KRIEGER & STEWART INCORPORATED

TECHNICAL MEMORANDUM

TO: NINA JAZMADARIAN, GENERAL MANAGER
FOOTHILL MUNICIPAL WATER DISTRICT

FILE: 349-2.25.5

FROM: JOSH P. MACPEEK JPM
KRIEGER & STEWART, INCORPORATED

DATE: 9/14/2011

SUBJECT: MAIN PUMP STATION AND BERKSHIRE PUMP STATION GENERATOR REPLACEMENT

1.0 INTRODUCTION / PURPOSE

The Main Pump Station is equipped with two 500 kW, 480 volt, emergency standby diesel generators installed in separate containers. The two existing emergency generators were originally permitted by the South Coast Air Quality Management District (SCAQMD) for use as portable generators. We understand that the District has recently received a citation from the SCAQMD and that the generators can no longer be permitted for use as portable generators. The generators were originally designed to operate in parallel and are equipped with manual synchronizing controls. Currently, the synchronizing controls are out of service and only one generator can be operated at a time, limiting the station's flow to approximately 14 cfs during power outages. In addition, several generator components have been replaced both prior to and after the generators have been exercised. Therefore, the generators are unreliable and have reached the end of their useful life. The generators are connected to a 480/2,400 volt transformer, which is connected to a keyed generator disconnect. The existing emergency standby power system is strictly a manual operation, requiring manual start of the generators and manual operation of the keyed main switch and keyed generator disconnect.

The Berkshire Pump Station is equipped with a 350 kW, 480 volt portable emergency standby diesel generator, which is currently connected to a generator pull box which is connected to an automatic transfer switch (ATS); however, the generator can only operate one pumping unit, limiting the station's flow to 4.5 cfs during power outages.

This Technical Memorandum addresses the following:

1. Replacing the Main Pump Station's generators with a new automatically-controlled, permanent emergency standby diesel generator mounted in a sound attenuated enclosure and sized to accommodate a pumping rate of 24.0 cfs.

2. Replacing the Main Pump Station's existing manual generator disconnect with an ATS.

3. An evaluation of the Main Pump Station's existing main switchboard components to determine condition of the components, potential modernization of the components, their availability, and cost of replacement. Depending upon the evaluation, certain components will either be upgraded or replaced.

4. Replacing the Berkshire Pump Station's existing generator with a new automatically-controlled, permanent emergency standby diesel generator mounted in a sound attenuated enclosure and sized to accommodate a pumping rate of 12.0 cfs.

2.0 EXISTING FACILITIES

2.1 Main Pump Station

2.1.1 Pumping Units

The Main Pump Station is equipped with ten vertical turbine booster pumping units with five booster pumping units (1E through 5E) pumping to the 1228 Altadena Zone (East Header) and five booster pumping units (1W through 5W) pumping to the 1188 La Canada Zone (West Header) summarized as follows:

East Header Booster Pumping Units

Pumping Unit	Horsepower	Starter Type	Pump Capacity (cfs)
1E	200	Across-the-Line	4.5
2E	200	Across-the-Line	4.8
3E	150	Across-the-Line	3.0
4E	100	Across-the-Line	2.4
5E	350	Reduced Voltage Auto Transformer	6.0
		Total:	**20.7**

West Header Booster Pumping Units

Pumping Unit	Horsepower	Starter Type	Pump Capacity (cfs)
1W	250	Across-the-Line	6.6
2W	250	Across-the-Line	7.0
3W	250	Across-the-Line	6.6
4W	125	Across-the-Line	3.5
5W	350	Reduced Voltage Auto Transformer	7.9
		Total:	**31.6**

Pumping plants are typically designed to provide the maximum day demand (MDD) with the largest pumping unit out of service. The East Header Booster Pumping Units have a combined pumping capacity of 20.7 cfs with all pumping units operating and a combined pumping capacity of 14.7 cfs with the largest pumping unit out of service. The West Header Booster Pumping Units have a combined pumping capacity of 31.6 cfs with all pumping units operating and a combined pumping capacity of 23.7 cfs with the largest pumping unit out of service.

