

# ENGINEERING SERVICES INC.

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August 16, 2017

Ms. Jacqueline Trotta  
Enforcement Analyst  
Office of Water Quality, Enforcement Branch  
Arkansas Department of Environmental Quality  
5301 Northshore Drive  
North Little Rock, AR 72118-5317

RE: Evaluation Report  
UV Disinfection System  
City of Berryville  
Carroll County, Arkansas

Dear Ms. Trotta:

Enclosed, for your review, is one (1) copy of our Evaluation Report for the UV Disinfection system installed at the Wastewater Treatment Facility owned by the City of Berryville, Arkansas and operated by CH2M. At this time, we do not believe that a Corrective Action Plan is necessary.

If you have any questions or need additional information, please do not hesitate to contact this office.

Sincerely,



Jeffrey K. Dehnhardt, P.E.  
Project Engineer

Enclosure (Evaluation Report)

Cc: Honorable Tim McKinney, Mayor, City of Berryville, Arkansas  
Tim Luther, Operations Manager, CH2M  
Mayo Miller, Project Manager, CH2M

# *EVALUATION REPORT*

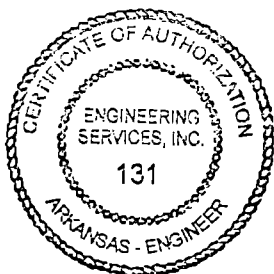
*FOR*

*UV DISINFECTION FACILITIES*

*FOR THE*

*CITY OF BERRYVILLE WWTP  
CARROLL COUNTY, ARKANSAS*

*AUGUST 2017*



***EVALUATION REPORT***

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# 1. GENERAL OVERVIEW

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## INTRODUCTION

Engineering Services, Inc. has prepared this Evaluation Report on behalf of the City of Berryville and its contract operator of the City's wastewater treatment plant (WWTP), CH2M, for the purpose of determining whether WWTP operational procedures are deficient and/or whether a Corrective Action Plan (CAP) is necessary to address issues related to discharges of partially treated effluent resulting from failures of the Ultraviolet (UV) Disinfection System installed at the WWTP.

This Evaluation Report was prepared at the request of the Water Division Enforcement Branch of the Arkansas Department of Environmental Quality (ADEQ). The Evaluation Report includes a brief history of and general background information about the UV Disinfection System deficiencies.

## **2. BACKGROUND AND EVALUATION**

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### **BACKGROUND**

The City of Berryville's WWTP utilizes ultraviolet (UV) radiation in order to disinfect its treated effluent prior to discharge. The system installed to perform this task is a Model Tak 55 as manufactured by Wedeco. Wedeco is a subsidiary of its parent company Xylem. The existing UV Disinfection System has been installed at the Berryville WWTP since 2003 making it approximately 14 years old. Maximum useable lifespan for this type of equipment is typically estimated to be 20 years. However, longevity of any piece of equipment is directly related to the care with which it is operated and maintained.

The City of Berryville's WWTP has reported several incidents related to its UV Disinfection system recently. Since 2015, six (6) incidents have been recorded where the UV Disinfection system has failed. These failures include discharges of partially treated effluent with a total estimated volume of 1,320,000 gallons. A copy of the letter received by the City of Berryville from ADEQ summarizing these incidents is included under Appendix A.

Each time there has been a failure, the CH2M operational staff have taken action to correct the issues. However, ADEQ has noted that there has been a pattern of repeated issues with this particular unit process. Figure 2.1 below summarizes the failures and includes volumes of discharge and corrective action associated with each of the reported events since July of 2015.

In total, four (4) of the incidents have been related to issues associated with the Control Center, one (1) incident was related to a mechanical failure of equipment, and one (1) incident was related to a lightning strike. Of the four (4) incidents associated with the Control Center, three (3) were associated with the air conditioning units designed to keep the control panels cool and within acceptable operating temperatures.

