

April 2023

# Alternative Treatment Technology Report For Recycled Water

STATE WATER RESOURCES CONTROL BOARD  
DIVISION OF DRINKING WATER



STATE WATER RESOURCES CONTROL BOARD  
REGIONAL WATER QUALITY CONTROL BOARDS

# **Alternative Treatment Technology Report For Recycled Water**

**April 2023**

(Replaces September 2014 Report)

This document has been developed to serve as a reference for those seeking information concerning technologies that have been recognized by the Division of Drinking Water (DDW) as being conditionally acceptable for compliance with treatment requirements of the California Water Recycling Criteria (Title 22). This is a “living” document that will be updated as needed.

Note:

The DDW was formally called the California Department of Public Health (CDPH) from July 1, 2007 to July 1, 2014. Prior to July 1, 2007, DDW was called the California Department of Health Services (CDHS).

## Table of Contents

1.	Introduction .....	5
2.	Treatment Technology Conditional Acceptance Process .....	7
3.	Conditionally Accepted Alternative Filtration Technology .....	8
a.	Cloth Filters .....	9
1)	Alfa Laval Ashbrook Simon-Hartley – Iso-Disc .....	9
2)	Aqua-Aerobic Systems - MMK2-13 acrylic pile fabric .....	9
3)	Aqua-Aerobic Systems - NF-102 needle felt fabric .....	10
4)	Aqua-Aerobic Systems - PA-13 nylon pile fabric .....	11
5)	Aqua-Aerobic Systems - PES-13 woven polyester pile fabric.....	11
6)	Aqua-Aerobic Systems - PES-14 woven polyester pile fabric.....	12
7)	Evoqua Water Technologies – Forty X Disc Filter OTM 2 (OTM 2) .....	13
8)	Five Star Filtration – Cloth 1A-Yellow Jersey Knit Fabric.....	14
9)	Five Star Filtration – Cloth 2A-Yellow Jersey Knit Fabric.....	14
10)	I. Kruger - Hydrotech .....	15
11)	Nexom – Infini-D Zero-Downtime Disk Filter.....	16
12)	Nordic Water – Nordic Water Disc Filter .....	17
13)	Sanitaire a Xylem Brand – Drumfilter .....	18
14)	Siemens Water Technologies - Forty X .....	18
15)	Xylem Treatment - Leopold Ultrascreen Disk Filter® .....	19
b.	Non-Granular Media Filters .....	20
1)	Amiad - AMF Wastewater Filter .....	20
2)	Schreiber – Fuzzy Filter .....	21
3)	Schreiber – Compressible Media Filter .....	21
c.	Other Filters and Non-Polymeric Membrane Filters .....	22
1)	BKT – BioFiltration (BBF).....	22
2)	BKT – Tightened Fiber Filter (TFF).....	23
3)	Meiden – Ceramic Flat Sheet Membrane (CFM) .....	24
4)	Metawater – Ceramic Membrane.....	25
4.	Conditionally Accepted Alternative Disinfection Technology.....	25
a.	Free Chlorine Disinfection .....	26
1)	Brentwood WTP – Free Chlorine Disinfection.....	26
2)	Camrosa Water Reclamation Facility – Free Chlorine Disinfection.....	27
3)	Chumash Casino Resort Water Reclamation Facility – Free Chlorine Disinfection.....	27
4)	Inland Empire Utilities Agency (IEUA) – Free Chlorine Disinfection.....	28
5)	Lathrop Consolidated Treatment Facility – Free Chlorine Disinfection .....	28
6)	Padre Dam Municipal Water District – Free Chlorine Disinfection .....	29
7)	City of Riverside Regional Water Quality Control Plant – Free Chlorine Disinfection.....	30
8)	Sacramento Regional County Sanitation District (Regional San) – Free Chlorine Disinfection .....	30
9)	San Jose Creek East WRP – Sequential Chlorination .....	31

10)	San Jose-Santa Clara Regional Wastewater Facility (RWF) – Free Chlorine Disinfection.....	32
11)	Western Riverside County Regional Wastewater Authority (WRCRWA) WTP – Free Chlorine Disinfection .....	32
b.	Ozone and Ozone/Peroxide Disinfection .....	33
1)	APTwater - HiPOx™ .....	33
c.	Pasteurization Disinfection.....	33
1)	Pasteurization Technology Group - Pasteurization System .....	33
d.	Ultraviolet Disinfection (UV) .....	34
1)	AquaAzul – AZ-4000 UV System.....	36
2)	Aquaray - 3X HO.....	36
3)	Aquaray - 40 HO VLS .....	37
4)	Aquaray - 40 VLS.....	37
5)	Aquaray – AZ-4000 HiCAP UV Disinfection System.....	38
6)	Aquionics - 400+ .....	38
7)	Aquionics - 16000+ .....	39
8)	Aquionics - 18000+ .....	39
9)	De Nora Capital Controls (formerly Calgon) – C3 500D .....	40
10)	Enaqua - Enlight UV System 60 mm Tubes .....	40
11)	Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-6800-10.....	41
12)	Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-6800-14.....	41
13)	Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-8800-14.....	42
14)	Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-16800-20.....	42
15)	Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-20800-20.....	43
16)	Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-22800-24.....	43
17)	Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-30800-24.....	44
18)	Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-30800-30.....	45
19)	Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-45800-30.....	45
20)	NeoTec – Aqua D438™.....	46
21)	NeoTec – Open Channel NOL-HM.....	47
22)	Quay Technologies - OCS 6000 Microwave.....	47
23)	Trojan Technologies – TojanUVFit 04AL20.....	48
24)	Trojan Technologies – TojanUVFit 8AL20.....	48
25)	Trojan Technologies – TojanUVFit 18AL40.....	49
26)	Trojan Technologies – TojanUVFit 32AL50.....	50
27)	Trojan Technologies – TojanUVFit 72AL75.....	50
28)	Trojan Technologies – TojanUVFit D72AL75 .....	51

29)	Trojan Technologies – UV 3000 .....	52
30)	Trojan Technologies – UV 3000+ .....	52
31)	Trojan Technologies – UV 4000 .....	53
32)	Trojan Technologies – TrojanUVSignaTM.....	53
33)	Xylem Water Solutions Wedeco – LBX 90.....	54
34)	Xylem Water Solutions Wedeco – LBX 400.....	54
35)	Xylem Water Solutions Wedeco – LBX 850E .....	55
36)	Xylem Water Solutions Wedeco – LBX 1000.....	56
37)	Xylem Water Solutions Wedeco – LBX 1500E .....	56
38)	Xylem Water Solutions Wedeco – TAK-55 320W.....	57
39)	Xylem Water Solutions Wedeco – TAK-55HP .....	57
40)	Xylem Water Solutions – Wedeco Duron UV System.....	58

## 1. Introduction

The purpose of this report is to provide general information concerning those treatment technologies that are being utilized to meet the filtration performance and disinfection requirements for compliance with Title 22. The information contained herein was generated from a review of DDW files and correspondence; and discussions with Field Operations Branch District Staff, SWRCB Staff, industry representatives, and manufacturers. All referenced reports, letters, and documents are on file with the DDW Recycled Water Unit. This report may not reflect all treatment technologies in place in California, but will be updated as additional information is obtained. This report will serve as the basis for DDW review and conditional acceptance of treatment technologies regarding compliance with the filtration and disinfection requirements of Title 22.

