SAN RAFAEL SANITATION DISTRICT
Agenda Item No. 6.a. ii.

DATE: October 24, 2022

TO: Board of Directors, San Rafael Sanitation District

FROM: Doris Toy, District Manager/District Engineer

SUBJECT: Discussion and Update on the Bayside Acres Beach Sewer Improvement Project – Backup Power

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BACKGROUND:

At the May 20, 2022, Board meeting, the Board directed staff to proceed with the engineering design of private individual pump systems for existing properties that are affected by the relocation of the sewer main in the beach for the Bayside Acres Sewer Improvement Project. Since backup power was one of the concerns of the property owners in regard to using a pump system, the Board asked staff to provide additional information on options for backup power sources, costs, and liability. The Board would then decide whether the District would provide a backup power source.

The District's engineering consultant on this project, Nute Engineering, asked its electrical engineering consultant, Beecher Engineering, to prepare a technical memo in regard to standby power alternatives.

ANALYSIS

With the assumption that each new pumping system must be capable of operating for up to 24 hours without the presence of a PG&E power source and the standby power source shall only be used for the new pump system equipment, Beecher Engineering offered two practical alternatives: a standby generator powered by natural gas and a battery system. Both systems will automatically turn on when PG&E power is unavailable.

Standby Generator

The advantages of having a standby generator backup power source are:

- The system can operate for an unlimited duration as long as there is PG&E natural gas;
- The generator equipment has an estimated service life of approximately 20 years before replacement is required.

The disadvantages of having a standby generator backup power source are:

- Somewhat noisy, similar to the noise level of a vacuum cleaner;
- Requires annual maintenance service, which costs approximately $1,000/year.
- Produces exhaust emissions when California is trying to reduce fossil fuel emissions;

- Requires a footprint of approximately 36"x 30" and will need to be set back from the house per local code requirements for an internal combustion engine exhaust.

Battery Backup

The battery system unit is similar to residential solar power systems with the dimension of approximately 21" wide by 30" high. It can be installed either indoors, typically within a residence garage or within a ventilated outdoor enclosure.

The advantages of having a battery backup as a power source are:

- System is quiet during operation
- Does not produce any emissions
- Consists of solid-state components which enhance system reliability

The disadvantages of having a battery backup as a power source are:

- Operating time is limited during a PG&E power outage, depending on the quantities of batteries installed.
- Battery service life is estimated to be approximately 5 years, at which time the batteries need to be replaced and old batteries need to be disposed of. The cost is approximately $5,000 for battery replacement; the estimated disposal cost will be dependent on the local waste management facility, if they do not have a "free" battery recycling program.

FINANCIAL IMPACT:

The estimated installed cost for the standby generator is $15,000 per residence, and for the battery system, the cost is $20,000 per residence.

ACTION REQUIRED:

Board to discuss the standby power source alternatives.

1. Decide whether the District will provide a standby power source to each of the private individual pump system residents within the Bayside Acres Sewer Improvement Project and decide which alternative:
   a. Standby generator; or
   b. Battery system
2. Provide other direction to staff.

Attachment: Beech Engineering Memorandum, dated October 21, 2022

Beecher Engineering, Inc.

MEMORANDUM

October 21, 2022

To: Mark Wilson (Nute)

From: Todd Beecher (BEI)

cc: Adrian Bartshire (Nute)

SUBJECT: San Rafael Sanitation District – Bayside Acres Residential Sewage Pumps: Standby Power Alternatives

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Mark,

Nute Engineering (Nute) provided the following information for the anticipated residential sewage pump units that will be required for the Bayside Acres Project:

Street Address	Pump Configuration	Pump Size (Hp)
9 MARINE DR	Duplex	0.5 - 0.75
11 MARINE DR	Duplex	0.5 - 0.75
177 OAK DR	Duplex	0.5 - 0.75
179 OAK DR	Duplex	0.5 - 0.75
181 OAK DR	Duplex	1
183 OAK DR	Duplex	1
187 OAK DR	Duplex	1
189 OAK DR	Duplex	0.5 - 0.75
191 OAK DR	Duplex	1.5
193 OAK DR	Duplex	1
800 PT SAN PEDRO RD	Duplex	1
816 PT SAN PEDRO RD	Duplex	0.5 - 0.75
824 PT SAN PEDRO RD Main	Duplex	0.5 - 0.75
824 PT SAN PEDRO RD ADU	Simplex	0.5 - 0.75
824 PT SAN PEDRO RD Pier	Simplex	0.5 - 0.75
828 PT SAN PEDRO RD	Duplex	0.5 - 0.75
832 PT SAN PEDRO RD	Duplex	0.5 - 0.75
836 PT SAN PEDRO RD	Duplex	0.5 - 0.75
50 BEACH DR	Duplex	0.5 - 0.75
51 BEACH DR	Duplex	0.5 - 0.75
53 BEACH DR	Duplex	0.5 - 0.75

