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Our ref: 8618134

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Binghamton / JC Sewage Treatment Plant
4480 Vestal Road
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Binghamton-Johnson City Joint Sewage Treatment Plant Microturbine Operations

Dear Elliot

The City of Binghamton has requested information regarding operation of the microturbines at the Binghamton-Johnson City Joint Sewage Treatment Plant (the Plant). This request pertains to the operational and maintenance costs of the microturbines, as well as the performance of a fifth microturbine in a series of five.

Microturbine Operation and Maintenance Costs

From August 2020 through December 2022 (excluding the six-month period from March to August 2022 when BAFs were out of service), the Plant's anaerobic digesters produced an estimated average 350 cubic feet of biogas per month. The microturbines, powered by this biogas, generated an average of 105,170 KWH per month, or 1,262,040 KWH per year, of electricity. The current NYSEG transmission and consumption rate that the Plant pays is $0.0931 per KWH. Therefore, the annual value of the electricity produced by the microturbines is approximately $117,000.

In addition to electricity, the microturbines generate heat, which is used to warm the Plant's anaerobic digesters. During the design phase, GHD estimated that the digesters would require approximately 9,806,000,000 BTU of heat, equivalent to around 100,000 therms per year. The current NYSEG transmission and consumption rate that the Plant pays is $0.55 per therm. Therefore, the annual value of the heat produced by the microturbines is estimated to be $54,000.

There are costs associated with operating and maintaining the microturbines. These costs include the microturbines themselves and the gas conditioning system, which cleans the biogas before it is burned in the microturbines. The Plant has service agreements for annual maintenance of the microturbines and associated digester gas conditioning system, costing $70,000 and $30,000 per year, respectively. Ancillary equipment required to operate the microturbines and the gas conditioning system, such as water pumps, Variable Frequency Drives (VFDs), external heat exchangers, gas compressors, chillers, heat exchangers, fans, and various control system components, is not covered under the service agreement. The operation and maintenance cost for these components is estimated to be on average $10,000 per year.

Based on the above data, the estimated average net annual savings is approximately $61,000. A detailed ledger for the accounting is provided in the following table. As the data is variable and subject to change, GHD is providing a spreadsheet that the Plant can use to adjust variables and recalculate net annual savings.

Table 1 ***Estimated average net annual savings***

	Annual Cost/Saving
Annual Savings	
Microturbine Electricity	$117,000
Microturbine Heat	$54,000
Subtotal (Annual Savings)	**$171,000**
Annual Costs	
Microturbine Service	$70,000
Gas Conditioning Service	$30,000
Microturbine and Gas Conditioning Operations and Maintenances	$10,000
Subtotal (Annual Costs)	**$110,000**
NET SAVINGS	**$61,000**

Performance of a Fifth Microturbine

The Plant staff reports that a fifth of five microturbine cannot operate for an extended period of time due to lack of flow rate in the digester heating loop system. This system provides heat to the anaerobic digesters, offsetting the heating costs discussed above. Each microturbine requires 25 gallons per minute to function with the digester heating loop system. The two existing pumps can pump approximately 100 gallons per minute, therefore a single microturbine does not receive enough water flow and shuts down.

GHD visited the site in February 2023 and developed a concept for increasing the flow of the digester heating loop system. The concept includes creating an integral water loop for a single microturbine using a new water pump with modified piping around the two microturbines at the end of the existing digester heating loop system. As proof of concept, it was suggested that a microturbine could be temporarily plumbed and operated with plant or potable water. The concept of the “integral water loop” is depicted in the accompanying figure. This strategy involves extracting the heated outlet water from Microturbine No. 2 and directing it to Microturbine No. 1. The heated outlet water from Microturbine No. 1 then merges back into the pre-existing digester heating loop system. The water is projected to enter and exit Microturbine No. 2 at approximately 140 and 160-degrees Fahrenheit, respectively. Subsequently, the water is expected to enter and exit Microturbine No. 1 at approximately 160 and 180-degrees Fahrenheit. These temperatures fall within the microturbines’ specifications.

The construction cost for the integral water loop is estimated to be around $20,000.

GHD remains available to the Plant, Joint Sewage Board, City, and Village. Should you have any questions, please do not hesitate to reach out to us.