**FIGURE 2.1 SUMMARY OF INCIDENT REPORTS, JULY 2015 – JULY 2017**

Date	UV Downtime	Total Gallons Discharged w/o Disinfection	Cause	Correction
7/21/2015	7 Hours	517,000 Gallons	One of the two A/C units that cool the electrical cabinet failed. The UV system overheated and shutdown for safety.	Replaced the failed A/C unit.
3/24/2016	6 Hours 35 Min	591,600 Gallons	Relay failed and shutdown system.	Replaced the relay.
4/16/2017	90 minutes	12,600 Gallons	Bushing on the discharge gate actuator stripped and would not rate the gate and flows decreased, thus exposing the UV bulbs and the system shutdown for safety.	Replaced the bushing on the gate actuator.
7/2/2017	51 minutes	72,433 Gallons	Storm event and lightning strike shutdown multiple pieces of equipment, including the UV system.	Reset the UV system.
7/5/2017	88 minutes	128,034 Gallons	Fuse for the second (two of two) A/C units failed causing the system to overheat and shut down for safety.	Replaced the fuse and the system resumed disinfection. Also ordered a replacement A/C unit as a safety precaution.
7/14/2017	18 minutes	14,670 Gallons	A/C unit two of two failed and caused the system to overheat.	The A/C unit was replaced on 7/17/17 as soon as the replacement parts arrived. A/C placed online and operational.

**FIELD EVALUATION**

At the request of the City of Berryville and CH2M, Mr. Tim Mays, P.E. and Mr. Jeffrey K. Dehnhardt, P.E. of Engineering Services, Inc. performed a site visit on July 21, 2017. The purpose of the field visit was to perform a field evaluation of the UV Disinfection units, and to



verify that all appropriate operational procedures were being followed. During the field evaluation, Engineering Services, Inc. representatives were accompanied by Mr. Mayo Miller, Project Manager for CH2M and Mr. Mike Maynard, also with CH2M.

All aspects of the UV System were reviewed, and the operational staff was interviewed about the historical operation of the equipment, its strengths and weaknesses, and the operational procedures used by CH2M staff.

#### Disinfection Basin

Disinfection at the Berryville WWTP takes place in a concrete channel which houses two separate banks of horizontally installed ultraviolet bulbs. Each bank contains four (4) modules of ten (10) bulbs, for a total of 40 bulbs. With two banks installed and operational, there are 80 bulbs in service. When in operation, the bulbs must stay submerged; otherwise there is risk of overheating resulting in bulb burnout.

Liquid level in the channel is controlled by an adjustable weir gate located at the downstream end of the channel. An ultrasonic level transmitter located in the channel reads the water surface elevation. A programmable logic controller (PLC) located at the control center receives the signal from the ultrasonic level transmitter and determines whether the liquid level needs adjustment. When the liquid level begins to rise or fall as a result of diurnal flow patterns at the WWTP, the PLC sends a signal to the weir gate actuator which automatically modulates the weir gate so that a constant liquid level is maintained. One of the bushings connecting the gate operator to the weir gate stem stripped in April of 2017 resulting in one of the reported violations.

Overall, the equipment in the Disinfection Basin appeared to be in good condition. During the field evaluation, all equipment was operational including the weir gate. When questioned about the equipment, the operational staff was generally pleased with the operation of the equipment installed in the disinfection basin. However, advancements have been made in recent years that do make the installed system somewhat obsolete and inefficient. For example, the installed unit does not have the capability to power down individual rows of bulbs within a bank, so, when changing a bulb, the entire bank must be shut down and taken off line. The banks are fairly heavy; it takes two staff members to perform this task. Each bank must be lifted from the channel by way of a manually operated davit type hoist. Additionally, UV Disinfection Systems are often housed inside a building to protect the units themselves as well as to protect the workers from the elements while they perform routine maintenance on the equipment.

