Sugarbush Elementary

Chesterfield, MI.

Mechanical and Electrical Systems Due Diligence & Feasibility Report

February 2, 2024

PBA Project No. 2023.0428.00

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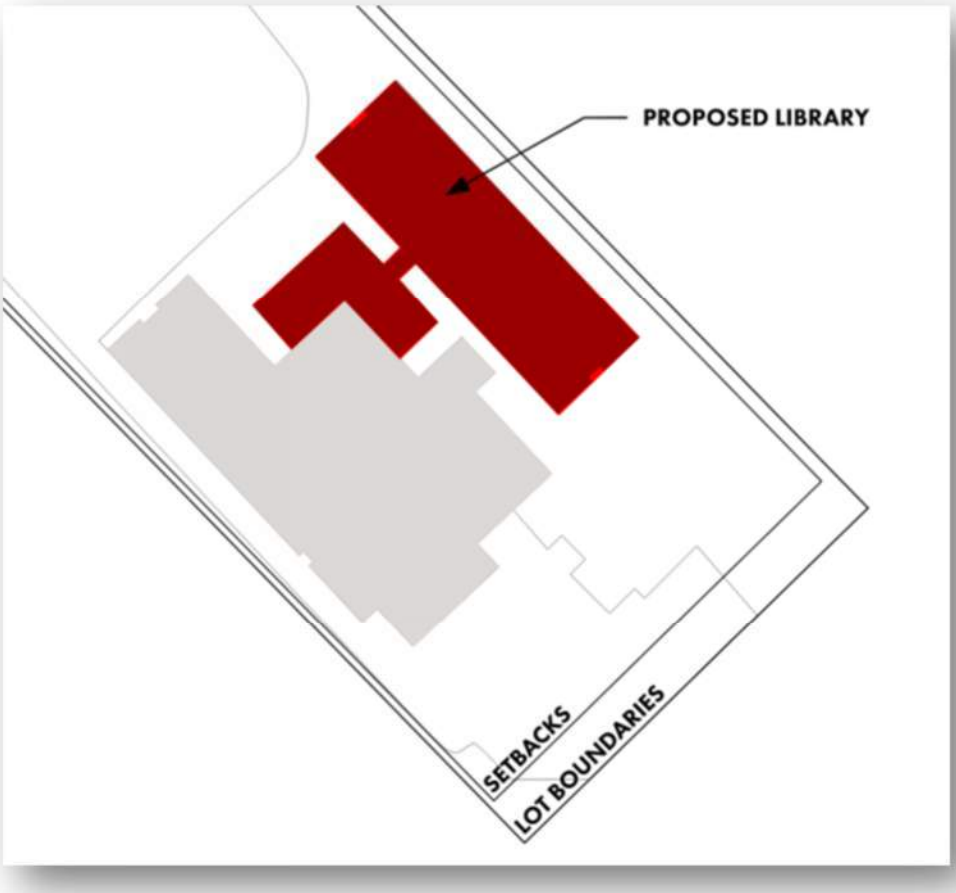
CONSULTING ENGINEERS

Mechanical and Electrical Systems - Executive Summary

Peter Basso Associates (PBA) was contracted by Quinn Evans Architects (Client) to perform a condition assessment of the existing mechanical and electrical systems at Sugarbush Elementary School in Chesterfield, Michigan. In addition to the condition assessment, PBA was asked to review the feasibility of utilizing the existing mechanical and electrical systems for the conversion of the east wing into a community library.



Overall, the mechanical systems are operational, however the equipment is in poor condition and has exceeded its useful service life. Maintenance staff noted the central heating and cooling systems are requiring additional maintenance calls yearly to keep the equipment operational. The temperature control system in the east wing is pneumatic and is antiquated. Plumbing fixtures and piping are original although they appear to be operational and in fair condition. The east wing is not provided with a fire suppression system.

In order to accommodate a library conversion, a new mechanical system is recommended. The existing systems are not adaptable to accommodate a library conversion. The section that follows provides multiple options and cost data for consideration by the Township.

Overall, the electrical systems are operational, however, some of the equipment is past the recommended lifespan. The condition of the conduit and feeders was observed to be, in most places, in good condition and could be selectively reused after testing for degradation. The panelboards, distribution panels, and transformers that primarily serve the proposed library will need to be replaced to accommodate the library conversion. The existing utility service and main distribution panelboard were observed to be in good condition and can accommodate the estimated loads for a library. Dividing the electrical load between the library and the community center would be feasible with some alterations and sub-metering.

The existing lighting, emergency egress lighting, lighting controls, receptacles, fire alarm, and exit signs would need to be replaced due to their age and incompatibility with the proposed layout.

The following section provides cost data for consideration by the Township.

Mechanical, Electrical, and Plumbing Feasibility for Library Conversion

PBA in conjunction with Quinn Evans Architects reviewed two conceptual floor plans for converting the existing school into a library. The following options that are being recommended can accommodate either concept.

Plumbing and Fire Protection Recommendations:

The existing building is provided with a single domestic water service, however there is no fire suppression system in the building. Based on the concept plans and the usage of the building the following are our recommendations.

