not include:

- Measurements of Line to Ground or Line to Line Voltages
- Measurements of Line, Ground or Neutral Conductor currents
- Measurements of Lighting Levels
- Existing single-line diagrams (unavailable)
- Internal examination of equipment requiring tools or keys for opening

#### Electrical Systems Inspected:

- Utility Service Transformers
- Main distribution Equipment
- High Bay Lighting
- Interior/Exterior Lighting
- IR Radiant Heating Systems
- Machine Tool Equipment
- Test Stand Equipment
- 400Hz Ground Power Generation Units
- Emergency Power Generation Units

Both buildings are supplied from a single utility pole with dual risers feeding underground service lateral conductors. These lateral conductors serve three large utility owned pad-mounted transformers located inside a fenced-in area between the Communications building and the Maintenance Hangar, each with its own enclosure for internal metering and connection equipment. The site is thus well positioned for any future increase in power requirements.

### Maintenance Hangar Electrical Evaluation

Building 107 is older (built in the 1940's) but its electrical systems appear to be of more recent vintage (1960's style equipment). The primary distribution within the building is a 208/120V 4-Wire, 3-Phase system served from a 1600A main distribution panel (GE AV-Line with 1600A main disconnect) located in the sheet metal shop and fed from one of the utility transformer. This panel in turn feeds a 63 KVA 400HZ Ground Power unit and the majority of the other distribution panels in the building (none of these circuits were labeled). There is also a single 480V Panel present in this room whose source was not readily apparent, but seemed to have its own feed from outside the building (perhaps directly from the transformer pad). Although these panels were observed to be in fair condition, the breakers are nearing their useful life. Consideration should be given to updating these main distribution panels at some point in the near future. Feeder, sub-feeder and branch circuit conductors are all enclosed in conduits and their condition could not be visually observed.

### Fuel Cell Hangar Electrical Evaluation

Building 121 is somewhat newer (built in the 1970's) with what appear to be the original electrical systems and equipment. The primary distribution within the building is a 208/120V 4-Wire, 3-Phase system served from a 1200A main switchboard (Square-D I-Line HCWM with 1200A main breaker) located in the "boiler room". This switchboard serves the majority of the other lighting and power distribution panels in the building as well as two Air Compressors (300A), the Avionics bus duct system and a small motor control center (90A). The switchboard is fed from a 300 KVA floor-mounted transformer also located in the boiler room. This transformer is fed from an 800A 480/277V 4-Wire, 3-Phase Main Distribution Panel used as the building's primary service entrance equipment fed directly from the utility transformers. This 480V panel also feeds several roof-top HVAC units along with a 63KVA 400 HZ Ground Power unit. All of this distribution equipment is in good condition and is not in need of replacement in the near future.

The boiler room has a single entrance. The 2005 National Electric Code requires that all electrical rooms containing distribution equipment of 1200A or greater must have two entrances – one on each side of the equipment. This safety requirement is designed to ensure servicing personnel a means of escape in the event of a fire without being trapped. In order to meet this requirement, a metal fire-door can be installed on the wall between the 1200A switchboard and the 480V Main distribution panel. This door would lead into the adjacent room. All other clearance requirements are being met.

### Emergency Power

A single 52A 208/120V stand-by diesel generator located outside the front of Bldg. 107 was observed to be supplying power to the 2<sup>nd</sup> Floor offices of Bldg. 121. A second



identical generator was observed between buildings 107 and 121 and appeared to be serving the rear areas of Bldg. 121. These generators are not connected to a transfer switch and must be started manually. Thus, it seems the majority of the Hangar spaces (both buildings) and all of building 107 are not backed up with stand-by power and cannot operate during a power outage. This includes both the interior (high-bay and shop areas) and exterior lighting for both hangars. The existing generators could be replaced with a single generator (250 or 300KW, 208/120V, 3-Phase, 4-Wire Diesel unit) to allow operation of all critical systems during the event of an outage.

#### Grounding and Lightning Protection

Visual inspection appeared to confirm that the service entrance equipment of both hangars was grounded in accord with NEC (National Electric Code) requirements. In addition, both buildings were observed to have lightning rods affixed to the roofing structure although lightning arrestors could not be located. In conversations with supervisory personnel, it was indicated that a lightning protection system upgrade has been identified in previous building evaluations. Such a system is required by the Air Force AFM 88-9 regulation governing lightning and static electricity protection. A proposal and cost estimate have been received by an authorized manufacturer in accord with this regulation.