2.1.2 Electrical Service

Electric power service for the Main Pump Station is 2,400 volts, 3-phase, 60 hertz, and is provided by the City of Pasadena. The main service and switchboard include a 1,200 amp keyed fused disconnect, a meter for the pump station (revenue meter), a meter for the building, a 400 amp fused disconnect for the East Header Booster Pumping Units, a 600 amp fused disconnect for the West Header Booster Pumping Units, and a manual keyed generator disconnect for switching from normal to emergency power. The main service and switchboard are located east of the control building out-of-doors.

2.1.3 Existing Generators

Two 500 kW, 480 volt, 3-phase, 60 hertz emergency standby diesel generators installed in separate containers are located to the east of the pump station. The generators are connected to a 480/2,400 volt transformer located to the east of the generators. The 480/2,400 volt transformer is connected to the keyed generator disconnect located at the end of the main switchboard. The generators were originally designed to operate in parallel and are equipped with manual synchronizing controls. Currently, the synchronizing controls are out of service and only one generator can be operated at a time, limiting the number of pumps that can operate and the station's flow to approximately 14 cfs. The existing

emergency standby power system is strictly a manual operation, requiring manual start of the generators and manual operation of the keyed main switch and keyed generator disconnect. The existing generators are installed on an existing concrete foundation and within an existing containment structure which consists of approximately 2 foot high walls.

2.2 Berkshire Pump Station

2.2.1 Pumping Units

The Berkshire Pump Station is equipped with four vertical turbine booster pumping units which pump to the 1650 La Crescenta Zone. Booster Pumping Unit No. 1B is equipped with a 300 hp electric motor and variable frequency drive, and is rated at 4.5 cfs. Booster Pumping Unit Nos. 2B, 3B, and 4B are equipped with 300 hp electric motors and soft starters, and are each rated at 4.5 cfs. The Berkshire Pump Station has a combined pumping capacity of 18.0 cfs with all pumping units operating and a pumping capacity of 13.5 cfs with the largest pumping unit out of service.

2.2.2 Electrical Service

Electric power service for the Berkshire Pump Station is 480 volt, 3-phase, 60 hertz, and is provided by Southern California Edison (SCE). The main switchboard includes a main circuit breaker and an ATS.

2.2.3 Existing Generator

A 350 kW, 480 volt portable generator is currently connected to a generator pull box which is connected to the ATS; however, the generator can only operate one pumping unit, limiting the station's flow to 4.5 cfs during power outages.

3.0 EMERGENCY PUMPING CAPACITY

3.1 Main Pump Station

The District has reviewed historic and projected agency demands and determined that the emergency standby generator should be sized to pump 24.0 cfs from the Main Pump Station during an electrical power outage. This is based on recent MDD from member agencies and as required per Title 22, Chapter 16, California Waterworks Standards, Article 2, Section 64554.

With a 1 MW generator, the District could operate 36 possible pumping unit combinations (flows ranging from 20.9 cfs to 25.4 cfs) as set forth in **Table 1**. With a 1.25 MW generator, the District could operate 49 possible pumping unit combinations (flows ranging from 20.9 cfs to 25.7 cfs) as set forth in **Table 2**.

Based on discussions with District staff, the replacement generator will be sized to allow operation of the 36 pumping combinations (1 MW generator) and will not be sized to operate all of the existing pumping units.

3.2 Berkshire Pump Station

The Berkshire Pump Station can deliver approximately 12.0 cfs with three pumping units operating (actual measured flow). The District has reviewed agency demands during the Station Fire (July through October 2009) to determine the highest demands during this event. During the Station Fire, two pumping units were operated for the majority of the time and the third pumping unit was operated intermittently. Therefore, the replacement generator will be sized to operate three pumping units during an electrical power outage to provide a minimum station flow of 12.0 cfs.

4.0 MAIN PUMP STATION MAIN SWITCHBOARD EVALUATION

We have field reviewed the existing main switchboard and found it to be in operable condition. However, the disconnect switches (excluding the fuses) are old and obsolete. Although the disconnect switches are considered obsolete (no longer produced by the manufacturer), replacement disconnect switches are available; however, in the event of a disconnect switch failure, it may require an extended period of time to obtain a replacement disconnect switch. We recommend that the District obtain and stock spare fuses for the disconnect switches.

A chain link fence has been installed in front of the main switchboard, which restricts the working clearances in front of the main switchboard. The National Electric Code (NEC) Table 110-34, Condition 2, specifies a minimum working clearance of 48" from the face of any 2,400 volt switchboard to adjacent grounded obstruction. The chain link fence is considered a grounded obstruction. Therefore, we recommend that the existing chain link fence be removed or relocated to provide the 48" minimum clearance.

