Clean Water State Revolving Fund Green Project Reserve
- Interim -

Coeur D'Alene WWTP Upgrade Project Phase 5C.2

SRF Loan #WW1601 (FY16) (pop. 46,146)

$20,000,000

Interim Green Project Reserve Justification

Categorical GPR Documentation

1. INSTALLS NEW ENERGY-EFFICIENT NEMA PREMIUM MOTORS AND VFDS ON PROCESS PUMPS AND AIR SCOUR BLOWERS (Energy Efficiency). Categorical per GPR 3.2-2: *projects that achieve a 20% reduction in energy consumption.* ($202,000).

Business Case GPR Documentation

2. INSTALLS HIGH SPEED TURBO BLOWERS (Energy Efficiency). Business Case GPR per Section 3.4-1: *project must be cost effective; …must identify energy savings and payback on capital …that does not exceed the useful life of the asset.* ($380,000).
3. INSTALLS TERTIARY FILTRATION TO REDUCE CHEMICAL USE AND UV DISINFECTION ENERGY OUTPUT REQUIREMENTS (Innovative). Business Case GPR per 4.5-5a: *Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment;* also Section 4.5-5b: *Treatment technologies or approaches that significantly…lower the amount of chemicals in the residuals;* Section 3.2-2: … *20% reduction in energy use.* ($5,800,000).
4. INSTALLS ADVANCED FLUORESCENT LIGHTING (Energy Efficiency). Business Case GPR per 3.5-7: *Upgrade of lighting to energy efficient sources such as …compact fluorescent lighting.* ($6,150).

1. New Premium Energy-Efficient Motors and VFDs

Summary

- All pumps and blowers are new and are to be equipped with variable frequency drives (VFDs) and premium efficiency motors to conserve energy and enhance the operability of the treatment process.
- Total Loan amount = $20,000,000
- Categorical energy efficient (green) portion of loan = 1.0% ($202,000) (Engineer's estimate)
- Annual Energy savings = 48%

Background

- The City of Coeur d'Alene's Advanced Wastewater Treatment Facility currently services approximately 46,500 people.
- The City of Coeur d'Alene faces changing effluent discharge conditions in the Spokane River and new regulatory requirements driven by water quality impairment in the Spokane River and downstream Lake Spokane (Long Lake reservoir).
- Premium efficiency motors save on average 3-7% over standard efficiency motors.
- Variable frequency drives greatly add to the efficiency of the process by allowing process equipment to operate at speeds that match the demands rather than operate at full speed all of the time.
- Current treatment processes include screening, grit removal, primary clarification, trickling filter/solids contact, secondary clarification, tertiary membrane filtration, and disinfection.
- The first phase of the tertiary membrane filtration facility (Phase 5C.1) installed two membrane trains each with three membrane cassettes. Tertiary Treatment Phase 2 Improvements will increase the capacity with installation of three additional membrane trains and 24 additional cassettes, totaling 30 cassettes, or six cassettes per train.
- The membrane operating system utilizes a lower energy air scour technology which allows the air scour blowers to operate at reduced speeds during certain periods of the day which allows for reduced operating costs through energy savings.

Results

- Premium efficiency motors save on average 3-7% over standard efficiency motors; a mid-point of 5% has been assumed for this evaluation.
- Variable frequency drives greatly add to the efficiency of the process by allowing process equipment to operate at speeds that match the demands rather than operate at full speed all of the time.
- Equipment that will have premium efficiency motors and/or will be controlled by VFDs is listed in the table below. Equipment controlled by VFDs is noted.

Equipment Name	HP	VFD
Dewatering Sump Pump	25	
Site Odor Control Fan 2	5	
Primary Clarifier 1 Scum Pump	5	
Primary Clarifier 2 Scum Pump	5	
Primary Clarifiers Spare Scum Pump	5	
Primary Clarifier 3 Mechanism Drive	0.5	
Primary Clarifier 3 Odor Control Fan	3	
Primary Sludge Pump 4	10	

Equipment Name	HP	VFD
Caustic Containment Sump Pump	1/3	
Alternative Coagulant Metering Pump 1	1/3	
Alternative Coagulant Metering Pump 2	1/3	
Secondary Effluent Transfer Pump 1	75	YES*
Secondary Effluent Transfer Pump 2	75	YES*
Secondary Effluent Transfer Pump 3	75	YES*
Membrane Tank 3 Slide Gate	1	
Membrane Tank 4 Slide Gate	1	

