



INSPECTION REPORT

PREPARED FOR: Riviera Beach Utilities Special District (RBUUSD)

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DATE: December 29, 2020

SUBJECT: High Service Pump Inspection, Testing & Recommendations

INTRODUCTION

The Riviera Beach Utility Special District (RBUUSD) Water Treatment Plant (WTP) utilizes seven (7) high service pumps (HSPs) to pump finished water stored in the clearwell into the distribution system. A one (1) million-gallon ground storage tank (GST) is located just south of the WTP and functions as an extension of the clearwell. Finished water is pumped to the GST by two (2) transfer pumps and is returned to the clearwell via gravity flow. The City had recently purchased seven (7) Goulds high service pumps each with a capacity of 4000 gallon per minute (gpm). The new HSPs were purchased on the following dates:

- One (1) pump - May 2017
- Two (2) pumps - November 2019
- Four (4) pumps - April 2020

Three of the existing high service pumps were replaced recently with the new HSPs. There are three (3) new HSPs are currently stored on a pallet at the site. It is not known where the 7th pump is. Several of the HSP motors failed recently when the City switched power to backup generator power. Currently only two of the HSPs are operating and both pumps are needed to operate together at times during the day. Globaltech, Inc was contacted to perform an evaluation of the existing HSPs and associated piping and electrical and provide improvement recommendations.



Figure 1. Existing High Service Pumps

This report summarizes the results of evaluation of the high service pump station at the water treatment plant operated by the RBUUSD. The inspection was performed by three different teams,



- Globaltech, Inc. – Mechanical Inspection
- Hillers Electrical Engineering, Inc. – Electrical Inspection
- Energy Efficient Electric – Electrical Testing

This report will provide a summary of the mechanical observations and recommendations along with the electrical report submitted by the electrical engineer of the electrical testing and inspection at the high service pump station.

MECHANICAL EVALUATION

A mechanical inspection of the high service pump station was conducted on December 2, 2020. The field observations and associated recommendations are listed below.

MECHANICAL FIELD OBSERVATIONS

1. Installed Pumps

- The pump slots were as follows:
 - Pump 1 -New Goulds pump is installed, 250 HP motor is missing.
 - Pump 2 – No pump installed in this slot.
 - Pump 3 – Older J-Line pump and 150 HP motor installed in this slot. Pump is out of service.
 - Pump 4 – Older unidentifiable pump with 150 HP motor is installed in this slot. Pump is out of service. The old drawings show that this pump slot used to house a 200 HP pump.
 - Pump 5 – New Goulds pump is installed, 250 HP motor is missing
 - Pump 6 – New Goulds pump with 250 HP motor is installed. Pump is operational.
 - Pump 7 – Older J-Line pump with 250 HP motor is installed. Pump is operational.
- Pump 1 is new pump with a new VFD that is out of service. RBUSD staff has stated they think the pump shaft is frozen and that the isolation and check valves are leaking substantially. The new motors are non-reverse ratchet (NRR) so the reverse flow should not have unscrewed the shaft couplings, but the status of the couplings should be confirmed after the pump is removed.
- Checked several of the installed pumps for level (including a new one) with a machinist's level. The pumps are not level and are off between 1/16 inch to 1/8 inch in 8-inch (0.0625 – 0.0078) machinist level (**Figure 2**). This exceeds the manufacturer's installation instructions of 0.000083-0.000417.
- The new pumps appear to be taller than the previous pumps and the existing concrete pedestals had to be chipped out for installation. Two of the sole plates of new pumps were also removed to reduce the installed pump height (**Figure 7**). This results in an uneven mounting surface for the pumps and places the anchor bolts very close to the pump penetration in the slab.
- Some of the pumps were installed with no visible grout (**Figure 3**). HSP 6 has caulk under the sole plate instead of grout (**Figure 4**). Some of the pumps that are grouted exhibit grout cracking.