We understand that an arc flash study has recently been performed for the Main Pump Station, and as a result of said study, several of the existing panels will require "Dangerous" labels, which prohibit energized work on the panels. This is a Cal/OSHA designation intended to reduce the personal risk by defining working space and personal protection requirements when working around switchgear with covers that are open and accessible. The calculated arc flash incident energy is purely a function of the deliverable power (voltage x current) verses time and does not take into account protective devices such as flash shielding. Although the arc flash incident energy generated may be slightly reduced if the existing fuses were replaced with faster acting fuses or with new zero time circuit breakers, we do not recommend same since the existing over current trip delays were designed into the switchgear because of the high starting currents generated from operating the pumping units. Therefore, replacing the existing main switchgear with new switchgear will not significantly reduce the arc flash energy generated or reduce the Cal/OSHA category designation. The "Dangerous" labeling would most likely still be required. As with all high voltage electrical panels, they should be de-energized prior to opening any interior compartment of the switchgear.

5.0 MAIN PUMP STATION GENERATOR AND MAIN SWITCHBOARD ALTERNATIVES

We have performed generator sizing calculations and determined that a 1 MW generator is required to deliver 24.0 cfs from the Main Pump Station during an electrical power outage. The proposed generator size was confirmed with two generator manufacturers (Caterpillar and Onan) based on each manufacturer's independent sizing calculations.

The new generator will be an automatically-controlled, permanent emergency standby diesel generator mounted in a sound attenuated enclosure with a 24-hour fuel tank, and will be located in the same location as the existing generators. Therefore, the existing generators will have to be removed and the containment structure and generator foundations will have to be demolished prior to constructing the new generator facilities. Due to limited space adjacent to the existing main switchboard, the new ATS will be located adjacent to the new generator. Since the new generator will be longer than the existing generators, the existing slope on the north side of the existing generators will have to be excavated and retaining walls will have to be constructed on three sides of the generator. New generator facilities will include a containment structure, a reinforced concrete foundation, conduit and conductors between the generator and ATS, and conduit and conductors between the ATS and main switchboard.

We have developed alternatives for replacing the existing generators with either a new 1 MW, 480 volt or a new 1 MW, 2,400 volt generator. For the 480 volt generator alternatives, the existing 480/2,400 volt transformer will remain in service. Each alternative includes replacing the existing manual generator disconnect with a new 2,400 volt ATS. We have also developed alternatives which incorporate replacing the existing main switchboard.

Although 480 volt and 2,400 volt generators are both capable of supplying emergency power to the pump station during a power outage, there are advantages and disadvantages associated with each. As noted above, a 480 volt generator requires a 480/2,400 volt step-up transformer, whereas a 2,400 volt generator does not require a step-up transformer. Since a 2,400 volt

generator is medium voltage, specially trained technicians are required to service it, whereas a 480 volt generator is low voltage and does not require specially trained technicians.

Estimated construction costs for each alternative are set forth in **Table 3** (attached). These costs do not include design or construction engineering fees. The estimated delivery schedule for a 480 volt generator is 20 to 26 weeks and the estimated delivery schedule for a 2,400 volt generator is 26 to 30 weeks.

As set forth in **Table 3**, the construction cost for a 1 MW, 480 volt generator is estimated to be $1,200,000 and is less expensive than a 1 MW, 2,400 volt generator. The 1 MW, 480 volt generator would be available four to six weeks sooner than a 1 MW, 2,400 volt generator. Replacing the existing main switchboard would add approximately $400,000 to the construction cost.

6.0 BERKSHIRE PUMP STATION GENERATOR

We have performed generator sizing calculations and determined that a 900 kW generator is required to deliver 12.0 cfs from the Berkshire Pump Station during an electrical power outage. The proposed generator size was confirmed with two generator manufacturers (Caterpillar and Onan) based on each manufacturer's independent sizing calculations. Caterpillar does not manufacture a 900 kW generator and therefore will have to furnish a 1,000 kW generator.

The new generator will be an automatically-controlled, permanent emergency standby diesel generator mounted in a sound attenuated enclosure with a 24-hour fuel tank and will be connected to the existing generator pull box which is connected to the existing 1,600 amp ATS. The existing main switchboard and ATS are adequate for the new generator and replacement of same will not be required. New generator facilities will include a new containment structure, a reinforced concrete foundation, and conduit and conductors between the generator and the existing generator pull box.

