

November 21, 2016

City of Hollywood  
Department of Public Utilities  
P. O. Box 229045  
Hollywood, FL 33022-9045

Attention: Steve Joseph, PE

Subject: Automation and SCADA Improvements for Optimization of the SRWWTP  
Oxygenation, Chlorination, and Pumping Systems

Thank you for the opportunity to develop this scope of work (SOW) to support the City of Hollywood's (City) Department of Public Utilities with the development of automation and SCADA improvements for the optimization of the Southern Regional Wastewater Treatment Plant's (SRWWTP) unit processes. The SOW presented below comprises the tasks that should be performed to optimize the operations of the Oxygenation, Chlorination and Pumping Systems unit processes through automation and additional SCADA improvements.

## **BACKGROUND**

The SRWWTP's Oxygenation, Chlorination, and Pumping Systems are comprised of several large and complex processes, including influent distribution and flow splitting, high purity oxygen aeration, oxygen generation plant, Return Activated Sludge (RAS) pump stations, chlorination facility, and effluent pumping. Most of this equipment is currently controlled manually by Operations professionals, as the existing SCADA system within the unit processes lacks the necessary level of automation to monitor and control the processes from a Human Machine Interface (HMI) in the control room. This lack of automation limits the level of efficiency that could be achieved during the operation of these unit processes. As a result, the City has identified as the operational efficiency goal of increasing the level of automation at these unit processes to allow for automatic or semi-automatic control from the HMI in the control room.

The SRWWTP is a wastewater treatment facility permitted at 55.5 MGD and includes an on-site oxygen generation facility for the operation of a pure oxygen-activated sludge process for treatment. The SRWWTP is divided into two sections, East and West, both of which are capable of operating independently. The Oxygenation, Chlorination, and Pumping Systems within the SRWWTP include an influent distribution box with appurtenances, an Oxygen Generation Plant, five oxygenation trains, eight clarifiers, four RAS pump stations, six chlorinators, three evaporators, two chlorine residual analyzers, and four effluent pumps (two effluent pumps with two backup diesel pumps). These systems consist of the following seven Programmable Logic Controllers (PLCs):

- PLC 3 – Chlorine Facility
- PLC 6 – Effluent Pump Station
- PLC 8 – RAS Pump Station 2
- PLC 9 – RAS Pump Station 3
- PLC 10 – Influent Distribution Box and Oxygenation Trains
- PLC 15 – RAS Pump Station 4
- Siemens PLC – Oxygen Generation Plant

The SCADA system within these processes that is part of Phase I for this SOW is comprised of the following:

Oxygen Generation Plant (Package PLC/HMI provided by vendor Air Products)

- PLC and HMI package used is Siemens SIMATIC PCS7 Distributed Control System (DCS) on one standalone computer. The PCS7 DCS integrates the development and runtime of a Siemens S7 PLC and Siemens WinCC HMI.
- The City has completed successful testing to determine if the iFix IGS driver is able to read values from Siemens S7 PLC. The iFix is currently polling 805 tags in the Siemens S7 PLC.
- The City requires a replication of all WinCC graphics, control, trends, alarms, and history on the GE iFix system, including eight overview screens and detailed control and status popups.
- The City does not require any PLC changes or any HMI changes from the original application.
- The City has verified that the computer running Siemens WinCC does not contain any control algorithms or logic that needs to be replicated in the GE iFix HMI.

Effluent Pump Station (PLC 6 I/O)

- Two 800-hp pumps with VFDs.
- Two automated gravity valves.
- Two backup diesel pumps.
- Equipment and instrumentation, including flow meters, pressure indicators, level indicators, diesel pump controllers, and electric pump variable speed drive controllers.

### Chlorine Facility (PLC 3 I/O)

- Three recirculation water pumps.
- Three caustic soda pumps.
- Caustic soda storage tank.
- A total of ten chlorinators, six of them are operational.
- Eight chlorine sensors.
- Three evaporators.
- Two chlorine residual analyzers.
- One ventilation blowers.
- Two emergency scrubbers and two scrubber blowers.
- Four scales.
- Equipment and instrumentation, including chlorine scale supply pressure indicators, chlorine supply weight indicators, level indicators, pressure indicators, power indicators, and temperature indicators for the evaporators; pressure indicators and flow indicators for the chlorinators; potable water booster pump pressure indicator, caustic soda storage tank level indicators, caustic feed pump variable speed controllers, scrubber recirculation pump pressure indicators, chlorine scrubber pH indicator, effluent chlorine residual indicator and flow meter.