- The newly installed pumps are anchored using 5/8-inch galvanized wedge anchors. The depth is unknown. The bolt holes on the new pumps measure 7/8-inch (**Figure 5**), normally the anchor bolt diameters are 1/8-inch smaller than the hole, which would result in a 3/4-inch anchor. More importantly, the anchors are galvanized steel, and the pump base is carbon steel. These metals are about 0.35 volts apart in the galvanic series. In coastal or humid areas, galvanic pairs should be limited to 0.15 volts to minimize corrosion. The galvanized steel is the anode in this pair and will lose metal to the carbon steel pump. This could result in the anchor bolts being compromised and potentially a dangerous situation if the pumps were no longer secured to the floor.
 - There are no working pressure gauges on any of the pump discharges.
 - There are no air release valves (ARV) installed downstream of each pump nor at the 90° bend downstream of the flowmeter in the distribution line. The ARV is an important part of the vertical turbine pump system. During each pump startup, a large volume of air must be vented from the pump discharge column to the atmosphere or it will be forced into the piping system. Air entrapped in the water system will restrict the water flow and could impact flow meter accuracy.
 - There were no shaft guards on any of the installed pumps (**Figure 6**).
 - HSP 7 was in operation and is missing two of the anchor bolts (**Figure 8**). Some missing bolts were found on some pump flanges (**Figure 9**). Some of the flange bolts on the new pumps are smaller diameter.
 - No pipe supports were installed between the header pipe and the pumps. A temporary wooden support is being used to support one of the discharge pipes. Piping should not be supported by the pump flange.
 - Pump supplier confirmed that they were not involved in the pump installation and no certificate of proper installation was issued.
 - The slot for Pump 1 has a new 250 pump and a new VFD sized for 250 HP so that pump should be operable. Plant staff stated that there is something wrong with the new pump itself and that it would not rotate. Plant staff also stated that the Slot 1 isolation and check valves would not hold when they tried to remove the new pump and when they tried to cap the line the restrained flange on the pipe started to slip. Therefore, the pump had to remain in place to help secure the piping.
2. New Uninstalled Pumps
- The new uninstalled pumps motors are being stored outside in the base of the North Lime Building without heaters attached (**Figure 10**). The motors were meggered and they tested satisfactory at that time.
 - The bottoms of the uninstalled pump sole plates were confirmed to have been coated.
 - The uninstalled pumps all have shaft guards.
 - The pumps are being stored on their sides for a long time. This could result in damaged to the bearings. When stored for extended periods, they should be stored vertically.



3. Miscellaneous

- The location of the existing isolation valves does not allow for work on any of the isolation valves, or check valves if the isolation valve is leaking without shutting down all HSPs.
- Exposed floor penetration at HSP 2 was not properly secured after pump was removed. Pressed wood piece (**Figure 11**) was placed loosely over the penetration and is falling apart. The wooden piece may collapse if stepped on. This arrangement is dangerous and unsanitary.
- No covers on electrical outlet observed and they do not appear to be ground fault protected (**Figure 12**). Electrical conduits do not fully cover wiring and are not properly terminated (**Figure 13**).
- Observed a large constant water flow coming from the HSP packing (**Figure 8**). The design drip rate for pump packing is normally given in drips per minute. Excessive drip rates can reduce the pump performance and prematurely wear the packing. Vendor can provide the actual design drip rate during their certification of proper installation inspection.

MECHANICAL RECOMMENDATIONS

Recommendations for the issues listed above are provided below.