1. Provide new fire suppression service and wet pipe sprinkler system throughout the library.
2. Split the existing water service and provide a separate tap for the library.
3. Provide a new water meter and backflow prevention device on the branch serving the library.
4. Provide a new domestic water heater, hot water piping, and hot water return system to serve plumbing fixtures.
5. Provide new plumbing fixtures throughout the library.
6. Provide new sanitary sewer to connect to existing site utilities.
7. Provide new roof drainage and drain to grade similar to current building.

Heating, Ventilating, and Air Conditioning (HVAC) Recommendations:

The HVAC systems in the existing east wing will be removed in their entirety. The following options are provided in a “Good”, “Better”, and “Best” order.

Option #1-Good

1. Provide (6) high efficiency packaged rooftop units designed for variable air volume.
    - Rooftop units will be provided with direct expansion cooling and modulating gas heat.
2. Provide (2) high efficiency wall mounted boilers that will deliver heating hot water to the library.
    - Heating system will be piped in a primary, variable only configuration.
    - Provide (2) hot water heating circulating pumps.
    - Provide expansion tank, air/dirt separator, and chemical bypass feeder.
3. Provide overhead supply air duct system and plenum return system.
4. Provide air terminal units with hot water tempering coils to serve the temperature control zones.
5. Provide new building automation system (BAS) with direct digital controls (DDC)

Option #2-Better

1. Provide (1) indoor air handling unit designed for variable air volume.
    - Air handling unit will be provided with direct expansion cooling and hot water heating coils.
    - Packaged air cooled condensing unit will be located on the roof.
2. Provide (2) high efficiency wall mounted boilers that will deliver heating hot water to terminal devices and air terminal unit tempering coils.
    - Heating system will be piped in a primary, variable only configuration.
    - Provide (2) hot water heating circulating pumps.
    - Provide expansion tank, air/dirt separator, and chemical bypass feeder.
3. Provide overhead supply air duct system and plenum return system.
4. Provide air terminal units with hot water tempering coils to serve the temperature control zones.
5. Provide new BAS with DDC for the library.

Option #3-Best

1. Provide geo-exchange field consisting of approximately (50) vertical bores to approximately 500 feet.
2. Provide two base mounted pumps indoors to circulate the geo-exchange fluid through the field and equipment.
3. Provide (1) indoor air handling unit designed for variable air volume.
    - Air handling unit will be provided with chilled water and heating hot water coils.
4. Provide (1) water to water heat pump that will generate chilled water and hot water heating for the building.
5. Provide (2) high efficiency wall mounted boilers that will deliver heating hot water as stand-by in the event the geo-exchange field cannot keep up with the low temperatures.
6. Provide overhead supply air duct system and plenum return system.
7. Provide air terminal units with hot water tempering coils to serve the temperature control zones.
8. Provide new BAS with DDC for the library.

Electrical Recommendations

PBA recommends revising and replacing the electrical system as follows:

1. Removal of all branch circuits serving the library area from distribution panels DP-2 and DP-1.
2. Removal and relocation of all mechanical equipment branch circuits serving the community center from distribution panels DP-3 and DP-4 to DP-2.
3. Provide new distribution panels in place of DP-3 and DP-4 to serve the library. Utilize the existing feeders.
4. Provide new transformers and branch circuit panelboards to serve the library.

The existing 250A feeder for DP-3 would supply the lighting, receptacles, and all other miscellaneous loads for the library via a new distribution panelboard. While the existing 350A feeder for DP-4 would feed all required mechanical equipment for the library via a new distribution panelboard. New meters will be located upstream of the new DP-3 and DP-4 distribution panelboards, allowing the library to pay for its percentage of the shared electric bill. The changes described above would provide the library with 600A at 480Y/277V, which equates to approximately 16W/ft^2 for the proposed 25,000ft^2 library. A typical library requires approximately 10 W/ft^2. The proposed split of the electrical system would give the library capacity to accommodate additional loads in the future including a small expansion.

Additionally, PBA recommends adding a generator to the back up any loads that would be needed to allow the library to function during a natural disaster or area power outage.

The existing National Time fire alarm system is operational and can remain. The existing fire alarm panel is located in the library area. PBA recommends maintaining the existing panel location. Existing notification devices may be able to be reused for the library. All new wiring will be needed for new or relocated devices.

The existing alarms in the school will be demolished back to the fire alarm panel with new alarms located in the library, where appropriate. The panel will be relocated, as needed, with all existing alarms feeders in the community center reconnected to the fire alarm panel.

The existing lighting is 2x4 fluorescent troffers installed in 2004. PBA recommends all new lighting and lighting controls for the library.

