HISTORIC
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ITEM #8
WRKS
11/26/13

MEMORANDUM

November 14, 2013

TO: Board of Mayor and Aldermen

FROM: Eric Stuckey, City Administrator
David Parker, City Engineer/CIP Executive
Mark Hilty, Water Management Director

SUBJECT: **Consideration of Resolution 2013-76 to Approve the Letter of Intent with Trojan Technologies for Ultraviolet (UV) Equipment for the Water Reclamation Facility (COF Contract Number 2013-0216) and to Authorize the City Engineer to Execute the Letter of Intent for Final Equipment Purchase**

Purpose
The purpose of this memorandum is to provide the Board of Mayor and Aldermen (BOMA) with information to consider Resolution 2013-76 that approves the Letter of Intent with Trojan Technologies (COF Contract Number 2013-0216) and to authorize the City Engineer to execute Contract 2013-0216 within the parameters of the Contract.

Background
The City of Franklin and CDM Smith performed a pre-selection process for the Water Reclamation Facility UV system to identify a specific product for design purposes. This process was necessary to establish parameters that affect various design aspects of the Water Reclamation Facility expansion such as UV channel sizing and hydraulic head considerations throughout plant processes.

A request for proposals (RFP) was submitted to five manufacturers to be considered for pre-selection including:

- Aquionics Inc. (Aquionics), Erlanger, Kentucky
- Calgon Carbon Corporation (Calgon), UV Technologies Division, Coraopolis, Pennsylvania
- Ozonia North America (Ozonia), LLC, Leonia, New Jersey
- Trojan Technologies (Trojan), London, Ontario, Canada
- WEDECO, Charlotte, North Carolina

The City received responsive bids from all manufacturers with the exception of Aquionics. The bids were evaluated using cost and non-cost factors to develop recommendations for selection (Technical Memorandum attached) with a final recommendation for the Trojan system. The Trojan system is not the lowest cost option; however, the operations and maintenance performance of the Trojan system in contrast to the head loss and maintenance concerns identified with the lower cost systems, compels staff to recommend Trojan.

Resolution 2013-76 will establish a contract with Trojan for the purchase of their UV system and will authorize the City Engineer to negotiate purchase of necessary equipment in accordance with the Base Selling Price and the Method of Cost Escalation as found in Attachment A of the Letter of Intent.

Financial Impact
The financial impact, as defined in Attachment A of the Letter of Intent (COF Contract Number 2013-0216), is $750,700 subject to the Method of Cost Escalation.

Recommendation
Staff recommends adoption of Resolution 2013-76 to approve the Letter of Intent with Trojan Technologies for UV equipment for the Water Reclamation Facility and to authorize the City Engineer to Execute the Letter of Intent for Final Equipment Purchase.

RESOLUTION NO. 2013-76

A RESOLUTION TO APPROVE THE LETTER OF INTENT WITH TROJAN TECHNOLOGIES FOR ULTRAVIOLET (UV) EQUIPMENT FOR THE FRANKLIN WATER RECLAMATION FACILITY AND AUTHORIZE THE CITY ENGINEER TO EXECUTE SAID LETTER AND REVISE FINAL EQUIPMENT PURCHASE WITHOUT FIRST SEEKING APPROVAL FROM THE BOARD OF MAYOR AND ALDERMEN

WHEREAS, the City of Franklin (City) Board of Mayor and Aldermen (BOMA) approved (COF Contract No 2013-0001) the Franklin Water Reclamation Facility (WRF) Modifications and Expansion Project (Project) with CDM Smith (Consultant) to provide for the design of the upgrade of the WRF to increase its treatment capacity in order to provide for the growth of the City; and

WHEREAS, during the design process, the Consultant with concurrence of the City's staff determined that it would be in the best interest of the Project to preselect the ultraviolet (UV) light disinfection system to be utilized in the Project due to each different manufacturer of UV disinfection equipment requiring a different designed facility for their equipment; and

WHEREAS, the Board of Mayor and Aldermen also find that it is in the best interest of the City and for the efficiency of performing the future WRF approved construction contracts and the Trojan Technologies Letter of Intent (COF Contract No 2013-0216) to authorize the City Engineer to execute and the authority to administer COF Contract 20133-0216 on behalf of the City; and

WHEREAS, the BOMA consistently strives to be effective and efficient in the administration of City business.