Title 22 defines 'filtered wastewater' and 'disinfected tertiary recycled water' as:

### **§60301.320. Filtered wastewater.**

"Filtered wastewater" means an oxidized wastewater that meets the criteria in subsection (a) or (b):

- (a) Has been coagulated\* and passed through natural undisturbed soils or a bed of filter media pursuant to the following:
  - (1) At a rate that does not exceed 5 gallons per minute per square foot of surface area in mono, dual or mixed media gravity, upflow or pressure filtration systems, or does not exceed 2 gallons per minute per square foot of surface area in traveling bridge automatic backwash filters; and
  - (2) So that the turbidity of the filtered wastewater does not exceed any of the following:
    - (A) An average of 2 NTU within a 24-hour period;
    - (B) 5 NTU more than 5 percent of the time within a 24-hour period; and
    - (C) 10 NTU at any time.
- (b) Has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity of the filtered wastewater does not exceed any of the following:
  - (1) 0.2 NTU more than 5 percent of the time within a 24-hour period; and
  - (2) 0.5 NTU at any time.

**\*Note:** For Title 22, Sections 60304(a) and 60307 uses only, coagulation need not be used as part of the treatment process provided that the filter effluent turbidity does not exceed 2 NTU, the turbidity of the influent to the filters is continuously measured, the influent turbidity does not exceed 5 NTU for more than 15 minutes and never exceeds 10 NTU, and that there is the capability to automatically activate chemical addition or divert the wastewater should the filter influent turbidity exceed 5 NTU for more than 15 minutes.

**§60301.230. Disinfected tertiary recycled water.**

"Disinfected tertiary recycled water" means a filtered and subsequently disinfected wastewater that meets the following criteria:

(a) The filtered wastewater has been disinfected by either:

- (1) A chlorine disinfection process following filtration that provides a CT (the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on peak dry weather design flow; or
- (2) A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plaque forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of the demonstration.

(b) The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed an MPN of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed and the number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30-day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 milliliters.

DDW considers a properly filtered and disinfected recycled water meeting the turbidity performance and coliform requirements outlined in Title 22 to be essentially pathogen free. As noted by Asano et al.<sup>1</sup>, "To achieve efficient virus removal or inactivation in tertiary treatment, two major criteria must be met: 1) the effluent must be low in suspended solids and turbidity prior to disinfection to prevent shielding of viruses and chlorine demand, and 2) sufficient disinfectant must be applied to the wastewater."

DDW determined the treatment requirements necessary to meet the disinfected tertiary recycled water criteria outlined in Title 22 must include media filtration or polymeric

---

<sup>1</sup>Asano, T.; Tchobanoglous, G.; and Cooper, R.C (1984), "Significance of Coagulation-Flocculation and Filtration Operations in Wastewater Reclamation and reuse", in Symposium Proceedings, The Future of Water Reuse, Water Reuse Symposium III, San Diego, California, August 26-31, 1984. American Waterworks Association Research Foundation.

membrane filtration to reduce turbidity to less than a daily average of 2 NTU or less than 0.2 NTU 5% of the time respectively, followed by a chlorine disinfection process to ensure a minimum CT of 450 milligram-minutes per liter at all times. This treatment scheme (or an equivalent per Title 22, Section 60320.5) is intended to remove solids (including some pathogens) and properly prepare the water for effective disinfection in order to achieve an approximate 5-log reduction of virus.

With respect to many existing filtration technologies, there has yet to be a demonstrated correlation between turbidity and pathogen concentration. The current turbidity performance standards for media and polymeric membrane filtration are based on achievable turbidity performance and do not necessarily assure any specific minimum level of pathogen removal. This is a recognized issue in the regulations that is being reviewed by DDW.

Since the Pomona Virus Study<sup>2</sup> was published, biological treatment has introduced additional variables into the picture. The type of biological treatment used can impact the particle size distribution, and downstream filter and disinfection performances. The current integration of these processes into a process train is not well understood at this time and must be addressed by industry and regulators. Nevertheless, it remains the intent of DDW to produce an essentially pathogen free effluent by maintaining a 5-log virus removal/inactivation barrier through filtration and disinfection. Additional information concerning treatment technologies may be found in Appendix A (California Department of Health Services-Reduction of Virus and Bacteria by Filtration and Disinfection, October 2001).

## **2. Treatment Technology Conditional Acceptance Process**

Please note that conditionally accepted treatment technologies are not proven to work on all wastewater sources. The technologies are known to work on some sources if designed and operated properly. Utilities are advised to pilot test the conditionally accepted treatment technologies before installation to assure the requirements of Title 22 can be met with the site-specific wastewater source.

A conditionally accepted treatment technology has been evaluated and shown to comply with Title 22, Section 60320.5 on a specific wastewater source. Demonstration studies conducted using a proposed treatment technology must satisfactorily show an equal degree of treatment and reliability as those technologies listed in Title 22. Once a proposed treatment technology is listed as 'conditionally accepted', it must go through the Regional Water Quality Control Board's (RWQCB) Water Reclamation permitting process to be 'approved' for use at a specific utility. DDW will also review and provide comments during this RWQCB permitting process to confirm full compliance with all applicable treatment and reliability features required by Title 22 for the specific treatment facility using the conditionally accepted treatment technology.

---

<sup>2</sup>County Sanitation Districts of Los Angeles County (1977), "Pomona Virus Study, Final Report", Prepared for Calif. State Water Resources Control Board, Sacramento, Calif., and USEPA, Washington, D.C.



To be listed as a conditionally accepted treatment technology:

- a) The manufacturer must find a suitable California utility to sponsor the proposed treatment technology.
- b) The Sponsor must agree in writing that DDW can bill the Sponsor for time spent on the proposed treatment technology's conditional acceptance review process.
- c) The manufacturer (or other party acting as their agent):
  - 1) Shall develop a demonstration study protocol that demonstrates the proposed treatment technology complies with Title 22, Section 60320.5. See Appendix A (Reduction of Virus and Bacteria by Filtration and Disinfection, October 2001). Manufacturers also have a second option of choosing to follow the 9 steps of the WaterVal validation protocol.
  - 2) Submit the developed study protocol for review by the DDW Recycled Water Unit. (This step is highly recommended, but not required.)
  - 3) Conduct the demonstration study.
  - 4) Submit a final engineering report (sometimes progress reports during testing are required), regardless of the outcome, for review by DDW.
- d) If the treatment technology is conditionally accepted, the DDW Recycled Water Unit will notify the manufacturer in writing and add the treatment technology to this document with appropriate limitations, performance standards, and recommended permit conditions.

### **3. Conditionally Accepted Alternative Filtration Technology**

Title 22, Section 60301.320 lists filter types, such as dual or mixed media and various polymeric membranes, that at the time of the regulation adoption were known to be capable of meeting the stated filtration performance criteria. Filter types included in Title 22, Section 60301.320 do not require testing to be conditionally accepted. Only alternative filtration methods that fall under Title 22, Section 60320.5 must receive conditional acceptance to be used in California.