Black & Veatch recommends that this project be completed in two phases, combining unit processes based on the logic to work on the PLCs that will result in minimum impact to operations. The two phases include:

- Phase I: Oxygen Generation Plant, Chlorine Facility (PLC 3), and Effluent Pump Station (PLC 6)
- Phase II: Influent Distribution Box and Oxygenation Trains (PLC 10), RAS Pump Station 2 (PLC 8), RAS Pump Station 3 (PLC 9) and RAS Pump Station 4 (PLC 15)

During Phase I, Black & Veatch will work on data gathering, programming and commissioning to replicate the Siemens PLC and HMI for the Oxygen Generation Plant. At the same time, Black & Veatch will work on data gathering and review, development of control strategies, programming, commissioning, and training to Operations staff for PLC 3 (Chlorine Facility) and PLC 6 (Effluent Pump Station). Phase II, which is not included as part of this SOW, but will be implemented upon completion of Phase I, per discussions with the City) will focus on the Influent Distribution Box and Oxygenation Trains (PLC 10) and RAS Pump Stations (PLCs 8, 9,

and 15), including improvements to RAS Pump Stations 1 – 4. Additional information on Phase I is provided below.

***Phase I – Oxygen Generation Plant, Chlorine Facility (PLC 3), and Effluent Pump Station (PLC 6)***

***Task 100 – Data Gathering and Review and Field I/O List Verification***

1. **Data Gathering and Review.** Black & Veatch will review the previous iFix HMI application and the Siemens DCS system relevant to the Oxygen Generation Plant, and additional information provided by the City. As part of the review, Black & Veatch will do onsite testing.
2. Black & Veatch will review the existing Chlorine Facility and Effluent Pump Station PLC panels and field I/O documentation, PLC communications network drawings, and electrical diagrams of the process equipment provided by the ICE Manager to determine the configuration and functionality of the existing systems. As part of the review, Black & Veatch will export the iFix HMI tags and PLC I/O configuration program and compare this to the existing drawings.

A draft I/O list will be created based on the information provided by the City. The City has indicated that the existing drawings and programming applications are not as-built and will need to be field verified.

3. **Field I/O List Verification.** Black & Veatch will provide one engineer to field verify (for a maximum of four business days) the existing I/O in PLCs 3 and 6. Using the draft I/O list developed during Task 1, each field I/O signal terminated in the PLC panel will be identified and verified that it is working properly. The deliverable of this effort will be an updated I/O list for each PLC. The City will provide one technician to assist the engineer during the I/O field verification.

Black & Veatch will coordinate with ICE Manager to gain an understanding of the drawings, PLCs, field instrumentation and equipment. In addition, Black & Veatch will coordinate with the ICE Manager to update the existing SCADA system network architecture drawings to reflect current conditions. Black & Veatch will scan the City's existing PLC panel drawings to PDF, if not already in PDF format, and red-lined mark-ups of the PDFs will be provided as part of this work. No AutoCAD panel drawings will be created; however, may be provided as supplemental services to this scope of work.

4. Following completion of the field investigations a working wrap-up meeting will be held with the ICE Manager and selected Operations staff to discuss findings, HMI and PLC standards and preferences, and identify outstanding issues.

Task 200 – Chlorine Feed System Upgrades Recommendations

1. Technical Memorandum. Based on information gathered in Task 100, Black & Veatch will develop a technical memorandum (TM) to include preliminary drawings (instrumentation, mechanical and/or other disciplines as necessary) recommending the modifications and/or upgrades to the City's chlorine feed system. The memorandum will provide recommendations to improve the following components:
  - a. Additional instrumentation or modifications to existing instrumentation for increased redundancy and reliability of the feed system.
  - b. Safety equipment, facility modifications, and if applicable procedural modifications to meet current industry safety standards.
  - c. Recommended chemical feed system materials and equipment upgrades (chlorine feed system components, piping, valves, etc.).

Control strategies for the Chlorine Facility will be based on the existing equipment, safety devices, operation and control functions and any new instruments, equipment, hardware modifications, wiring, or field modifications installed by the City based on the recommendations identified in the TM.