NOW THEREFORE, BE IT RESOLVED, BY THE BOARD OF MAYOR AND ALDERMEN OF THE CITY OF FRANKLIN, TENNESSEE THAT:

The Letter of Intent (COF Contract No 2013-0216) with Trojan Technologies is approved and the City Engineer is authorized to execute said Contract and approve necessary revisions to the equipment to be purchased and adjust the Base Selling Price in accordance with the Method of Cost Escalation as found in Attachment A of the Letter of Intent on behalf of the City of Franklin without seeking prior approval from the Board of Mayor and Aldermen.

RESOLVED this the 26th day of November, 2013

CITY OF FRANKLIN, TENNESSEE

Dr. Ken Moore
Mayor

Attest:

Eric S. Stuckey
City Administrator

APPROVED AS TO FORM BY:

Shauna R. Billingsley
City Attorney

ADMINISTRATION

David Parker
City Engineer/CIP Executive

Dr. Ken Moore
Mayor

Eric S. Stuckey
City Administrator

HISTORIC
FRANKLIN
TENNESSEE

November 6, 2013

COF Contract No 2013-0216

Mr. Michael Shortt
Regional Manager
Trojan Technologies
3020 Gore Road
London, Ontario N5V 4T7
Canada

Subject: **Letter of Intent**
City of Franklin, Tennessee
Franklin WRF Modifications & Expansion Project (City Contract No. 2013-0001)

Dear Mr. Shortt:

This letter represents the intent of the City of Franklin (City) to preselect the Trojan Technologies (Trojan) TrojanUVSigna™ ultraviolet (UV) light disinfection system for the Franklin Water Reclamation Facility (WRF) Modifications & Expansion Project (Project). The following documents form the basis of this selection and are collectively referred to as the "Proposal":

- Trojan's quote number 204317, originally dated June 28, 2013, and revised July 17, 2013.
- The Request for Proposals (RFP) package; issued by CDM Smith and dated May 24, 2013.
- Addendum No. 1 to the RFP package; issued by CDM Smith and dated June 12, 2013.
- Addendum No. 2 to the RFP package; issued by CDM Smith and dated June 13, 2013.
- Addendum No. 3 to the RFP package; issued by CDM Smith and dated June 18, 2013.
- Addendum No. 4 to the RFP package; issued by CDM Smith and dated June 21, 2013.

By signature of this letter, Trojan agrees to enter into an agreement with the general contractor that the City intends to select to construct the Project. In accordance with this agreement with the general contractor, Trojan will provide the equipment and services as established in the Proposal. In return, the City agrees to design the Project around the UV disinfection equipment defined in the Proposal.

By signature of this letter, Trojan also agrees to the following:

- Trojan agrees to provide the equipment, materials and services at the Adjusted Selling Price, calculated in accordance with the attached Method of Cost Escalation for UV Disinfection Equipment (Attachment A).
- Trojan agrees to furnish replacement parts at a guaranteed price calculated based on the cost escalation method described in Specification Section 11265, Paragraph 1.07C.
- The City reserves the right to delete optional items from the scope of supply and deduct the cost of these optional items from the Base Selling Price.
- If for any reason the City does not award the Project, the City is under no obligation to purchase the equipment, materials, and services in the Proposal.

After signing this letter in the space below, please return one signed original to me.

HISTORIC
FRANKLIN
TENNESSEE

We look forward to working with you on this project. If you have any questions or comments, please do not hesitate to contact me at (616) 550-6660.

Sincerely,

David Parker, P.E.
City Engineer/CIP Executive
City of Franklin

Signed:
Trojan Technologies

_____ _____

Title: _____ Date

Print Name: _____

Attachment

cc: Mark Hilty, Director Water Management Department
Bob Huguenard, CDM Smith
Project File

ADMINISTRATION

David Parker
City Engineer/CIP Executive

HISTORIC
FRANKLIN
TENNESSEE

Dr. Ken Moore
Mayor

Eric S. Stuckey
City Administrator

Attachment A
City of Franklin, Tennessee
Franklin WRF Modifications & Expansion Project (City Contract No. 2013-0001)
Method of Cost Escalation for UV Disinfection Equipment

1. The Base Selling Price of the Franklin WRF UV disinfection equipment is set at $750,700. This price includes the following items listed in the Proposal:

Item	Description	Price
a.	UV Disinfection System including the following: • Spare Parts & Accessories • 18-Month Warranty & Warranty Bond • Manufacturer's Services including Training, Studies & Testing • PLC Software Licenses • UL Listing for Panels	$759,000
b.	Replace ControlLogix PLC with CompactLogix PLC	-$5,100
c.	Furnish NEMA 3R Transformers with Stainless Steel Enclosures	-$3,200
	Base Selling Price	**$750,700**

This Base Selling Price is valid as of June 28, 2013, the Due Date for UV Proposals.