### Control Center

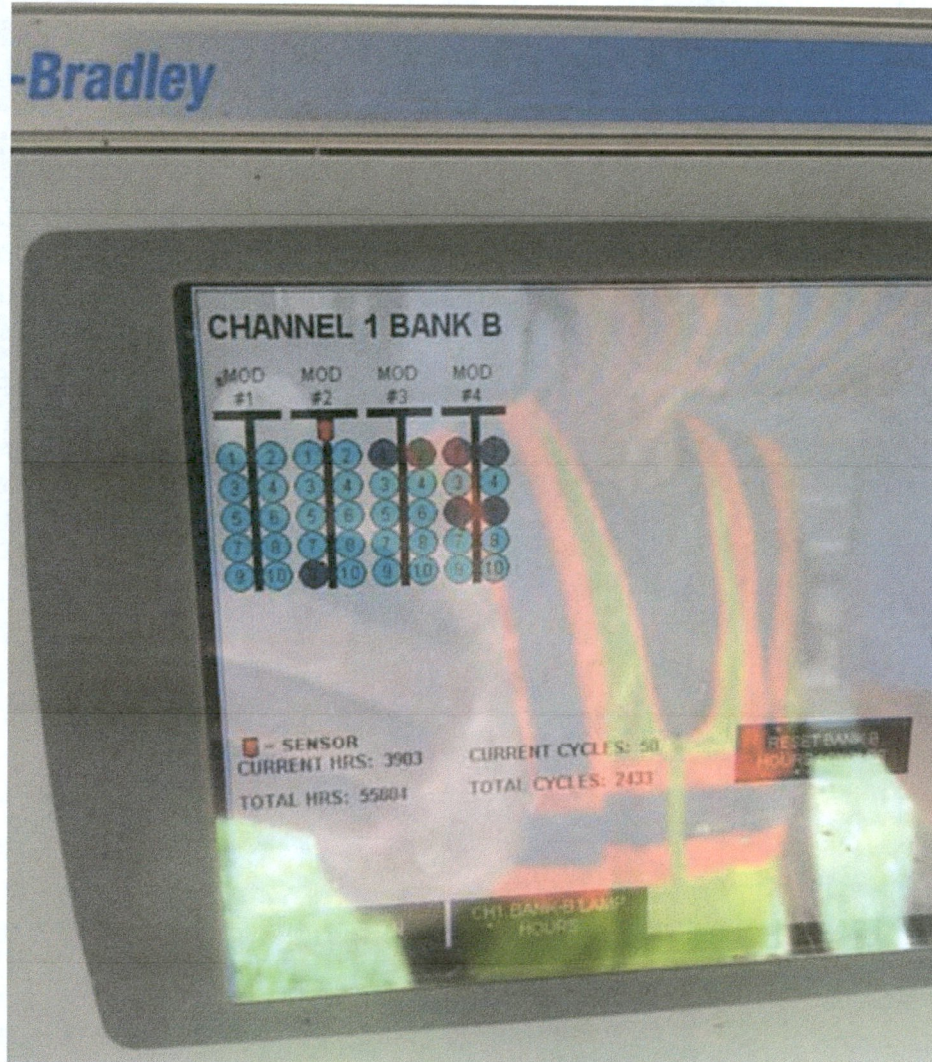
The Control Center for the Berryville WWTP UV Disinfection System is located adjacent to the disinfection basin and consists of a series of three control panels installed outdoor on a concrete pad and covered by metal carport type structure with metal siding. The central panel houses the PLC and various relays that control the operation of the system. The panels on either side primarily house the ballasts for the bulbs installed in each bank located in the Disinfection Basin. During normal operations, the electrical and controls equipment generates heat. Therefore, two (2) air conditioning units have been installed to maintain the temperature inside the panels within the proper operating range. Pictures of the Control Center cabinets and electrical/controls equipment are shown in Figures 2.2 through 2.5.