As set forth in **Table 4** (attached), the construction cost for a 900 kW, 480 volt generator is estimated to be $600,000. The cost does not include design or construction engineering fees. The estimated delivery schedule for the generator is 20 to 26 weeks.

7.0 RECOMMENDED PROJECT

Since the Main Pump Station's existing main switchboard is in operable condition and replacement of same would add approximately $400,000 to the construction cost, we do not recommend replacement of the main switchboard at this time. Since the Main Pump Station's existing emergency standby power system is strictly a manual operation and only one generator can be operated at a time limiting the station's flow to approximately 14 cfs during power outages, we recommend replacing the existing generators with a 1 MW, 480 volt generator and replacing the existing keyed generator disconnect with an ATS. Since the Berkshire Pump Station's existing portable generator can only operate one pumping unit, limiting the station's flow to 4.5 cfs, we recommend replacing the existing portable generator with a 900 kW, 480 volt generator.

The recommended project includes the following components:

<u>Main Pump Station</u>

- 1 MW, 480 volt, 3-phase, 60 hertz, automatically-controlled, permanent emergency standby diesel generator mounted in a sound attenuated enclosure with 24-hour fuel tank
- 1,200 amp ATS
- Containment structure

Berkshire Pump Station

- 900 kW, 480 volt, 3-phase, 60 hertz, automatically-controlled, permanent emergency standby diesel generator mounted in a sound attenuated enclosure with 24-hour fuel tank
- Containment structure

The construction cost for the recommended project is estimated to be $1,800,000 ($1,200,000 for the Main Pump Station and $600,000 for the Berkshire Pump Station).

8.0 MAINTAINING STATION OPERATION DURING CONSTRUCTION

Maintaining pump station operation, including standby power, during replacement of the generators at the Main Pump Station and the Berkshire Pump Station is critical. We have prepared a brief outline of the sequence of work for each pump station to maintain pump station operation during replacement of the generators. The sequence of work addresses the anticipated pump station down time and the requirement to provide temporary power (generator). A more detailed sequence of work should be addressed during preparation of the contract documents for purchase and installation of the generator facilities.

8.1 Main Pump Station

The new generator will be located in the same location as the existing generators, which will require removal of the existing generators and demolition of the containment structure and generator foundation prior to constructing the new generator facilities. Approximately 60 days will be required to remove the existing generator facilities and construct the new generator facilities. Following is a brief outline of the sequence of work required at the Main Pump Station.

1. Prior to removal of the existing generator facilities, all materials and equipment (including the new generator and ATS) shall be onsite.

2. Install and test a temporary 500 kW generator prior to commencing construction to provide standby power during the replacement of the generator facilities. The temporary generator would remain in place until the new generator has been installed and tested.

3. Remove existing generator facilities and install new generator facilities (including the generator foundation, containment structure, generator, and ATS) prior to making connections to the existing main switchboard.

4. Install connections to the existing main switchboard. This phase will require the pump station to be shut down for approximately eight hours.

5. Test the new generator facilities.

6. Remove the temporary generator once the new generator facilities have been successfully tested.

8.2 Berkshire Pump Station

Following is a brief outline of the sequence of work required at the Berkshire Pump Station.

1. Prior to commencing construction of the new generator facilities, all materials and equipment (including the new generator) shall be onsite.

2. Relocate the existing portable generator to provide room for construction of the new generator facilities and install temporary conductors between the existing portable generator and the existing generator pull box to provide standby power during the replacement of the generator facilities. The existing portable

generator would remain in place until the new generator has been installed and tested.

3. Install new generator facilities (including the generator foundation, containment structure, and generator) prior to making connections to the existing generator pull box.

4. Install the connections to the existing generator pull box. The pump station will remain in service during connection to the existing generator pull box.

