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Binghamton-Johnson City Joint Sewage Board

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Microturbine Heat Recovery Piping Recommendations

RAMBOLL

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Sustainable change.

Microturbine Heat Recovery Piping Recommendations

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Date	**November 9, 2023**
Prepared by	**Makayla Jackson**
Checked by	**Daniel Harter**
Approved by	**Daniel Harter**

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1. Executive Summary

The Binghamton-Johnson City Wastewater Treatment Plant owns five (5) Capstone C65 iCHP Microturbines. The equipment is used for combined heat and power generation and is located in the Sludge Processing Building within the treatment plant at 4480 Vestal Road, Vestal, NY.

The purpose of the Preliminary Engineering Report is to provide an overview of the existing microturbine system and establish a preliminary basis of design for improvements to optimize the system which includes process/mechanical, electrical, and instrumentation scope of work.

Site visits have been conducted by Ramboll to review the existing microturbines system. The scope of evaluation includes:

1. Existing hot water supply and return piping to and from the microturbines, as well as associated instrumentation and controls
2. The condition and performance of the existing hydronic pumps
3. The leaks in the underground hot water lines between the Sludge Processing Building and the Digester Control Building
4. Proposed area of upgrades to the microturbine hot water heat recovery system in the Sludge Processing Building
5. Existing HVAC in the microturbine room

The following recommendations are intended to optimize the thermal and electrical output of the existing microturbines.

1.1 Process/Mechanical Evaluation and Recommendations

The microturbines and associated pumps and controls were evaluated to determine recommended updates. These recommendations include:

1. Remove the existing hydronic piping associated with the microturbine hot water heat recovery loop in the Sludge Processing Building and Digester Control Building
2. Remove the existing in-line centrifugal hydronic pumps and variable frequency drives (VFDs)
3. Isolate the microturbine hot water heat recovery loop to the Sludge Processing Building
4. Install two new hydronic pumps with new VFDs and new piping to provide 40 gallons per minute (GPM) of water to each microturbine for a total of 200 GPM system flowrate
5. Install insulation on all new hydronic piping
6. Install a pot feeder with biocides and rust inhibitors in hydronic system
7. Install an air separator and expansion tank in hydronic system
8. Install domestic cold make-up water to the hydronic system
9. Install a new sludge/water heat exchanger with appropriate concrete housekeeping pad
10. Install new flow control valves (FCVs) for each microturbine branch and the water side of the sludge/water heat exchanger
11. Adjust the existing rotary lobe blended thickened sludge pump to the updated parameters
12. Abandon below grade piping between the Sludge Processing Building and the Digester Control Building
13. Repair existing pipe penetrations and provide new penetrations as needed within the Sludge Processing Building

1.2 Electrical and Instrumentation Evaluation and Recommendations

The existing pumps and controls were evaluated to determine recommended updates. These recommendations include:

1. Remove the wiring for the existing FCVs and pump VFDs
2. Install power to the new pumps, VFDs, and FCVs
3. Install new hot water pressure sensor and wire to VFD to control pump speed

2. Project Background

2.1 Microturbine System Background

The microturbines were originally installed in 2017. The combined heat and power (CHP) equipment utilizes digester gas generated from the plant. According to Capstone, the nominal rated output, at full heat recovery for a copper heat recovery module (HRM), is 0.42 MMBTU/hr (124 kWt) of hot water given the microturbine is operating at the full electrical output of 65 kW, under ISO conditions and with an inlet water temperature of 140°F and a flow of 40 GPM. It should be noted that changes to these baseline operating conditions will impact both the electrical and thermal power output of the microturbine. The hot water heat recovery is currently used to preheat the boiler water for the recirculating digester water heat exchangers. These boilers and heat exchangers are located within the Digester Control Building.

2.2 Definition of the Problem

The plant has been experiencing frequent faults on the microturbines. The site staff determined there was a leak in the underground hot water lines between the Sludge Processing Building and the Digester Control Building. The leak has since been resolved. Despite being repaired, the system has never provided sufficient flow for all microturbines to run simultaneously. The existing hot water piping serving the microturbines is smaller than recommended, along with the associated pumps. The flow switches that are integral to the microturbines are set for a minimum flow of 20 GPM. Capstone recommends at least 25 GPM per microturbine. With the low-flow faults, the microturbine cannot operate in any modes.

When the CHP equipment is not running, the site must flare the digester gas. Additionally, the site does not benefit from an offset in natural gas demand for the boilers when the microturbines are not operating. These two factors directly impact the site utilities requirements.

3. Conditions Assessments

Ramboll performed assessments of the site to review the existing microturbine hot water heat recovery water loop piping and has provided repair or replacement options, sketches, and budgetary costs of each option. Ramboll has coordinated with the Capstone microturbine vendor, RSP Systems, for detailed operating specifications and requirements. Ramboll has identified several deficiencies in the existing system and has prepared three preliminary design options and associated cost estimates. The options were presented to the Binghamton-Johnson City Joint Sewage Board (BJCJSB) at the October 2023 board meeting. The project proceeded with the strongest option in the opinion of Ramboll. This option, which has been detailed in this report, is to create a system that would be isolated to the Sludge Processing Building and use the heat generated from the microturbines to pre-heat the sludge prior to flowing to the digestors.

4. Recommendations

4.1 Piping

It is recommended to remove the existing piping associated with the microturbine hot water heat recovery loop. This includes the piping from the point of connections at the microturbines in the

Sludge Processing Building to the point of connection at the boiler water main in the Digester Control Building. The existing below grade piping will be capped and abandoned in place. To provide adequate flow to the microturbine HRMs, it is recommended to install 4"Ø carbon steel piping mains for the hydronic loop. The branches to and from each microturbine are recommended to be 2"Ø copper piping to provide 40 GPM to each unit. The control valves and balancing valves for each microturbine HRM branch are recommended to be installed on the outlet. New 6"Ø ductile iron sludge piping would be required to connect the sludge main to the new sludge/water heat exchanger. New 3/4"Ø domestic cold make-up water piping is suggested to connect the new hydronic loop to the cold water main on the first floor.

4.2 Hydronic Loop Equipment and Accessories

It is required to install an expansion tank and an air separator with a strainer in the hot water loop to allow for hot water expansion, ensure a constant water pressure, and help any entrained air come out of the hydronic solution.

4.3 Pumps

It is recommended to remove the existing hydronic pumps and controls associated with the microturbine loop. It is suggested that two new hydronic pumps in a primary/back-up approach be sized for 200 GPM and sequenced to alternate each week to extend the life of the pump. The redundancy is recommended in case of pump failure. Each pump would require a VFD which is rated for a 5-horsepower motor.

4.4 Heat Exchanger

A sludge/water heat exchanger, such as the Lackeby HSW 100-18-3, would provide a heat transfer of 1,516 MMBTU/hr which equates to a rise in sludge temperature of 16°F at 200 GPM water and 200 GPM sludge. This calculated outcome is with an assumption of 45°F sludge and 155°F hot water supply. The new heat exchanger would require a new concrete housekeeping pad. Refer to Appendix 1 for further details.

4.5 Wall Penetrations and Repairs

It is recommended to repair the existing penetrations in the Digester Control Building and Sludge Processing Building to restore the walls and floors to the original condition. New penetrations are likely required within the Sludge Processing Building for the increased hot water piping diameter, as well as the new make-up water installation.

4.6 Microturbine Controls

There are no suggested updates to the microturbines as they will adjust accordingly to the increased flowrate and the recommended operating temperatures.

To elaborate, the C65 iCHPs have a linear actuator which controls the leaving water temperature (LWT) based on the adjustable setpoint. The entering water temperature (EWT) would be based on the flowrate through the iCHP and the LWT setpoint.

As long as the HRM receives constant and adequate flow, the linear actuator will modulate to maintain the LWT setpoint. During the start-up sequence, when the turbine is off and the EWT is 70°F (ambient temperature) and the LWT is set for 155°F (adjustable), the linear actuator will fully open to heat the water until it starts to approach the LWT setpoint. The linear actuator will then start to modulate to bypass some of the thermal energy. If the LWT reaches the setpoint then the linear actuator will close. This means all the thermal energy will be bypassed with the exception of 10,000 BTU/hr of thermal energy absorbed by the water through conduction of the

iCHP. The linear actuator will maintain the LWT within approximately 1°F-2°F of the setpoint during operation.

4.7 Electrical

Electrical updates would consist of powering the new pumps, VFDs, FCVs and miscellaneous control wiring.

5. Opinion of Cost

5.1 Project Cost Estimate

The following table shows an overview of the estimated cost for the recommended updates:

Table 1 Cost Estimate

Description	Opinion of Cost
Division 03/05 - Concrete / Metals	**$5,320**
Form, Reinforce, Pour Interior Equipment Pad for HX	$5,320
Division 11 – Equipment	**$116,075**
Remove Existing Pumps, Supply & Install Replacement Pumps	$32,140
Supply & Install HX	$76,730
Supply & Install Misc. Items – Air Separator, Expansion Tank, Chem Feeder	$7,205
Division 15 – Mechanical	**$193,360**
Disconnect & Remove Existing Piping to/from Existing Pumps	$9,140
Disconnect & Remove Existing Piping to Microturbines	$6,260
Supply & Install 6" Piping, Valves, Gauges – Sludge Building to/from HX	$20,400
Supply & Install 4" Piping, Valves, Gauges – HX to Pumps to Microturbines	$61,200
Supply & Install 4" Piping, Valves, Gauges – Microturbines to HX	$40,800
Supply & Install 3/4” Makeup Water Piping, Valves, Gauges – From CW Tie-in	$9,700
Building Floor & Wall Penetrations & Repairs	$7,760
Insulation & Jacketing – All Piping	$38,100
Division 16 – Electrical	**$37,740**
Disconnect & Remove Wiring to Existing Pumps	$2,160
Supply & Install VFD with Stand	$6,480
Supply & Install Breaker, Disc Switch, Conduit & Wire to VFDs & Pumps	$15,800
Controls Wiring	$13,300
Division 17 - Instrumentation & Controls	**$30,960**
Supply Instruments	$6,000
Supply Control Valves	$12,000
Programming	$12,960
Construction Subtotal	**$383,455**
Small Tools, Consumables, etc. (3%)	$5,962
Sales Tax (8% Materials and Rental Equipment)	$6,972
General Conditions / Project Management (10%)	$39,639
Contractor OH&P (20%)	$87,205
Construction Contingency (30%)	$156,970
Summary	
Construction Costs	$680,203
Engineering Cost (15%)	$102,030
Construction Management (15%)	$102,030
Design / Owner Contingency (20%)	$176,853
Total Cost	**$1,061,116**

5.2 Life Cycle Cost Analysis

The analysis of the life cycle cost can be simplified to a comparison of utilities costs, taking into consideration the cost of investment of the proposed recommendations. From these factors, the

return on investment can be calculated. The site currently has three (3) microturbines in operation at a given time so that is used for the baseline cost. The recommended conditions would allow five (5) microturbines to be operating simultaneously which is reflected in the analysis. Refer to Table 2 for detailed operational costs and the associated return on investment.