2. The Base Selling Price shall be adjusted in accordance with the percent change in the Producer Price Index (PPI) for Capital Equipment, not seasonally adjusted, as appears in the monthly PPI Detailed Report published by the Bureau of Labor Statistics (http://www.bls.gov/ppi/ppi_dr.htm).

In the event that the PPI for Capital Equipment is unavailable for either or both of the time periods used in the adjustment of the Base Selling Price, the PPI for Finished Goods Less Foods and Energy, not seasonally adjusted, shall be used in its place.

3. The Adjusted Selling Price shall be calculated according to the following formula:

Adjusted Selling Price =
Base Selling Price x (PPI as of Date of Advertisement for Bids / PPI as of June 28, 2013)

Where

- Base Selling Price is as listed in Paragraph 1 above.

- PPI as of Date of Advertisement for Bids = PPI for Capital Equipment, not seasonally adjusted, available on the first Date of Advertisement for Bids. The PPI used shall be for the most recent month for which data are available and shall be the first-published version.

- PPI as of June 28, 2013 = Latest version of the PPI for Capital Equipment, not seasonally adjusted, available for June 2013. The latest version of the PPI shall incorporate revisions or corrections made by BLS prior to the first Date of Advertisement for Bids.

4. The UV Manufacturer shall honor the Adjusted Selling Price for a period of two (2) years from June 28, 2013.

Technical Memorandum

To: *City of Franklin*

From: *CDM Smith*

Date: *October 4, 2013*

Subject: *Franklin WRF Modifications & Expansion Project*
Results of UV Manufacturer Preselection Evaluation – FINAL DRAFT

Introduction & Project Background

CDM Smith Inc. (CDM Smith) has been retained by the City of Franklin (the City) to design a new UV disinfection facility for the Franklin Water Reclamation Facility (WRF). The City and CDM Smith agreed that the initial step for design of a new UV system was to preselect a UV system prior to design. It was agreed by both parties that the preselection evaluation would consider economic and non-economic criteria to select the UV manufacturer and establish the UV system that would be the basis of design. This technical memorandum (TM) documents the preselection process and the recommended UV system for the Franklin WRF.

Request for Proposal

The design criteria summarized in **Table 1** were used to develop a performance specification. This specification was submitted to the UV manufacturers as their primary source of information for developing a proposal. On May 24, 2013, the Request for Proposals (RFP) was issued to the following UV manufacturers.

- Aquionics Inc. (Aquionics), Erlanger, Kentucky
- Calgon Carbon Corporation (Calgon), UV Technologies Division, Coraopolis, Pennsylvania
- Ozonia North America (Ozonia), LLC, Leonia, New Jersey
- Trojan Technologies (Trojan), London, Ontario, Canada
- WEDECO, a Xylem brand, Charlotte, North Carolina

Appendix A includes the RFP and the four addenda CDM Smith issued in response to manufacturer questions.

Table 1 New UV Disinfection System Design Parameters for the Franklin WRF

Parameter	Value
Lamp Type	Low Pressure, High Intensity
Design Dose, mJ/cm^2	24 (validated using MS2 bacteriophage) 15 (validated using T1 bacteriophage) 24 (validated using *B. subtilis*)
Flow Rates (mgd) Peak Hour Design Annual Average Day Minimum	 33.0 16.0 2.0
UV Transmittance at 254 nm, percent	65
Anticipated Discharge Permit Limits TSS (mg/L) *Summer (May 1 – Oct. 31)* Weekly Average Daily Maximum *Winter (Nov. 1 – Apr. 30)* Weekly Average Daily Maximum pH, Daily Maximum (standard units) 5-day CBOD (mg/L) *Summer (May 1 – Oct. 31)* Monthly Average Weekly Average Daily Maximum *E. coli* Bacteria (CFU/100 mL) Monthly Average Daily Maximum	 15 20 40 45 6.0 to 9.0 4.0 6.0 8.0 126 941
Redundancy	One redundant bank per channel or one redundant channel at peak hour flow
Electronics Enclosures	NEMA 4X, Type 316 stainless steel

All five UV manufacturers returned proposals before the 5 p.m. Eastern Time deadline on June 28, 2013. Two manufacturers, Aquionics and Ozonia, provided multiple proposals.