5. Test the new generator.

6. Remove the existing portable generator after the new generator has been successfully tested.

JPM/jmw
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Attachments: Table 1 - Main Pump Station with 1,000 kW (1 MW) Generator, Possible Pumping Combinations to Deliver 24± cfs
Table 2 - Main Pump Station with 1,250 kW (1.25 MW) Generator, Possible Pumping Combinations to Deliver 24± cfs
Table 3 - Main Pump Station Preliminary Construction Cost Estimates
Table 4 - Berkshire Pump Station Preliminary Construction Cost Estimate

cc: Justin Bailey, Foothill Municipal Water District

TABLE 1
FOOTHILL MUNICIPAL WATER DISTRICT
MAIN PUMP STATION AND BERKSHIRE PUMP STATION GENERATOR REPLACEMENT
MAIN PUMP STATION WITH 1,000 KW (1 MW) GENERATOR
POSSIBLE PUMPING COMBINATIONS TO DELIVER 24± CFS

Item	Running Pumps	1 W	2 W	3 W	4 W	5 W	1 E	2 E	3 E	4 E	5 E	Flow West (cfs)	Flow East (cfs)	Total Flow (cfs)	Total Pump Horsepower
1	1E, 2E, 3E, 4E, 5E						x	x	x	x	x	0.0	20.9	20.9	1,000
2	1W, 4W, 1E, 2E, 3E, 4E	x			x		x	x	x	x		9.9	14.9	24.8	1,025
3	3W, 4W, 1E, 2E, 3E, 4E			x	x		x	x	x	x		9.9	14.9	24.8	1,025
4	2W, 4W, 1E, 2E, 3E, 4E		x		x		x	x	x	x		10.3	14.9	25.2	1,025
5	1W, 3W, 1E, 3E, 4E	x		x			x		x	x		13.2	10.1	23.3	950
6	1W, 3W, 2E, 3E, 4E	x		x				x	x	x		13.2	10.4	23.6	950
7	1W, 2W, 1E, 3E, 4E	x	x				x		x	x		13.6	10.1	23.7	950
8	2W, 3W, 1E, 3E, 4E		x	x			x		x	x		13.6	10.1	23.7	950
9	1W, 2W, 2E, 3E, 4E	x	x					x	x	x		13.6	10.4	24.0	950
10	2W, 3W, 2E, 3E, 4E		x	x				x	x	x		13.6	10.4	24.0	950
11	1W, 3W, 4W, 1E, 3E	x		x	x		x		x			16.5	7.7	24.2	975
12	1W, 3W, 4W, 2E, 3E	x		x	x			x	x			16.5	8.0	24.5	975
13	1W, 3W, 4W, 4E, 5E	x		x	x					x	x	16.5	8.4	24.9	1,075
14	1W, 2W, 4W, 1E, 3E	x	x		x		x		x			16.9	7.7	24.6	975
15	2W, 3W, 4W, 1E, 3E		x	x	x		x		x			16.9	7.7	24.6	975
16	1W, 2W, 4W, 2E, 3E	x	x		x			x	x			16.9	8.0	24.9	975
17	2W, 3W, 4W, 2E, 3E		x	x	x			x	x			16.9	8.0	24.9	975
18	1W, 2W, 4W, 4E, 5E	x	x		x					x	x	16.9	8.4	25.3	1,075
19	2W, 3W, 4W, 4E, 5E		x	x	x					x	x	16.9	8.4	25.3	1,075
20	1W, 4W, 5W, 1E, 4E	x			x	x	x			x		17.8	6.9	24.7	1,025
21	3W, 4W, 5W, 1E, 4E			x	x	x	x			x		17.8	6.9	24.7	1,025
22	1W, 4W, 5W, 2E, 4E	x			x	x		x		x		17.8	7.2	25.0	1,025
23	3W, 4W, 5W, 2E, 4E			x	x	x		x		x		17.8	7.2	25.0	1,025
24	1W, 4W, 5W, 5E	x			x	x					x	17.8	6.0	23.8	1,075
25	3W, 4W, 5W, 5E			x	x	x					x	17.8	6.0	23.8	1,075
26	2W, 4W, 5W, 1E, 4E		x		x	x	x			x		18.2	6.9	25.1	1,025
27	2W, 4W, 5W, 2E, 4E		x		x	x		x		x		18.2	7.2	25.4	1,025
28	2W, 4W, 5W, 5E		x		x	x					x	18.2	6.0	24.2	1,075
29	1W, 2W, 3W, 1E	x	x	x			x					20.2	4.5	24.7	950
30	1W, 2W, 3W, 2E	x	x	x				x				20.2	4.8	25.0	950
31	1W, 3W, 5W, 3E	x		x		x			x			21.1	3.2	24.3	1,000
32	1W, 2W, 5W, 3E	x	x			x			x			21.5	3.2	24.7	1,000
33	2W, 3W, 5W, 3E		x	x		x			x			21.5	3.2	24.7	1,000
34	1W, 3W, 4W, 5W	x		x	x	x						24.4	0.0	24.4	975
35	1W, 2W, 4W, 5W	x	x		x	x						24.8	0.0	24.8	975
36	2W, 3W, 4W, 5W		x	x	x	x						24.8	0.0	24.8	975