1. Install the missing bolts on HSP 6 as soon as possible.
2. The Pump 1 body should not be used to secure piping that is not properly restrained. Separation of the pipe at this location could result in loss of all the high service pumps as well as damage to the watermain, high service pump building, filter structure and electrical room. Restraining rods should be connected through ductile iron spool with the slipping restraint immediately. We would also recommend that the isolation valve be replaced, and a new restraint be installed on the ductile iron spool at that time.
3. All new installed pumps need to be removed and installed correctly. Proper installation of the pumps will require chipping out the existing concrete pedestal several inches further, then setting the pump with the sole plate, leveling and grouting. New uninstalled pumps will also have to be installed following the same procedure. Sole plates are recommended to be installed for the pumps that were installed removing the sole plates. Installing sole plates will make level installation easier, allows for better grouting under the pump, allows for easier removal of the pump for maintenance later and it spreads out the stresses placed on the anchors farther from the slab penetration for the column.
4. All pumps need to be grouted in securely both for proper operation of the pump and to prevent any debris from entering the clearwell through gaps.
5. We recommend using epoxy anchors for installation of pumps, particularly when the anchors are close to the hole edge as in the case here where the pumps were installed without the sole plates.
6. Install new pressure gauges on each pump discharge.
7. Install new ARV on each pump discharge as close to the check valve as possible. A new ARV should also be installed on the common discharge header at the 90 ° bend downstream of the flowmeter.



8. Install shaft guards on all the pumps.
9. We recommend stored motors be connected to strip heaters as soon as possible until they are installed. The uninstalled motors do not need to be sent in for baking at this time. If they continue to be stored outside without heaters, then they should be meggered again to confirm they do not have moisture in the windings.
10. We recommend pump manufacturer to be involved in pump installation and certify the installations and issue a manufacturer's certificate of proper installation for each pump.
11. We recommend installing a 20-inch isolation valve on header between HSP 5 and HSP 6 to allow work on HSPs 1 to 5 without shutting down. Another option would be to reconnect the header between the HSPs and the transfer pumps. This would allow the HSPs to pump into the distribution system via the south piping. This would allow work on HSP 6 and 7 isolation/check valves while the other HSPs were operating (albeit, unmetered and at a lower flow rate).
12. Every bolt hole must be bolted up.
13. Bolt down a competent steel plate and provide caulk around the edges at the exposed floor penetration at HSP 2.
14. The HSP room is a potentially wet room. Exposed electrical wires at several HSPs should be properly terminated and all electrical outlets should have a cover and be ground fault protected.
15. Piping should not be supported by the pump flange. We recommend installing adjustable pipe supports on each pump discharge piping.
16. Existing caulk under HSP 5 should be removed and non-shrink grout should be installed under the base plate.
17. Flange bolts should all be sized correctly for the bolt holes. We recommend installing bolts 1/8-inch smaller than bolt holes.

ELECTRICAL INSPECTION

The HSP electrical components were tested December 1, 2020. HSPs 6 and 7 were in operation during the inspection and could not be shut off; therefore, their cables and motors could not be tested. The starters, cable and motors were all electrically tested, and the breakers were visually inspected. Based on the testing and inspection, it appears that the breakers, starters, and wires are not causing the HSP motor/pump failures but there are numerous electrical issues that need to be addressed. Some cables and starter contactors need to be replaced for the HSPs as per the report. A detailed electric report along with the test results is included in **Appendix A**. A new 250 HP pump was installed in the Pump 5 slot which is powered by a starter only rated for 200 HP motors. This is not recommended and can result in premature winding failure.

SUMMARY

Several of the pump HSPs are not coordinated with the breaker/starter size. This issue may have contributed to the recent motor failures. While there are numerous mechanical and electrical issues to



address, getting more high service pumps online is of the utmost importance. There are plans to install new soft starts/VFDs and electrical for the new Goulds 250 HP pumps, but it will likely take at least 3 months for that material to arrive on site. The bullets below highlight the motor/electrical sizing issues and what could be done to get more HSPs online as soon as possible.