- Aquionics submitted proposals for an open-channel system and a closed-vessel system. Because neither proposal met the requirements of the RFP, Aquionics was considered non-responsive.
- Ozonia furnished proposals for two- and three-channel systems. Because the three-channel system did not meet the requirements of the RFP, it was not evaluated. Only the two-channel system was evaluated.

Using the information submitted by the UV manufacturers, CDM Smith evaluated the four proposed systems based on economic and non-economic factors that were developed with input from the City. Additional information needed to complete the evaluation was obtained from each manufacturer.

The major features of each manufacturer's proposed system are summarized in **Table 2.** The complete proposals, including additional information submitted at CDM Smith's request, are attached to this TM as **Appendix B.**

Cost Analysis

CDM Smith's economic analysis included calculation of the estimated capital cost to construct each UV system and the anticipated annual operation and maintenance (O&M) cost of each system, using the equipment and replacement parts costs provided by each manufacturer.

The capital and O&M costs developed for each UV system are comparative costs calculated in order to determine the relative installation and operating costs of each UV system. Because these costs are comparative in nature, certain common elements were removed where they were considered to be identical among options. The capital and O&M costs presented in this TM are not intended to be a comprehensive representation of total cost, but instead an indication of the relative cost between options for the purpose of comparing the systems. Neither the capital nor the O&M costs presented in this TM should be used for budgeting purposes.

The estimated capital and O&M costs were subsequently used to calculate the net present cost (NPC) of each system. The following sections discuss the cost components and the assumptions made in CDM Smith's calculations.

Capital Costs

UV Disinfection System Equipment Costs

Capital costs associated with the UV system included the base system cost as well as spare parts, an 18-month warranty period and warranty bond, an accessory chemical cleaning tank, and a spare compressor, if applicable, for the automatic cleaning system. These items were added to the manufacturer's base system cost so that all of the manufacturers could be compared on an equal basis (*i.e.*, equal scopes of supply and services as requested by the RFP).

Table 2 UV System Technical Comparison

Parameter	Calgon Carbon C 500™D	Ozonia North America Aquaray® 3X	Trojan Technologies TrojanUVSigna™	WEDECO Duron 6012-2.5x2
System Design				
Minimum UV Dose	15 mJ/cm^2	15 mJ/cm^2	15 mJ/cm^2	15 mJ/cm^2
Dose Design Basis	T1	T1	T1	T1
Lamp Cleaning	In-channel, motorized	In-channel, motorized	In-channel, hydraulic	In-channel, motorized
Lifting Device	Not integrated	Not integrated	Integrated	Integrated
Lamp Life & Sleeve Fouling Factors	0.80 & 0.88	0.85 & 0.95	0.86 & 0.94	0.85 & 0.95
System Configuration				
Number of Channels	2	2	2	2
Banks per Channel (one is redundant)	2	3	2	2.5
Racks/Modules per Bank	9	1	1	2
Lamps/Rack or Module	8	36	26	12
Total Number of Lamps	288	216	104	120
System Layout				
Channel Length	44 ft	25 ft	42 ft	31 ft
Channel Width	54 in; flares to 70 in	29.5 in	57.5 in	59 in; flares to 83 in
Channel Depth	72 in	84 in	122 in	75 in
Effluent Depth in Channel	48 in	61 in	87 in	42 in
Hydraulic Considerations				
Influent Control	Slide gate	Slide gate	Slide gate	Slide gate
Effluent Control	Fixed weir	Weir gate	Weir gate	Weir gate
System Headloss				
At PHF of 33 mgd	9.3 in	9 in	4.2 in	14.9 in
Electrical Requirements				
Input Voltage	400/230V, 3-phase	230V, 3-phase	480Y/277V, 3-phase	480V, 3-phase
Lamp Power Consumption	575 W	406 W	1,053 W	600 W
Design ADF of 16 mgd	53 kW	29 kW	44 kW	37 kW
PHF of 33 mgd	97 kW	58 kW	89 kW	74 kW
All Modules/Banks On	166 kW	88 kW	117 kW	90 kW
Component Guarantees				
Lamp Life	12,000 hrs	12,000 hrs	15,000 hrs	14,000 hrs
Ballast Life	5 yrs	5 yrs	10 yrs	10 yrs