Filters meeting the criteria of "filtered wastewater" under Title 22, Section 60301.320 are allowed the option of either of the disinfection approaches outlined in Section 60301.230 without additional restrictions or requirements.

DDW strongly recommends that when utilities consider a particular filtration technology, they carefully evaluate its appropriateness for their particular water being treated. The net production capacities of some filter technologies are especially sensitive to assumptions about how much flow can be processed per operating unit or module;

assuming a flow rate that is too high can result in a filtration plant that is too small to meet system capacity requirements. Depending on the filter treatment process being employed, consideration must be given to solids loading from the secondary treatment process on the filter medium which can have a significant effect on loading/flux rate, TMP, filter run times, backwashing efficiency, and other O&M and design elements. These concerns are best addressed by pilot testing the filter treatment process being considered to ensure it will meet the required treatment criteria outlined in Title 22.

Title 22, Section 60301.320 filtration performance criteria must be reliably met by all filtration technologies. DDW strongly recommends that utilities develop and implement performance optimization plans and make reasonable effort to minimize effluent turbidity levels. Furthermore, all treatment facilities shall be operated in accordance with the manufacturer's recommendations and the specific conditions required by DDW.

The following filter technologies have demonstrated their ability to meet the performance criteria of Title 22.

**a. Cloth Filters**

**1) Alfa Laval Ashbrook Simon-Hartley – Iso-Disc**  
(Formally Ashbrook)

Description: 10-micron supported by fiber reinforced plastic grid. Gravity as driving force, outside-in path.

References:

- Conditional acceptance letter dated February 23, 2012 from CDPH.
- Report entitled "Iso-Disc Disk Filter Pilot Study Report at 69<sup>th</sup> Street Wastewater Treatment Complex" (February 2012).

Conditions of Acceptance:

- Loading rate not to exceed 9 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);
- Scheduled inspections of cloth conditions;
- Ensure adequate sludge wasting.

Comments: None

Installations: Unknown

---

**2) Aqua-Aerobic Systems - MMK2-13 acrylic pile fabric**

Description: Utilizing the MMK2-13 acrylic pile fabric under a vacuum.

References:

- Conditional acceptance letter (Corrected Copy) dated January 13, 2009 from CDPH.
- Report entitled "Comparative Evaluation of the Aqua-Aerobic Systems, Inc. MMK2-13 Acrylic Pile Filter Media To Meet California's Title 22 Reuse Criteria" (April 2006).

Conditions of Acceptance:

- Loading rate shall not to exceed 6 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);
- Scheduled inspections of cloth conditions; ensure adequate sludge wasting.

Comments: Utilizes the "MMK2-13 acrylic pile fabric", operates under vacuum. Both the Submerged Cloth Media Rotating Disk (AquaDisk®) and the Submerged Fixed Cloth Media (AquaDiamond®) designs are acceptable.

Installations: Unknown

---

### 3) Aqua-Aerobic Systems - NF-102 needle felt fabric

Description: Utilizing the NF-102 needle felt fabric under a vacuum.

References:

- Conditional acceptance letter (Corrected Copy) dated January 13, 2009 from CDPH.
- Report entitled "Evaluation of the Aqua-Aerobic Systems Cloth-Media Disk Filter (CMDF) for Wastewater Recycling Applications in California" prepared by UC Davis (March 2001).
- Report entitled "Evaluation of Aqua-Aerobics Systems AquaDisk® Filter Technology at Orange County Water District, Fountain Valley, California" (February 25, 2000).

Conditions of Acceptance:

- Loading rate not to exceed 6 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Acceptance limited to the random woven NF-102 needle felt cloth media having openings ranging from 10 to 30 microns and a thickness of 3.8 mm;
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);

- Operations plan shall specify minimum FTW cycle following high pressure wash based on displacement of two filtrate volumes and effluent turbidity below 2 NTU;
- Scheduled inspections of cloth conditions;
- Ensure adequate sludge wasting.

Comments: Utilizes the "102 needle felt fabric", operates under vacuum.

Installations: Unknown

---

#### **4) Aqua-Aerobic Systems - PA-13 nylon pile fabric**

Description: Utilizing the PA-13 nylon pile fabric under a vacuum.

References:

- Conditional acceptance letter (Corrected Copy) from CDPH dated January 13, 2009.
- Report entitled "Use of PA-13 Pile Fabric, Supplement to: Evaluation of the Aqua-Aerobic Systems Cloth-Media Disk Filter (CMDf) for Wastewater Recycling Applications in California" prepared by UC Davis (February 2002).
- Conditional acceptance letter dated April 24, 2017 from DDW.
- Report entitled "Title 22 Re-Rating of Aqua-Aerobic Systems, Inc. Cloth Media Filters PA-13, PES-13, and PES-14 for Wastewater Recycling Applications in California", by Kennedy/Jenks Consultants (January 2017).

Conditions of Acceptance:

- Loading rate not to exceed 22 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Acceptance limited to the PA-13 nylon pile fabric (as tested);
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);
- Scheduled inspections of cloth conditions;
- Ensure adequate sludge wasting.

Comments: Utilizes the "PA-13 nylon pile fabric", operates under vacuum. Both the Submerged Cloth Media Rotating Disk (AquaDisk®) and the Submerged Fixed Cloth Media (AquaDiamond®) designs are acceptable for use.

Installations: Unknown

---

#### **5) Aqua-Aerobic Systems - PES-13 woven polyester pile fabric**

Description: Utilizing the PES-13 woven polyester pile fabric under a vacuum.

References:

- Conditional acceptance letter from CDPH dated November 14, 2007.
- Report entitled "Evaluation of the Aqua-Aerobic Systems, Inc. PES-13 Cloth Media Filter for Wastewater Reuse Applications" (September 2007).
- Conditional acceptance letter dated April 24, 2017 from DDW.
- Report entitled "Title 22 Re-Rating of Aqua-Aerobic Systems, Inc. Cloth Media Filters PA-13, PES-13, and PES-14 for Wastewater Recycling Applications in California", by Kennedy/Jenks Consultants (January 2017).

Conditions of Acceptance:

- Loading rate not to exceed 22 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);
- Scheduled inspections of cloth conditions;
- Ensure adequate sludge wasting.

Comments: Utilizes the "PES-13 woven polyester fabric". Both the Submerged Cloth Media Rotating Disk (AquaDisk®) and the Submerged Fixed Cloth Media (AquaDiamond®) designs are acceptable for use.

Installations: City of Lodi

---

**6) Aqua-Aerobic Systems - PES-14 woven polyester pile fabric**

Description: Utilizing the PES-14 microfiber woven polyester pile fabric.

References:

- Conditional acceptance letter dated February 1, 2013 from CDPH.
- Report entitled "Evaluation of the Aqua-Aerobic Systems, Inc. OptiFiber PES-14 Cloth Medium for Wastewater Recycling Applications in California" (January 2013).
- Conditional acceptance letter dated April 24, 2017 from DDW.
- Report entitled "Title 22 Re-Rating of Aqua-Aerobic Systems, Inc. Cloth Media Filters PA-13, PES-13, and PES-14 for Wastewater Recycling Applications in California", by Kennedy/Jenks Consultants (January 2017).

Conditions of Acceptance:

- Loading rate not to exceed 22 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);

- Scheduled inspections of cloth conditions;
- Ensure adequate sludge wasting.