**FIGURE 2.2 PLC USER INTERFACE**





FIGURE 2.3 PLC USER INTERFACE – BANK B STATUS



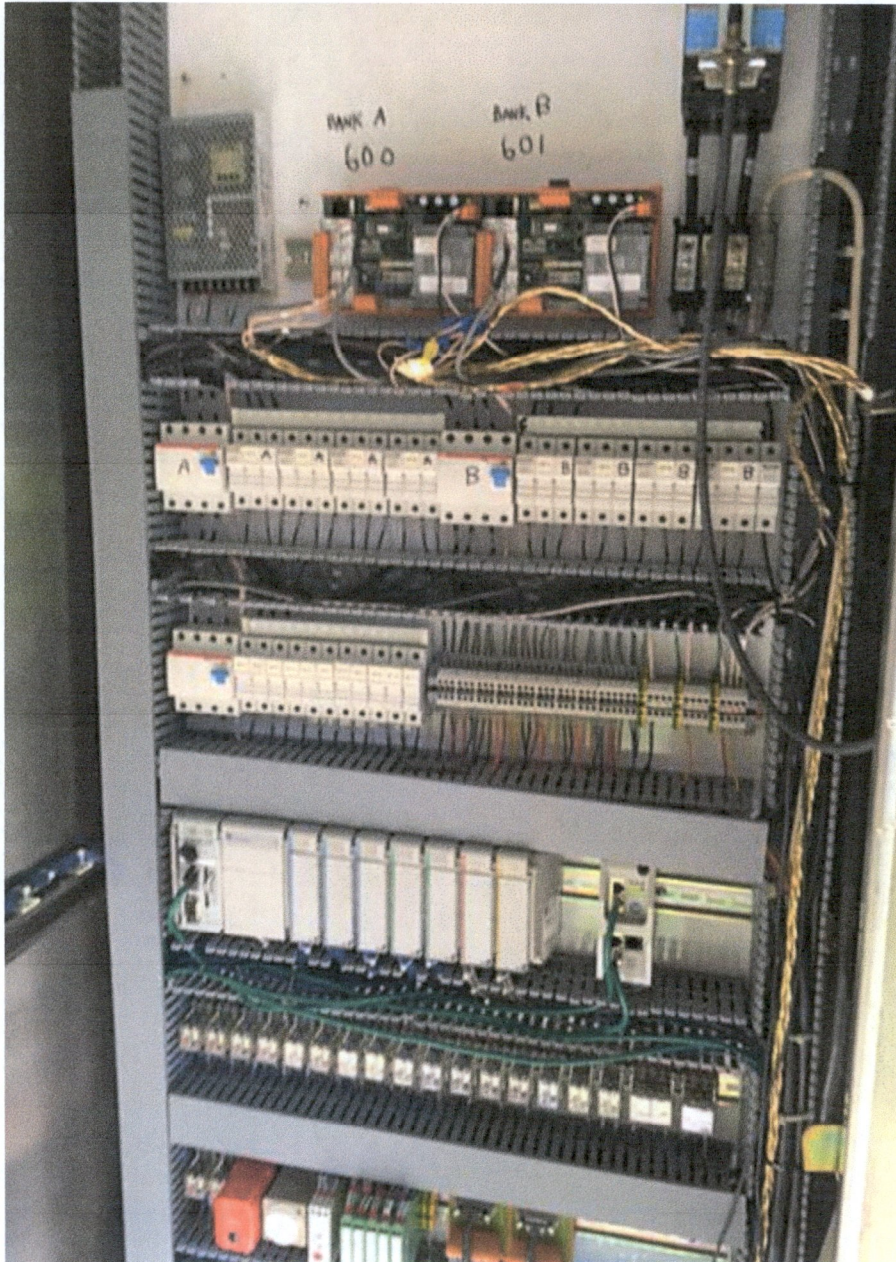


**FIGURE 2.4 CONTROL CENTER – BALLAST CABINET**





**FIGURE 2.5 CONTROL CENTER – PLC CABINET**



Overall, the electrical and controls equipment installed in the Control Center appeared to be in good condition. During the field evaluation, the controls appeared to be working satisfactorily. Again, much like the Disinfection Basin equipment, the Control Center is somewhat outdated with more modern control capabilities available in newer installations. One of the primary issues is the lack of flexibility in the PLC. The CH2M staff is unable to make any modifications to the underlying software. The manufacturer's representative must come out whenever there are changes that need to be made. Furthermore, while the air conditioning units appeared to have been functioning well during the field evaluation, it is apparent that modifications could be made