Mechanical Opinion of Probable Cost - Option #1							
Description	**Cost**			**Unit**	**Qty**	**Low Total**	**High Total**
Demolition of Existing Mechanical Systems	$2	-	$4	per sq ft	25,000	$50,000	$100,000
Fire Protection	$6	-	$8	per sq ft	25,000	$150,000	$200,000
Plumbing	$18	-	$20	per sq ft	25,000	$450,000	$500,000
HVAC - Option #1	$45	-	$55	per sq ft	25,000	$1,125,000	$1,375,000
Temperature Controls	$5	-	$6	per sq ft	25,000	$125,000	$150,000
Total Mechanical Cost of Option #1						$1,900,000	$2,325,000

Mechanical Opinion of Probable Cost - Option #2							
Description	**Cost**			**Unit**	**Qty**	**Low Total**	**High Total**
Demolition of Existing Mechanical Systems	$2	-	$4	per sq ft	25,000	$50,000	$100,000
Fire Protection	$6	-	$8	per sq ft	25,000	$150,000	$200,000
Plumbing	$18	-	$20	per sq ft	25,000	$450,000	$500,000
HVAC - Option #2	$65	-	$75	per sq ft	25,000	$1,625,000	$1,875,000
Temperature Controls	$5	-	$6	per sq ft	25,000	$125,000	$150,000
Total Mechanical Cost of Option #2						$2,400,000	$2,825,000

Mechanical Opinion of Probable Cost - Option #3							
Description	**Cost**			**Unit**	**Qty**	**Low Total**	**High Total**
Demolition of Existing Mechanical Systems	$2	-	$4	per sq ft	25,000	$50,000	$100,000
Fire Protection	$6	-	$8	per sq ft	25,000	$150,000	$200,000
Plumbing	$18	-	$20	per sq ft	25,000	$450,000	$500,000
HVAC - Option #3	$75	-	$85	per sq ft	25,000	$1,875,000	$2,125,000
Temperature Controls	$5	-	$6	per sq ft	25,000	$125,000	$150,000
Total Mechanical Cost of Option #3						$2,650,000	$3,075,000

Electrical Opinion of Probable Cost							
Description	**Cost**			**Unit**	**Qty**	**Low Total**	**High Total**
Demolition of Existing Electrical Systems	$2	-	$4	per sq ft	25,000	$50,000	$100,000
Lighting + Lighting Controls	$15	-	$20	per sq ft	25,000	$375,000	$500,000
Power (Distribution + Devices)	$16	-	$19	per sq ft	25,000	$400,000	$475,000
Communications	$2	-	$4	per sq ft	25,000	$50,000	$100,000
Fire Alarm	$3	-	$4	per sq ft	25,000	$75,000	$100,000
Total Electrical						$950,000	$1,275,000
Optional - Generator for Library (220 kW)	*$80,000*	-	*$100,000*	*each*	*1*	*$80,000*	*$100,000*
Optional - Full Building Generator (500 kW)	*$170,000*	-	*$200,000*	*each*	*1*	*$170,000*	*$200,000*

General Overview of Mechanical:

General Condition:

The majority of the mechanical equipment in the east wing is original and in poor condition. The equipment has been in service for over 20 years. The central heating and cooling systems appear to be in poor condition as well. These systems are between 15-20 years old and were noted to require maintenance several times a year. PBA observed leaks on the boiler room floor which indicates a pipe connection is lose or the boilers have an internal failure. The rooftop equipment serving the administration area is in poor condition.

The following table from 2015 ASHRAE HVAC Applications Handbook provides the median useful life expectancy of the mechanical equipment.

ASHRAE Equipment Life Expectancy chart

ASHRAE is the industry organization that sets the standards and guidelines for most all HVAC-R equipment. For additional info about ASHRAE the website is www.ashrae.org .

Equipment Item	Median Years
Air conditioners	
Window unit	10
Residential single or Split	
Package	15
Commercial through-the wall	15
Water-cooled package	15
Heat Pumps	
Residential air-to-air	15
Commercial air-to-air	15
Commercial water-to-air	19
Roof-top air conditioners	
Single-zone	15
Multi-zone	15
Boilers, hot water (steam)	
Steel water-tube	24 (30)
Steel fire-tube	25 (25)
Cast iron	35 (30)
Electric	15
Burners	21
Furnaces	
Gas- or oil-fired	18
Unit heaters	
Gas or electric	13
Hot water or steam	20
Radiant Heaters	
Electric	10
Hot water or steam	25

Equipment Item	Median Years
Air terminals	
Diffusers, grilles, and registers	27
Induction and fan coil units	20
VAV and double-duct boxes	20
Air washers	17
Ductwork	30
Dampers	20
Fans	
Centrifugal	25
Axial	20
Propeller	15
Ventilating roof-mounted	20
Coils	
DX, water, or steam	20
Electric	15
Heat Exchangers	
Shell-and-tube	24
Reciprocating compressors	20
Packaged chillers	
Reciprocating	20
Centrifugal	23
Absorption	23
Cooling towers	
Galvanized metal	20
Wood	20
Ceramic	34

Equipment Item	Median Years
Air-cooled condensers	20
Evaporative condensers	20
Insulation	
Molded	20
Blanket	24
Pumps	
Base-mounted	20
Pipe-mounted	10
Sump and well	10
Condensate	15
Reciprocating engines	20
Steam turbines	30
Electric motors	18
Motor starters	17
Electric transformers	30
Controls	
Pneumatic	20
Electric	16
Electronic	15
Valve actuators	
Hydraulic	15
Pneumatic	20
Self-contained	10

Note:

1. *Opinions of equipment condition and service life are based on our collective experience as well as published industry guidelines from sources such as American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). There is no specific metric that can be applied to identify when a piece of equipment may fail.*

Site Mechanical Utilities:

- 3" water service enters the northwest corner of the Administration Area.
- 6" sanitary sewer exits the building along the northeast.
- The natural gas service is located on the northeast wall of the gymnasium addition.
- Storm drainage from the roof spills onto grade.
- The site is provided with several catch basins to handle the storm water.