1. Pump 1 -New Goulds 250 HP pump (no motor) is installed. Pump is out of service. New VFD rated for 250 HP motor is installed and tested satisfactory. Electric cable should be replaced. Not sure why this pump is not operating. RBUSD said the shaft is frozen. The capability of the pump to rotate cannot be confirmed without the motor installed and the pump cannot be removed due to leaking valves and a slipping restrained flange. Recommend putting one of the new motors on this pump to see if it will rotate and operate. This should be done with the pump vendor representative present. The plant has expressed concern that the isolation and check valve for this pump are not holding. If this is correct, then there is no quick way to replace this pump now.
2. Pump 2 – No pump installed in this slot. Starter is in satisfactory condition. Breaker shows arcing, should be isolated and tested. The Size 4 starter in this slot is only rated for up to 100 HP motors. See text below for Pump 3. The VFD and breaker from Slot 1 could be used to power a new 250 HP pump/motor installed in the Pump 2 slot. The wiring will either need to be extended or replaced and the reducer will need to be replaced with a flanged spool, but these materials should be readily available. After installation of the refurbished pump in Slot 5, this is the next quickest option to get another pump online.
3. Pump 3 – Older J-Line 150 HP pump and motor installed in this slot. Pump is out of service. Starter contactors are in satisfactory condition, but hand switch does not work. Control wiring should be corrected when starter is replaced. Electric cable should be replaced. The Size 4 starter in this slot is only rated for up to 100 HP motors. Someone previously field engineered the Slot 3 and 4 starters (each rated for 100 HP motors) in parallel so that they could operate one of the 150 HP pumps. In theory, this may work; however, if both contacts don't close at the same time, the windings will see a high inrush and the motor can be damaged. We do not recommend this type of arrangement and suggest limiting any new pump in Slots 2 or 3 to 100 HP, until the starters are upsized.
4. Pump 4 – Older 200 HP pump installed in this slot. Pump is out of service. Autotransformer (RVSS) is not operational. It appears the RBUSD staff tried to re-wire the Autotransformer for Pump Slot 5 to this pump. This rewiring has not resulted in being able to operate Pump 4. We do not know why Pump 4 is not operable but based on the condition of the autotransformers only one of Pump 4 or Pump 5 can be operable. We recommend placing a refurbished pump in Slot 5 as discussed below.
5. Pump 5 - New Goulds 250 HP pump (no motor) is installed. Pump is out of service. Electrical is sized for a 200 HP motor. Based on our recent conversations about this issue, Riviera Beach has sent the previous pump and 200 HP motor that was previously in this slot in for rehabilitation. This option results in the quickest way to get another HSP online and this pump/motor should be re-installed in this slot ASAP.



Inspection Photos



Figure 2. Uneven level of an installed pump



Figure 3. No visible grout on HSP No. 1



Figure 4. Caulk under sole plate of HSP No. 6



Figure 5. Sole plate bolt holes of uninstalled pumps



Figure 6. No shaft guards on any pump



Figure 7. No sole plate on newly installed pump



Figure 8. Missing bolts and constant seal water flow at HSP No. 7



Figure 9. Missing bolts on pump flange



Figure 10. New uninstalled HSP motors



Figure 11. Exposed floor penetration not secured properly for HSP No. 2



Figure 12. Open electrical outlet

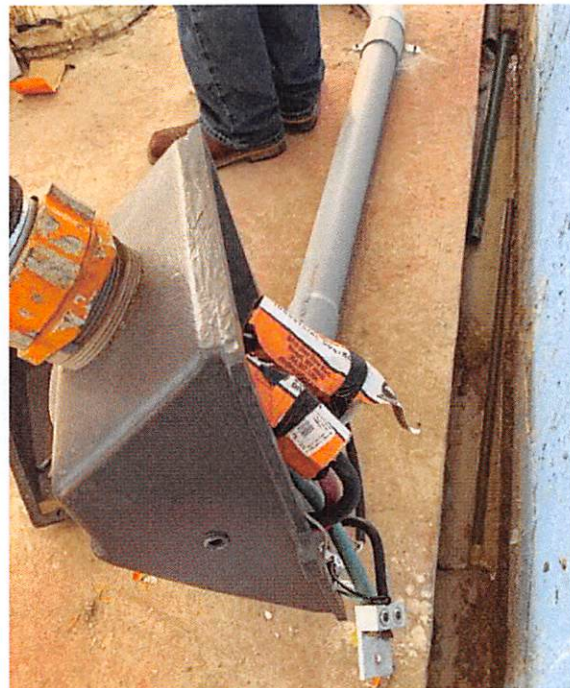


Figure 13. Exposed electric wires

RIVIERA BEACH SPECIAL UTILITIES DISTRICT

HIGH SERVICE PUMP INSPECTION, TESTING AND RECOMMENDATIONS

APPENDIX A

ELECTRICAL TESTING/EVALUATION



HSP Electrical Study Report

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Project:	Riviera Beach Utility District WTP Chemical Feed System Improvements	Client:	City of Riviera Beach Utility Special District (RBUSD)
Job No.	GT106	Date:	December 1, 2020
Conducted By:	Jose Diaz		
Talked with:	Dave D.		
Subject:	Megging of New and Existing HSP Motors and Cables (except HSP6 and HSP7)		