Comments: Utilizes the "PES-14 woven polyester fabric".

Installations: Unknown

---

## **7) Evoqua Water Technologies – Forty X Disc Filter OTM 2 (OTM 2)**

Description: Disc filter utilizing 316L stainless steel micron screen

References:

- Conditional acceptance letter dated September 21, 2020 from DDW.
- Report entitled "Forty X Disc Filter OTM2 Stainless Steel Media Pilot test report for Title 22 submittal" by Trussell Technologies (August 21, 2019).

Conditions of Acceptance:

- Loading rate not to exceed 10 gpm/ft<sup>2</sup>;
- Use of identical materials and manufacturing for each filter as described in the August 21, 2019 report;
- Turbidity performance shall be in accordance with Section 60301.320 (a 2);
- Coagulation, per Title 22, section 60349, shall be added upstream of the alternative filtration technology to meet the requirement of Title 22, section 60301.320(a) whenever the filter supplies recycled water for a cooling use area;
- The alternative filtration technology must be complimented by with a disinfection process that is compliant to Title 22, Section 60301.230;
- Operations plan shall include a performance goal that adequate backwash duration is provided to ensure effective solids removal;
- Operations plan shall include scheduled inspections and assessments of the media condition as an operational safeguard, which includes at least a monthly visual inspection and annual in-depth assessment of the media condition;
- Operations plan shall provide for assurances that adequate sludge wasting is practiced to ensure against excessive solids buildup in the filter vessel.

Comments: OTM 2 is woven from 316L stainless steel threads that are attached to a polypropylene structural frame. The OTM 2 media has a porosity rating of 60% or greater, and a strength of 19 – 22 N/mm.

Installations: Unknown

---

**8) Five Star Filtration – Cloth 1A-Yellow Jersey Knit Fabric**

Description: Utilizing the “Cloth 1A-Yellow Jersey Knit Fabric”

References:

- Conditional acceptance letter dated September 12, 2008 from CDPH.
- Title 22 Validation Testing Report dated August 1, 2008 submitted to CDPH.
- CDPH letter dated October 26, 2011 to raise the filter loading rate condition to 12.75 gpm/ft<sup>2</sup>.
- Report entitled, “Application for Title 22 Approval – Cloth 1A – Increase Flow Approval Request” (June 2011).

Conditions of Acceptance:

- Loading rate not to exceed 12.75 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);
- Scheduled inspections of cloth conditions.

Comments: Utilizes the Cloth 1A-Yellow Jersey Knit Fabric (20% acrylic/80% polyester face, 100% polyester backing yarn, acrylic latex back coating) with 37.5-oz per linear yard.

Installations: Unknown

---

**9) Five Star Filtration – Cloth 2A-Yellow Jersey Knit Fabric**

Description: Utilizing the “Cloth 2A-Yellow Jersey Knit Fabric”

Acceptance / References:

- Conditional acceptance letter dated October 26, 2011 from CDPH.
- Report entitled “Application for Title 22 Approval – Cloth 2A –Approval Request” (June 2011).

Conditions of Acceptance:

- Loading rate not to exceed 10.35 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);
- Scheduled inspections of cloth conditions.

Comments: Utilizes the Cloth 1A-Yellow Jersey Knit Fabric (20% acrylic/80% polyester face, 100% polyester backing yarn, acrylic latex back coating) with 63-oz per linear yard

Installations: Unknown

**10) I. Kruger - Hydrotech**

Description: Utilizing the PET mono-filament filter fabric

References:

- Conditional acceptance letter dated October 2, 2003 from CDPH.
- Report entitled "Evaluation of the Hydrotech Filter for Compliance With Title 22 For Recycled Water Applications" prepared by Water 3 Engineering, Inc. (August 2003).

Conditions of Acceptance:

- Loading rate not to exceed 6 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);
- Scheduled inspections of cloth conditions.

Comments: Cloth media disk or drum filter utilizing the PET mono-filament, 2:2 twill weave, 11 micron (+/-2.0) mesh opening, 523.2 (n/inch), 60 micron thickness, wt. rating of 1.48 oz./yd<sup>2</sup>., stabilized finish.

Installations: Unknown

**NOTE:** This technology uses the PET filtration media manufactured by Sefar under the trademark PETEX®. The following two media are approved for use of this technology:

Product Reference	Mesh Opening (µm)	Open Area (%)	Mesh count, both warp & weft (n/cm)	Mesh count, both warp & weft (n/in)	Yarn Diameter, both warp & weft (µm)	Weight (oz/yd <sup>2</sup> )	Thickness (µm)	Width (cm)
07-11/5	0	5	206.0	523	38	1.5	60	102, or 158 205
07-20/13	20	13	177.0	450	37	1.2	60	110

Source: "SEFAR Precision Woven Synthetic Monofilament Fabrics", May 2015, [techlist.sefar.com](http://techlist.sefar.com)



**11) Nexom – Infini-D Zero-Downtime Disk Filter**  
(Formally Entex Technologies – FlowTex Disc Filter)  
(Formally Parkson – DynaDisc Model 4)

Description: Utilizing Generation 3 and 4 cloth filter media.

References:

- Conditional acceptance letter dated November 5, 2007 from CDPH.
- Report entitled "Parkson DynaDisc™ Cloth Media Filter" dated September 27, 2007 regarding the Cloth-Media Filter.
- Conditional acceptance letter dated September 3, 2010 from CDPH regarding the Parkson DynaDisc Model 4.
- Report entitled "Parkson Corporation MBBR Package Water Treatment System" dated August 12, 2010 regarding Parkson DynaDisc Model 4 compliance with California Water Recycling criteria.
- CDPH letter dated March 7, 2011 regarding company and product name changes from Parkson Corp (DynaDisc Model 4) to Entex Technologies (FlowTex Disc Filter).
- Email from Nexom Technologies to DDW dated March 24, 2017 to state acquisition of the FlowTex Disc Filter and change its name to the Infini-D Zero-Downtime Disk Filter.
- Conditional acceptance letter dated May 12, 2022 from DDW.
- Report entitled "Nexom Infini-D Zero-Downtime Disk Filter (Nexom Infini Filter) Validation Study Report" by Pacific Advanced Civil Engineering, Inc. (June 2021).

Conditions of Acceptance:

- Use of identical materials and manufacturing for each filter as described in the June 2021 report;
- Loading rate not to exceed 10 gpm/ft<sup>2</sup>;
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);
- Pretreatment processes should be designed and operated to ensure that the turbidity of the influent filter does not exceed 5 NTU for more than fifteen minutes within a 24-hour period and never exceeds 10 NTU;
- Coagulation, per Section 60349 (T-22), shall be added upstream of the alternative filtration technology to meet the requirement of Section 60301.320(a) (T-22) whenever the filter effluent supplies recycled water for a cooling use area or a nonrestricted recreational impoundment per Sections 60305 and 60306 (T-22);
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Ensure adequate backwash duration to ensure effective solids removal;
- Scheduled inspections of cloth conditions;
- Ensure adequate sludge wasting.

Comments: Utilizes Generation 3 and 4 cloth filter media, which have nominal pore sizes of 10 and 5 microns, respectively.