Domestic Water System:

- Domestic water piping from service entrance is routed into the main corridor and then splits to serve the entire building.
- A water meter is located in a storage room in the Administration area.
- The domestic water service is not provided with a backflow prevention device.
- The water service is provided with a valved bypass.
- The domestic cold water main is insulated and therefore the piping material could not be verified.

Photo 1: Domestic Water Service

Conclusions (domestic water system):

- The existing water service appears to be sized adequately for the current function of the building.
- There were no reported issues with the domestic water system.

Recommendations (domestic water system):

- *The existing service should be separated or a separate dedicated service be brought to the new Library.*
- *A backflow prevention device should be installed on the existing service.*

Domestic Hot Water:

- The building is equipped with a high efficiency gas fired water heater located in the storage room below the boiler room.
- The domestic hot water heater serves the plumbing fixtures throughout the building and the main kitchen.
- The domestic hot water and hot water return piping appears to be copper with soldered joints.
- The piping was insulated with fiberglass insulation in the areas that were visible.
- The hot water return system was equipped with an in-line circulating pump.

Photo 2: Domestic Hot Water Heater

Conclusions:

- The domestic hot water heater is in good condition.
- The condition of the hot water piping throughout the building is unknown, but it is assumed that any new piping near the water heater is in good condition.
- The hot water and hot water return piping is insulated.
- Township staff noted there are no problems with the hot water or hot water return system.

Recommendations (domestic hot water system):

- *Separate the area that will be converted into a library from the remainder of the building.*
- *Provide a dedicated water heater for the library.*

Fire Protection:

The school is not provided with a fire suppression throughout the building. A 2" branch is connected to the domestic water service and provided with backflow prevention device and flow switch. The sprinkler piping is extended to an adjacent Technology room. The room is provided with upright sprinkler heads.

Conclusions:

- The system appears to be in good condition.
- The fire protection system appears to have been inspected on a regular basis due to tags on equipment.
- The system only serves one room.

Recommendations (fire protection):

- *Leave the existing system in place.*
- *Provide a dedicated fire suppression system for the library.*

Heating, Ventilating and Air Conditioning Systems:

Classroom Units

- The original classrooms are provided with Trane, horizontal style unit ventilators.
- These units are equipped with supply fan, hot water heating coil, and chilled water coil. The original units were provided with electric heating coils and direct expansion cooling coils, however sometime in the 90's or early 2000's the units were converted to hot water and chilled water.
- Supply air from these units is direct to the space through a supply grille located on the top of the unit.
- Return air from the space is through a grille located along the bottom of the unit.
- Ventilation air is through a louver mounted in the exterior wall and connected to the rear of the unit.
- The units are capable of airside economizer. A relief grille is located in the ceiling of each classroom. A transfer duct is mounted in the wall separating the corridor form the classroom. These devices allows the relief air a path from the classroom to the corridor ceiling plenum. Once in the corridor ceiling plenum the relief air is removed by a roof mounted relief fan.
- The units are controlled by a pneumatic thermostat on the wall.
- The 2000's addition are provided with an Airedale vertical style vertical unit ventilator (VUV).

- These units are equipped supply fan, hot water heating coil, chilled water cooling coil, and relief fan.
- The supply air is delivered to the space is through an overhead duct system connected ceiling mounted diffusers.
- Return air for the unit is through a grille located on the front of the unit.
- Ventilation air is through a louver in the exterior wall that connects to the rear of the VUV.
- These units are capable of airside economizer. The unit can supply 100% outside air to the space. The relief air is then transferred through the return grille on the front of the unit where it is removed by the relief fan through the outside air louver that is separated into two sections. One section is for outside air and the other is relief air.

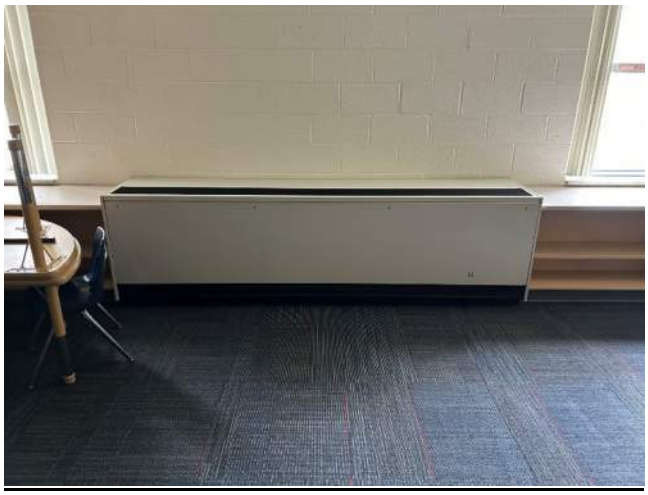


Photo 3: Horizontal Unit Ventilator

Photo 4: Vertical Unit Ventilator

Conclusions:

- The original units have exceeded their useful service life.
- The air distribution in the original classrooms based on the unit design is poor.
- The VUV's added in the early 2000's are in fair condition; however they have also exceeded their useful service life.
- The overhead distribution system provides a better environment for occupants than the original units.

Administration Area

- The administration area is served by a packaged multi-zone rooftop unit.
- The original mammoth rooftop unit is equipped with supply fan, direct expansion cooling coil, electric heating coil, and relief fan.
- The unit is provided with 7 zones that provide heating and cooling to the spaces in the Administration area.
- The supply air is delivered to the spaces through an overhead duct system that is connected to ceiling mounted supply air diffusers.
- The return air from each space is through a ceiling mounted return grille that tis connected to a return duct system.
- The unit is capable of airside economizer.
- During economizer mode the fresh air is delivered to the space through the overhead duct system. The air is relieved from the space through the return air duct system with the assistance of the relief fan located in the unit.
- Ventilation air is through louvers located on the rooftop unit.

Photo 5: Packaged Rooftop Unit serving Administration

Conclusions:

- The Mammoth unit is original and has exceeded its useful service life.
- The multi-zone system although very popular in the 1970's is not energy efficient.
- The dampers that modulate for each zone over time fail and the parts are difficult to maintain causing poor occupant comfort.
- The overall condition of the unit is poor due to age and exposure to the elements for over 45 years.

Air Conditioning System

- The building is provided with a Trane air cooled chiller located on grade surrounded by a masonry enclosure.
- The chiller is approximately 100-120 tons, nameplate data was weathered and not legible.
- Chilled water piping is extended throughout the building and connected to unit ventilators located throughout the school.
- Glycol is injected into the chilled water system to prevent freezing during the winter.
- The chilled water system is equipped with two base mounted circulating pumps, expansion tank, and chemical shot feeder.
- The chilled water system appears to be constant volume.

Photo 6: Air Cooled Chiller

Photo 7: Chilled Water Pumps

Photo 8: Glycol Feed Unit

Photo 9: Second Glycol Feed Unit

Photo 10: Chemical Bypass Feeders for Heating & Cooling Systems

Conclusions:

- The chiller appears to be installed in 2001 and is approximately 23 years old based on the minimal amount of information from the compressor nameplate.
- The chiller is utilizing R-22 refrigerant which is not produced anymore and is very costly to fill in the event of a leak.
- The chilled water system is operating in a constant volume arrangement, which is not energy efficient.
- Due to the piping arrangement the glycol solution is being pumped throughout the school, resulting in reduced system capacity and additional pumping power.
- During our site investigation it was noted the chiller has been experiencing more and more service calls.
- Township staff noted that they would like to eliminate the chilled water system and go to packaged rooftop units to reduce operating costs and maintenance costs.

Heating System

- The building is provided with two Raypak gas fired boilers located in the second floor boiler room.
- The units provide approximately 1,700 MBH each of heating to the building.
- The units are rated at 84% efficient and were installed in 2001.
- The hot water heating system is equipped with two base mounted circulating pumps, expansion tank, and chemical shot feeder.
- The hot water heating piping is extended throughout the school and connected to unit ventilators and cabinet unit heaters.
- The hot water heating system appears to be a constant volume system.

Photo 11: Hot Water Heating Boilers

Photo 12: Hot Water Heating Boiler

Photo 13: Hot Water Heating Pump

Photo 14: Hot Water Heating Pump

Conclusions:

- Only one boiler is operational and the other boiler has been used for parts.
- The boilers are over 20 years old and have exceeded their useful service life.
- Overall, the boilers appear in poor condition.
- The State of Michigan Boiler Certificate indicates the last year it was inspected was 2020.
- The heating system piping in the boiler rooms has signs of leaks.
- The staff did not report any issues with the heating system.

Recommendations (HVAC):

- *Remove all unit ventilators in the areas that will be converted to a library function.*
- *Remove the areas that are being converted to a library function from the chilled water system.*
- *Remove the areas that are being converted to a library function from the hot water heating system.*
- *Remove the rooftop unit serving the Administration Area.*
- *Provide new mechanical systems to serve the renovated library. The system should be separated from the remainder of the building.*

General Overview of Electrical Systems:

General Condition:

The electrical distribution equipment was installed in 3 different time periods; 1974, 2000, and 2004; as the building was expanded and renovated. The electrical distribution appeared functional and in good condition. Electrical equipment and installations appeared to have been done by qualified tradesmen.

Equipment Serviceable Life:

The electrical distribution equipment installed at the time the building was built, 1974, has been in service for 50 years.

Most electrical distribution equipment will eventually fail. Upon installation, all electrical equipment begins to deteriorate due to absorption of moisture, temperature cycles, collection of dust, condensation, mechanical wear of circuit breaker contacts and contactors, weakening of operating springs, deterioration of insulating materials and rusting of enclosures.

All electrical equipment ages at different rates based upon the quality of equipment, maintenance, and service conditions.