Task 300 – Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6) PLC and HMI Control Strategies

1. Operations Review. Black & Veatch will meet with the ICE Manager and selected Operations staff to coordinate access to equipment and review, from a control and automation perspective, the current operating procedures for the Chlorine Facility and Effluent Pump Station. A Black & Veatch instrumentation and controls engineer, process engineer, and operations specialist will visit the SRWWTP for a maximum of two business days. The team will document the City's operational procedures and processes associated with start-up, operations, and shutdown of the Chlorine Facility and Effluent Pump Station.
2. Based on information gathered in Task 1 above, Black & Veatch will develop control strategies and, if necessary, update the I/O listing for the Chlorine Facility and Effluent Pump Station that will serve as the basis for the PLC and HMI automation programming efforts described in Task 400 below.
3. A draft of the Chlorine Facility and Effluent Pump Station control strategies will be provided to the ICE Manager for review and comment. After a two-week review period, comments will be incorporated and the final Chlorine Facility and Effluent Pump Station control strategies will be prepared.

4. The Chlorine Facility and Effluent Pump Station control strategies will utilize the PLC and HMI standards and conventions developed under the Sludge Process Control System Automation and SCADA Improvements Project. Black & Veatch will update the Standards and Conventions document to incorporate any changes required for the Chlorine Facility and Effluent Pump Station.
5. Implementation of the control strategies in the PLCs and HMI may require control system equipment and hardware changes such as new PLC processors, PLC input/output cards, new instrumentation, network hardware, and communication cable. As an appendix to the Chlorine Facility and Effluent Pump Station control strategies, Black & Veatch will prepare a brief narrative description of the control system equipment and hardware improvements that are required. The appendix will also include an updated SCADA system network architecture drawing including these improvements. Detailed connection diagrams, updated PLC panel drawings, P&IDs and construction specifications are not included as part of this SOW. The City will be responsible for furnishing and installing all new PLC equipment, instrumentation and network improvements identified prior to the commissioning of the programming improvements.

Task 400 – Oxygen Generation Plant, Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6) PLC and HMI Programming

1. Black & Veatch will replicate, to the extent possible, the Siemens HMI for the Oxygen Generation Plant, including WinCC graphic displays, control, trends, alarms and history in the GE iFix system. The Siemens HMI may include features or functions that may not be exactly replicated using the standard features and functions of the GE iFix system. If there are instances of differences in functionality between the two softwares, Black & Veatch will work with the City to determine the most appropriate approach using standard iFix HMI features and functions.

The SOW does not include any changes to the existing Siemens PLC or HMI, or development of custom code in the GE iFix system to mimic features of the Siemens HMI software that are not standard in the GE iFix system.

2. Black & Veatch will re-program PLCs 3 and 6 based on the control strategies developed in Task 300.
3. Black & Veatch will provide new iFix graphic displays for the Chlorine Facility and Effluent Pump Station based on the control strategies developed in Task 300.
4. Black & Veatch will utilize iFix historian tools to map existing tag names to the new standard tag names to retain access to existing historical data.
5. Programming will include tagging updates to existing trends.

6. Programming will be based on the final I/O list developed in Task 100. An additional update to the I/O list requiring changes to the programming or iFix may be provided as a supplemental service to this scope of work.
7. Reports development will not be part of the Programming SOW. If desired by the City, Reports development may be provided as supplemental services.

Task 500 – Oxygen Generation Plant, Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6) PLC and HMI Commissioning

1. Black & Veatch will import the Oxygen Generation System tag database, graphics, and I/O driver files into the existing iFix SCADA. The new iFix Oxygen Generation System graphics will be compared to and tested side-by-side with the Siemens DCS graphics running in parallel. Testing will include status, control, and alarming of each Oxygen Generation System graphic. It may not be possible to test every status, control point, or alarm due to testing being done on an operating facility. The City operations will assist during the commissioning.
2. PLC and HMI Commissioning will not commence until the City has installed any Chemical Facility and Effluent Pump Station equipment, hardware, and/or instrumentation improvements identified in Task 300, as necessary to implement the automation control strategies.
3. Black & Veatch, in a coordinated effort with ICE staff, will download the PLC programs developed in Task 400 and commission the I/O, database, graphic screens and control logic on a system by system basis, as defined herein.
4. City ICE staff will assist in loop checks, testing, startup and commissioning activities.
5. Commissioning activities will include final documentation and correction of punch list items.
6. The level of effort for the Commissioning activities considers the following:
  - a. Fifteen business days for PLC 3, including HMI displays.
  - b. Ten business days for PLC 6, including HMI displays.
  - c. Six business days for the Oxygen Generation Plant Siemens HMI to iFix (two site visits, three days per site visit).

Task 600 – Operations Staff Training

Black & Veatch will provide an operations specialist to develop and conduct system training sessions for the City's O&M staff. The training sessions will focus on the system design, control

and automation concepts for the SCADA system and treatment processes identified in the SOW. Two sessions, of up to two hours each, will be provided for each major process system. Training will be provided as follows:

1. A training document will be prepared and distributed for each session. The document will be comprised of a PowerPoint, control and automation information topics, and drawings. An electronic (PDF) version of the PowerPoint presentation will be provided.
2. Training will include a discussion of the principles of operation, process troubleshooting, and trending.
3. Training will be conducted at the SRWWTP site.

Hands-on-training will be provided with individual operators while on site during the training. A Black & Veatch operations specialist will be available to work with Operations staff at the workstation in the control room to assist operators in understanding the new automation and control system.

Level of effort on site is two business days for HMI & PLC training of City Operations and Maintenance staff.

#### **WORK TO BE PERFORMED BY THE CITY**

1. If there are instances of differences in functionality between the Siemens HMI for the Oxygen Generation Plant and the GE iFix, the City will work with Black & Veatch to determine the most appropriate approach using standard iFix HMI features and functions.
2. The City will provide PLC panel and field I/O documentation, PLC communications network drawings, and electrical diagrams of the process equipment.
3. The City will provide one technician to assist the field engineer during the I/O field verification.
4. The City's ICE Manager will review the control strategies and standard operating procedures developed and provide comments to Black & Veatch.
5. The City will be responsible for furnishing and installing all new PLC equipment, instrumentation and network improvements identified prior to the commissioning of the programming improvements. Improvements also include the equipment, safety devices, operation and control functions and any new instruments, equipment, hardware modifications, wiring, or field modifications identified in the Chlorine Feed System Upgrades Recommendations.



6. PLC and HMI Commissioning will not commence until the City has installed any equipment, hardware and instrumentation improvements necessary to implement the automation control strategies.
7. City ICE staff will assist in loop checks, testing, startup and commissioning activities, including the Oxygen Generation Plant.
8. City will provide access to Oxygenation, Chlorination, and Pumping Systems equipment during commissioning and make temporary provisions including manual control, temporary wiring, temporary networks, etc., to maintain plant operations during commissioning.
9. City will make ICE staff available to participate in the operations training.

#### **SUPPLEMENTAL SERVICES**

The following items are not included in this SOW and can be provided as supplemental services to this Task Order.

1. Implementation of Phase II, which will commence upon completion of Phase I and approval of the SOW by the City.
2. Preparation of AutoCAD panel drawings.
3. Programming will be based on the final I/O lists developed. Additional programming or iFix as a result of additional updates to the final I/O list.
4. Additional updates to the final I/O list developed under this SOW.
5. Replication in the GE iFix HMI of control algorithms or logic for the computer running Siemens WinCC.
6. Changes to the existing Siemens PLC or HMI, or development of custom code in the GE iFix system to mimic features of the Siemens HMI software that are not standard in the GE iFix system.
7. Reports development.

## PROJECT SCHEDULE

Black & Veatch will perform the services in accordance with the following schedule:

Task Series	Task Description	Schedule
<b>PHASE I – Oxygen Generation Plant, Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6)</b>		
Task 100	Data Gathering and Review and Field I/O List Verification	To be completed 6 weeks after Kick-off Meeting
Task 200	Chlorine Feed System Upgrades Recommendations	To be completed 2 weeks after Task 100
Task 300	Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6) PLC and HMI Control Strategies	To be completed 6 weeks after Task 200
Task 400	Oxygen Generation Plant, Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6) PLC and HMI Programming	To be Completed 16 weeks after Task 300
Task 500	Oxygen Generation Plant, Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6) PLC and HMI Commissioning	To be Completed 10 weeks after Task 400
Task 600	Operations Staff Training	To be completed 2 weeks after Task 500
<b>Total Project Duration</b>		<b>42 weeks</b>

We estimate that project execution for Phase I should not exceed 42 weeks after Kickoff Meeting. We will work closely with the City to minimize project duration and impact to SRWWTP operations as much as practical.