Installations: Unknown

## 12) Nordic Water – Nordic Water Disc Filter

Description: Utilizing the Type 20/13 polyester fabric

References:

- Conditional acceptance letter dated March 7, 2008 from CDPH.
- Report entitled "Nordic Water Disc Filter Validation Report" prepared by Eco-Logic Engineering (March 22, 2007).

Conditions of Acceptance:

- Loading rate not to exceed 6 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);
- Scheduled inspections of cloth conditions.

Comments: Utilizes the Type 20/13 polyester fabric.

Installations: Unknown

**NOTE:** This technology uses the PET filtration media manufactured by Sefar under the trademark PETEX®. The following two media are approved for use of this technology:

Product Reference	Mesh Opening (µm)	Open Area (%)	Mesh count, both warp & weft (n/cm)	Mesh count, both warp & weft (n/in)	Yarn Diameter, both warp & weft (µm)	Weight (oz/yd <sup>2</sup> )	Thickness (µm)	Width (cm)
07-11/5	0	5	206.0	523	38	1.5	60	102, or 158 205
07-20/13	20	13	177.0	450	37	1.2	60	110

Source: "SEFAR Precision Woven Synthetic Monofilament Fabrics", May 2015, [techlist.sefar.com](http://techlist.sefar.com)

**13) Sanitaire a Xylem Brand – Drumfilter**  
(Formally ITT Sanitaire)

Description: Operates as a mechanical sieve, PET, monofilament, 2.2 twill weave, nominal 21 micron pores.

References:

- Conditional acceptance letter dated September 20, 2011 from CDPH.
- Report entitled "Drumfilter Title 22 Validation Report" prepared by Santec Consulting Services (June 2011).

Conditions of Acceptance:

- Loading rate not to exceed 12 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);
- Scheduled inspections of cloth conditions.

Comments: None

Installations: Unknown

**NOTE:** This technology uses the PET filtration media manufactured by Sefar under the trademark PETEX®. The following two media are approved for use of this technology:

Product Reference	Mesh Opening (µm)	Open Area (%)	Mesh count, both warp & weft (n/cm)	Mesch count, both warp & weft (n/in)	Yarn Diameter, both warp & weft (µm)	Weight (oz/yd <sup>2</sup> )	Thickness (µm)	Width (cm)
07-11/5	0	5	206.0	523	38	1.5	60	102, or 158 205
07-20/13	20	13	177.0	450	37	1.2	60	110

Source: "SEFAR Precision Woven Synthetic Monofilament Fabrics", May 2015, [techlist.sefar.com](http://techlist.sefar.com)

**14) Siemens Water Technologies - Forty X**

Description: Disk filters utilizing the PET mono-filament filter fabric.

References:

- Conditional acceptance letter dated June 3, 2008 from CDPH.
- Performance data report for the Forty X Disc Filter submitted to CDPH (May 2008).

Conditions of Acceptance:

- Loading rate not to exceed 6 gpm/ft<sup>2</sup>;
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Section 60301.230 (T-22);
- Turbidity performance shall be in accordance with Section 60301.320 (a 2), and Sections 60304 (a) and 60307 (a) (Title 22);
- Scheduled inspections of cloth conditions.

Comments: Utilizes the Siemens 11/5, PET (polyester) mono-filament, 2:2 twill weave, 11 micron mesh opening, 523 (n/inch), 60 micron thickness, wt. rating of 1.5 oz./yd<sup>2</sup>, stabilized finish.

Installations: Unknown

**NOTE:** This technology uses the PET filtration media manufactured by Sefar under the trademark PETEX®. The following two media are approved for use of this technology

Product Reference	Mesh Opening (µm)	Open Area (%)	Mesh count, both warp & weft (n/cm)	Mesch count, both warp & weft (n/in)	Yarn Diameter, both warp & weft (µm)	Weight (oz/yd <sup>2</sup> )	Thickness (µm)	Width (cm)
07-11/5	0	5	206.0	523	38	1.5	60	102, or 158 205
07-20/13	20	13	177.0	450	37	1.2	60	110

Source: "SEFAR Precision Woven Synthetic Monofilament Fabrics", May 2015, [techlist.sefar.com](http://techlist.sefar.com)

**15) Xylem Treatment - Leopold Ultrascreen Disk Filter®**  
(Formally Nova Quantum Disk Filter and Nova Ultrascreen Filter)

Description: AISI 316 steel micronic screen, 20 microns nominal size.

References:

- Conditional acceptance letter from CDPH dated November 12, 2009.
- Evaluated by Carollo Engineers (Report entitled "Title 22 Performance Testing of the Nova Water Technologies Ultrascreen® Microfilter" dated June 2008).
- Conditional acceptance letter dated January 14, 2015 from DDW to state that Xylem Treatment is the new supplier of the Ultrascreen Disk Filter.

Conditions of Acceptance:

- Filter screen specified as AISI 316 steel micron screen mesh with a nominal size rating of 20 microns (down to 10 micron when using “dynamic tangential filtration”);
- Filtration rate not to exceed 6 gpm/ft<sup>2</sup> when complimented with a disinfection process which has been demonstrated to achieve 4-log inactivation of plaque-forming units of F-specific bacteriophage MS2, or polio virus in the filtered wastewater;
- Filtration rate not to exceed 16 gpm/ft<sup>2</sup> when complimented with a disinfection process which has been demonstrated to achieve 5-log inactivation of plaque-forming units of F-specific bacteriophage MS2, or polio virus in the filtered wastewater;
- Required schedule of inspection and assessment of the screen condition;
- Operations plans shall provide for assurances that adequate sludge wasting is practiced to ensure against excessive solids buildup in the filter vessel.

Comments: As of January 1, 2015, Xylem Treatment is the only authorized supplier of the Leopold Ultrascreen Disk Filter.

Installations: Unknown

---

**b. Non-Granular Media Filters**

**1) Amiad - AMF Wastewater Filter**

Description: TC-20 thread cassette media

References:

- Conditional acceptance letter date June 8, 2009 from CDPH.
- Report entitled “Amiad Filtration System – AMF Wastewater Filter Final Validation Report” by Eco-Logic Engineers (May 2009).

Conditions of Acceptance:

- Media limited to the TC-20 design;
- Filtration rate not to exceed 2.1 gpm/ft<sup>2</sup>;
- Each cassette to be embossed with the micron degree of filtration commensurate with the TC-20 rating;
- Required schedule of inspection of individual cassette units.

Comments: None

Installations: Unknown

---

## 2) Schreiber – Fuzzy Filter

Description: Compressible synthetic fiber filter media - upflow design. Media is quasi spherical, highly porous and compressible.

Media configuration:

Media Type	Media Depth (in)	Effective Size (in)	Uniformity Coefficient
Synthetic	30	1.25	1.50

References:

- Conditional acceptance letter date February 24, 2003 from CDPH.
- Evaluated by U.C. Davis (Report dated September 1996).

Conditions of Acceptance:

- Media design specifications as noted above;
- Loading rate not to exceed 30 gpm/ft<sup>2</sup>;
- All Title 22 installations shall have design changes as outlined by Schreiber in correspondence dated January 21, 2003 (i.e. - backwash with filtered water, wash outlet below filtered outlet, valving position alarms);
- Individual operations plans shall include recommended operational configurations (i.e. percent compression and loading rate) based on secondary quality.

