Clean Water State Revolving Fund Green Project Reserve

- Final -

City of Nampa Phase I: Wastewater Treatment Plant Upgrade Project

SRF Loan #WW1306

$17,000,000

Final Green Project Reserve Justification

Categorical Energy Efficient GPR Documentation

1. PREMIUM ENERGY EFFICIENT MOTORS AND VFDS (Energy Efficiency). Premium energy efficient motors and VFDs will be installed as part of the Wastewater System Upgrade project. GPR Categorical Case per Section 3.2-2: *Use of premium efficiency motors and VFD pumps in a new project to achieve 20% reduction in energy consumption.* ($684,400).

Environmentally Innovative GPR Documentation

2. INSTALL INNOVATIVE MULTI-STAGE ACTIVATED BIOLOGICAL PROCESS FOR BIOLOGICAL NUTRIENT REMOVAL (Innovative). Environmentally Innovative GPR-eligible per Section 4.5-5a: *Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment; 4.5-5b: …approaches that significantly reduce the volume of residuals, or lower the amount of chemicals in the residuals*. ($4,660,371).

State of Idaho SRF Loan Program
December 2017

1. Premium Efficiency Motors & VFDs

Summary

- The City of Nampa is upgrading and renovating their wastewater treatment plant (WWTP), funded with a FY13 SRF Loan. The upgraded system includes pumps with premium motors and variable frequency drives (VFDs).
- Total loan amount = $17,000,000[1]
- GPR-eligible = Pumps/VFDs = $684,400 (installed cost)
- Estimated portion of loan = 4%

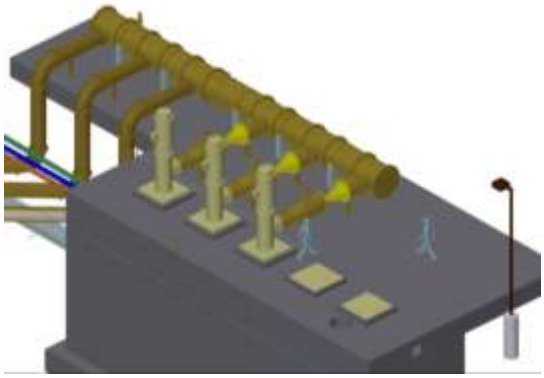
Description

- Energy efficient items installed in the Nampa WWTP upgrade include:
  - Primary effluent vertical turbine, solids handling, premium efficient pumps + VFDs: 100 hp Fairbanks Nijhuis 20" VTSH AWF; U.S. Electrical Motors (two duty, one standby).

GPR Justification[2]

VFDs:

- The Baseline Standard Practice for comparison is a standard EPAct motor not controlled by a VFD[2].
- VFD efficiency data were calculated using the Baldor Adjustable Speed Drive Energy Savings Calculator[3] (for pump applications).
- The combined annual energy savings for utilizing VFDs is estimated to be 331,600 kWh per year per pump/VFD system (58% reduction in energy compared to motors without VFDs). This corresponds to a cost savings of $16,580 per year (at an energy cost of $0.05 per kWh) per VFD system when compared to the Baseline Standard Practice, with a total cost savings of $33,160 per year (two VFD systems in operation continuously).



- With an estimated incremental cost increase of $31,364 per unit, the simple payback is approximately 3.8 years for the system.

Motors:

- Premium motor energy savings over the EPAct motor is $480 per year per motor or $960 per year total (two motors in operation continuously).[4]
- With an estimated incremental cost increase of $4,672 per unit, the simple payback is 9.1 years per motor.

Conclusion

- The use of premium energy-efficient pumps and VFDs achieve more than a 20% reduction in energy consumption and are cost effective.
- **GRP Costs Identified**:
  - Premium Efficiency Pumps + VFDs = **$684,400** (installed cost[5])
- **GPR Justification**: The Pump/VFD system is Categorically GPR eligible (Energy Efficiency) per Section 3.2-2 page 9[6]: *Use of premium efficiency motors and VFD pumps in a new project where they are cost effective and achieve a 20% reduction in energy consumption*. Section 3.5-9 also states: *Variable Frequency Drives can be justified based upon substantial energy savings*[7]; such savings are identified above.

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[1] FY13 SRF Loan Agreement
[2] NYS Energy Research and Development Authority, Energy Evaluation Memorandum, Village of Greenport WWTP Upgrade 8-2009
[3] http://www.baldor.com/support/software_download.asp?type=BE$T+Energy+Savings+Tool
[4] Productive Energy Solutions Motor Slide Calculator. Energy cost at $0.05/kWh. 94.1% efficiency for premium motor vs. 92.4% for EPAct motor.
[5] 12/20/2017 email Smith - McNeill
[6] 2012 Clean Water State Revolving Fund 10% Green Project Reserve: Guidance for Determining Project Eligibility
[7] Attachment 2. April 2012 EPA Guidance for Determining Project Eligibility.