Table 2 Analysis of Utilities Costs and Return on Investment

Baseline Operational Value

Power (Electricity)	Cost per kWh*	kWh	Value per Hour	Value per Day	Value per Year
Existing Pump	$ 0.15	1.655	$ 0.25	$ 6.10	$ 2,228.31
Microturbines (3 operating)	$ 0.15	195	$ 29.97	$ 719.32	$ 262,550.34
Heat (Natural Gas)	Cost per MCF*	MCF	Value per Hour	Value per Day	Value per Year
Heat Added to Boiler Loop	$ 10.57	0.788641	$ 8.33	$ 199.98	$ 72,993.78
		Net Operational Value	$ 38.05	$ 913.19	$ 333,315.81

Recommended Operational Value

Power (Electricity)	Cost per kWh*	kWh	Value per Hour	Value per Day	Value per Year
New Pump	$ 0.15	2.685	$ 0.41	$ 9.90	$ 3,615.12
Microturbines (5 operating)	$ 0.15	325	$ 49.95	$ 1,198.86	$ 437,583.90
Heat (Natural Gas)	Cost per MCF*	MCF	Value per Hour	Value per Day	Value per Year
Heat Transferred to Sludge	$ 10.57	1.516	$ 16.02	$ 384.58	$ 140,371.29
		Net Operational Value	$ 65.56	$ 1,573.53	$ 574,340.07

Return on Investment

Time (years)	Cost	Cumulative Savings	Cumulative Returns	ROI (%)
1	$ 1,061,116.00	$ 574,340.07	$ (486,775.93)	-45.87
2		$ 1,148,680.15	$ 87,564.15	8.25
3		$ 1,723,020.22	$ 661,904.22	62.38
4		$ 2,297,360.30	$ 1,236,244.30	116.50
5		$ 2,871,700.37	$ 1,810,584.37	170.63

*Prices are according to the U.S. Energy Information Administration website. The 2022 New York State price of natural gas sold to commercial customers was used for natural gas cost per unit. The 2022 utility bundled retail sales for commercial sales through New York State Electric and Gas was used for the electricity cost per unit.

6. Next Steps

The Preliminary Design Report is intended to be included as an appendix in a report to the New York State Environmental Facilities Corporation (NYSEFC) for financing consideration. An Engineering Report Certification and a Smart Growth Assessment Form, both required by the NYSEFC, are included as Appendix 3 and 4, respectively. If financed, it is understood that the intent of the Binghamton-Johnson City Wastewater Treatment Plant is to create documents for bid and retain a contractor to implement the improvements recommended within this report.

Appendix 1

Equipment Cut Sheets

Bell & Gossett
a xylem brand

Submittal

Job/Project: MJ E80 Pump 100423		Representative: Frank P Langley	
ESP-Systemwize: WIZE-7975D331	Created On: 10/04/2023	Phone: 607-422-4816	
Location/Tag: P-xx		Email: jwinters@fplco.com	
Engineer:		Submitted By:	Date:
Contractor:		Approved By:	Date:

Close Coupled In-Line Centrifugal Pump

Series: e-80

Model: 3x3x9.5C

Features & Design

- Best in Class Hydraulic Performance
- Low Operating and Maintenance Cost
- Horizontal or Vertical Installation

The Series e-80 is a highly efficient, heavy duty, close coupled pump designed for horizontal or vertical in-line mounting. The e-80 is available in stainless steel fitted construction, with flows up to 2500 GPM, heads to 380 feet.

http://bellgossett.com/pumps-circulators/in-line-pumps/series-e-80/

Pump Selection Summary

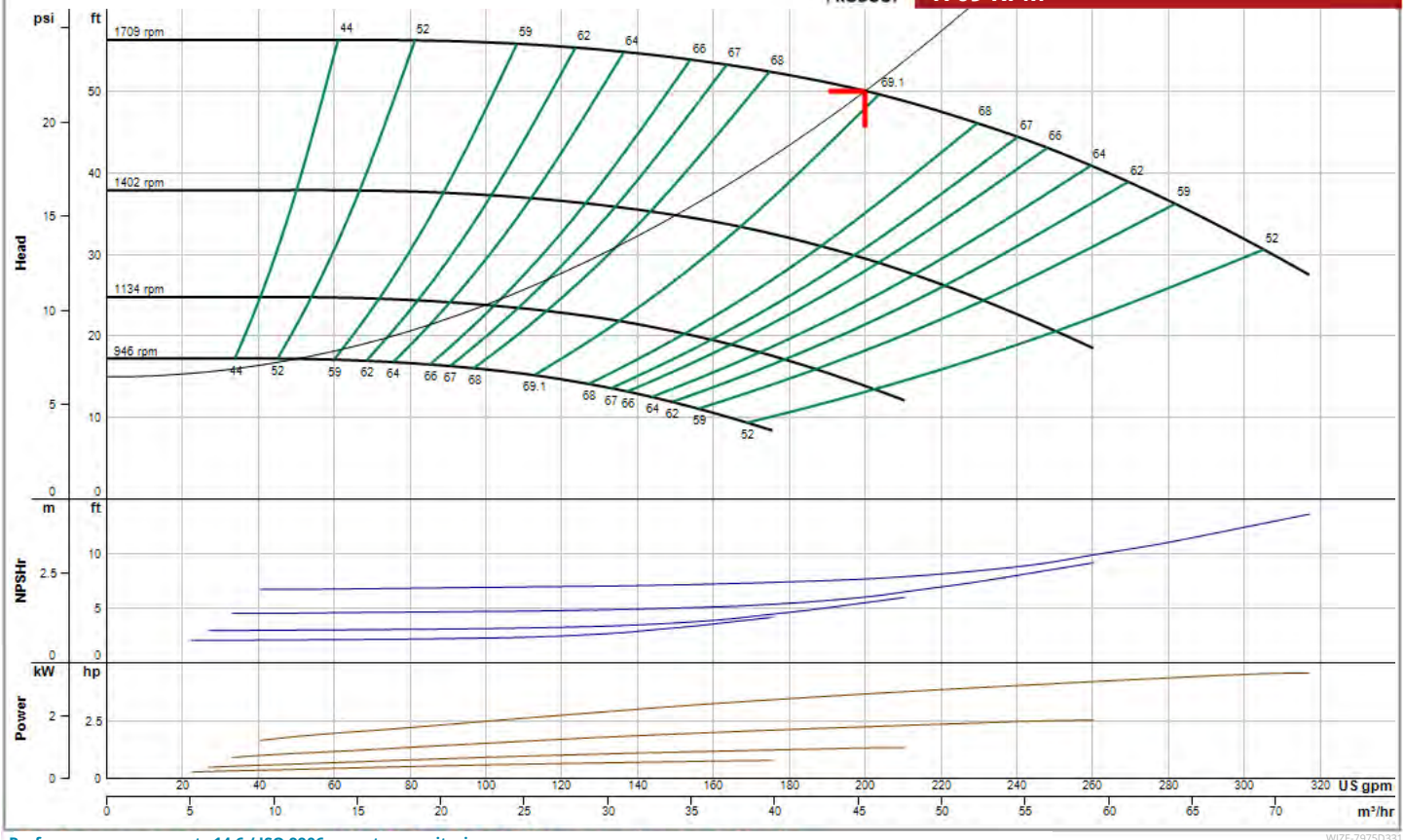
Duty Point Flow	200 US gpm
Duty Point Head	50 ft
Control Head	15 ft
Duty Point Pump Efficiency	68.8 %
Part Load Efficiency Value (PLEV)	65.2 %
Impeller Diameter	7.75 in
Motor Power	5 hp
Duty Point Power	3.65 bhp
Motor Speed	1800 rpm
RPM @ Duty Point	1709 rpm
NPSHr	7.71 ft
Minimum Shutoff Head	56.3 ft
Minimum Flow at RPM	40.7 US gpm
Flow @ BEP	204 US gpm
Fluid Temperature	68 °F
Fluid Type	Water
Weight *(approx. - consult rep for exact)*	255 lbs
Pump Floor Space Calculation	2.86 ft²

Performance Curve

Energy Efficiency Ratings:
Pump & Motor PEIcl: 0.94 ERcl: 6
Pump, Motor & Drive: PEIvl: 0.47 ERvl: 53