Equipment Name	HP	VFD
Makeup Air Exhaust Fan	1	
Makeup Air Unit	3	YES
Hot Water Boiler Pump	1.5	
Heat Loop Pump 1	1.5	
Heat Loop Pump 2	1.5	
Secondary Clarifier 3 RSS Pump 1	7.5	YES
Secondary Clarifier 3 RSS Pump 2	7.5	YES
Secondary Clarifier 3 WSS Pump 1	3	
Scum Pump 1	5	
Scum Pump 2	5	
Secondary Clarifier 3 Mechanism Drive	0.5	
Overhead Rolling Door	0.5	
Secondary Control Building 2 Sump Pump 1	2	
Secondary Control Building 2 Sump Pump 2	2	
Alum Containment Sump Pump	1/3	

Equipment Name	HP	VFD
Membrane Tank 5 Slide Gate	1	
Secondary Effluent Strainer 3	1	
Permeate Pump 1	20	YES*
Permeate Pump 2	20	YES*
Permeate Pump 3	20	YES
Permeate Pump 4	20	YES
Permeate Pump 5	20	YES
Backpulse/CIP Pump 1	15	YES*
Backpulse/CIP Pump 2	15	YES*
Return Tertiary Sludge Pump 3	20	YES
Scour Air Blower 1	150	YES
Scour Air Blower 2	150	YES
Scour Air Blower 3	150	YES
TMF 3W Pump 1	25	YES
TMF 3W Pump 2	25	YES

Energy Efficiency Improvements

- Equipment controlled by VFDs will operate between 33 and 100 percent of full speed. With VFDs, the estimated yearly power consumption is approximately 1,900,000 kW-hr.
- Without the variable frequency drives, the estimated yearly power consumption is approximately 3,450,000 kW-hr. Thus the variable frequency drives allow for a decrease of approximately 1,550,000 kW-hr per year. The City will reduce their power cost by approximately $101,000/year.
- Equipment powered by premium efficiency motors will provide a decrease of approximately 173,000 kW-hr per year. The City will reduce their power cost by approximately $11,000 each year.

Conclusion

- By using variable frequency drives and providing premium efficiency motors, the City will reduce their power cost by approximately $112,000 each year or approximately 48 percent.
- **GPR Costs**:

Equipment Name	Cost	Equipment Life	Payback
Variable Frequency Drives *	$46,000	20 years	5.5 months
Premium Efficiency Motors *	$143,000	20 years	13 years
Estimated Total	**$202,000**		
* Does not include turbo blower component cost as those are included in Section 2.			

- **GPR Justification:** The Equipment is Categorically GPR-eligible (Energy Efficiency) per Section 3.2-2: *"projects that achieve a 20% reduction in energy consumption."* and per Section 3.4-1: *"... energy savings and payback on capital and operation and maintenance costs that does not exceed the useful life of the asset."*

2. HIGH SPEED TURBO BLOWERS

Summary

- Membrane scour air blowers for this project phase will be high-speed turbo blowers.
- Total Loan amount = $20,000,000
- Categorical energy efficient (green) portion of loan = 2% ($380,000) (Engineer's estimate)
- Annual Energy savings = 13%

Background[1]

- The first phase of the tertiary membrane filtration facility (Phase 5C.1) installed two membrane trains each with three membrane cassettes. The current phase will increase the capacity with installation of three additional membrane trains and 24 additional cassettes, totaling 30 cassettes, or six cassettes per train.
- The additional membrane cassettes being installed as part of this project require the existing scour air system to be improved significantly due to the large increase in air demand.
- Larger high-speed turbo blowers will replace the existing positive displacement air scour blowers which are too small to accommodate the increased air demand.

Results

- The horsepower (HP) requirement of the new high-speed turbo blowers is 150 HP for each of three blowers (two operating, one stand-by).
- A master control panel will be utilized to control the turbo blowers to meet the required air scour demand (varies throughout the day) for the membrane operating system.

Energy Efficiency Improvements

- High-speed turbo blowers operate with an increased wire to air efficiency of approximately 73 percent compared to multi-stage centrifugal blowers which operate with a wire to air efficiency of approximately 60 percent.[2]
- The estimated energy consumed by the proposed system will be 1,120,000 kW-hr per year at a cost of $73,000. This represents a decrease in power consumption of approximately 146,000 kW-hr per year per blower or approximately $9,500 per blower.