System Assumptions:

The following has been assumed with respect to evaluating the standby power requirements for each location:

- Where “duplex” pumps are indicated, it is assumed that both pumps may be required to operate simultaneously

- Where “duplex” pumps are indicated, it is assumed that the controls for the pumps will “stagger” the starting of the pumps so that they are not called to start at the same time

- Where a range has been indicated for a location, the upper limit horsepower size for the pumps has been assumed with respect to evaluating the standby power requirements

- Each residence location will be implemented as a dedicated system which shall include the pumping equipment and associated wet well, pump control system and instrumentation, utility power source from the residence’s main panelboard and dedicated standby power source. No “sharing” of new systems between different residence locations is assumed.

- It has been assumed that each new pumping system must be capable of full-load operation for up to (24) hours without the presence of the residence’s PG&E utility power source (i.e. inverter/battery backup system must provide a minimum of 24 hours of continuous operation during a PG&E outage).

- Standby power provisions shall only be utilized with the new pumping system equipment. Other loads connected to each residence main panel will not be supplied from the standby power provisions that are utilized for the new pumping systems.

Background Discussion:

As we have discussed, the new sewage pumps will be the sole means for conveying sewage from each residential property into the San Rafael Sanitation District (SRSD) conveyance system, thus necessitating a high level of reliability for the new pumping systems. To achieve an acceptable level of reliability, each new pumping system will need to be capable of operation without limitation regardless of whether the residence’s utility power source is available or not. Therefore, a reliable standby power source is required for each residential pumping system being provided in order to maintain full-load operation during utility power outages for an assumed maximum duration of up to (24) hours.

Following are the two (2) practical approaches for supplying standby power to each provided pumping system:

- Standby generator utilizing an internal combustion engine driving a rotating synchronous generator

- Inverter system in conjunction with batteries

Each of these approaches is discussed in detail below.

Alternative 1: Standby Generator:

Figure 1 below indicates standby power implementation utilizing a standby generator source. This approach utilizes an automatic transfer switch in conjunction with an engine-driven standby generator that is fueled from the residence's PG&E natural gas supply. Upon sensing PG&E power loss, the automatic transfer switch automatically transmits a "start" signal to the standby generator. Once the generator starts and is up to speed and voltage, the automatic transfer switch will transition to the "Standby Source" position, restoring power to the sewage pumping system. Upon sensing return of PG&E power, the automatic transfer switch will transition back to the "Normal Source" position, returning the sewage pump system back to the PG&E power source.

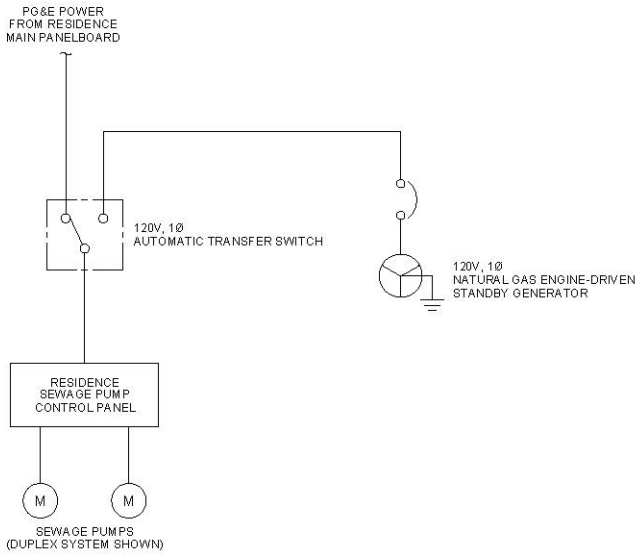

FIGURE 1: SYSTEM WITH STANDBY GENERATOR BACKUP POWER

The advantages of a standby generator backup power source are listed below:

- System can operate from the standby power source for an unlimited duration (i.e. as long as the PG&E natural gas source is present)

- Rotating generators can “ride through” pump starting inrush currents without requiring excessive sizing of the generator equipment

- Automatic transfer switch and generator equipment has an estimated service life of approximately 20 years before replacement is required

FIGURE 2: EXAMPLE RESIDENTIAL NATURAL GAS GENERATOR

The disadvantages of a standby generator backup power source are listed below:

- Somewhat noisy during operation (similar to the noise level of a vacuum cleaner, approximately 70 dBA), particularly since ALL of the residences in this vicinity will likely be simultaneously operating during a PG&E outage

- Automatic transfer switch consists of mechanical components that must be maintained on a yearly basis to ensure proper operation. It is estimated that the annual maintenance cost for both the generator and automatic transfer switch will be approximately $1,000.

- Produces exhaust emissions, which runs counter to present-day goals in California to reduce fossil fuel emissions

- The generator will require a footprint of approximately 36” x 30” and will need to be set back from the house per local Code requirements for an internal combustion engine exhaust.

Alternative 2: Battery Backup:

Figure 3 below indicates standby power implementation utilizing an inverter with battery backup. For this approach, the inverter accepts alternating current (AC) power from the PG&E source and direct current (DC) power from the backup batteries. The inverter "passes through" the PG&E AC power when it is available. When PG&E power is not available, the inverter automatically transitions to the battery backup source, converting the DC power to AC power for supply of the pumping equipment.

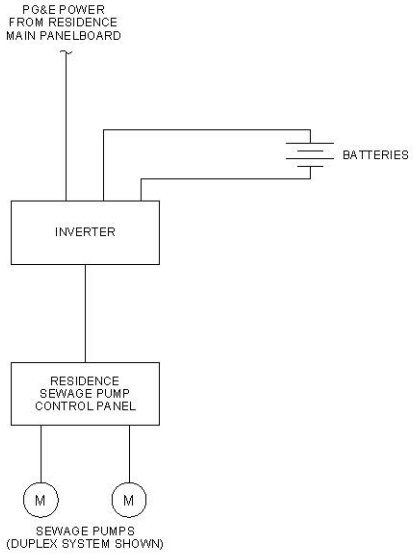

FIGURE 3: SYSTEM WITH INVERTER AND BATTERIES

The inverter will be similar to units that are used with residential solar power systems and will have dimensions of approximately 21" wide by 30" high. These units are required to be installed either indoors or within a ventilated outdoor enclosure (typically installed within a residence garage).

The advantages of an inverter/battery backup power source are listed below:

- System is quiet during operation
- Consists of solid-state components which enhance system reliability
- Does not produce any emissions

The disadvantages of an inverter/battery backup power source are listed below:

- Operating time is limited during a PG&E power outage depending on the quantities of batteries installed
- The inverter must be sized to accommodate the inrush current to the pump motors (i.e. sizing must be larger than required for steady-state operation of the pumping equipment)

- Battery service life is estimated to be approximately 5 years, at which time the batteries must be replaced and the old batteries disposed of (approximately $5,000 for the battery replacement with an estimated disposal cost that will be dependent on the local waste management facility, provided that the facility does not have a “free of charge” battery recycling program)

FIGURE 4: TYPICAL 20kW RESIDENTIAL INVERTER

Estimated Costs:

The estimated installed costs for each system are presented below. Costs presented below do not include conduit/wiring for each system (these costs are assumed to be similar for each presented alternative):

Alternative 1: Standby Generator:

Standby Generator: $10,000

Automatic Transfer Switch: $5,000

Alternative 1 Total Estimated Installation Cost: $15,000 (per residence)

Alternative 2: Inverter/Batteries:

Inverter: $15,000

Batteries: $5,000

Alternative 2 Total Estimated Installation Cost: $20,000 (per residence)

Recommendations:

Although the cost of utilizing an inverter/battery backup system will be more costly than utilizing a standby generator, the simplicity of the inverter/battery system coupled with the quiet operation in a residential setting coupled with clean operation with respect to emissions is the recommended choice for each residence.

It should be noted that inverter/battery system technology is constantly evolving and there is no “proven” solution for this specialized application. Furthermore, in light of today’s supply chain issues, costs and procurement of solid-state equipment such as inverters and batteries may vary widely. Should the District decide to move forward with the selection of utilizing an inverter/battery backup system, it is recommended that there be a “phased approach” which limits the pumping system initial installation to a single residence. Ideally, the recommended “phased approach” would be to install one, complete new pumping system including the inverter/battery backup system. This will allow a complete “prototype” system to be completely constructed and placed into operation so that system performance and actual final construction costs can be accurately determined for a complete system before committing District resources to the remaining (20) residences.

Please let me know if you would like to further discuss the information contained within this memorandum.