Task 6.3 Pump Control System Conceptual Design Technical Memorandum

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East Bay Municipal Utility District

Influent Pump Station Resiliency Project
December 4, 2023

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5. Conclusions

5.1 Option Comparison

Table 3 summarizes and compares the project options. The LCI modernization (option 1) is the lowest cost option but would result in a partial improvement that would rely on several pieces of electrical equipment that are nearing the end of their life and not meet the EBMUD's resiliency objective. Replacing the LCI's with VFDs plus new transformers (option 2) would leave the existing motors which are 30 years old plus require a new duct bank outside the facility. Replacing the LCI's with VFD's and the existing motors with induction motors (option 3) will provide EBMUD with the most reliable upgrade and lowest cost option if EBMUD is going to replace the motors in the near future.

These three options were discussed with the EBMUD engineering and operations team on June 12, 2023 and considering the benefits and risks of all three options it was concluded that option 3 was the best approach to meet EBMUD's resiliency goals.

Table 3. Option Comparison Summary

Options	Cost Comparison Estimate	Benefits	Risks
1. LCI Modernization	▪ $493,774 for first drive, $255,750 for remaining drives ▪ Total Estimated Cost = $1,977,090[a].	▪ Least invasive option to existing electrical system	▪ Existing transformers are not operating reliably, motors still 30+ years old ▪ LCIs are rare and difficult to get parts for, and would power an aging system (transformers and motors)
2. VFD Drives with transformers to retain existing motors	▪ VFD Drive: $200,000 each, plus $50,000 per drive for synchronization equipment to interface with synchronous motors. ▪ New Transformer: $71,000 each. Note: estimated 120-week lead time. ▪ Total Equipment Cost = $1,605,000 ▪ New Duct Bank = $150,000 ▪ Total Estimated Costs = $7,500,000 ▪ Cost Range $3,700,000-$14,900,000[b]	▪ Drives are replaced with new VFD drives ▪ Gives ability to replace motors in the future but would require some rebuild of the VFD.	▪ Reuse of 30-yr old motors. ▪ Transformers located outside the IPS would require more site work and new duct bank. Motors are still 30+ years old. Most invasive option to existing system. [c] ▪ Future replacement of the pump motors would require the new VFDs to be modified
3. VFD Drives with MV Motors (selected option)	▪ VFD Drive: $200,000 each ▪ MV Motor: $380,000 each ▪ Total Equipment Cost = $2,900,000[d] ▪ Total Estimated Costs = $9,200,000 Cost Range $4,610,000-$18,440,000	▪ Fully replaced system, reducing electrical components and aging equipment ▪ Most cost-effective approach if the motors are going to be replaced in the future	▪ Highest initial cost option (lower cost if motors are to be replaced in the future)

[a] Modernization of LCI cost is based on the 2022 bid for modernizing the LCIs at the EBMUD MWWTP Effluent Pump Station. Cost in this table has been escalated by 11.7% for a 2026 construction year (consistent with the other alternatives).

[b] Assumes install, demo, and indirect costs are similar for option 2 and 3. Primary difference in project cost is the equipment cost.

[c] This option would require new transformers located to the west of the building under the concrete canopy. This will require use of the existing conduit between the IPS and this electrical equipment plus an additional duct bank and conduit from the new transformers back to the IPS. This construction cost for the new duct bank is anticipated to be more than the install and demo work for replacing the motors shown in option 3.

[d] Installation, associated demo, and contractor markup costs are shown in the Cost Estimate in Attachment 3. Note that the installation costs, associated demo costs, and contractor markups are assumed to be approximately similar for option 2 and 3. Exclusions to the cost are shown in part 4 of the Basis of Estimate in Attachment 3.

5.2 Construction Considerations for the Selected Option

Jacobs recommends the following project sequence be implemented during the April to October construction period. The recommendation is based on the IPS influent flow data and the seasonal flow rates:

1. Demolish one or two LCIs.
2. Install the new associated drive and motor.
3. Retest each pump train.

This proposed sequence would prevent the available flow capacity of the IPS from dropping to less than three pumps for any portion of the construction period. See Attachment 4 for a detailed construction schedule.

The replacement sequence could be as follows, based on the size of the new MV VFD drives and the working clearance requirements at MV or LV (600 V and less):

1. Demolish Drives 5 and 6, making room for new MV VFD Drives 4 and 5 (Pumps 1 to 3 operational).
2. Install new MV VFD drives connected to Pumps 4 and 5 (existing Drive 4 not connected).
3. Demolish Drives 3 and 4, making room for new MV VFD Drive 3 (Pumps 1, 2, 4, and 5 operational).
4. Install new MV VFD drive connected to Pump 3.
5. Demolish Drives 1 and 2, making room for new MV VFD Drives 1 and 2 (Pumps 3, 4, and 5 operational).
6. Install new MV VFD drives connected to Pumps 1 and 2.

The room's new layout would then be organized as shown on Figure 2, where the green hatched areas indicate demolition of the existing LCIs, and the orange solid lines indicate the new VFDs and motor control centers.

It is possible to complete the construction for replacing all the drives in 1 season but the schedule would not include any float if there are delays during construction that would put EBMUD at risk of not having the full IPS operable at the start of the wet season and is therefore not recommended. Additional float could be created by working double shifts or weekends. A cost estimate and construction schedule for doing this work in one season has been included in Attachment 5 and 6, respectively.

Figure 2. New Room Layout