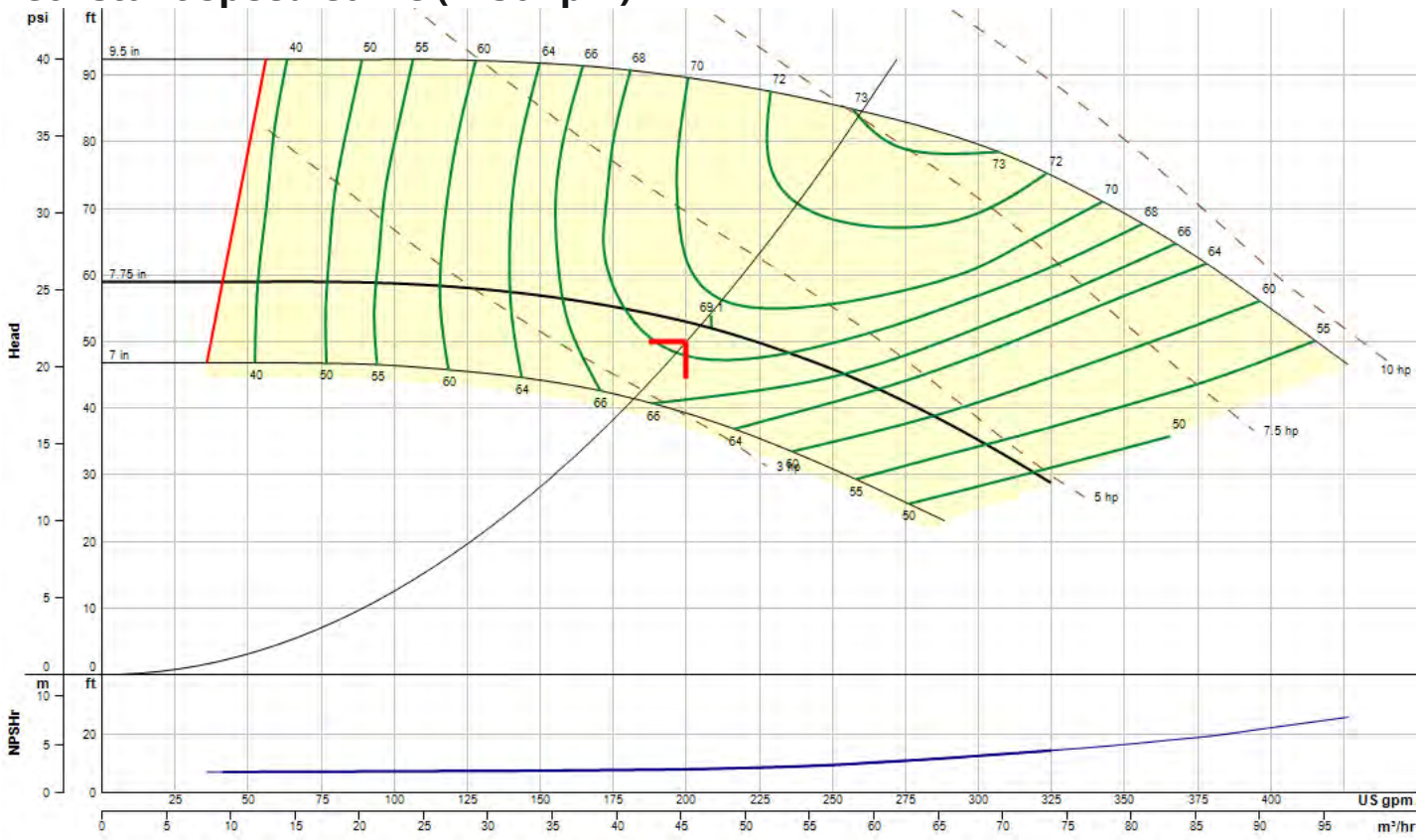
PREMIUM EFFICIENCY PRODUCT

e-80
3x3x9.5C
1709 RPM



Performance curve meets 14.6 / ISO 9906 acceptance criteria

Constant Speed Curve (1750 rpm)

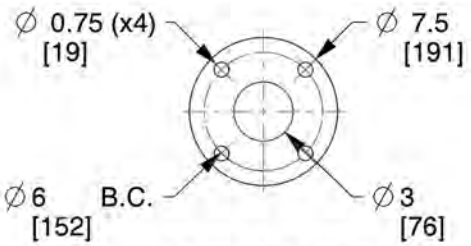


Operating Point

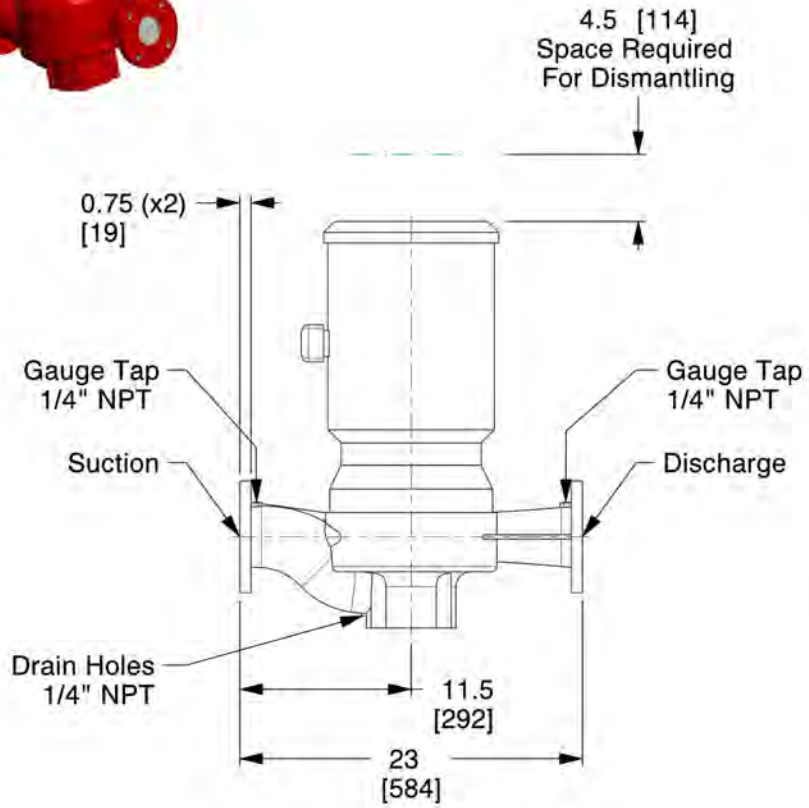
Flow: 200 US gpm **Head:** 50 ft **Speed:** 1709 **Efficiency:** 68.8% **Point BHP:** 3.65 **End Of Curve:** 63%

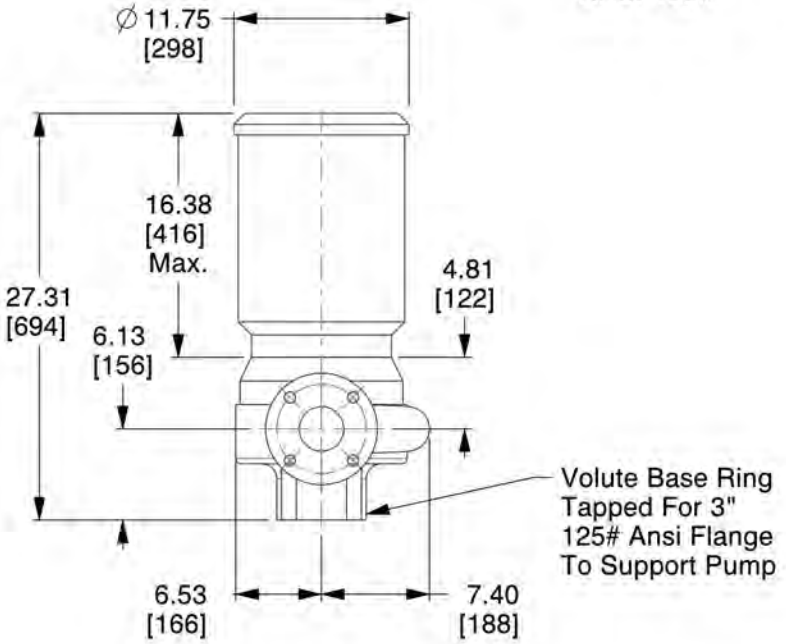
Maximum Duty Point (at rated motor speed)

Flow: 205 US gpm **Head:** 52.4 ft **Speed:** 1750 **Efficiency:** 68.9% **Point BHP:** 3.92 **NOL Flow:** 325 US gpm **Runout Flow:** 325 US gpm **NOL (BHP):** 4.9



3" SUCTION & DISCHARGE FLANGE DETAILS ANSI 125#





Bell & Gossett
a xylem brand

8200 N. Austin Ave.
Morton Grove, IL 60053, USA

Dimensions are subject to change

Not to be used for construction unless certified

BG-E80-3x3x9.5C-SS184JM-1-IN

Series e-80 Close Coupled In-Line Centrifugal Pump

Seal Type:Standard Seal | Motor Frame:184JM | Flange:ANSI 125#

Dimensions : IN (mm)	Scale : N.T.S.	Submittal # : B-139.14B

Standard Materials of Construction

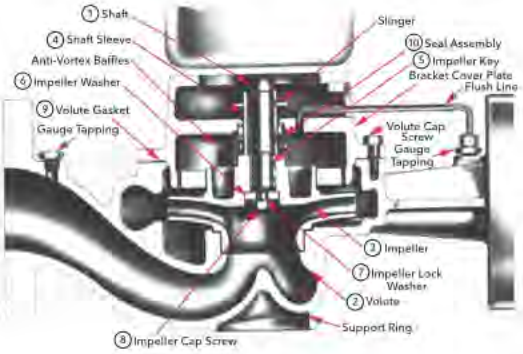
Construction:	Stainless Steel Fitted Pump
1 Shaft:	Carbon Steel
2 Volute:	Cast Iron ASTM A48 Class B
3 Impeller:	ASTM A743 Grade CF8 - 304 Stainless Steel
4 Shaft Sleeve:	Stainless Steel
5 Impeller Key:	#304 Stainless Steel
6 Impeller Washer:	Carbon Steel
7 Impeller Lock Washer:	#304 Stainless Steel
8 Impeller Cap Screw:	#304 Stainless Steel
9 Volute Gasket:	Cellulose Fiber

10 Standard Mechanical Seal Assembly

Bellows	Buna N
Faces	Carbon-Ceramic
Metal Parts	Brass or Stainless Steel
Spring	Stainless Steel

Maximum Working Pressure

Max Working Pressure (standard)	175 psi (12 bar)
Max Working Pressure (optional)	175#, 250#, and 300# working pressure designs.



Pump Options *contact your local rep to configure

TECHNOLOGIC STANDARD FEATURES	
CONTROL METHOD WITH INTEGRATED TECHNOLOGIC® SENSORLESS CONTROL (ITSC)	Factory configured for sensorless operation.
CONTROL METHOD WITH INTEGRATED TECHNOLOGIC® (IT)	Field configurable for sensor by others, building management system input, or optional sensor(s) provided.
ENCLOSURE	NEMA 12 (same as IP55 & UL type 12)
POWER DISCONNECT SWITCH	Included standard. Fused Disconnect Switch optional with three phase input voltage.
HARMONIC SUPPRESSION	Integrated non-saturating dual DC link reactors provide better harmonic performance than a 5% AC line reactor.
COOLING	Fan-cooled through temperature controlled and easy replacement.
AMBIENT TEMPERATURE RATING	14°F to 113°F (-10°C to 45°C)
COMMUNICATION PROTOCOLS	BACnet, Modbus RTU, N2 Metasys, FLN Apogee
ANALOG INPUTS	2 configurable for either voltage (0 to 10VDC) or current(0/4 to 20mA)
ANALOG OUTPUTS	1 (0/4 to 20mA) up to 500 ohm load accurate to 1% of full scale
DIGITAL INPUTS	4 (0 to 24VDC), NPN or PNP, 0 to 24VDC, on 5 msec scan interval. Up to 2 can be configured as pulse inputs.
DIGITAL OUTPUTS	2 (0 to 24VDC), 40mA max current, configurable as pulse outputs.
RELAY OUTPUTS	2 programmable, 240VAC or 400VAC up to 2 A
MINIMUM CONTROL HEAD	_____ ft (default set to 40% of design head if not unknown)

xylem
Let's Solve Water

Xylem Inc.
8200 N. Austin Avenue, Morton Grove, IL 60053
Phone: (847)966-3700 Fax: (847)965-8379
www.bellgossett.com

Proposed Sludge/Water Heat Exchanger

CleanTek®
WATER SOLUTIONS

LACKEBY SLUDGE/WATER HEAT EXCHANGER

HIGH HEAT TRANSFER WITH A SMALL FOOTPRINT

LACKEBY

www.cleantekwater.com

CleanTek® WATER SOLUTIONS

FLEXIBLE AND HIGH PERFORMANCE SLUDGE/WATER HEAT EXCHANGER

The Lackeby Sludge/Water Heat Exchanger is a “Tube in Shell” heat exchanger used to heat and cool biological sludge. The sludge tubes are a circular cross section surrounded by rectangular cross section water channels. The flow of the sludge and the water is cross current for the highest efficiency possible.