● Observation Report:

During the field testing, it was observed that:

- Cables and motors for HSP-6 and HSP-7 were not tested due to pumps being in service. Currently, there are limited quantities of high service pumps available and the plant personnel are not comfortable with taking those running pumps out of service for testing. If other pumps are available in the near future, we can perform the test on HSP-6 and HSP-7.
- Feeder and Soft-Starter No.5 are being temporarily used to run the motor for HSP-4 via SO cable extension, there is no motor installed for HSP-5. See Photo No.1
 - a. Electrical connections at motor for HSP-4 and inside of old terminal box for HSP-5 are made via mechanical set-screw lugs. Mechanical set-screw lugs are not recommended for motor connections as vibration and heat may cause cables to become loose at lugs. High-pressure terminal connectors or split bolts are preferred. See Photo No.2
 - b. Terminations at terminal box for Motor-5 have exposed metal, which may cause electrical shock to personnel or short-out if in contact with another conductive object. See Photo No.3
- Electrical connections at motor for HSP-3 are made via Mechanical lugs (Polaris taps). Mechanical set-screw lugs are not recommended for motor connections as vibration and heat may cause cables to become loose at lugs. High-pressure terminal connectors or split bolts are preferred. See Photo No.4
 - a. Energy Efficient Electric (EEE) was not able to test the feeders for HSP-3 independent of motor windings due to existing lugs being seized and not enough slack in the cables to cut and make new terminations. Terminations were left as found. See Photo No.4
- While trying to run starter for HSP-3 in Hand for testing, it was noticed that the Hand switch does not work.
- There are no motors installed for HSP No.1, 2, 5.
- Feeder cable insulation (C phase) for HSP-1 is cracked to the point that copper is visible. Crack is at the motor-end of cable, partially inside the flexible conduit. Recommend replacing cable. See Photo No.5
- Circuit Breaker inside Starter Bucket for HSP-2 has arcing marks where mounting bracket attaches to backplate. Recommend isolating breaker and testing prior to energizing. See Photo No.6