The weakest and fastest degrading component of any electrical equipment is the insulation. In cables, transformers and trip coils of circuit breakers solid synthetic and paper insulation is used to prevent energized conductors from faulting to one another or ground. The degradation of this insulation depends greatly upon the maximum temperature to which it is subjected which is a combination of its service duty and the ambient temperatures.

Manufacturer's stated service life on most electrical equipment is between 20 and 30 years, depending on the type of equipment. Because of the wide range of variables, it is difficult to make a finite determination of the remaining service life of equipment.

Based on our observations and perceived service conditions, we would anticipate this equipment, with proper service and maintenance, should remain serviceable for several more years, but not indefinitely.

Equipment Labels:

In general, major distribution equipment was labeled in a variety of fashion, including marker, nameplates and paper inserts.

Proper documentation, specifically a one-line diagram (and/or a detailed riser diagram), that matches the nameplates of equipment is recommended for maintenance.

Arc Flash Labeling

None of the equipment observed had Arc Flash Hazard Labels. A short circuit and coordination study is required to provide the necessary input for performing Arc Flash Hazard Calculations.

This information is required for proper labeling of distribution equipment to advise service personnel of the potential hazard and associated personnel protective equipment (or PPE) that is required per NFPA 70E and OSHA.

It is recommended that a short circuit, coordination and arc flash study be performed, and the proper arc flash hazard training be performed for maintenance staff. Until such study is performed, it is recommended that working on live equipment is prohibited. If it becomes necessary, we recommend that policy be to wear the most restrictive PPE.

Electrical Service:

The electrical service for the building is provided by DTE Energy. There is a 750 kVA 13.2kV-480/277V pad-mounted transformer located on the exterior of the building near the main electrical room.

Photo 15: Pad Mounted 750 kVA Utility Transformer

The 1200A main switchboard (MSB) is located in the southern corner of building and services the entire building.

The equipment is approximately 24 years old.

Photo 16: Main Switchboard

The proposed library portion of the building is serviced by 3 distribution panel in the main electrical closet (rm. 129) of the building fed from the MSB.

- DP-2 480Y/277V 400A MLO 3 phase 4 wire distribution panel
- DP-3 480Y/277V 400A MLO 3 phase 4 wire distribution panel
- DP-4 480Y/277V 400A MLO 3 phase 4 wire distribution panel

This equipment is approximately 49 years old.

The only code violation noted was the room being used for storage within the clearance area of the electrical equipment.

Photo 17: Library and Community Center Electrical Room (DP-2, DP-4, DP-3 respectively)

Power is then distributed from 400A 480Y/277V 3 phase 4 wire distribution panel DP-2 to eight (8) panelboards:

1. RP-A1: 100A MLO 208Y/120V 3 phase 4 wire panelboard via 45kva transformer (T-A1) secondary side. This equipment is approximately 20 years old.

Photo 18: RP-A1 (Panel RP-A1, Disconnect, T-A1 respectively)

2. RP-B: 225A MCB 208Y/120V 3 phase 4 wire panelboard via 45kva transformer (T-B) secondary side. This equipment is approximately 49 years old.

Photo 19: RP-B (Panel RP-B, T-B respectively)

3. RP-C: 100A MCB 208Y/120V 3 phase 4 wire panelboard via 30kva transformer (T-C) secondary side. This equipment is approximately 49 years old.

Photo 20: RP-C (RP-C, T-C respectively)

4. RP-D: 225A MCB 208Y/120V 3 phase 4 wire panelboard via 45kva transformer (T-D) secondary side. This equipment is approximately 49 years old.

Photo 21: RP-D (Panel RP-D, T-D respectively)

5. RP-E: 100A MCB 208Y/120V 3 phase 4 wire panelboard via 30kva transformer (T-E) secondary side. This equipment is approximately 49 years old.

Photo 22: RP-E (T-E, RP-E Respectively)

6. RP-F1: 100A MLO 208Y/120V 3 phase 4 wire panelboard via 45kva transformer (T-A1) secondary side. This equipment is approximately 20 years old.

Photo 23: RP-F1 (Disconnect, T-A1, RP-F1 respectively)

7. LP-HB: 100A MLO 480Y/277V 3 phase 4 wire panelboard. This equipment is approximately 49 years old.

Photo 24: LP-HB

8. LP-HC: 100A MLO 480Y/277V 3 phase 4 wire panelboard. This equipment is approximately 49 years old.

Photo 25: LP-HC

The electrical service for the community center portion of the building and building wide night lightings is distributed via a 400A MLO 480Y/277V 3 phase 4 wire distribution panel DP-1 and a 100A MLO 480Y/277V 3 phase 4 wire distribution panelboard LP-X (both added in 1974). DP-2 and LP-X are both fed from the MSB. This equipment is approximately 49 years old.

Photo 26: LP-X and DP-1

The only code violation noted was the room being used for storage within the clearance area of the electrical equipment. This equipment is approximately 49 years old.

Photo 27: Main Community Center Electrical Room

Panel RP-A 225A MCB 208Y/120V 3 phase 4 wire panelboard is fed via secondary side of floor mounted 75KVA transformer (T-A) the primary side is fed from DP-1. This equipment is approximately 49 years old.