HIGH QUALITY, RELIABLE, AND EFFICIENT

Lackeby heat exchangers are completely constructed of high corrosion resistant materials. The sludge tubes are 316 stainless steel. All of the other wetted material is Duplex stainless steel alloy. The covers and support legs are 304 stainless steel. The 316 stainless steel sludge tubes provide a much longer life and more efficient heat transfer than carbon steel.

MODULAR

The heat exchangers utilize a modular construction, with each heat exchanger being designed specifically for each application. This design flexibility optimizes multiple sludge flow characteristics for the most efficient heat transfer. This also provides flexibility in the physical size of the heat exchanger, as the design is easily modified to fit in an existing plant.

PROPRIETARY DESIGN

All of our heat exchangers have proprietary sludge turning chambers. The chambers have a small radius for a compact design. The mixing action in the turning chambers equalize the thermal profile in the sludge tubes for more efficient heat transfer.

SMALL FOOTPRINT

All units are designed to have a small footprint. The use of only corrosion resistant stainless steel materials in the design, the compact design of the turn chambers, and the modular design provides a large degree of design flexibility to provide a small footprint.

All units are constructed in accordance with Section VIII, Division I, of the ASME Pressure Vessel Code.

ADVANTAGES

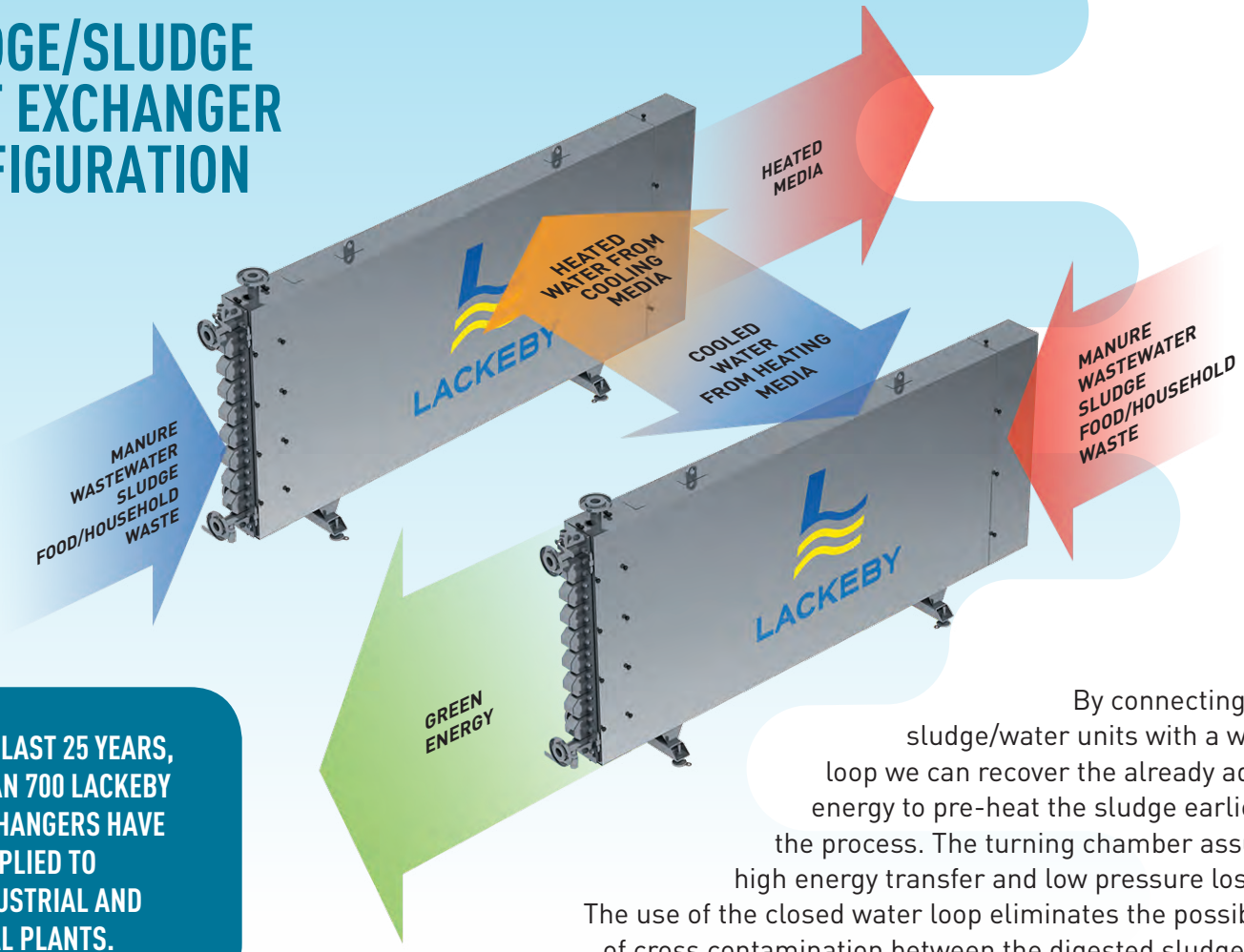
- Modular design for high flexibility and configurablity.
- Robust, compact, reliable, and easy to install.
- Circular sludge channels ensure that large solids can be handled while minimizing clogging risk.
- Innovative design with proprietary turning chamber assures high energy transfer and low pressure losses.
- Uniquely designed unit for medias with a high viscosity.
- The proprietary turning chambers enable the highest possible heat transfer as well as meeting demands for a small footprint.
- Heating and cooling system runs with low load in order to keep customer operating costs low.

KEY PRODUCT APPLICATIONS

- DIRECT HEATING OR COOLING OF RAW OR DIGESTED SLUDGE ON THE FEED LINE
- HEATING AND/OR COOLING OF DIGESTED SLUDGE BY DIGESTER OR PASTEURIZATION CIRCULATION
- ENERGY RECOVERY FROM HEATED SLUDGE

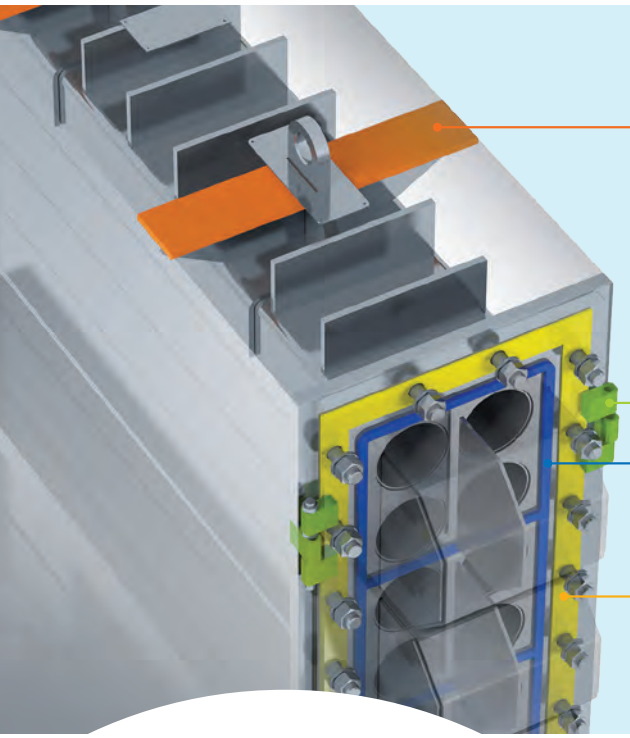
LACKEBY

SLUDGE/SLUDGE HEAT EXCHANGER CONFIGURATION



OVER THE LAST 25 YEARS, MORE THAN 700 LACKEBY HEAT EXCHANGERS HAVE BEEN SUPPLIED TO BOTH INDUSTRIAL AND MUNICIPAL PLANTS.

By connecting two sludge/water units with a water loop we can recover the already added energy to pre-heat the sludge earlier in the process. The turning chamber assures high energy transfer and low pressure losses. The use of the closed water loop eliminates the possibility of cross contamination between the digested sludge and undigested sludge while also providing system flexibility.



NEW IMPROVEMENTS

SAFER SHIPPING
Security bars have been added to allow us to better secure the unit for safer shipping to your plant.

SIMPLIFIED MAINTENANCE
All units are hinged on the customer selected side to enable easy access for inspection and maintenance.

HIGH RESISTANCE GASKET
Gaskets are now made of an improved material which is highly resistant to oil and high temperatures.

GASKET SPACER BARS
Newly implemented spacer bars further extend the lifetime of the gasket and lower the time and cost for maintenance.

CleanTek® WATER SOLUTIONS

CleanTek Water Solutions
7984 University Avenue NE
Fridley, MN 55432

Tel: 866.929.7773
info@cleantekwater.com
www.cleantekwater.com

Budget Pricing:

Description	Budget Price
One (1) Lackeby HSW 100-18-3 Sludge/Water Heat Exchanger (Sludge Side - 50 psi, Water Side – 50 psi) as described above. Includes start-up services and freight to jobsite.	$ 69,500.00 USD

Exclusions:

- Taxes or bonds of any kind
- Controls
- Pumps or grinders
- Liquidated or consequential damages
- Offloading
- Installation or supervision of installation
- Stairs and grating
- Any piping or piping connections not integral to the equipment proposed above.
- Any valves, gauges, controls, or sensors not noted above.
- Anchor bolts
- Field painting
- Concrete work
- Civil design
- Structural calculations or design
- Buildings
- Field Wiring
- Electrical connections
- Finish painting
- Spare parts (available upon request).

Terms:

- 20% due Net 30 upon approval of submittal package.
- 80% due Net 30 upon delivery of equipment to jobsite.
- Credit approval required.

Approvals:

- Submittal package provided 2 to 3 weeks from receipt of a fully executed purchase order.

Delivery:

- Equipment delivered to site 22 to 26 weeks from receipt of signed submittal approvals.

Warranty:

- Standard 12 months from date of installation or 18 months from date of shipment (which ever is earliest).

Validity:

- This budget proposal is valid for budgetary purposes only. A fixed proposal will be provided when all project details are finalized.

For any questions related to this budget proposal, please feel free to contact Mr. Cory Kopp of CleanTek Water Solutions at 866-929-7773 or via email at cory.kopp@cleantekwater.com. We look forward to working with you on this project.