Comments: Media configuration/porosity/depth varies based on percent compression; water passes through media rather than around media.

Installations: City of Yountville

## 3) Schreiber – Compressible Media Filter

Description: Also known as Fuzzy Filter. Compressible synthetic fiber filter media - upflow design. Media is quasi spherical, highly porous, and compressible polyphenylene sulphide.

Media configuration:

Media Type	Media Depth (in)	Effective Size (in)	Uniformity Coefficient
Synthetic	30	1.50	-

References:

- Conditional acceptance letter date July 14, 2011 from CDPH.
- Report entitled “Evaluation of the New Compressible Media Filter at Higher Filtration Rates for California Title 22 Unrestricted Water Reuse Approval” by Kennedy/Jenks Consultants (December 2010).

Conditions of Acceptance:

- Media design specifications as noted above;
- Filtration rate not to exceed 40 gpm/ft<sup>2</sup>;
- All Title 22 installations shall have design changes as outlined by Schreiber in correspondence dated January 21, 2003 (i.e. - backwash with filtered water, wash outlet below filtered outlet, valving position alarms);
- Individual operations plans shall include recommended operational configurations (i.e. percent compression and loading rate) based on secondary quality;
- Process controls shall confirm filter effluent and wash water valve positions with alarms.

Comments: Media configuration/porosity/depth varies based on percent compression; water passes through media rather than around media.

Installations: Unknown

---

### c. Other Filters and Non-Polymeric Membrane Filters

#### 1) BKT – BioFiltration (BBF)

Description: The BFF is a type of biological aerated filter technology. It is an up-flow biological filter with floating expanded polypropylene bead media that provides physical filtration and allows the growth of a biofilm for biological treatment. The biofilm developed on the beads make the pores between beads smaller and the filtration function of the BBF can be enhanced by the biofilm. The BBF can be backwashed by reversing the flow. The BBF was tested in two configurations: BBF operating in the filtration mode, BBF-F, and BBF operating in the filtration and nutrient removal mode, BBF-N.

References:

- Conditional acceptance letter dated January 27, 2015 from CDPH.
- Report entitled “Evaluation of TFF and BBF Technologies for Conditional Acceptance of California Water Recycling Criteria (Title 22)” by CDM Smith, Consulting Engineers (November 2014).

Conditions of Acceptance:

- Loading rates shall not exceed 5 gpm/ft<sup>2</sup>;

- Turbidity in the filtered water shall not exceed an average of 2 NTU within a 24-hour period, 5 NTU more than 5 percent of the time within a 24-hour period, and 10 NTU at any time
- Coagulation per Title 22, Section 60349 shall be added upstream of the alternative Filtration technology to meet the requirement of Title 22, Section 60301.320(a) whenever the filter effluent supplies recycled water for a cooling use area as per Title 22, Section 60306
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Title 22, Section 60301.230.
- Operations plan shall include a performance goal that adequate backwash duration is provided to ensure effective solids removal;
- Operations plan shall include scheduled inspections and assessments of the media condition as an operational safeguard, which includes at least a monthly visual inspection and annual in-depth assessment of the media condition;
- Operations plan shall provide for assurances that adequate sludge wasting is practiced to ensure against excessive solids buildup in the filter vessel.

Comments: The BBF-F mainly targets suspended solid removal. In this mode, the BBF operates with a single, anoxic reactor. The BBF-N targets biological nitrogen removal as well as suspended solid removal. In this mode, the BBF has two reactors that operate in series, one under aerobic conditions and the other under anoxic conditions. Nitrogen removal is not required for compliance with Title 22, Section 60320.5, thus was not reviewed for this conditional acceptance.

Installations: Unknown

## 2) **BKT – Tightened Fiber Filter (TFF)**

Description: TFF is a back-washable fiber filter which uses flexible polypropylene fiber bundles as filtration media. A perforated pipe in the center of the fiber bundles collects the filtrate and operates in an outside-in filtration mode. During filtration, the fibers are pulled up tightly in the longitudinal direction to reduce the effective pore sizes of the filter media. The filter can be periodically backwashed by reversing the flow after loosening the fibers.

### References:

- Conditional acceptance letter dated January 27, 2015 from CDPH.
- Report entitled “Evaluation of TFF and BBF Technologies for Conditional Acceptance of California Water Recycling Criteria (Title 22)” by CDM Smith, Consulting Engineers (November 2014).

### Conditions of Acceptance:

- Loading rates shall not exceed 3.7 gpm/ft<sup>2</sup>;



- Turbidity in the filtered water shall not exceed an average of 2 NTU within a 24-hour period, 5 NTU more than 5 percent of the time within a 24-hour period, and 10 NTU at any time
- Coagulation per Title 22, Section 60349 shall be added upstream of the alternative Filtration technology to meet the requirement of Title 22, Section 60301.320(a) whenever the filter effluent supplies recycled water for a cooling use area as per Title 22, Section 60306
- Acceptance of this technology is contingent on it being complimented with a disinfection process which is compliant with Title 22, Section 60301.230.
- Operations plan shall include a performance goal that adequate backwash duration is provided to ensure effective solids removal;
- Operations plan shall include scheduled inspections and assessments of the media condition as an operational safeguard, which includes at least a monthly visual inspection and annual in-depth assessment of the media condition;
- Operations plan shall provide for assurances that adequate sludge wasting is practiced to ensure against excessive solids buildup in the filter vessel.

Comments: None

Installations: Unknown

### **3) Meiden – Ceramic Flat Sheet Membrane (CFM)**

Description: Ceramic flat sheet membrane, made of alumina with a 0.1 micron nominal pore size.

References:

- Conditional acceptance letter dated June 30, 2016 by DDW.
- Report titled “Assessing the Ability of the Meiden Ceramic Flat Sheet Membrane (CFM) to Meet Existing Water Reuse Criteria” by Black & Veatch, (June 2016).

Conditions of Acceptance:

- Loading rates shall not exceed 3.7 gpm/ft<sup>2</sup>;
- Use of identical material as described in the June 2016 engineering report;
- Technology must be complimented with a disinfection process that is compliant with Title 22, Section 60301.230;
- Turbidity in the filtered water shall not exceed 0.2 NTU more than 5% of the time within a 24-hour period and neve exceeds 0.5 NTU at any time.

Comments: The CFM was tested using an MBR pilot plant treating primary effluent from the Hale Avenue Resource Recovery Facility (HARRF) over an 8 week period. During the testing, the CFM instantaneous flux was 24.5

gallons per square foot per day. No chemicals were added upstream of the pilot to enhance filtration

Installations: Unknown

---

**4) Metawater – Ceramic Membrane**  
(Formerly NGK Insulators)

Description: METAWATER Co., Ltd. Ceramic Membrane Filtration System with a nominal 0.1 micron pore size. The membranes operate under positive pressure.

References:

- Conditional acceptance letter dated March 7, 2007 from CDPH. Amendment letter dated August 19, 2008, recognizing ownership change from NGK to METAWATER.
- Report submitted by MWH, Consulting Engineers, dated October 2005, outlining study results conducted for compliance with the Surface Water Treatment Rule.