Regards

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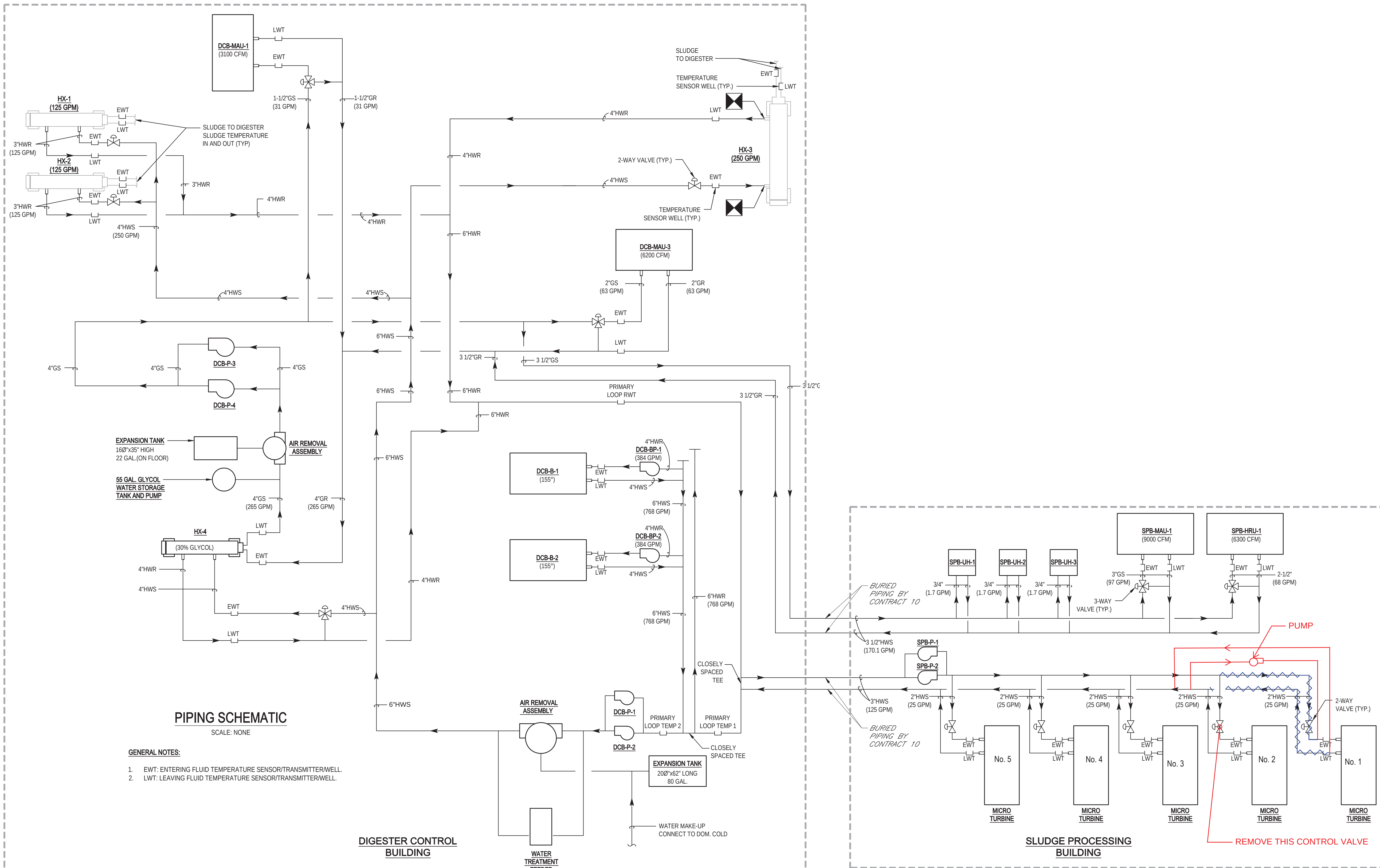
Copy to: Ronald Lake, PE (City of Binghamton)



Note: The 2-way control valves from Microturbines No, 2 and No. 1 must be removed. The 2-way control valves from Mcroturbines Nos. 5, 4 and 3 can be removed to increase hydraulic efficiency.

Binghamton John City Joint Sewage Treatment Plant
Concept Sketch for an Integral Water Loop for Microturbine No. 1
Purpose: To supplement the existing pumps (SPB-P-1 and SPB-P-2) to supply 25 gallons per minute to Microturbine No. 1
2/7/2024