● **Test Results – See attached:**

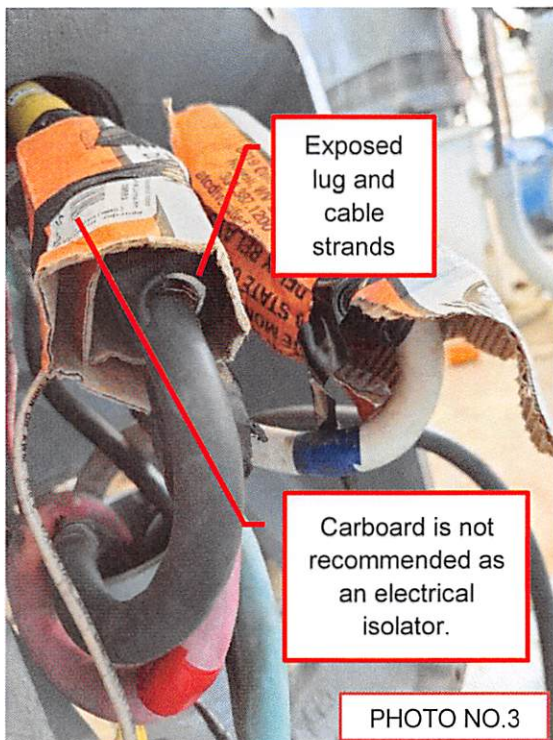
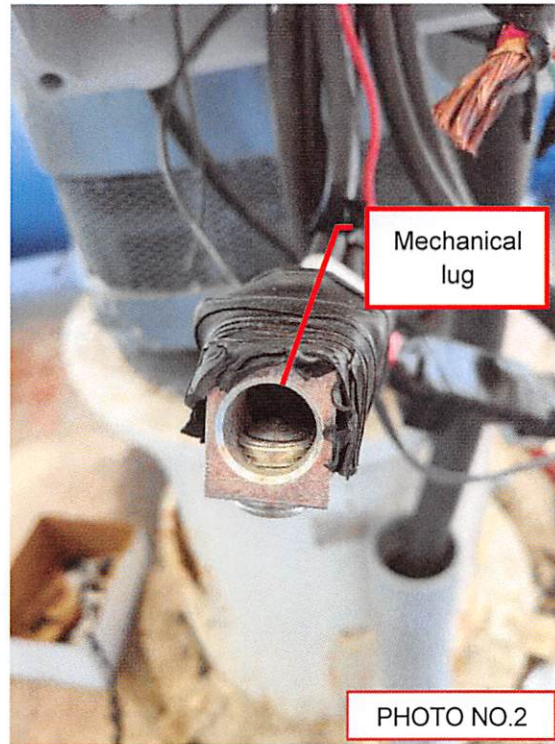
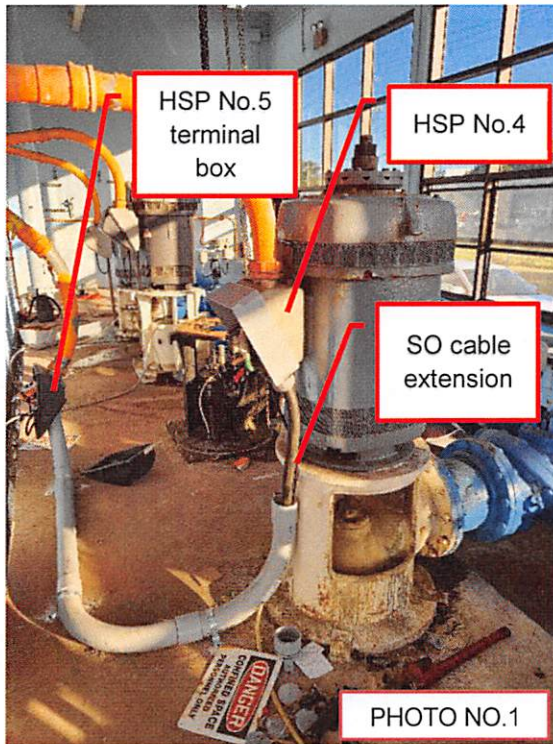
- LOW VOLTAGE CABLE TEST REPORT
- LOW VOLTAGE MOTOR TEST REPORT (Old Motors)
- LOW VOLTAGE MOTOR TEST REPORT (New Motors)
- LOW VOLTAGE STARTER TEST REPORT