Conclusion

- By using high-speed turbo blowers, the City will reduce the power demand by approximately 13 percent, saving $9,500 in energy costs for each of two active blowers.
- GPR Costs:

Equipment Name	Cost
High-speed Turbo Blowers	$400,000*
Equipment Savings = $9,500/yr x 2 blowers = $19,000/yr x 20 yrs = $380,000	
Estimated GPR-eligible Costs	**$380,000**
*Estimated. $510,000 complete package minus assumed $100,000 master control panel.	

- **GPR Justification:** Business Case GPR-eligible per Section 3.2-2[3]: *"If a project achieves less than a 20% reduction in energy efficiency, then it may be justified using a business case."* and per Section 3.4-1: *"Project must be cost effective."*

[1] 2012 Update to the 2009 Facility Plan, City of Coeur D'Alene, HDR Engineering Inc. February 2012
[2] *City of Coeur d'Alene Advanced Water Reclamation Facility (AWRF) Phase 5 Expansion Preliminary Design Report*, Section 8 - Blower Building, 5/09
[3] Attachment 2. April 2010 EPA Guidance for Determining Project Eligibility.

3. Treatment Process Selection – Tertiary Filtration

Summary

- Tertiary Treatment Phase 2 will provide tertiary filtration capacity up to 5 mgd.
- Total Loan amount = $20,000,000
- Categorical energy efficient (green) portion of loan = 29% ($5,800,000) (Engineering estimate)

Background

- The first phase of the tertiary membrane filtration facility (Phase 5C.1) installed two membrane trains each with three membrane cassettes. The current phase will increase the capacity with installation of three additional membrane trains and 24 additional cassettes, totaling 30 cassettes, or six cassettes per train.
- The tertiary filtration capacity will be up to 5mgd.

Results

Chemical Reduction

- The tertiary membrane filtration (TMF) system was tested in two modes: conventional filtration mode, and recirculation mode.
- When operated in recirculation mode, the chemical sludge generated in the process is retained to maintain a solids inventory. This allows for a longer contact time with the chemical sludge for surface complexation, potentially resulting in greater phosphorus removal.
- When the chemical feed was turned off, the effluent phosphorus did increase over the period without chemical addition; however, the chemical sludge inventory provided a buffer. In conventional filtration mode, the effluent phosphorus increases almost immediately following turning off the chemical feed.
- The flexibility of the TMF System allows for surface complexation of the alum sludge in recirculation mode, resulting in the use of less chemical since the process utilizes it more efficiently.

Typical Membrane Cassette

Conclusion

- The flexibility of operation of the Tertiary Membrane Filtration System can result in reduced chemical use for phosphorus removal, also resulting in less chemical residuals.
- GPR Costs: Tertiary filter = $5,800,000
- GPR Justification: Innovative Business Case GPR-eligible per Section 4.5-5a: *Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment*; also Section 4.5-5b: *Treatment technologies or approaches that significantly…lower the amount of chemicals in the residuals*.

4. Advanced Fluorescent Lighting

Summary

- Energy efficiency from the installation of advanced fluorescent lighting in all indoor spaces, high efficiency discharge lighting-high efficiency LED lighting for use in outdoor areas with lighting controls.
- Total Loan amount = $20,000,000
- Categorical energy efficient (green) portion of loan = ($6,150)

Energy Efficiency Improvements

- Energy efficient T-8 magnetic fluorescent lighting is approximately 28 percent more energy efficient than standard T-12 magnetic fluorescent lighting for relatively the same light output. [4]
- LED lighting is approximately 58 percent more energy efficient that typical high pressure sodium lighting for relatively the same light output.[5]
- Outdoor lighting will be controlled with photocells. The instant ON capability of LED allow for motion sensing which provides potential for greater control over on-OFF cycles.

Conclusion

- **GPR Costs**:

Equipment Name	Cost
Interior/Exterior Lighting and Controls	$6,150
Estimated Total	**$6,150**

- **GPR Justification**: Advanced fluorescent lighting is GPR-eligible by a Business Case per 3.5-7[6]: *Upgrade of POTW lighting to energy efficient sources such as …compact fluorescent.*

[4] National Lighting Product Information Program, *Lighting Answers*, Volume 1 Issue 1, April 1993.
[5] Global Green Energy, *ROI Analysis - 250W high pressure sodium vs. EcoBright 120W LED street light*, accessed via http://www.gg-energy.com/
[6] Attachment 2. April 21, 2010 EPA Guidance for Determining Project Eligibility. Page 10.