Additional Capital Cost Assumptions

The following assumptions were incorporated into the capital costs presented in **Table 3.**

- Installation costs, yard piping and site work for all four systems were assumed to be relatively equal and are not included.
- Conceptual opinions of probable construction cost (OPCCs) were prepared by CDM Constructors Inc. (CCI) for each manufacturer's proposed UV structure, including earthwork and subgrade preparation; construction of concrete slabs and walls; handrails; aluminum grating to cover the channels; and a pre-engineered metal canopy to cover the structure.
- Lifting equipment was included in CCI's OPCC for the Ozonia UV structure. The other three systems include integral module lifting systems (Trojan and WEDECO) or supply light-duty lifting equipment (Calgon). It was assumed that the lifting equipment for the Ozonia system would consist of a ½-ton capacity traveling bridge crane with a minimum lifting height of 10 feet as recommended in Ozonia's proposal.
- A $20,000 allowance for motorized effluent isolation gates was included in the capital cost for Calgon's UV system, which includes a fixed weir at the end of each channel.
- Construction cost markups were as follows.
  - Electrical and I&C costs: 25 percent of equipment cost.
  - Permits: 0.5 percent of total direct costs.
  - Sales Tax: 9.5 percent.
  - Builder's Risk: 0.5 percent of total capital cost.
  - General Liability: 1.0 percent of total capital cost.
  - Bonds & Insurance: 1.5 percent of total capital cost.
  - General Conditions: 10 percent of subtotal prior to overhead & profit.
  - Contractor's Overhead & Profit: 10 percent of subtotal prior to overhead & profit.
  - Construction Contingency: 25 percent of subtotal with overhead & profit applied.
  - Escalation to midpoint of construction: 9 percent of cost at today's dollars. The midpoint of construction was assumed to be July 2016.

Table 3 UV Disinfection System Comparative Capital Costs

Cost Factor	Calgon Carbon C³500™ D	Ozonia North America Aquaray® 3X	Trojan Technologies TrojanUVSigna™	WEDECO Duron 60i2-2.5x2
Base System Cost				
UV Disinfection System Equipment	$855,360	$517,814	$759,000	$443,499
Spare Parts & Accessories	$74,300	$22,086	Included	Included
18-Month Warranty	$44,430	$10,530	Included	$7,085
Manufacturer's Services[1]	$26,360	$35,750	Included	$20,205
Adders Supplied by UV Manufacturer				
Module Cleaning Station	$11,560	$10,100	n/a	n/a
Submersible Pump for Cleaning Tank	$1,130	$1,285	n/a	n/a
PLC Software Licenses	Included	$6,010	Included	$10,000
UL Listing for Panels	Included	$7,750	Included	Included
Deducts Supplied by UV Manufacturer				
Replace PLC with CompactLogix PLC	-$34,900	-$3,846	-$5,100	$0
Provide NEMA 3R Transformers	-$2,300	-$6,600	-$3,200	-$7,785
Additional Project Requirements				
Lifting Equipment	Included	$69,000	Included	Included
Concrete Structure	$231,000	$104,000	$302,000	$224,000
Pre-Engineered Metal Canopy	$69,000	$77,000	$108,000	$76,000
Effluent Isolation Gates	$20,000	n/a	n/a	n/a
Electrical/I&C	$323,985	$212,720	$290,175	$193,251
Total Direct Costs	***$1,657,125***	***$1,074,045***	***$1,459,175***	***$974,040***
Permits	$8,286	$5,370	$7,296	$4,870
Sales Tax	$39,523	$52,372	$72,105	$42,132
Builder's Risk	$15,090	$9,730	$13,225	$8,780
General Liability	$30,180	$19,460	$26,450	$17,560
Bonds & Insurance	$45,270	$29,190	$39,675	$26,340
Subtotal Prior to OH&P	***$1,845,474***	***$1,190,167***	***$1,617,926***	***$1,073,723***
General Conditions	$184,547	$119,017	$161,793	$107,372
Contractor's Overhead & Profit	$184,547	$119,017	$161,793	$107,372
Subtotal with OH&P	***$2,214,569***	***$1,428,200***	***$1,941,511***	***$1,288,467***
Construction Contingency	$553,642	$357,050	$485,378	$322,117
Total Cost at Today's Dollars	**$2,768,211**	**$1,785,251**	**$2,426,889**	**$1,610,584**
Escalation to Midpoint of Construction	$249,348	$160,807	$218,603	$145,074
TOTAL CAPITAL COST	**$3,018,000**	**$1,946,000**	**$2,645,000**	**$1,756,000**

