

## MEMORANDUM

TO: Azalea Mitch, PE (City of San Mateo)  
Matt Fabry, PE (City of San Mateo)

FROM: Leif Coponen, PE

SUBJECT: Marina Lagoon PS – Pump Rehab Document Review

DATE: May 4, 2023

JOB#: CSMT.56.23



The City of San Mateo requested Schaaf & Wheeler review photos taken by Koffler Electrical Mechanical Apparatus Repair, Inc during the rehabilitation process of the five axial flow storm water pumps from the City's Marina Lagoon Storm Water Pump Station. The following collection of photos were reviewed, each pertaining to an individual pump. The unique identifier for each pump was not available at the time of S&W's review (i.e. Pump No. 1-5), pump identification is based on photos (when available) of pump removal or replacement. This memorandum provides comments based on review of photos and is intended to provide a general narrative of pre-rehabilitation pump condition based on visual inspection. Detail and location of photos is not consistent for all pumps, so observations vary for the different pumps.

Koffler Job # 0602	May 2017	Pump No 1
Koffler Job # 2923	July 2018	Pump No 2
Koffler Job # 5145	September 2019	Pump No 3
Koffler Job # 6608	August 2020	Pump No 4
Koffler Job # 7977	June 2021	Pump No 5

### **Koffler Job # 0602 Review**

Corrosion of interior and exterior steel pump body is apparent, pitting of surface visible in multiple locations.

Pump shaft bearing with longitudinal crack visible.

Significant corrosion of lube-line protector steel components.

Significant corrosion of shaft enclosure tube stabilizing spider.

Significant discoloration of upper pump shaft at packing box bearing location (likely due to high heat), grooves visible in shaft at bearing location.

Some leading edge and propeller face wear, but not substantial.

### **Koffler Job # 2923 Review**

Corrosion of interior and exterior steel pump body is apparent, pitting of surface visible in multiple locations.

Shaft enclosure tube stabilizer spider corroded and disconnected from pump body.

Some leading edge and propeller face wear, but not substantial.

### **Koffler Job # 5145 Review**

Corrosion of interior and exterior steel pump body is apparent, pitting of surface visible in multiple locations. Several locations of deep pitting and holes present.

Significant corrosion of shaft enclosure tube stabilizing spider with at least one of three legs disconnected from pump body.

Detailed photos of propeller not provided, some leading edge and propeller face wear, but not substantial.

### **Koffler Job # 6608 Review**

Corrosion of interior and exterior steel pump body is apparent, pitting of surface visible in multiple locations.

Significant corrosion of lube-line protector steel components.

Suction bell shaft propeller stabilizer housing (nose cone) cracked, stabilizer legs cracked.

Diffuser legs cracked (pump section above propeller).

Shaft enclosure tube stabilizer spider corroded and disconnected from pump body.

Pump shaft enclosure tube corroded with holes present (allowing water to enter bearings).

Appears lower pump shaft sheared at top of suction bell. Severe corrosion present.

Suction bell bearing has longitudinal crack. No grease evident at bearing.

Suction bell bearing housing cracked longitudinally.

Detailed photos of propeller not provided, some leading edge and propeller face wear, but not substantial.

Based on mud line on pump suction bell and growth on propeller, appears pump was not operated for a period of time prior to removal.

### **Koffler Job # 7977 Review**

Corrosion of interior and exterior steel pump body is apparent, pitting of surface visible in multiple locations.

Significant corrosion of lube-line protector steel components.

Upper portion of pump shaft enclosure tube severe corrosion.

Suction bell shaft propeller stabilizer housing (nose cone) cracked, stabilizer legs cracked.

Several locations of suction bell outer housing cracks.

Some leading edge and propeller face wear, but not substantial.

## Conclusions

All pumps exhibit significant corrosion of carbon steel components. The original pump station design included impressed current cathodic protection for pump components, although it is not known how long the cathodic protection system was operational and protecting the pumps. Given the significant corrosion and currently non-operational cathodic protection system, we recommend routine condition assessment and vibration analyses to enable detection of bearing contamination and pump imbalance prior to component failure. The City may want to consider rehabilitation of the existing cathodic protection system or installation of sacrificial anodes on the pumps to help protect the pump components from corrosion.

There is evidence of bearing wear and failure, along with significant fractures in pump body components in multiple pumps. While the exact cause of the wear and fractures cannot be determined from viewing photographs alone, the typical causes of these types of conditions in pumps are due to adverse operating conditions. Adverse operating conditions can generate high imbalanced loads on the propeller, pump shaft, and bearings, as well as high vibrations which lead to accelerated wear and potential failure of components. Failure of one component can lead to cascading failure of other components. Typical causes of adverse operating conditions in axial flow pumps include cavitation, surface vortices, and submerged vortices, which are most commonly due to wetwell hydraulics and lowering the water level below a pump's minimum submergence requirements. The City should consider conducting a physical modeling study of the pump station wetwell to identify potential adverse operating conditions and determine recommendations for improving the operating conditions for the pumps.

**Koffler Job # 0602 Reference Photos**



Damaged shaft bearing



Pump shaft with heat discoloration



Propeller



Pump discharge elbow w/ corrosion

**Koffler Job # 2923 Reference Photos**



Machining of pump shaft to remove bearing grooves



Pump discharge elbow with stabilizing spider and shaft enclosure tube

**Koffler Job # 5154 Reference Photos**



Pump discharge elbow w/ visible corrosion (full penetration)



Pump column after media blasting w/ visible material loss

**Koffler Job # 6608 Reference Photos**



Pump shaft enclosure tube corrosion (full penetration)



Pump diffuser section vane cracks (preparation for welding)



Pump suction bell bearing housing crack repair



Pump suction bell stabilizer crack repair



Pump propeller w/ broken pump shaft visible

**Koffler Job # 7977 Reference Photos**



Pump suction bell and bearing housing w/ cracks highlighted for repair



Pump column and shaft enclosure tube w/ visible corrosion