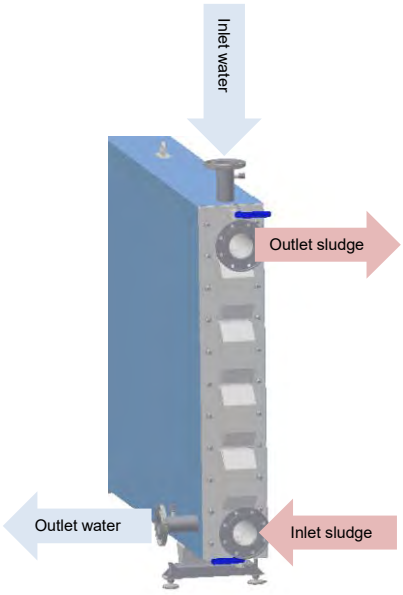
Best Regards,

Cory Kopp
CleanTek Water Solutions

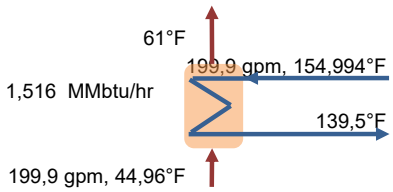
DESIGN
Lackeby Heat Exchanger Sludge/Water

Project:	Binghamton - Ramboll
Project country:	USA
Position:	Heating Circulation 4-6% DS
Quotation no :	0
Revision:	10-31-23
Date:	10-4-23

		Secondary side	Primary side
Customer input			
For information			
Media		Municipal sludge	Water
Required power transfer	MMbtu/hr		
Required outgoing temperature	°F	103,0	-
Allowable pressure loss	psi		
Required design pressure	psi	50,0	50
DS content (Only as an indication, the design is based on viscosity)	%	4-6	-
Operating hours	h/d		
Other information		-	
For calculations			
Flow	gpm	199,9	199,9
Inlet temperature	°F	45,0	155,0
Fluid consistency index (K)	$Pa•s^n$	0,76	-
Flow behaviour index (n)		0,30	-
Measuring temperature for K & n values	°C	20	-
Friction coefficient		0,060	0,027
Density	kg/m^3	1017	998
Heat capacity	J/kg,K	3970	4182
Thermal conductivity	W/m,K	0,56	0,58
Glycol content	% glycol	-	0%
Configuration			
Inner pipe diameter	mm	100	-
Number of pipe rows	pcs	1	-
Number of pipe levels	pcs	8	-
Pipe length per row and level	m	3,0	-
Volume	l	209	140
Model name for choosen heat exchanger		HSW 100-18-3	
Estimated outer measures (L x W x H)	m	3,7 x 0,5 x 1,6	
Weigth (Empty / Full)	kg	795 / 1148	
Heat transfer area	m^2	7,8	
Calculations			
Power transfer	MMbtu/hr	1,516	
Outgoing temperature	°F	61,0	139,5
Pressure loss	psi	7,4	13,3
Design pressure	psi	50,8	50,8
Velocity	m/s	1,6	2,1
Shear rate	S^{-1}	129	583
Kinematic viscosity - Average	$m^2/s*10^{-6}$	33,43	0,44
Reynolds number - Average		4 805	143 080
Coefficient of thermal transmittance	$W/m^2,K$	1 148	



Lackeby have during many years recorded values for many different substrates, why we can estimate these parameters according to our best knowledge and experience. However, Lackeby cannot be held responsible if these are proven wrong, so if any uncertainty exists, we recommend doing a rheological sludge test



Bell & Gossett
a xylem brand

Proposed Expansion Tank **Submittal**

Job/Project:	**Representative: Frank P. Langley Co.**	
ESP-Systemwize: WIZE-7D8544A2 Created On: 10/31/2023	**Phone: (716) 691-7575**	
Location/Tag:	**Email: sales@fplco.com**	
Engineer:	**Submitted By:**	**Date:**
Contractor:	**Approved By:**	**Date:**

Expansion Tanks: Pre-Charged Diaphragm

Bell & Gossett Series: D ASME

Series "D" expansion tanks are ASME rated precharged diaphragm-type pressure vessels. The Series "D" tank is designed to absorb the expansion forces of heating/cooling system water while maintaining proper system pressurization under varying operating conditions. The heavy duty diaphragm separates system water from the tank air charge thereby eliminating waterlogging problems. All Series "D" expansion tanks include an integrated bladder integrity monitor and are available with sight glass and/or seismic restraints.

Designed and constructed per ASME Section VIII, Division 1

Selection Criteria

Model	D15
Quantity	1
Required Tank Volume	7.52 gal
Required Acceptance	6.03 gal
Actual Tank Volume	7.8 gal
Actual Acceptance Volume	6.3 gal
Orientation	Horizontal/Vertical
Type	Diaphragm
ASME Rated	true
Fill/Max Temperature	50 °F /170 °F
Fill/Max Pressure	13 psi / 125 psi
System Volume	250 gal
System Medium	Water

Tank Details

Not For Potable Water System

D15

- Increases system performance
- Reduces oxygen corrosion
- Prevents waterlogging
- Tank sizes: 8-211 gallons
- Suitable for both horizontal and vertical installation
- Maximum operating temperature: 240°F
- Integrated bladder integrity monitor on all models
- Seismic restraints available
- Sight glass available

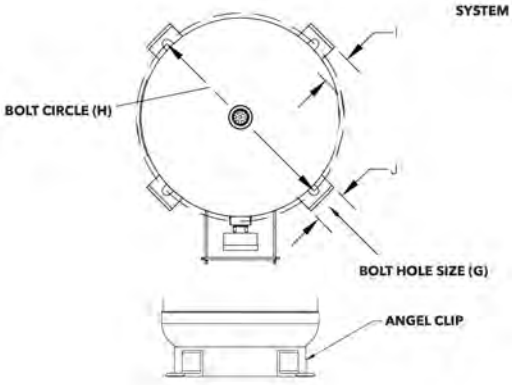
Operating Data

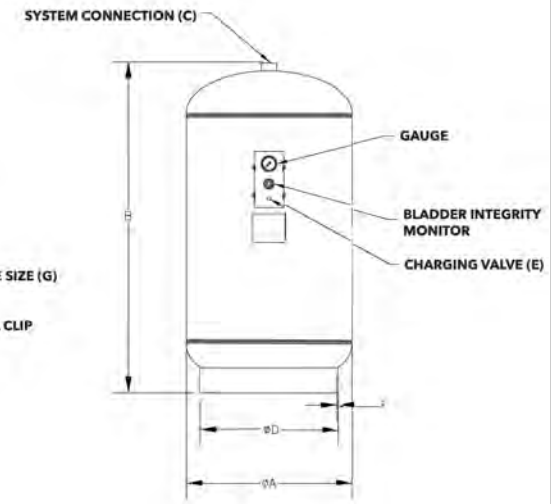
Max Design Temperature	170 °F
Max Working Pressure	125.0 psig
Shipping Weight	42 (19)
Flooded Weight	107 (49)

Performance Curve Data

Materials of Construction

Shell	Carbon Steel
Diaphragm	Heavy Duty Butyl Rubber
System Connection	Forged Steel





Dimensions are subject to change. Not to be used for construction purposes unless certified.

A	B	C (NPTM)	D	E	F	G	H	I	J
12 (305)	19 (483)	3/4	10 (254)	.302"-32 NC	0.14 (4)	9/16 (14)	12 (305)	2 (51)	2 (51)

Inches (mm)

xylem
Let's Solve Water

Xylem Inc.
8200 N. Austin Avenue, Morton Grove, IL 60053
Phone: (847)966-3700 Fax: (847)965-8379
www.bellgossett.com

Proposed Air Separator

Bell & Gossett
a xylem brand

Submittal

Job/Project:		Representative: Frank P. Langley Co.	
ESP-Systemwize: WIZE-7CF6B5AA	10/31/2023	Phone: (716) 691-7575	
Location/Tag:		Email: sales@fplco.com	
Engineer:		Submitted By:	Date:
Contractor:		Approved By:	Date:

Rolairtrol Air Separator Hot & Chilled Water

Bell & Gossett Model: R-4F

The Bell & Gossett Rolairtrol is a patented air separator with significant advantages. The Rolairtrol is capable of removing the air that commonly causes problems in commercial hot and chilled water systems. The Rolairtrol provides air free flow, improving efficiency and performance of the HVAC system

Designed and constructed per ASME Section VIII, Division 1

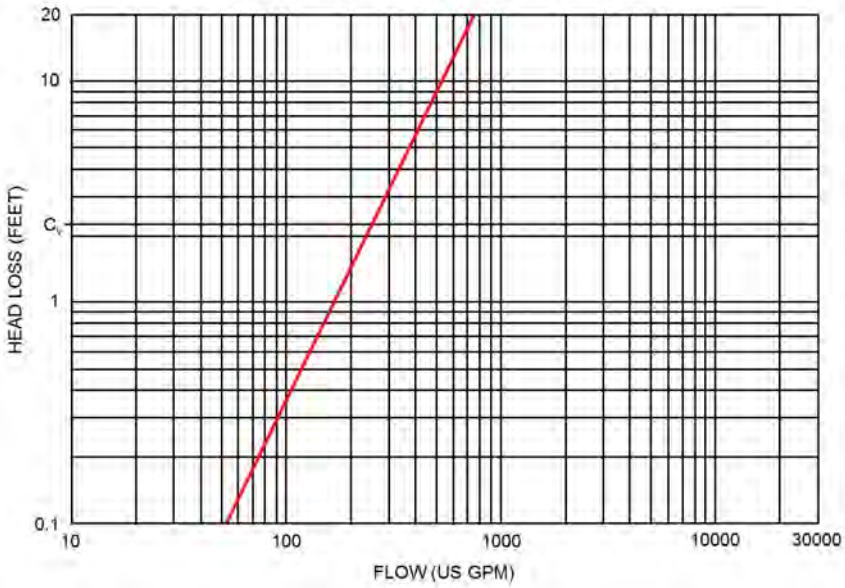
Separator Selection

Model	R-4F
Size	4.0 in
Recommended Max Flow	300.0 gpm
ASME Certified	true
Pressure Drop @ Design Flow	1.4'
Shipping Weight	170.0 lbs
Flooded Weight	278.0 lbs