to improve the panel cooling system. The central panel that houses the PLC is not directly cooled. Instead, small openings in the bottom of the interior side walls of the central cabinet allow the cooled air from either side to circulate through. This could be modified to allow for an increased amount of cool air to be directly furnished to the PLC cabinet.

Additionally, it is unusual for a Control Center of this nature to be installed in an exterior situation. Ideally, these panels would be located inside a climate controlled building. This would mitigate some of the panel overheating issues as the ambient temperature inside a climate controlled building would be much more ideal for operations. Furthermore, a controls building would help protect the equipment as well as the workers from the elements, especially while they maintenance on the equipment is being performed. Eliminating the possibility of CH2M staff working on electrical components while exposed to rain would certainly be a safety improvement. Finally, a controls building would help to protect the panels from flooding during heavy rainfall events. Major damage to the controls components could occur if the cabinets were to flood.

#### Operational Procedures

As previously discussed, operations of the Berryville WWTP are performed on a contract basis by CH2M. CH2M is known for its expertise in WWTP operations, nationwide. Multiple cities in the northwest Arkansas area employ CH2M for their WWTP operations. During the field evaluation, members of the CH2M staff were interviewed regarding typical maintenance routines as well as typical stores of reserve equipment and/or components. Overall, the maintenance routines and spare parts reserves were excellent. Work areas were well kept and no safety concerns were observed.

UV bulbs are being replaced in accordance with manufacture's guidelines regarding UV transmittance; half of the installed bulbs were less than one year old. Adequate stores of bulbs and ballasts were on hand.

CH2M has made provisions to ensure replacement parts are available for the mechanical and electrical component that have recently failed. There are multiple spare relays should there be another failure of the type that occurred on March 24, 2016. CH2M is currently holding two spare brass bushings to repair failures of the type that occurred on April 16, 2017. There are spare air conditioner parts on hand and a complete air conditioner unit on order in case of another failure of this sort.

### 3. RECOMMENDATIONS

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#### Disinfection Basin

There are no recommendations for immediate changes or alterations to the equipment installed in the Disinfection Basin. The existing equipment appears to be working well and should provide several more years of reliable service. However, as previously mentioned, advancements in technology have resulted in the obsolescing of the installed equipment, and the existing equipment is nearing the end of its useful life. More efficient technologies exist that provide operators the ability to control rows of bulbs, or even individual bulbs, rather than entire banks of bulbs. The City of Berryville might want to consider a replacement of this equipment sometime in the next 5-10 years.

#### Control Center

The control center appears to be working well, and does not require immediate replacement or modifications. However, there could be some changes made at the discretion of the operations staff that could improve performance of the control center.

The cooling system for the cabinets, while completely functional as is, could be bolstered to provide increased performance / redundancy. As previously discussed, the central cabinet which houses the PLC is not directly cooled. Instead, openings in the bottom of the side walls in the cabinet allow cooled air from either side cabinet to circulate through and cool the components located in the central cabinet. Improvements to this scheme could be made by installation of an additional air conditioning unit, some associated ductwork, and directly cool the central cabinet, or to install circulation fans inside the cabinets to improve air circulation.

Another alternative to consider which could improve performance would be to install a temperature probe in the central cabinet and provide a high temperature alarm. The recent issues associated with the air conditioning units lead to the panels overheating, which in turn causes the entire system to shut down as a preventative measure. A temperature probe with an alarm setting at a temperature that was warmer than normal operation, but cooler than shut down temperature could give the operational staff some advanced warning that a temperature-dependent shut down was imminent. The advanced warning could provide the operators the time necessary to correct the issue prior to a hard shut down, thus eliminating discharge of untreated effluent.