Conditions of Acceptance:

- Turbidity shall not exceed 0.2 NTU more than 5 percent of the time within a 24-hour period, and 0.5 NTU at any time.

Comments: Tested on raw surface water at the Aqua De Lejos Water Treatment Plant in Upland, California. Part number for the NGK ceramic membrane tested is 431011.

Installations: Unknown

---

#### **4. Conditionally Accepted Alternative Disinfection Technology**

Gaseous chlorine and hypochlorite are the most commonly used disinfectants. Title 22, Section 60301.230(a)(1) lists criteria that must be met when using a chlorine disinfection process. However alternative technologies are also recognized as being acceptable, including Ultraviolet, Ozone, and Pasteurization disinfection. These alternative disinfection methods fall under Title 22, Section 60320.5 and must receive conditional acceptance to be used in California.

DDW strongly recommends that when utilities consider a particular disinfection technology, they carefully evaluate its appropriateness for their particular water being treated. The net production capacity of some disinfection technologies are

especially sensitive to assumptions about how much flow can be processed per operating unit or module; assuming a flow rate that is too high can result in a disinfection process that is too small to meet system capacity requirements. Additionally, the project flow rate should take into account provisions for redundant standby process equipment.

Title 22, Section 60301.230 disinfection performance criteria must be reliably met by all disinfection technologies. DDW strongly recommends that utilities develop and implement performance optimization plans. Furthermore, all treatment facilities shall be operated in accordance with the manufacturer's recommendations and the specific conditions required by DDW.

The following disinfection technologies have demonstrated their ability to meet the performance criteria of Title 22.

#### **a. Free Chlorine Disinfection**

Use of Free Chlorine is recognized as a conditionally acceptable disinfection method for meeting the inactivation criteria in Title 22 on a case-by-case basis. Pilot studies conducted in California satisfactorily demonstrated the ability of this technology to achieve greater than 5-log reduction in seeded MS2 coliphage under defined conditions.

##### **1) Brentwood WTP – Free Chlorine Disinfection**

Description: Free chlorine disinfection.

References:

- Conditional acceptance letter dated November 2, 2017 from DDW.
- Report entitled "Demonstration of Tertiary Free Chlorine Disinfection at the City of Brentwood Wastewater Treatment Plant" by Trussell Technologies, Inc. (August 2017).

Conditions of Acceptance:

- Thirteen conditions of acceptance are outlined in the 11-02-2017 acceptance letter.

Comments: Conditional acceptance is only applicable to the Brentwood WTP.

The City must deliver a minimum free chlorine residual contact time of 9 mg-min/L at all times to receive 5-log virus inactivation credit and meet a minimum free chlorine residual at the compliance point of 1.0 mg/L at all times. The City must also maintain a minimum free chlorine modal contact time of four (4.0) minutes at all times.

Installations: Brentwood WTP

---

---

## 2) **Camrosa Water Reclamation Facility – Free Chlorine Disinfection**

Description: Free chlorine disinfection.

References:

- Conditional acceptance letter dated May 4, 2015 from DDW.
- Report entitled "Camrosa Water Reclamation Facility: Chlorine Disinfection Study. Bioassay Testing Results and Proposed Contractor Rerating" by MWH Global (April 2015).

Conditions of Acceptance:

- Nine conditions of acceptance are outlined in the 05-04-2015 acceptance letter.

Comments: The bioassay testing demonstrated that the Camrosa Water Reclamation Facility can use free chlorine disinfection to meet Title 22 requirements, allowing a shorter contact time in its chlorine contact chambers. The shorter contact time will allow the Camrosa Water Reclamation Facility to increase their plant flow rate from 1.5 to 3.24 MGD peak flow. Conditional acceptance is only applicable to the Camrosa Water Reclamation Facility.

Installations: Camrosa Water Reclamation Facility

---

---

## 3) **Chumash Casino Resort Water Reclamation Facility – Free Chlorine Disinfection**

Description: Free chlorine disinfection.

References:

- Conditional acceptance letter dated October 10, 2017 from DDW.
- Report entitled "Chumash Water Reclamation Facility Free Chlorine CT Study Report" by Pacific Advanced Civil Engineering, Inc. (September 2017).

Conditions of Acceptance:

- Thirteen conditions of acceptance are outlined in the 10-10-2017 acceptance letter.

Comments: The study demonstrated that Chumash Casino Resort Water Reclamation Facility can use free chlorine disinfection to meet Title 22 requirements, allowing a shorter contact time in its chlorine contact basin. The shorter contact time will allow the Chumash Casino Resort to increase their

plant flow rate from 72,000 GPD average flow to 0.32 MGD peak flow. Conditional acceptance is only applicable to the Chumash Casino Resort Water Reclamation Facility.

Installations: Chumash Casino Resort Water Reclamation Facility

---

#### **4) Inland Empire Utilities Agency (IEUA) – Free Chlorine Disinfection**

Description: Free chlorine disinfection.

References:

- Conditional acceptance letter dated August 17, 2021 from DDW.
- Reports entitled "Inland Empire Utilities Agency Regional Water Recycling Plant No. 1 Free Chlorine Disinfection Validation Report" and "Inland Empire Utilities Agency Regional Water Recycling Plant No. 4 Free Chlorine Disinfection Validation Report" by Trussell Technologies, Inc. (July 2021).

Conditions of Acceptance:

- Ten conditions of acceptance are outlined in the 08-17-2021 acceptance letter.

Comments: The reports validated the virus inactivation from using free chlorine disinfection at the IEUA Water Recycling Plants No.1 and No. 4. Tracer studies conducted at both water recycling plants are also included in the report. Conditional acceptance is only applicable to the Inland Empire Utilities Agency (IEUA) Water Recycling Plants No.1 and No. 4.

Installations: Inland Empire Utilities Agency (IEUA)

---

#### **5) Lathrop Consolidated Treatment Facility – Free Chlorine Disinfection**

Description: Free chlorine disinfection.

References:

- Conditional acceptance letter dated May 13, 2016 from DDW.
- Report entitled "City of Lathrop Phase 2 Expansion of the Lathrop Consolidated Treatment Facility" by Pacific Advanced Civil Engineering, Inc. (February 2016).

Conditions of Acceptance:

- Thirteen conditions of acceptance are outlined in the 05-13-2016 acceptance letter.

Comments: The study demonstrated that Lathrop Consolidated Treatment Facility can use free chlorine disinfection to meet Title 22 requirements, allowing a shorter contact time in its chlorine contact basin. The shorter contact time will allow the adoption of free chlorine disinfection will allow the Lathrop Consolidated Treatment Facility to increase their plant flow rate from 1.6 MGD peak dry weather flow to 4 MGD peak dry weather flow without expanding the chlorine contact basin. Conditional acceptance is only applicable to the Lathrop Consolidated Treatment Facility.

Installations: Lathrop Consolidated Treatment Facility

---

## **6) Padre Dam Municipal Water District – Free Chlorine Disinfection**

Description: Free chlorine disinfection.

References:

- Conditional acceptance letter dated March 7, 2017 from DDW.
- Report entitled “Final Report: Advanced Water Purification Demonstration Project” by Trussell Technologies, Inc. (December 2016).