Type of Separator	Centrifugal, With Strainer

Performance Coverage Chart: R-4F

R-4F Rolairtrol Air Separator Performance Chart



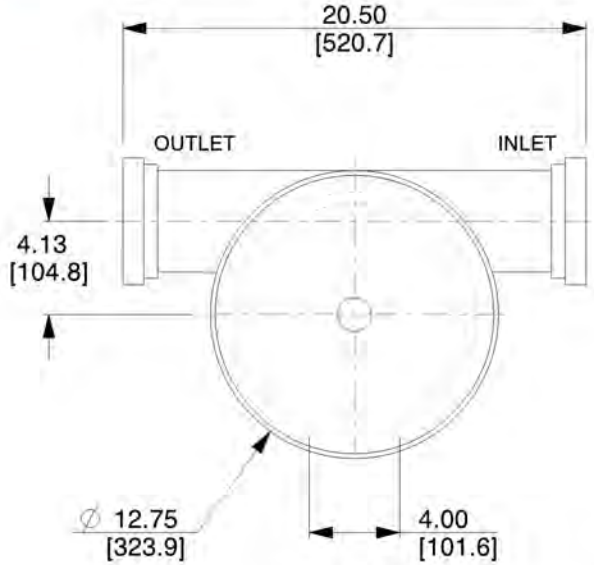
Materials of Construction

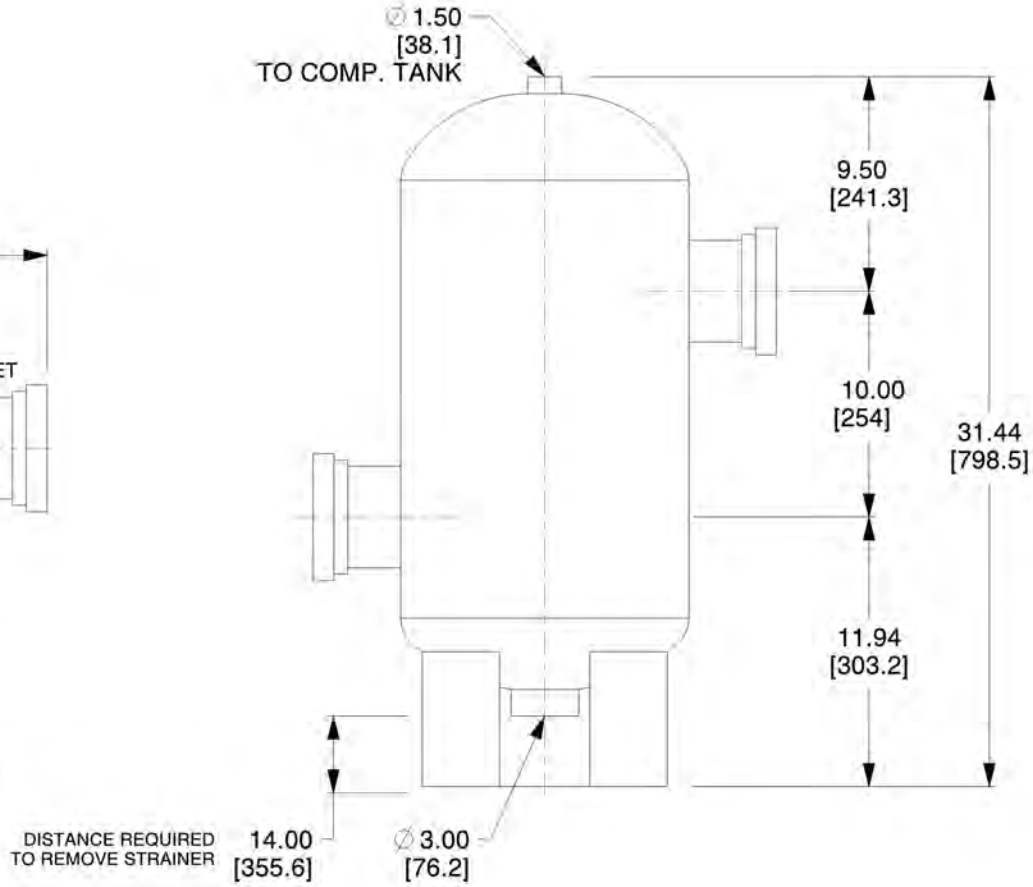
Body	Carbon Steel
Baffle	Carbon Steel
Strainer	304 SS

Maximum Working Pressure

Max Working Pressure	125psig
Max Operating Temperature	350°F

Consult local rep for higher working pressures and temperatures.





Bell & Gossett

a xylem brand

8200 N. Austin Ave.
Morton Grove, IL 60053, USA

Dimensions are subject to change

Not to be used for construction unless certified

5360-04F-12-003

ROLAIRTROL Air Separator

Flanged with Strainer Air Control and Elimination

Dimensions : INCH [MM]	Scale : N.T.S.	Approval :

VX186-130Q

The VX Series is our advanced line of pumps. You'll find VX pumps in many applications in agriculture, industry and municipalities. To minimize wear and maximize performance these pumps feature design innovations that you can only get from Vogelsang such as HiFlo Lobes, Blockring Cartridge Seals and adjustable housing segments.

VOGELSANG

HIFLO POSITIVE DISPLACEMENT ROTARY LOBE PUMPS

Run Dry Without Damage: Vogelsang pumps are warranted against damage from run dry for a period up to 30 minutes.

Complete Wet-End Rebuilds Inline: Change rotors, mechanical seals, lip seals, wear plates, and adjust housing segments with ease.

100% Pulsation Free Operation: Vogelsang HiFlo Rotors provide pulsation free operation through the entire range of pumping.

Maximum Mechanical Seal Life: Vogelsang pumps use a pressurized oil canister to maintain pressure inside a buffer chamber between the wetend and gear box. This pressure reduces the wear on the mechanical seals and help keep your pump at optimum performance.

Self Priming to 25' (Wet): With suction lifts to 25', Vogelsang pumps excel at the toughest suction lift applications.

Compact Size Reduces Expense: Small footprints equate to reduced construction and fabrication expense.

Unlimited Drive Options: V-Belt drives, Geared Motors with reducers, Close coupled hydraulic motors, air or submersible, Power Take Off. Vogelsang pumps offer unlimited drive options.

Low Noise Operation: Just 78db at 3 feet.

Excellent for Shear Sensitive Material: Our gentle pumping action coupled with 100% pulsation free operation makes Vogelsang the pump of choice for all your shear sensitive material pumping needs

MECHANICAL SPECIFICATIONS: STANDARD & OPTIONAL

Materials:

Bearing Housing: Gray Cast Iron (230-260 Brinell)

Front Cover: Gray Cast Iron (230-260 Brinell)

Front & Rear Wear Plate Options: Hardox (700 Brinell), Optional: Tungsten Carbide, Stainless Steel.

Pump Shaft: Carbon Steel (ASTM A470)

Shaft Sleeve: Stellite Coated Stainless Steel.

Housing Segment Options: Gray Cast Iron (750 Brinell), Optional: Tungsten Carbide, Stainless Steel.

Mechanical Seal Options: Component Seal, Duronite or Silicon Carbide. Block Ring Cartridge Seal, Duronite (standard in new pumps) or Silicon Carbide.

Rotor Core: Gray Cast Iron

Rotor Coating Options: SBR, NBR (standard in new pumps), SewageLine©, Viton, Werobust©, Steel, Stainless Steel.

Mechanical Specifications:

Connections: Suction, 6" Discharge, 6"

Weight: 509lbs.

Rotor Options: HiFlo 4-wing Lobes

Mounting & Drive Options: Inline Gear Motor, Piggy-Back V-belt, Hydraulic, PTO.

Housing Segment Options: Standard or Dynamic

Warranty, Testing & Quality Assurance:

Warranty: Municipal, 2 years, 100% parts and labor, including wear. Industrial & Agricultural, 1 year, manufacturer's defects.

Testing: Each pump is factory tested at the customers specified duty point at a suitable range of flow and pressure conditions in accordance with Hydraulic Institute Standards.

ISO 9001:2000 Certification: Vogelsang is a fully certified for the manufacture and repair of industrial pumping equipment.

Specification Sheet (1/2)

VOGELSANG

PROCESS CONDITIONS

Customer Number	100006	Abrasion	
Customer Name	Koester Associates, Inc.	Abrasiveness (1-10)	not Provided
Project	Binghamton Johnson City joint STP flood	Suction Condition	0.0 ft. flooded
Quote Number	7972701	Requested Capacity	300 gpm
Quote Position Number	2	Discharge Pressure	40.0 psi
Number of Pumps	2	Discharge Head	92 ft
Pumping Temperature	100 °F	Inlet Pressure	0.0 psi
Viscosity	not Provided	Differential Pressure	40.0 psi
Density	not Provided	Actual Capacity	301.5 gpm
Specific Gravity	not Provided	Motor HP Reserve %	10
Liquid PH	7	Rated Power	12.9 BHP
% Solids	6	Pump Speed	269 RPM
Solid Size		Rated Volumetric Efficiency %	84.1
NPSH-Available	31.14 ft.	Starting Torque	3008 in.lbs.
NPSH-Required	6.56 ft.	Running Torque	3017 in.lbs.
Medium	Other Medium, not on the list	Tag Number 1	Not Specified

POSITIVE DISPLACEMENT PUMP INFORMATION

Pump Part Number	PPK0000202	Mechanical Seal Single/Double	Single Mechanical Seal
Pump Model	VX186-130Q	Seal Carrier Material	Mild Steel
Material of Construction	Grey Cast Iron	Material Block Ring 1	304 Stainless Steel (1.4301)
Cover Type	Q	Material Block Ring 2	None
Housing Segment Material	0.6025 (Grey Cast Iron)	Material Mechanical Seal 1	Duronit
Housing Segment Coating	None	Material Mechanical Seal 2	None
Housing Segment Form	Straight	Thrust Washer Material	Mild Steel
Rotary Lobe Material	NBR	Strain Bolt Material	Galvanized
Rotary Lobe Coating		Pump Shaft Top	Motor Shaft Long Ø60
Rotary Lobe Form	HiFlo®	Pump Shaft Bottom	Motor Shaft Short
Rotary Lobe # of Wings	4	Pump Length	25.9 inch
O-Ring Material	NBR	Pump Width	13.0 inch
Lip Seal Material	HNBR	Pump Weight	508 lbs
Wear Plate Material	High Wear Resistant Special Steel	Pump Shaft Diameter	85 mm
Wear Plate Coating	Galvanized	Pump Shaft Diameter (Flange)	60 mm
Oil Bottle	Standard Pressurized Oil Bottle	Pump Shaft Length	5.5 inch
Buffer Chamber Fluid	Titan Gear MP90 Gear Oil	Maximum Shaft Deflection	0.0024 inch
Mechanical Seal Type	Cartridge		

TESTING INFORMATION

Performance Test - Level A	Yes

PERFORMANCE DATA

	Pump	60 Hz	
Pump Speed	268	269	RPM
Flow Rate (new)	300	301.5	gpm
Flow Rate (used)	268	269.5	gpm
Starting Torque	3008	3008	in.lbs.
Running Torque	3016	3017	in.lbs.
Starting Power	12.8	12.8	BHP
Running Power	12.8	12.9	BHP
Efficiency (Volume)	84.1	84.1	%
Efficiency (Total)	54.7	54.7	%
Dynamic Pressure Reduction	0.87	0.88	psi
NPSH-r	6.56	6.56	ft