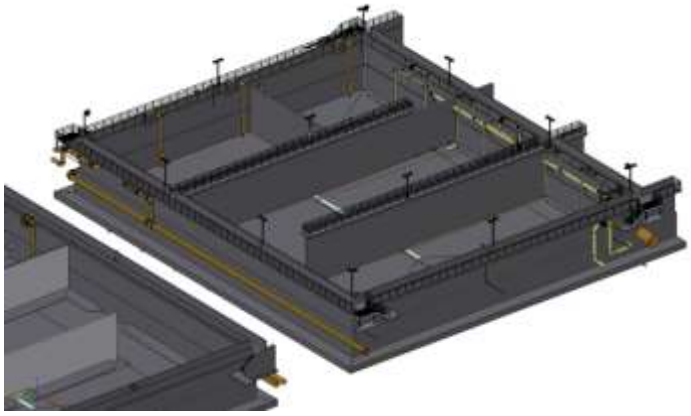
2. POTW Unit Process: Biological Phosphorus Reduction

Summary

- An innovative biological phosphorus removal (BPR) system was incorporated into the treatment process which results in phosphorus removal while significantly reducing the use of chemicals.
- Total Loan amount = $17,000,000
- Estimated green portion of loan = 27% ($4,660,371) (installed cost[8])

Background[9]

- In the past, the Nampa WWTP operated using a combination of trickling filters and a nitrifying activated sludge system (aerobic only) for secondary treatment. This system was capable of biochemical oxygen demand (BOD) and ammonia-nitrogen removal. The Nampa WWTP was not able to remove phosphorus.
- The City's renewed NPDES permit has both ammonia and total phosphorus effluent limits.
- The secondary treatment system was reconfigured to provide biological removal of phosphorus, along with ammonia and BOD.
- BPR is a proven innovative technology that can significantly reduce phosphorus levels in WWTP effluent without the use of chemical coagulants.



Treatment Description

- The biological activated sludge treatment system incorporates anaerobic and aerobic zones to accomplish removal of both ammonia-nitrogen and phosphorus. To achieve this biological treatment configuration, two existing aeration basins were modified and an additional activated sludge basin was constructed.
- The activated sludge basins consist of a combination anaerobic selector zone followed by a flexible aerated (swing) zone that allow for process flexibility (for phosphorus removal). Anaerobic zones are used to promote the growth of phosphorus accumulating organisms (PAOs), which perform BPR. These initial zones are followed by two aeration passes.
- Return activated sludge (RAS) is recycled from the existing secondary clarifiers to the front of the activated sludge process.
- It is estimated that biological phosphorus removal without chemical addition will be capable of lowering the phosphorus concentration to approximately 0.5 mg/L. A chemical trim system is used as needed for polishing to keep effluent phosphorus concentrations below NPDES permitted levels.

Innovative Process Justification

- The GPR-eligibility of BPR was established by comparison to a Baseline Standard Practice (BSP). The BSP for the City of Nampa is the current operating practice of treatment with trickling filters and nitrification (aerobic) basins. To meet effluent phosphorus limits using this arrangement, large quantities of chemical (metal salt) coagulant would need to be added to the treatment process in addition to tertiary filters.
- For the project startup year (2018), the WWTP expects to remove 778 lb/day of total phosphorus (TP) at the average annual (summer) loading condition. Approximately 3,270 gallons of liquid ferrous chloride per day (or 1,193,000 gallons per year) would be required to remove that TP load using the BSP. At $1.97 per gallon of liquid ferrous chloride, the WWTP would spend over $2.3 million annually for chemical supply. This treatment method would create a quantity of chemical sludge that would require handling and disposal. Based on the chemical usage costs, the BPR upgrades have a simple payback period of 2.5 years.

[8] 12/20/2017 email Smith - McNeill

[9] Nampa Wastewater Treatment Plant Phase I Upgrades: Preliminary Engineering Report by Brown and Caldwell; October 1, 2013

CONT: BIOLOGICAL PHOSPHORUS REDUCTION

A detailed business case evaluation of treatment alternatives was conducted in the Nampa Wastewater Treatment Plant Phase I Upgrades Preliminary Engineering Report (Brown and Caldwell, October 1, 2013). BPR using an A/O process was determined to have a 20-year net present value almost $7 million lower than any other biological alternative evaluated.

Conclusion

- Compared to the BSP, BPR significantly reduces the need for chemical addition for phosphorus removal and minimizes the amount of chemical sludge to be disposed.
- **GPR Costs Identified**:
    - Modifications to existing nitrification basins = $1,030,532
    - Construction of a new activated sludge basin = $3,629,839
    - **Total = $4,660,371**
- **GPR Justification**: The process is GPR-eligible per Section 4.5-5a: *Projects that significantly reduce or eliminate the use of chemicals in wastewater treatment; 4.5-5b: …significantly reduce the volume of residuals, or lower the amount of chemicals in the residuals*[10].

[10] Attachment 2 of the April 2012 EPA Guidance for Determining Project Eligibility.