Photo 28: RP-A (RP-A, T-A respectively)

Panel LP-HA 100A MLO 480Y/277V 3 phase 4 wire panelboard is fed from DP-1. This equipment is approximately 49 years old.

Photo 29: Panel LP-HA

Panel RP-X MCB 100A 208Y/120V 3 phase 4 wire panelboard is fed via secondary side of wall mounted 9KVA transformer (T-X) the primary side is fed from LP-X.

This equipment is approximately 49 years old.

Photo 30: Panel RP-X and Transformer T-X

Distribution and Circuiting:

The branch circuit distribution observed appeared to be installed with code compliant wiring methods. Panelboards are original to the building and are in good condition. There are two main electrical rooms containing panelboards with distribution panels DP-1, DP-2, DP-2, and DP-4 as shown below. There is also various panelboards and transformers located throughout the building in miscellaneous rooms. Dry type transformers, including primary transformers, are approximately 20-49 years old. The original electrical equipment is past the end of their expected service life, but they may continue to operate without issues.

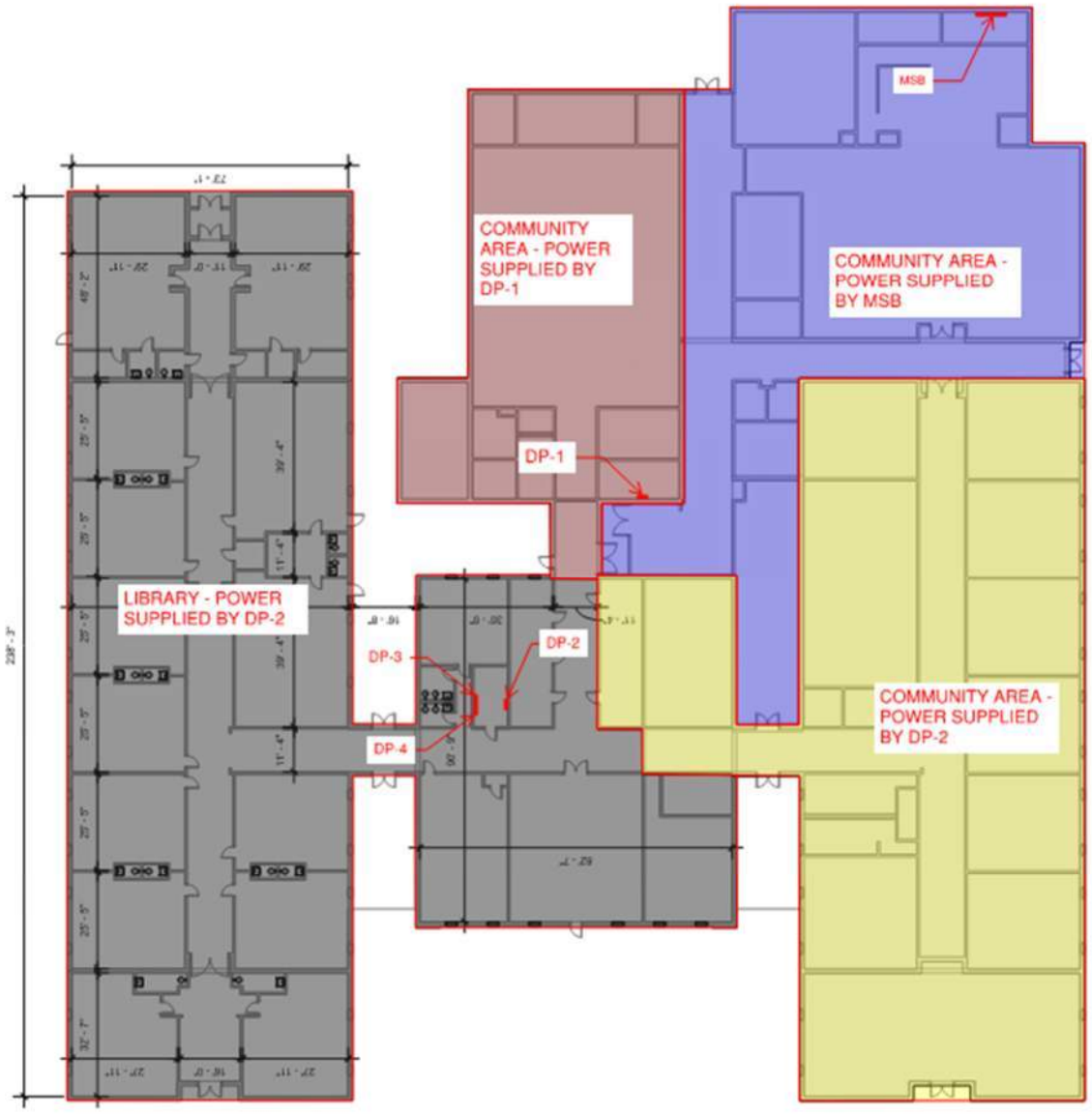


Figure 1: Sugarbush Light, Receptacle, and Misc. Power Distribution Zones.