Specification Sheet (2/2)

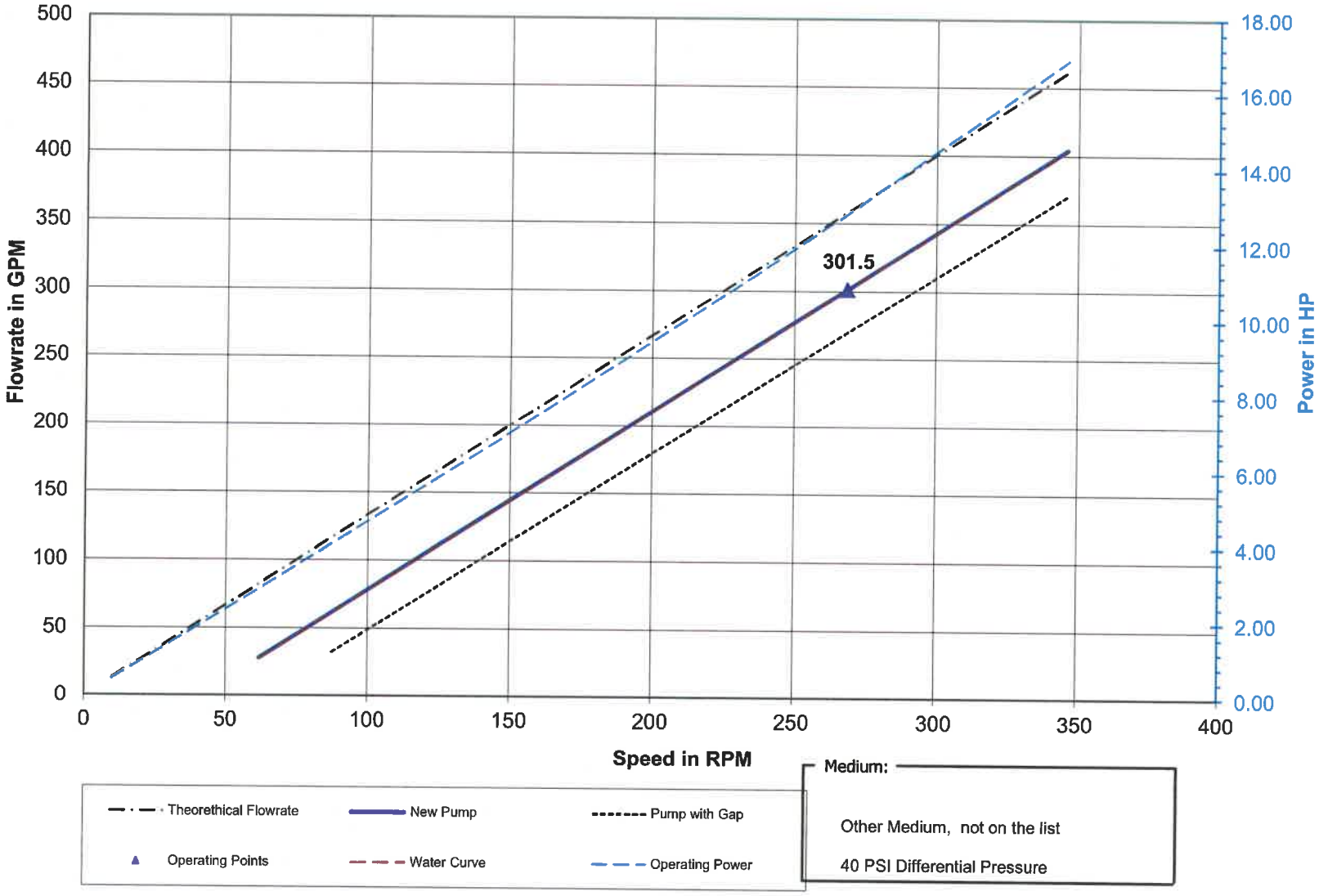
VOGELSANG

MOTOR INFORMATION			
Manufacturer	Baldor Electric Company	Class	F
Vendor Part Number	IDXM7554T	Phase	3
Motor Family	Explosion Proof	KVA Code	
Mounting	C-Face Footed	Useable at 208V	
Motor Type	AC	Grease	
Enclosure	XPFC	Power Factor	
Frame Size	256TC	Frequency	60 Hz
Conduit Box Mounting	F1	NEMA Design	B
Rotation	R	ODE Bearing	
Poles	4	DE Bearing	
Insulation Class	F	Service Factor	1
HP	15 HP	Shaft Diameter	1.625 inch
RPM	1765 RPM	Shaft Length	3.75 inch
Voltage	230/460 V	Overall Length	26 inch
Amperage	34/17 A	Width (- Conduit)	11.21 inch
Rating (Amb. + Duty)	40C AMB-CONT	Weight	381 lbs
Nominal Efficiency %	92	M23A - Add Thermostats	
GEARBOX INFORMATION			
Manufacturer	NORD Gear Corp.	Shaft Diameter	2.125
Vendor Part Number	SK872.1-250TC-6.57	Shaft Length	3.94
Gear Ratio	6.57	Overall Length	22.01
Frame Size	250TC		
COUPLING INFORMATION			
Coupling Manufacturer	TB Woods	Coupling Flange Drive	9S218
Coupling Sleeve	9HS	Coupling Flange Pump	9S60MM
FLANGE CONFIGURATION			
Flange Size	6.0 inch	Right Flange Type	Mild Steel Galvanized, Gooseneck
Left Flange Part Number	GPA.161	Right Flange Material	Hot Dipped Galvanized Steel
Left Flange Type	Mild Steel Galvanized, 90° Bend	Marathon Flange Part Number	N/A
Left Flange Material	Hot Dipped Galvanized Steel	Marathon Flange Material	N/A
Right Flange Part Number	GPA.151	Marathon Flange Configuration	N/A

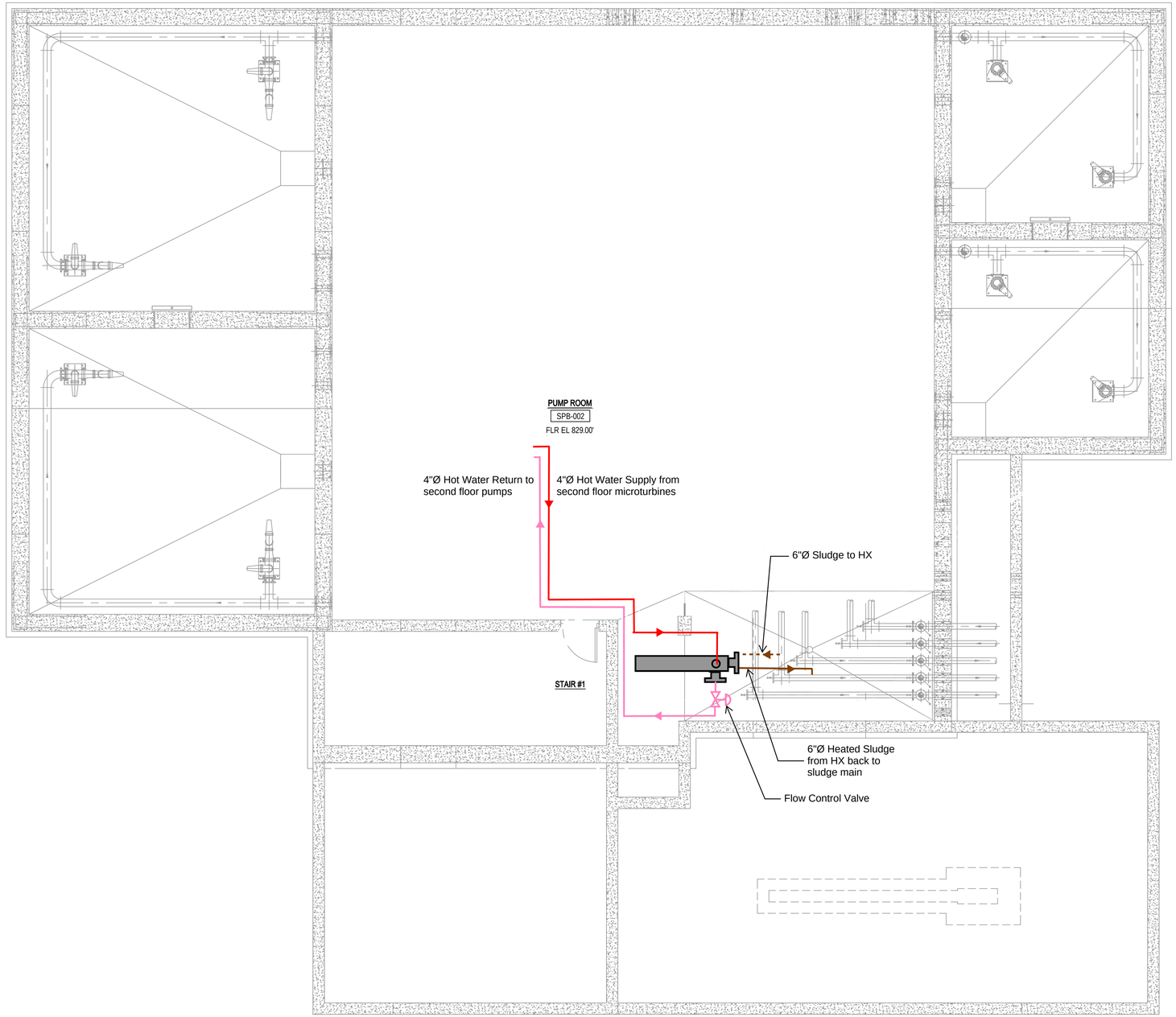
VOGELSANG

Flowrate / Speed at Constant Pressure
VX186-130Q

Project: Binghamton Johnson City
Quote No.: 7972701
NPSH-R: 6.56 ft.