Finally, as with the equipment installed in the Disinfection Basin, the Control Center is nearing the end of its useful life. The City of Berryville might want to consider replacement of the Control Center, at the same time that the Disinfection Basin equipment is replaced, sometime in

the next 5-10 years. When replaced, consideration should be given to construction of a climate controlled building to house the Control Center.

Operational Procedure

There are no recommendations for changes or alterations to the operational procedures carried out by CH2M staff. The operations staff was very professional and devoted to maintaining the working condition of the UV Disinfection System as well as the rest of the Berryville WWTP. They appear to be ready to handle future maintenance tasks, including those that might happen unexpectedly. Scheduled maintenance appeared to be performed as required. Overall, the staff appeared to be very conscientious regarding maintenance, including but not limited to, cleanliness of work areas, timely replacement of UV bulbs, and checking electrical connections inside the control center cabinets.



## 4. CONCLUSIONS

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### SUMMARY OF CONCLUSIONS

- Equipment in the Disinfection Basin appears to be working well.
- No immediate changes to Disinfection Basin are recommended.
- Control Center appears to be working well.
- Operations Staff could perform Control Center upgrades, but not required to maintain existing performance.
- Both Equipment and Control Center are nearing end of useful life. City should consider replacement within the next 5-10 years.
- When upgrades are made, consider placing new Control Center inside a building.
- Current Operational Procedures observed at the WWTP are very good. No changes recommended at this time.
- Corrective Action Plan (CAP) not recommended at this time.

**APPENDIX A**

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**ENGINEERING SERVICES, INC.**

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# ADEQ

ARKANSAS  
Department of Environmental Quality

July 5, 2017

Honorable Tim McKinney  
Mayor, City of Berryville  
P.O. Box 227  
Berryville, AR 72616

RE: NPDES Permit Number: AR0021792, AFIN08-00034  
Partially Treated Effluent Discharge Reports

Dear Mayor McKinney:

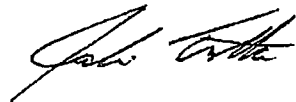
A review of the NPDES file for the above mentioned facility reveals the following compliance issues:

Since July 2015, the City of Berryville has reported 5 incident reports of partially treated effluent due to different events that led to failures of the UV system being discharged totaling over 1,320,000 gallons. The reports stated that corrective actions were performed to correct each issue. However, due to repeated occurrences of partially treated effluent being discharged due to UV system shutdowns, the Department recommends consulting with a professional engineer (PE) registered in the state of Arkansas for the purposes of evaluating the facility's operational procedures to determine if a Corrective Action Plan (CAP) is needed to address the discharges of partially treated effluent due to UV system failures. Please submit the evaluation report, certified by a PE, to the Department by **August 20, 2017**. If a CAP is needed, please include it with an expected date of compliance with the evaluation report.

Any violation of your NPDES Permit is subject to enforcement action by this Department, pursuant to the Arkansas Water and Air Pollution Control Act. The regulations and your NPDES Permit require that you take all reasonable measures necessary to eliminate or prevent the occurrence of violations.

Should you have any questions concerning the above referenced compliance issues, please feel free to contact me at 501-682-0632, or you may e-mail me at [trotta@adeq.state.ar.us](mailto:trotta@adeq.state.ar.us).

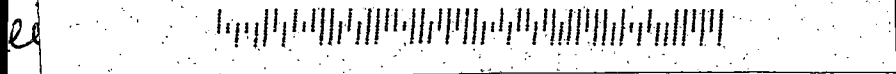
Sincerely,



Jacqueline Trotta  
Enforcement Analyst  
Office of Water Quality, Enforcement Branch

cc: Tim Luther, Operations Manager, CH2M  
Mayo Miller, Project Manager, CH2M

en Dehnhardt, P.L.



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