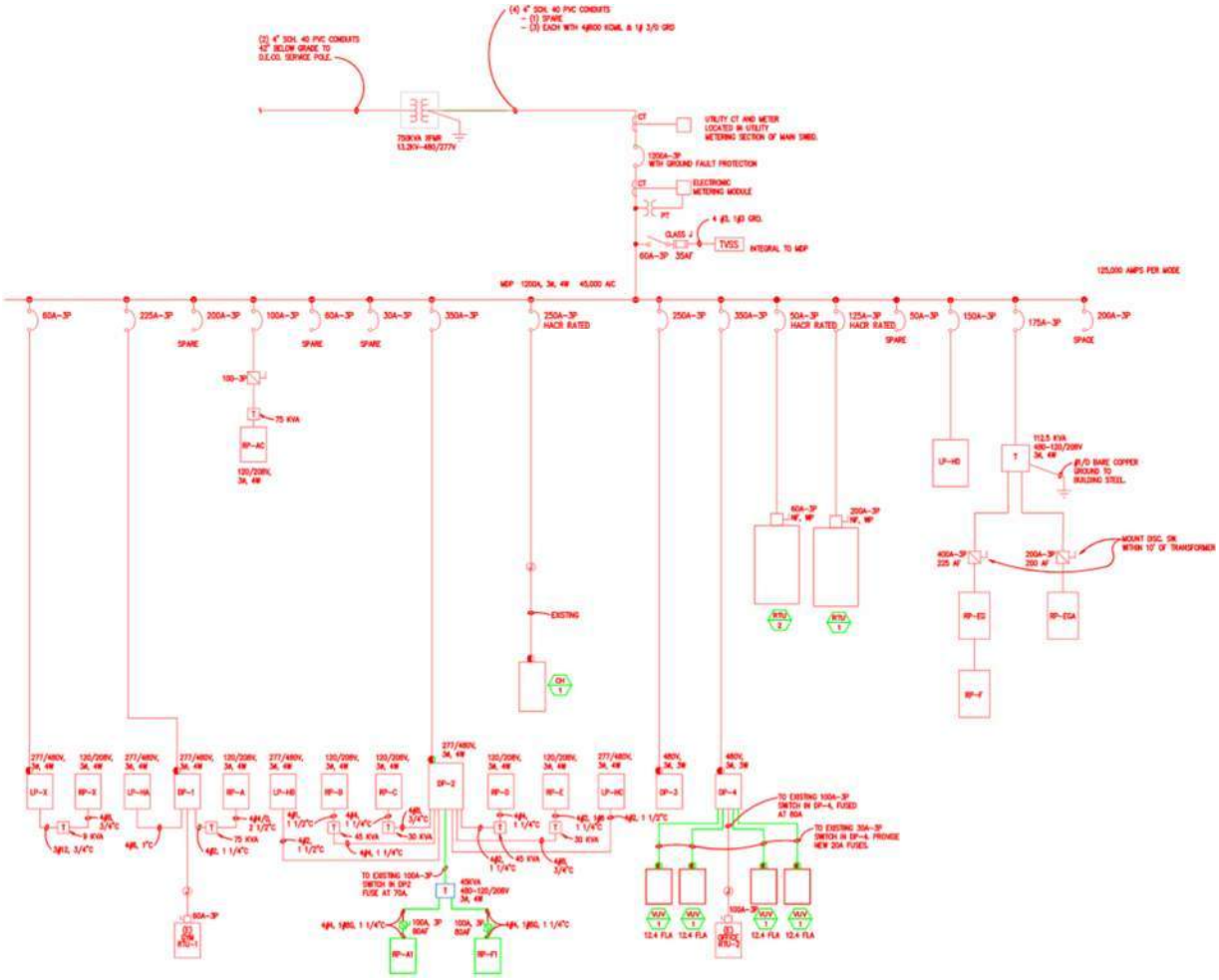


Figure 2: Sugarbush Existing One Line Diagram

Emergency Lighting:

Emergency lighting is provided by emergency battery units (EBU's) in exit signs and night light fixtures wired ahead of local control. No generator or related alternate power available onsite. EBU's generally appear in good condition and appear to be from the renovation in 2004.

Photo 31: Typical Corridor EBU/Exit Sign

Fire Alarm:

The fire alarm control panel and system devices appear to be new and in good condition. The panels are Central Station Fire units – 900 series by National Time and Signal Corporation. It appears to have been recently serviced/tested by Chesterfield Township Building Department. Activation of the system is by manual pull stations.

Photo 32: Existing Fire Alarm Panel

Lighting:

Lighting in the corridors and the classrooms is provided by two-foot (2') by four-foot (4') troffer lights with fluorescent bulbs. The lights appear to be in good condition and were installed in 2004.

Photo 33: Typical Corridor and Classroom 2x4 Troffer Light

Recommendations (Electrical):

- *Perform a short circuit, coordination and arc flash hazard analysis and provide appropriate arc flash hazard labels on all distribution equipment.*
- *Replace fluorescent lamps with LED lamps or replace light fixture entirely to lower energy usage.*
- *Test emergency lighting and replace all batteries or fixtures that are not operational.*
- *Remove storage items from the clear space required in front of electrical equipment.*