Appendix 2
Project Sketches



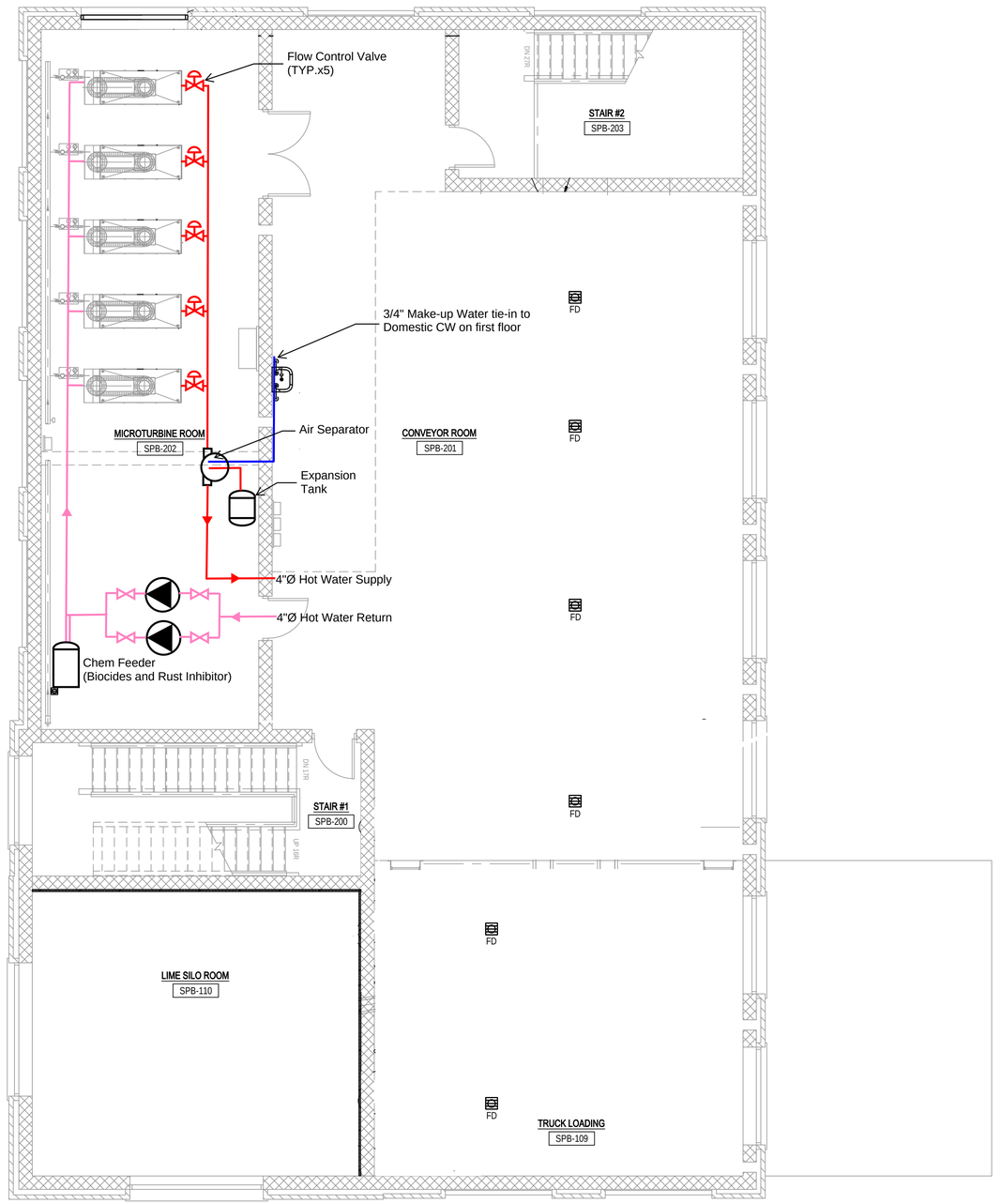
0 4'-0" 8'-0" 12'-0"

SCALE 3/16"=1'-0" AT ORIGINAL SIZE

BASEMENT PLAN AT ELEV 829.00'

SCALE: 3/16" = 1'-0"

BINGHAMTON - JOHNSON CITY WASTEWATER TREATMENT PLANT
SLUDGE PROCESSING BUILDING
BASEMENT FLOOR PLAN



SECOND FLOOR PLAN

SCALE: 3/16" = 1'-0"

0 4'-0" 8'-0" 12'-0"

SCALE 3/16"=1'-0" AT ORIGINAL SIZE

BINGHAMTON - JOHNSON CITY WASTEWATER TREATMENT PLANT
SLUDGE PROCESSING BUILDING
SECOND FLOOR PLAN

Appendix 3
Engineering Report Certification

Engineering Report Certification

To Be Provided by the Professional Engineer Preparing the Report

During the preparation of this Engineering Report, I have studied and evaluated the cost and effectiveness of the processes, materials, techniques, and technologies for carrying out the proposed project or activity for which assistance is being sought from the New York State Clean Water State Revolving Fund. In my professional opinion, I have recommended for selection, to the maximum extent practicable, a project or activity that maximizes the potential for efficient water use, reuse, recapture, and conservation, and energy conservation, taking into account the cost of constructing the project or activity, the cost of operating and maintaining the project or activity over the life of the project or activity, and the cost of replacing the project and activity.

Title of Engineering Report: Binghamton-Johnson City WWTP - Microturbine Heat Recovery Piping Recommendations

Date of Report: 11/9/23

Professional Engineer's Name: Daniel Harter

Signature: 

Date: 11/9/23

Appendix 4

Smart Growth Assessment Form

NEW YORK STATE OF OPPORTUNITY. | Department of Health | Environmental Facilities Corporation

Smart Growth Assessment Form

This form should be completed by an authorized representative of the applicant, preferably the project engineer or other design professional.[1]

Section 1 – General Applicant and Project Information

Applicant: Binghamton-Johnson City Joint Sewage Board Project No.:

Project Name: Microturbine Heat Recovery Piping Recommendations

Is project construction complete? ☐ Yes, date: ☑ No

Please provide a brief project summary in plain language including the location of the area the project serves:

The project includes process/mechanical and electrical/instrumentation improvements to address operational faults in the microturbine system.

Section 2 – Screening Questions

A. Prior Approvals

1. Has the project been previously approved for Environmental Facilities Corporation (EFC) financial assistance? ☐ Yes ☑ No
2. If yes to A(1), what is the project number(s) for the prior approval(s)? Project No.:
3. If yes to A(1), is the scope of the previously-approved project substantially the same as the current project? ☐ Yes ☐ No

If your responses to A(1) and A(3) are both yes, please proceed to Section 5, Signature.

B. New or Expanded Infrastructure

1. Does the project involve the construction or reconstruction of new or expanded infrastructure? ☐ Yes ☑ No

Examples of new or expanded infrastructure include, but are not limited to:

(i) The addition of new wastewater collection/new water mains or a new wastewater treatment system/water treatment plant where none existed previously;

(ii) An increase of the State Pollutant Discharge Elimination System (SPDES) permitted flow capacity for an existing wastewater treatment system; and OR

[1] If project construction is complete and the project was not previously financed through EFC, an authorized municipal representative may complete and sign this assessment.

(iii) An increase of the permitted water withdrawal or the permitted flow capacity for the water treatment system such that a Department of Environmental Conservation (DEC) water withdrawal permit will need to be obtained or modified, or result in the Department of Health (DOH) approving an increase in the capacity of the water treatment plant.

If your response to B(1) is no, please proceed to Section 5, Signature.

Section 3 –Smart Growth Criteria

Your project must be consistent will all relevant Smart Growth criteria. For each question below please provide a response and explanation.

1. Does the project use, maintain, or improve existing infrastructure?
   ☐ Yes ☐ No

   Explain your response:

2. Is the project located in a (1) municipal center, (2) area adjacent to a municipal center, or (3) area designated as a future municipal center, as such terms are defined herein (please select one response)?

   ☐ Yes, my project is located in a municipal center, which is an area of concentrated and mixed land uses that serves as a center for various activities, including but not limited to: central business districts, main streets, downtown areas, brownfield opportunity areas (see *www.dos.ny.gov* for more information), downtown areas of local waterfront revitalization program areas (see *www.dos.ny.gov* for more information), areas of transit-oriented development, environmental justice areas (see *www.dec.ny.gov/public/899.html* for more information), and hardship areas (projects that primarily serve census tracts or block numbering areas with a poverty rate of at least twenty percent according to the latest census data).

   ☐ Yes, my project is located in an area adjacent to a municipal center which has clearly defined borders, is designated for concentrated development in the future in a municipal or regional comprehensive plan, and exhibits strong land use, transportation, infrastructure, and economic connections to an existing municipal center.

   ☐ Yes, my project is located in an area designated as a future municipal center in a municipal or comprehensive plan and is appropriately zoned in a municipal zoning ordinance

   ☐ No, my project is not located in a (1) municipal center, (2) area adjacent to a municipal center, or (3) area designated as a future municipal center.

   Explain your response and reference any applicable plans:

3. Is the project located in a developed area or an area designated for concentrated infill development in a municipally-approved comprehensive land use plan, local waterfront revitalization plan, and/or brownfield opportunity area plan?

   ☐Yes ☐No

   Explain your response and reference any applicable plans:

4. Does the project protect, preserve, and enhance the State's resources, including surface and groundwater, agricultural land, forests, air quality, recreation and open space, scenic areas, and significant historic and archaeological resources?

   ☐Yes ☐No

   Explain your response:

5. Does the project foster mixed land uses and compact development, downtown revitalization, brownfield redevelopment, the enhancement of beauty in public spaces, the diversity and affordability of housing in proximity to places of employment, recreation and commercial development, and the integration of all income and age groups?

   ☐Yes ☐No

   Explain your response:

6. Does the project provide mobility through transportation choices including improved public transportation and reduced automobile dependency?

   ☐Yes ☐No ☐N/A

   Explain your response:

7. Does the project involve coordination between State and local government, intermunicipal planning, or regional planning?

   ☐Yes ☐No

   Explain your response and reference any applicable plans:

8. Does the project involve community-based planning and collaboration?

   ☐Yes ☐No

   Explain your response and reference any applicable plans:

9. Does the project support predictability in building and land use codes?

   ☐Yes ☐No ☐N/A

   Explain your response:

10. Does the project promote sustainability by adopting measures such as green infrastructure techniques, decentralized infrastructure techniques, or energy efficiency measures?

    ☐Yes ☐No

    Explain your response and reference any applicable plans:

11. Does the project mitigate future physical climate risk due to sea-level rise, storm surges, and/or flooding, based on available data predicting the likelihood of future extreme weather events, including hazard risk analysis data, if applicable?

    ☐Yes ☐No

    Explain your response and reference any applicable plans:

Section 4 – Miscellaneous

1. Is the project expressly required by a court or administrative consent order? ☐ Yes ☐ No

   If yes, and you have not previously provided the applicable order to EFC/DOH, please submit it with this form.

Section 5 – Signature

By signing below, you agree that you are authorized to act on behalf of the applicant and that the information contained in this Smart Growth Assessment is true, correct and complete to the best of your knowledge and belief.

Applicant: Binghamton-Johnson City Joint Sewage Board	Phone Number:
Name and Title of Signatory:	
Signature:	Date: