

Appendix D. Task 302 Technology Equipment and Software – Backup Power Generation

FINAL

TASK 302 - TECHNOLOGY, EQUIPMENT AND SOFTWARE – BACKUP POWER GENERATION

BLACK & VEATCH PROJECT NO. 401414

PREPARED FOR



Santa Rosa

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1.0 Introduction and TM Organization

This technical memorandum (TM) summarizes the options for the City of Santa Rosa (City) Water Department to address backup power generation.

The TM is organized into the following sections:

- Section 2.0, Project Background.
- Section 3.0, Backup Power Generation.

A review of best practices for backup generation for pump stations with variable frequency drives (VFD) is included in Section 3.0.

2.0 Project Background

In a telephone conversation the week of June 10, 2019, a Black & Veatch electric harmonics expert and a City engineer discussed the challenges of engine generators providing power to VFDs at pump stations.

3.0 Backup Power Generation

3.1 PROBLEM STATEMENT

Pump Station 3 has a fuel-driven generator and VFD. When driven by the generator, the pumps can suddenly trip off-line for no apparent reason. Two different organizations analyzed the problem for the City.

The conclusion was to add harmonic filters to Pump Station 3. As of this writing, installation of the filters has begun. Filters are being considered for additional pump stations.

Black & Veatch was asked to review the analyses and make recommendations to the City on the use of harmonic filters on future projects.

3.2 ANALYSIS

In general, harmonic filters and low harmonic drives (18 pulse or “clean” drives) are effective in mitigating harmonic distortion that can potentially lead to generator overheating and/or voltage exceedance, causing breakers to trip. Harmonic filters are less expensive than low harmonic drives but require additional maintenance/replacement costs, and the filters have the potential for increased capacitor storage, which can also overload generators if they are not properly designed and specified for the specific generator. Low harmonic drives (18 pulse drives) are more expensive but do not require the additional maintenance and do not have the issues with overloading. The additional cost of low harmonic drives may be negligible in the overall cost of a pump station capital project. The following are some general guidelines for looking at the design/specification of harmonic filters or 18 pulse drives:

- For applications with less than 100 horsepower (hp) of load, a traditional drive (6 pulse) should be considered, with the addition of a harmonic filter, if necessary. The addition of a filter would need to be assessed by the design engineer based on the specific power requirements of the station and generator. Often, the generator can be tuned specifically for use with the VFD that is needed for the application, without the need for a harmonic filter.

Consideration should be given to overall plant or pump station load. While Black & Veatch typically uses 6 pulse drives for motors less than 100 hp, a facility with several 6 pulse drives may require a different design approach. Black & Veatch has utilized active harmonic filters at the bus level instead of individual harmonic filters at each drive and specified 18 pulse or active front end drives where harmonics were likely to be an issue. An analysis should be performed during design to determine the best solution.

- For applications with 100 hp of load or greater, 18 pulse drives should be specified to ensure that minimum harmonics are generated when producing the alternating current (ac) output waveform for the motor from direct current (dc) power on the line side. Filters are not required with 18 pulse drives since the total dynamic harmonic is usually 5 percent or less. Black & Veatch uses 18 pulse or active front end drives for 100 hp or above.
- Power source(s) should be considered during design. If there will be a generator on the project, harmonic analysis should be performed for both scenarios where the plant or pump station operates on utility power or on generator power. Generator manufacturers should be consulted about any harmonic design considerations.
- Institute of Electrical and Electronic Engineers (IEEE) 519, Recommended Practice and Requirements for Harmonic Control in Electric Power Systems, is the industry standard that sets harmonic distortion limits and requirements.

Black & Veatch recommends that the City add harmonic filters to existing pump stations with generators and VFDs. In addition, the City should include a harmonic analysis for all power sources during design on any future pump stations.