TABLE 2
FOOTHILL MUNICIPAL WATER DISTRICT
MAIN PUMP STATION AND BERKSHIRE PUMP STATION GENERATOR REPLACEMENT
MAIN PUMP STATION WITH 1,250 KW (1.25 MW) GENERATOR
POSSIBLE PUMPING COMBINATIONS TO DELIVER 24± CFS

Item	Running Pumps	1 W	2 W	3 W	4 W	5 W	1 E	2 E	3 E	4 E	5 E	Flow West (cfs)	Flow East (cfs)	Total Flow (cfs)	Total Pump Horsepower
1	1E, 2E, 3E, 4E, 5E						x	x	x	x	x	0.0	20.9	20.9	1,000
2	4W, 1E, 2E, 3E, 4E, 5E				x		x	x	x	x	x	3.3	20.9	24.2	1,125
3	1W, 1E, 2E, 3E, 5E	x					x	x	x		x	6.6	18.5	25.1	1,150
4	3W, 1E, 2E, 3E, 5E			x			x	x	x		x	6.6	18.5	25.1	1,150
5	1W, 1E, 2E, 4E, 5E	x					x	x		x	x	6.6	17.7	24.3	1,100
6	3W, 1E, 2E, 4E, 5E			x			x	x		x	x	6.6	17.7	24.3	1,100
7	2W, 1E, 2E, 3E, 5E		x				x	x	x		x	7.0	18.5	25.5	1,150
8	2W, 1E, 2E, 4E, 5E		x				x	x		x	x	7.0	17.7	24.7	1,100
9	1W, 4W, 1E, 2E, 3E, 4E	x			x		x	x	x	x		9.9	14.9	24.8	1,025
10	3W, 4W, 1E, 2E, 3E, 4E			x	x		x	x	x	x		9.9	14.9	24.8	1,025
11	2W, 4W, 1E, 2E, 3E, 4E		x		x		x	x	x	x		10.3	14.9	25.2	1,025
12	1W, 3W, 1E, 3E, 4E	x		x			x		x	x		13.2	10.1	23.3	950
13	1W, 3W, 2E, 3E, 4E	x		x				x	x	x		13.2	10.4	23.6	950
14	1W, 2W, 1E, 3E, 4E	x	x				x		x	x		13.6	10.1	23.7	950
15	2W, 3W, 1E, 3E, 4E		x	x			x		x	x		13.6	10.1	23.7	950
16	1W, 2W, 2E, 3E, 4E	x	x					x	x	x		13.6	10.4	24.0	950
17	2W, 3W, 2E, 3E, 4E		x	x				x	x	x		13.6	10.4	24.0	950
18	1W, 5W, 1E, 5E	x				x	x				x	14.5	10.5	25.0	1,150
19	3W, 5W, 1E, 5E			x		x	x				x	14.5	10.5	25.0	1,150
20	1W, 5W, 2E, 5E	x				x		x			x	14.5	10.8	25.3	1,150
21	3W, 5W, 2E, 5E			x		x		x			x	14.5	10.8	25.3	1,150
22	2W, 5W, 1E, 5E		x			x	x				x	14.9	10.5	25.4	1,150
23	2W, 5W, 2E, 5E		x			x		x			x	14.9	10.8	25.7	1,150
24	1W, 3W, 4W, 1E, 3E	x		x	x		x		x			16.5	7.7	24.2	975
25	1W, 3W, 4W, 2E, 3E	x		x	x			x	x			16.5	8.0	24.5	975
26	1W, 3W, 4W, 4E, 5E	x		x	x					x	x	16.5	8.4	24.9	1,075
27	1W, 2W, 4W, 1E, 3E	x	x		x		x		x			16.9	7.7	24.6	975
28	2W, 3W, 4W, 1E, 3E		x	x	x		x		x			16.9	7.7	24.6	975
29	1W, 2W, 4W, 2E, 3E	x	x		x			x	x			16.9	8.0	24.9	975
30	2W, 3W, 4W, 2E, 3E		x	x	x			x	x			16.9	8.0	24.9	975
31	1W, 2W, 4W, 4E, 5E	x	x		x					x	x	16.9	8.4	25.3	1,075
32	2W, 3W, 4W, 4E, 5E		x	x	x					x	x	16.9	8.4	25.3	1,075
33	1W, 4W, 5W, 1E, 4E	x			x	x	x			x		17.8	6.9	24.7	1,025
34	3W, 4W, 5W, 1E, 4E			x	x	x	x			x		17.8	6.9	24.7	1,025
35	1W, 4W, 5W, 2E, 4E	x			x	x		x		x		17.8	7.2	25.0	1,025
36	3W, 4W, 5W, 2E, 4E			x	x	x		x		x		17.8	7.2	25.0	1,025
37	1W, 4W, 5W, 5E	x			x	x					x	17.8	6.0	23.8	1,075
38	3W, 4W, 5W, 5E			x	x	x					x	17.8	6.0	23.8	1,075
39	2W, 4W, 5W, 1E, 4E		x		x	x	x			x		18.2	6.9	25.1	1,025
40	2W, 4W, 5W, 2E, 4E		x		x	x		x		x		18.2	7.2	25.4	1,025
41	2W, 4W, 5W, 5E		x		x	x					x	18.2	6.0	24.2	1,075
42	1W, 2W, 3W, 1E	x	x	x			x					20.2	4.5	24.7	950
43	1W, 2W, 3W, 2E	x	x	x				x				20.2	4.8	25.0	950
44	1W, 3W, 5W, 3E	x		x		x			x			21.1	3.2	24.3	1,000
45	1W, 2W, 5W, 3E	x	x			x			x			21.5	3.2	24.7	1,000
46	2W, 3W, 5W, 3E		x	x		x			x			21.5	3.2	24.7	1,000
47	1W, 3W, 4W, 5W	x		x	x	x						24.4	0.0	24.4	975
48	1W, 2W, 4W, 5W	x	x		x	x						24.8	0.0	24.8	975
49	2W, 3W, 4W, 5W		x	x	x	x						24.8	0.0	24.8	975