[1] Includes training, harmonic studies, and testing.

n/a: Not applicable to UV manufacturer's design.

Operation & Maintenance Costs

Each UV system manufacturer provided data on power consumption at design average daily flow (ADF) conditions, as well as replacement costs for its lamps, ballasts, wipers, quartz sleeves, and cleaning chemicals, where applicable.

CDM Smith's calculation of estimated annual O&M costs included the following assumptions.

- Based on preliminary wastewater flow projections provided by others, the plant ADF in Year 2018 is expected to be close to 16 mgd. It was therefore assumed that the treated flow for all 20 years of operation would be 16 mgd.
- The four components of the O&M cost are power consumption, lamp replacement, ballast replacement, and quartz sleeve replacement.
- The quantities of lamps and ballasts replaced are based on the respective component's anticipated lifetime (12,000 to 15,000 hours for lamps and 5 to 10 years for ballasts).
- Approximately two percent of the total number of quartz sleeves will be replaced each year.
- The costs of O&M labor, cleaning chemical, and wiper replacement costs were assumed to be relatively equal among the four manufacturers and were therefore excluded from the O&M cost comparison.
- The unit cost for power was $0.095 per kilowatt-hour (kWh) based on 2012 billing data provided by the City.

The estimated annual O&M costs are presented in **Table 4.**

Table 4 Estimated Annual O&M Costs at 16 mgd ADF

Cost Factor	Calgon Carbon C^{3}500™ D	Ozonia North America Aquaray® 3X	Trojan Technologies TrojanUVSigna™	WEDECO Duron 60i2-2.5x2
Power Consumption				
Annual Power Consumption, kWh	462,000	256,000	387,000	326,000
Annual Power Cost @ $0.095/kWh	$43,900	$24,300	$36,800	$31,000
Lamp Replacement				
Lamps Replaced per Year	53	53	23	31
Cost per Replacement Lamp	$220	$150	$450	$185
Annual Cost for Replacement Lamps	$11,700	$8,000	$10,400	$5,700
Ballast Replacement				
Ballasts Replaced per Year	15	8	2	3
Cost per Replacement Ballast	$400	$285	$880	$400
Annual Cost for Replacement Ballasts	$6,000	$2,300	$1,800	$1,200
Quartz Sleeve Replacement				
Quartz Sleeves Replaced per Year	6	5	3	3
Cost per Replacement Sleeve	$90	$65	$158	$164
Annual Cost for Quartz Sleeves	$500	$300	$500	$500
Total Annual O&M Cost	**$62,000**	**$35,000**	**$50,000**	**$38,000**

Net Present Cost Calculation

The following assumptions were incorporated into the NPC calculation.

- Because disinfection is required year-round, the UV system will be required to operate continuously.
- The calculation includes a time period of 20 years, a discount rate of 5 percent, and a 3 percent inflation rate.
- Capital costs will be incurred in 2015 for the construction of the UV disinfection system.
- 2017 will be the new system's first full year of operation.
- The quartz sleeves for all systems will need replacement at Year 10 (2026).

The results of the NPC analysis are summarized below in **Table 5.** Detailed NPC tables are attached to this memorandum in **Appendix C** as **Table C-1.**

Table 5 Summary of Net Present Cost Analysis

Cost Factor	Calgon Carbon C³500™ D	Ozonia North America Aquaray® 3X	Trojan Technologies TrojanUVSigna™	WEDECO Duron 60Z 2.5x2
Total NPC of Capital Costs	$2,924,000	$1,884,000	$2,558,000	$1,705,000
Total NPC of Annual O&M Costs	$963,000	$541,000	$766,000	$596,000
Total NPC	**$3,887,000**	**$2,425,000**	**$3,324,000**	**$2,301,000**
Rank	4	2	3	1

WEDECO's proposed system had the lowest total NPC of the four manufacturers due to its low base system pricing and relatively low electrical power consumption. The small total number of lamps (120) and ballasts in WEDECO's proposed system also contributed to its relatively low lamp, quartz sleeve, and ballast replacement costs.

Despite having a relatively high number of UV lamps (216), Ozonia's proposed system had the second-lowest total NPC because it had the second-lowest capital cost, the lowest power consumption, and the lowest prices for replacement parts.

Trojan's and Calgon's UV systems had the highest capital costs and relatively high O&M costs, which resulted in the highest NPCs. Although Trojan's UV system had the lowest number of lamps (104), the O&M costs for this new system remain high due to the cost of replacement parts. Calgon's system, with the highest power consumption and the most lamps (288), had the highest annual O&M cost.

Non-Cost Analysis

In addition to the economic evaluation, CDM Smith evaluated each UV disinfection system according to seven non-cost criteria. Each non-cost criterion was given a raw score on a scale of 1 (most desirable) to 5 (least desirable) and weighted on a scale of 1 (low priority) to 5 (high priority). The raw score for each criterion was multiplied by its respective weighting, and the seven weighted scores were added together to obtain the Raw Non-Cost Score on a scale of 0 to 110 points. In general, a low score indicated that the system is reliable, easy to maintain, and well-supported by its manufacturer.

The non-cost criteria and their definitions and weights are described below.

- **Ease of lamp replacement.** Because lamp replacement is one of the most frequently performed service activities for a UV disinfection system, this criterion received the maximum weighting of 5.

- **Ease of ballast replacement.** While it is a common procedure, ballast replacement received a moderate weighting of 3 as it does not occur as frequently as lamp replacement.

- **Ease of chemical cleaning.** Chemical cleaning of the UV system (and servicing of a system's in-situ chemical cleaning systems, if present) is a relatively infrequent activity; however, the City favors a combination of mechanical and chemical cleaning over mechanical-only cleaning. Therefore, this criterion received a relatively high weighting of 4. Trojan's TrojanUVSigna™ system is the only system to use automatic, in-situ chemical cleaning; in the other systems, manual cleaning with chemicals requires removal of the modules from the channel.

- **Ease of wiper replacement.** Wiper replacement is also a relatively infrequent activity, so it received the lowest weighting of 1.

- **Relative ability to provide responsive support after startup.** This criterion received a moderate weighting of 3 and reflects the quality of both the manufacturer's and its local or regional representative's support.

- **Relative availability of spare parts.** This criterion received a low weighting of 2 because each manufacturer offers express delivery of spare parts. Calgon stated that replacement lamps were only available through Calgon and its distributors, and Trojan stated that the use of aftermarket lamps would void the system warranty.

- **Headloss impacts.** Because minimizing headloss is a goal of this project, this criterion received a high weighting of 4. Systems with the lowest headloss received the most favorable scores.

The results of the non-cost scoring are presented in **Table 6.** The complete non-cost scoring table is included in Appendix C as **Table C-2.** Trojan Technologies' TrojanUVSigna™ system received the lowest (most favorable) score due to its in-channel chemical cleaning capability, integral lifting equipment, and low headloss.

Table 6 Summary of Non-Cost Scoring

Parameter	Calgon Carbon C500™ D	Ozonia North America Aquaray® 3X	Trojan Technologies TrojanUVSigna™	WEDECO Duron 6012-2.5x2
Raw Non-Cost Evaluation Score (out of 110 points)	66	55	22	56
Rank	4	2	1	3

Final Scoring & Discussion

Table 7 presents the calculation of the final Total Score for each UV disinfection system. The method by which the Total Score was calculated is described below.

- The cost score and the non-cost score each received equal weighting of 50 percent. This equal weighting indicates that each UV system's non-cost attributes carry equal importance compared to its capital, operating and maintenance costs.
- The Raw Cost Score for a UV system is its NPC as a percent of the highest of the four systems' NPCs, multiplied by 100. This Raw Cost Score was then multiplied by the 50 percent weighting factor to yield the Weighted Cost Score.
- Because the Raw Non-Cost Score from Table C-2 is on a scale of 0 to 110 points, it was first normalized to a 0- to 100-point scale, then multiplied by the 50 percent weighting factor to obtain the Weighted Non-Cost Score.
- The Total Score is the sum of the Weighted Cost Score and the Weighted Non-Cost Score and is expressed on a scale of 0 to 100 points. The lowest Total Score indicates a preferred UV disinfection system.