Summary of Evaluations

The following table summarizes the results of the electrical system evaluation:

Equipment	Evaluation	Recommendation	Cost	Schedule
Main Distribution Equipment (Bldg. 107)	Fair	Replace	\$15,000	5-10 yrs
Main Distribution Equipment (Bldg. 121)	Good	The equipment is in good condition, however current code requires the installation of a second exit door.	\$2,000	0-5 yrs
IR Radiant Heating	Fair	Several of the heating elements are exhibiting excessive corrosion and should be replaced individually as required	\$7,000	0-5 yrs
High-Bay Lighting Systems	Good	None	-	-
Interior Lighting Systems	Fair	Consider upgrading existing magnetic ballasts to electronic for energy efficiency	\$25,000	0-5 yrs
Emergency Power	Poor	Upgrade. Existing generators are insufficient to operate these facilities during a power outage (estimate includes single generator serving both buildings)	\$90,000	0-5 yrs
Grounding and Lightning Protection	Fair	Upgrade to meet Air Force regulations (estimate includes buildings 107, 111 and 121 also)	\$240,000	0-5 yrs

Following through on these recommendations will extend the useful life of these facilities beyond the current programming horizon, which we understand to be 2012.

## VI. SUMMARY OF CONDITIONS AND RECOMMENDATIONS

### Condition

Both of the hangars and their respective support spaces have been extremely well maintained and are in good to very good condition.

### Adaptability

Both buildings can readily be added to or modified to accommodate future expansion, modernization and adaptations.

**Building 107 Hangar.** The hangar can be readily expanded to the West (door side) to increase the depth of the facility. Doing so will reduce the apron out front. The main limitation of this facility is it's width which according to plans is approximately 145'-0" clear between columns and up to the springline of the arches which occurs at +/- 12' above the finished floor. The width then narrows as the arches taper in above this point giving differing clearances depending upon the elevation of the aircraft wing above grade.

**Building 107 Support Facilities:** To accommodate more shop space or office space these facilities could be expanded in many ways:

- If the hangar were extended to the West, then these facilities could also be extended to the West.
- These facilities could be extended on the ground floor approximately 30 feet to the East to the edge of Commando Road.
- The extension to the East could be a 2 story addition to move the offices residing in the existing hangar shop space.
- A second floor could be added over top of the existing shops and support spaces. These 2<sup>nd</sup> floor areas could be office, restrooms, locker rooms or storage facilities

**Building 121 Hangar:** The hangar can be readily expanded to the West (door side) to increase the depth of the facility. Doing so will reduce the apron out front. The main limitation of this facility is also it's width which according to plans is 150'-0" at the doors and approximately 165' inside walls.

**Building 121 Support Facilities:** These areas can also be expanded and adapted in many ways:

- If the hangar were extended to the West, then these facilities could also be extended to the West.
- These facilities could be extended on multiple floors to the North, but doing so will limit the apron.
- Additional floors could potentially be added over top of the existing shops and support spaces.



**Noted areas of improvement:**

The chart below gives an approximate magnitude to the items discovered to potentially be deficient.

Column One addresses issues specific to these particular structures; issues that are mostly due to the age of the facilities and how they were constructed.

Column Two addresses items found in the existing facility that would cost the same if building new facilities at this time.

Column Three lists maintenance and life cycle costing issues that typically are budgeted into every building.

Column Four items are those items deemed to be optional because they deal with convenience or comfort.

**AGGREGATE VALUES FOR ITEMS DISCOVERED**

	Code Issues Existing Only	Code Issues New or Existing	Maintenance Issue	Optional Issues
<b>Architectural</b> 121 ADA Elevator		\$ 50,000.00		
<b>Structural</b> 107 Tighten and tack weld cross brace 107 Additional roof steel for snow load 107 Epoxy paint curtain wall purlins	\$ 500.00 \$ 5,000.00			\$ 2,500.00
<b>Plumbing, Fire, HVAC</b> 107 Backflow preventor 107 Asbestos testing/abatement 107 Emergency shower 107 Latrines 107 Storage areas sprinklers 107 Latrine exhausts & makeup air 107 Hangar ventilation 107 A/C shops & offices 121 Backflow preventor	\$ 5,000.00 \$ 5,000.00	\$ 10,000.00 \$ 2,000.00 \$ 100,000.00 \$ 10,000.00	\$ 15,000.00 \$ 7,500.00	\$ 15,000.00
<b>Electrical</b> 107 Main Distribution equipment 121 Main Distribution equipment 107 IR Radiant Heating 107 Interior Lighting Systems both Emergency Power *** both Grounding and Lightning Protection		\$ 90,000.00 \$ 240,000.00	\$ 15,000.00 \$ 2,000.00 \$ 7,000.00	\$ 25,000.00
<b>Total Code Items specific to existing facilities</b>	\$ 15,500.00			
<b>Total Code Items necessary for New or Existing</b>		\$ 502,000.00		
<b>Total Maintenance Items</b>			\$ 46,500.00	
<b>Total Optional Items</b>				\$ 42,500.00