TABLE 3
FOOTHILL MUNICIPAL WATER DISTRICT
MAIN PUMP STATION AND BERKSHIRE PUMP STATION GENERATOR REPLACEMENT
MAIN PUMP STATION PRELIMINARY CONSTRUCTION COST ESTIMATES

Costs	Alternative			
	480 Volt Generator with Existing Main Switchboard	480 Volt Generator Replace Main Switchboard	2,400 Volt Generator with Existing Main Switchboard	2,400 Volt Generator Replace Main Switchboard
Demolition	$20,000	$20,000	$20,000	$20,000
ATS	$270,000	$270,000	$270,000	$270,000
Grading and Retaining Walls	$25,000	$25,000	$25,000	$25,000
Generator	$475,000	$475,000	$540,000	$540,000
Foundation and Containment Structure	$30,000	$30,000	$35,000	$35,000
Conduit and Conductors	$270,000	$270,000	$270,000	$270,000
Main Switchboard	N/A	$235,000	N/A	$235,000
Conductors to Building	N/A	$120,000	N/A	$120,000
Construction Subtotal:	$1,090,000	$1,445,000	$1,160,000	$1,515,000
Construction Contingency @ 10%:	$109,000	$144,500	$116,000	$151,500
Construction Total:	$1,199,000	$1,589,500	$1,276,000	$1,666,500
Construction Total (Rounded):	**$1,200,000**	**$1,590,000**	**$1,280,000**	**$1,670,000**

TABLE 4 FOOTHILL MUNICIPAL WATER DISTRICT MAIN PUMP STATION AND BERKSHIRE PUMP STATION GENERATOR REPLACEMENT BERKSHIRE PUMP STATION PRELIMINARY CONSTRUCTION COST ESTIMATE	
Item	**Cost**
Demolition	$10,000
Generator	$475,000
Foundation and Containment Structure	$30,000
Conduit and Conductors	$30,000
Construction Subtotal:	$545,000
Construction Contingency @ 10%:	$54,500
Construction Total:	$599,500
Construction Total (Rounded):	**$600,000**