Table 7 Final Scoring of UV Disinfection Systems

Parameter	Calgon Carbon C 500™ D	Ozonia North America Aquaray® 3X	Trojan Technologies TrojanUVSignal™	WEDECO Duron 6012-2.5x2
Calculation of Weighted Cost Score				
Total NPC	$3,887,000	$2,425,000	$3,324,000	$2,301,000
Percent of Highest NPC	100.0%	62.4%	85.5%	59.2%
Raw Cost Score (0 to 100 points)	100.0	62.4	85.5	59.2
Weighted Cost Score (50% of Total Score)	*50.0*	*31.2*	*42.8*	*29.6*
Calculation of Weighted Non-Cost Score				
Raw Non-Cost Score (0 to 110 points)	66	55	22	56
Normalized Non-Cost Score (0 to 100 points)	60.0	50.0	20.0	50.9
Weighted Non-Cost Score (50% of Total Score)	*30.0*	*25.0*	*10.0*	*25.5*
Calculation of Total Score				
Total Score (0 to 100 points)	***80.0***	***56.2***	***52.8***	***55.1***
Rank	4	3	1	2

Trojan, Ozonia and WEDECO received the lowest (best) total scores of the four manufacturers. The relatively small separation of their total scores indicates that these systems offer the City a good combination of pricing, reliability, and serviceability. However, the City and CDM Smith decided to

remove the WEDECO Duron system from consideration due to its high headloss and the tight hydraulics that are anticipated in this retrofit design.

In addition to the final scoring in Table 7, information gathered during site visits, conducted in order to inspect installations of two UV systems, and interviews with plant staff were incorporated into the final selection.

- City staff visited a TrojanUVSigna™ system at the H.C. Morgan WWTP in Auburn, Alabama. The staff was generally impressed with the installation, including the UV modules' combination mechanical/chemical cleaning system.
- City and CDM Smith staff visited the City of Madison WWTP in Madison, Alabama, in order to familiarize themselves with the operation and maintenance of the Ozonia Aquaray® 3X system. Because this facility does not have filters upstream of the UV system, algae that dislodges from final clarifier launders causes the UV module wiper plates to bind. City staff liked the canopy above the facility, as well as the traveling bridge crane used to raise and lower the UV modules.
- City staff conducted telephone interviews with facility staff from two WWTPs with CDM Smith-designed Ozonia Aquaray® 3X systems. One client gave a very positive reference but noted that UV lamp life was reduced; however, this reduction in lamp life did not appear to be caused by Ozonia's design. The second client has a facility that is similar in configuration to the Madison WWTP, with no filtration upstream of the UV system. Consequently, this client has similar problems with binding of the wiper plates.

Based on the TrojanUVSigna™ system's first-place ranking in the final scoring, as well as City staff's preference for the system, CDM Smith recommends that the City select the TrojanUVSigna™ system for design and installation.

Summary & Recommendation

After developing an RFP for the City's new UV system, CDM Smith conducted an evaluation of four UV manufacturers' proposals for the Franklin WRF Modifications & Expansion Project. This evaluation compared each UV system on the basis of its 20-year NPC and non-cost criteria scoring. The combined cost and non-cost scoring showed that the proposed systems by Ozonia North America, LLC, and Trojan Technologies both offer a good combination of pricing, reliability, and serviceability. City staff expressed a preference for the operational simplicity of the Trojan Technologies TrojanUVSigna™ system, which placed first in the final scoring of systems.

CDM Smith recommends that the City select Trojan Technologies' TrojanUVSigna™ UV disinfection system for the Modifications and Expansion Project at the Franklin WRF. CDM Smith also recommends that the City negotiate with Trojan Technologies to obtain the best pricing for both equipment capital as well as replacement parts costs. The costs of replacement parts should be tied

to a price index in order to guarantee long-term pricing for these O&M items, which represent a substantial fraction of the project cost.

Attachments:

Appendix A – RFP & Addenda
Appendix B – Manufacturer Proposals, RFIs & Additional Information
Appendix C – NPC & Non-Cost Scoring Tables

cc: Katherine Bell, CDM Smith
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Project File