● **Conclusion and Recommendation:**

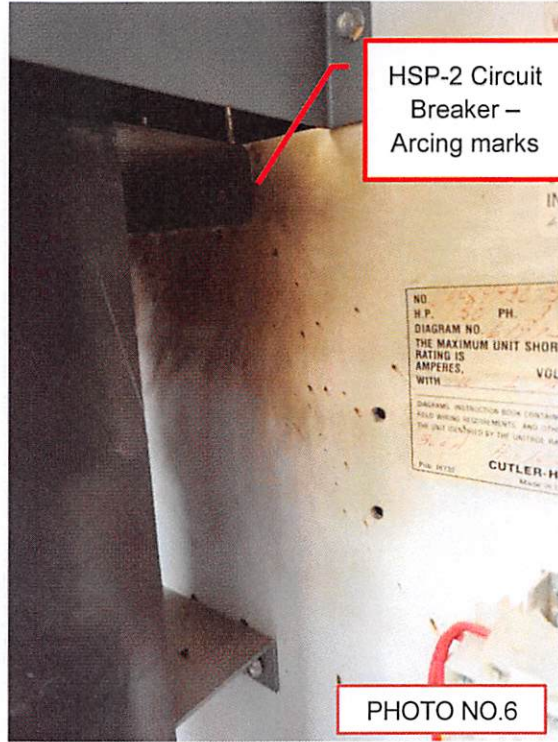
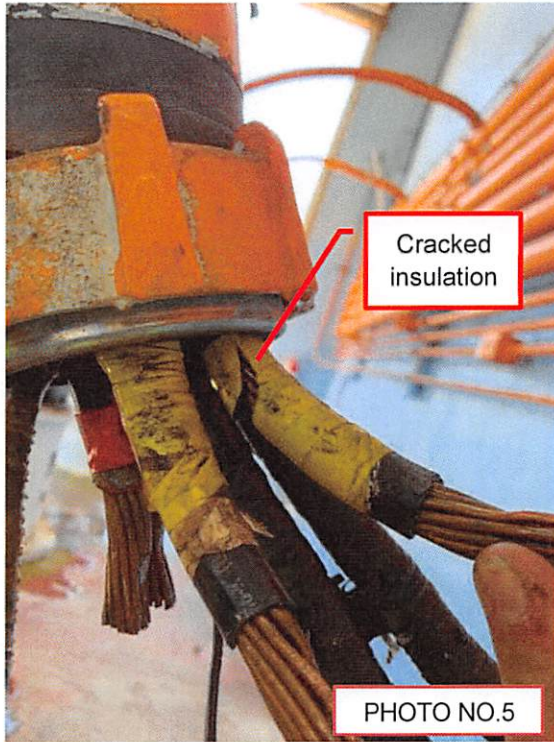
- As per the electrical testing results, it is safe to assume that the breakers, starters, and wires are not causing the HSP motor/pump failures. The city should send the failed motor to a reputable motor repair shop to diagnose the cause of motor failure. After knowing the problem of motor failure, there will be a need to further determine the source of the problem.
- The wires for HSP-1 thru HSP-5 tested with acceptable resistance reading under dry condition.
- Cables for HSP-1 have exposed copper due to cracked insulation. Replace cables for HSP-1 for personnel safety if HSP1 motor and pump will be installed in the future.
- VFD for HSP-1 is functional but the pump shaft is seized and both motor and pump need to be replaced. Additional work may be required in preparation to replace the pump, as the existing check valve and isolation valve are leaking, which will cause water to come out of the pump casing when trying to remove the pump.
- Due to the arc flash marks on the breaker for HSP-2, it is recommended to obtain the service of MCC manufacturer to isolate the breaker from MCC for testing. Depending on the test results, breaker may need to be replaced.
- The starter contactors for HSP-2 were tested and found to be functional.
- Although HSP-3 wires show acceptable resistance reading, the lugs are seized and cannot be disconnected from the motor. Since there is not enough slack in the existing cables to make new connections, it is recommended to replace the cables and connectors.
- The starter contactors for HSP-3 were tested and found to be functional. The local hand switch and HOA switch at the starter are not functional and the control wiring needs to be corrected when starter is replaced.
- The starters for HSP-2 and HSP-3 are beyond their reliable lifespan. NEMA starters are relatively inexpensive compared to VFD of the same horsepower. It is recommended to replace the NEMA starters in the same MCC bucket locations. Note that HSP-2 and HSP-3 are smaller horsepower pumps. If the City does not operate them often, it might not be beneficial for the City to replace them.
- Recommend replacing the mechanical set-screw lugs for HSP-4 with high-pressure lug connectors.
- Currently HSP-4 auto transformer has an internal failure and HSP-5 is operational. HSP-4 and HSP5 auto transformer starters are old technology and beyond their reliable lifespan. Recommend replacing the existing auto transformers of HSP-4 and HSP-5 with new reduced voltage solid state straters due to lack of readily available replacement parts.

If you have any questions please call,
Jose Diaz
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561-451-9165, ext.236

● Photos:



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