## PROJECT COST

The level of effort for the described SOW is a lump sum amount of \$299,973.00, as detailed in the table below. Monthly invoices that will be submitted to the City based on project progress.

Task	Cost
<b>PHASE I – Oxygen Generation Plant, Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6)</b>	
Task 100: Data Gathering, Review and Field I/O List Verification	\$23,740.00
Task 200: Chlorine Feed System Upgrades Recommendations	\$13,560.00
Task 300: Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6) PLC and HMI Control Strategies	\$34,023.00
Task 400: Oxygen Generation Plant, Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6) PLC and HMI Programming	\$145,930.00
Task 500: Oxygen Generation Plant, Chlorine Facility and Effluent Pump Station (PLC 6) PLC and HMI Commissioning	\$67,060.00
Task 600: Operations Staff Training	\$15,660.00
<b>Total Phase I</b>	<b>\$299,973.00</b>

We look forward to the opportunity to continue to assist the City with this innovative and important project. Please, feel free to contact me with any questions at (954) 465-6872.

Very truly yours,

BLACK & VEATCH CORPORATION



Rafael E. Frias III, PE  
Client Director

cc: Francois Domond, PE  
Juan Reyes

City of Hollywood, FL  
Automation and SCADA Improvements for Optimization of the SRWTP Oxygenation, Chlorination, and Pumping Systems  
Level of Effort Estimate - Phase I



Task Description	Project Director	Project Manager	Engineering Manager	Sr. Technical Specialist	National Practice Leader	Technical Specialist	Project Engineer	Sr. Engineer II	Sr. Engineering Technician	Senior Administrator	Subs and Expenses			Totals		
											Reproduction	Mark-up	Total	Hours	Cost	
<b>Phase I – Oxygen Generation Plant, Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6)</b>																
<b>Task 100</b>	<b>Data Gathering and Review and Field I/O List Verification</b>															
100	2	4	4	8	4	4	4	80	40	4			\$0.00	\$0.00	154	\$23,740.00
	2	4	4	8	4	4	4	80	40	4			\$0.00	\$0.00	154	\$23,740.00
<b>Task 200</b>	<b>Chlorine Feed System Upgrades and Recommendations</b>															
200		4	8					64	8	4			\$0.00	\$0.00	88	\$13,560.00
	0	4	8	0	0	0	0	64	8	4			\$0.00	\$0.00	88	\$13,560.00
<b>Task 300</b>	<b>Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6) PLC and HMI Control Strategies</b>															
300	8	8	24	48	4	16	12	60		12			\$130.00	\$13.00	192	\$34,023.00
	8	8	24	48	4	16	12	60	0	12			\$130.00	\$13.00	192	\$34,023.00
<b>Task 400</b>	<b>Oxygen Generation Plant, Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6) PLC and HMI Programming</b>															
400		8	16		8	440	434						\$0.00	\$0.00	906	\$145,930.00
	0	8	16	0	8	440	434	0	0	0			\$0.00	\$0.00	906	\$145,930.00
<b>Task 500</b>	<b>Oxygen Generation Plant, Chlorine Facility (PLC 3) and Effluent Pump Station (PLC 6) PLC and HMI Commissioning</b>															
500		8	24		8	248	92						\$0.00	\$0.00	380	\$67,060.00
	0	8	24	0	8	248	92	0	0	0			\$0.00	\$0.00	380	\$67,060.00
<b>Task 600</b>	<b>Operations Staff Training</b>															
600	2	4	4	36		24	8			2			\$200.00	\$20.00	80	\$15,660.00
	2	4	4	36	0	24	8	0	0	2			\$200.00	\$20.00	80	\$15,660.00
<b>Phase I Totals</b>	12	36	80	92	24	732	550	204	48	22			\$330.00	\$33.00	1,800	\$299,973.00
	Hourly Rates															
	\$250.00	\$170.00	\$165.00	\$215.00	\$235.00	\$195.00	\$125.00	\$160.00	\$120.00	\$90.00						
<b>Phase I Totals</b>	\$3,000.00	\$6,120.00	\$13,200.00	\$19,780.00	\$5,640.00	\$142,740.00	\$68,750.00	\$32,640.00	\$5,760.00	\$1,980.00			\$363.00		1,800	\$299,973.00