Conditions of Acceptance:

- Thirteen conditions of acceptance are outlined in the 03-07-2017 acceptance letter.

Comments: The report outlines findings from the demonstration study at the Padre Water Recycling Facility using a pilot scale chlorine contactor with secondary effluent from the Ray Stoyer WRF as the feed to the pilot system. The demonstration study evaluated a potential advanced treatment train for indirect potable reuse, as the Padre Water Recycling Facility currently only provides recycled water for non-potable reuse. DDW will accept the following virus inactivation credits when using free chlorine:

- 6-log when using UF filtrate and a CT of 9 mg/L-min, and;
- 5-log when using granular media filter (GMF effluent) and a CT of 9 mg/L-min.

Conditional acceptance is only applicable to the Padre Dam Municipal Water District.

Installations: Padre Dam Municipal Water District

---

**7) City of Riverside Regional Water Quality Control Plant – Free Chlorine Disinfection**

Description: Free chlorine disinfection.

References:

- Conditional acceptance letter dated May 6, 2019 from DDW.
- Report entitled “City of Riverside, Chlorine CT and Modal Contact Time Study, Contact Time Testing and CT Demonstration Results” by Carollo Engineering (November 2018).

Conditions of Acceptance:

- Twelve conditions of acceptance are outlined in the 05-06-2019 acceptance letter.

Comments: The study demonstrated that the Riverside Regional Water Quality Control Plant’s full-scale chlorine disinfection contact basin #2 can use free chlorine disinfection to meet Title 22 requirements. The use of free chlorine disinfection will allow a shorter contact time in the facility’s chlorine contact basin #2, reduce disinfection byproducts, and improve overall operational efficiency. Conditional acceptance is only applicable to the Riverside Regional Water Quality Control Plant’s chlorine contact basin #2.

Installations: Riverside Regional Water Quality Control Plant

---

**8) Sacramento Regional County Sanitation District (Regional San) – Free Chlorine Disinfection**

Description: Free residual chlorine disinfection.

References:

- Conditional acceptance letter dated October 12, 2015 from DDW.
- Report entitled “Demonstration of a Conditionally Accepted Treatment Technology for Title 22 Tertiary Recycled Water, Equivalency at the Sacramento Regional Wastewater Treatment Plant” by the Sacramento Regional County Sanitation District (June 2015).

Conditions of Acceptance:

- Fifteen conditions of acceptance are outlined in the 10-12-2015 acceptance letter.

Comments: The report conducted a full comparison between filter performances at 5 and 6.5 gpm/ ft<sup>2</sup> using DDW approved protocols similar to previous Filter Loading Rate Evaluation for Water Reuse (FLEWR) studies. The demonstration study found no statistical difference in the ability to disinfect (by measuring total coliform after the proposed free residual chlorine process), filtered effluent turbidity, or particle counts when operating at either filter performance. The instantaneous filter rates should not exceed 7.5 gpm/ft<sup>2</sup>. Regional San must meet a minimum free residual chlorine of 1.3 mg/L at all times and maintain a minimum free chlorine modal contact time of thirty (30.0) minutes. Conditional acceptance is only applicable to the Sacramento Regional County Sanitation District.

Installations: Sacramento Regional County Sanitation District

---

---

## **9) San Jose Creek East WRP – Sequential Chlorination**

Description: A two-step disinfection process called sequential chlorination. The process applies free chlorine and chloramines in sequence and effectively inactivates viral and bacterial target organisms while minimizing the formation of N-nitrosodimethylamine (NDMA) and trihalomethanes (THMs).

References:

- Conditional acceptance letter dated August 21, 2013 from CDPH.
- Report entitled “Demonstration of Sequential Chlorination for Tertiary Recycled Water Disinfection at the San Jose Creek East Water Reclamation Plant” by Sanitation Districts of Los Angeles County (April 2013).

Conditions of Acceptance:

- Ten conditions of acceptance are outlined in the 08-21-2013 acceptance letter.

Comments: The San Jose Creek East WRP must deliver a minimum free chlorine residual contact time of 9 mg-min/L and a minimum free chlorine residual of 1.0 mg/L at all times. This technology is only applicable to San Jose Creek East WRP.

Installations: San Jose Creek East WRP

---

---



**10) San Jose-Santa Clara Regional Wastewater Facility (RWF) – Free Chlorine Disinfection**

Description: Free chlorine disinfection.

References:

- Conditional acceptance letter dated May 18, 2018 from DDW.
- Report entitled “Demonstration of Tertiary Free Chlorine Disinfection at the San Jose-Santa Clara Regional Wastewater Facility” by Trussell Technologies Inc. (September 2017).

Conditions of Acceptance:

- Thirteen conditions of acceptance are outlined in the 05-18-2018 acceptance letter.

Comments: The RWF uses a constructed 10-gpm pilot-scale disinfection plant with tertiary filtered effluent. Conditional acceptance is only applicable to the San Jose-Santa Clara Regional Wastewater Facility.

Installations: San Jose-Santa Clara RWF

---

**11) Western Riverside County Regional Wastewater Authority (WRCRWA) WTP – Free Chlorine Disinfection**

References:

- Conditional acceptance letter dated June 17, 2021 from DDW.
- Report entitled "Western Riverside County Regional Wastewater Authority Free Chlorine Disinfection Validation Report " by Trussell Technologies, Inc. (December 2020).

Conditions of Acceptance:

- Eleven conditions of acceptance are outlined in the 06-17-2021 acceptance letter.

Comments: Conditional acceptance is only applicable to the WRCRWA WTP. The chlorine contact basins (CCBs) should not be operated at flows above the Peak Wet Weather Design Flow of 35 MGD, or 11 MGD per CCB if one of the four CCBs is offline.

Installations: WRCRWA WTP

---

## **b. Ozone and Ozone/Peroxide Disinfection**

Use of Ozone (with and without hydrogen peroxide addition) is recognized as a conditionally acceptable disinfection method for meeting the inactivation criteria in Title 22. Pilot studies conducted in California satisfactorily demonstrated the ability of this technology to achieve greater than 5-log reduction in seeded MS2 coliphage under defined minimum contact time conditions.

### **1) APTwater - HiPOx™ (Formerly Applied Process Technology, Inc.)**

Description: Ozone disinfection (with or without peroxide) - HiPOx™ System

References:

- Conditional acceptance letter dated December 22, 2008 from CDPH.
- Report entitled “Performance Validation of the HiPOx™ Disinfection Technology Using Ozone and Ozone/Peroxide for Reclaimed Water” by Carollo Engineers (May 2008).

Conditions of Acceptance:

- Nine conditions of acceptance are outlined in the 12-22-2008 acceptance letter.

Comments: Pilot studies were conducted at the Dublin San Ramon Services District (DSRSD) Wastewater Treatment Plant.

Installations: City of Anaheim

---

## **c. Pasteurization Disinfection**

Use of pasteurization is recognized as a conditionally acceptable disinfection method for meeting the inactivation criteria in Title 22. Pilot studies conducted in California in 2006 and 2007 satisfactorily demonstrated the ability of this technology to achieve a minimum 4-log reduction in seeded MS2 coliphage under defined minimum contact time and temperature conditions.

### **1) Pasteurization Technology Group - Pasteurization System (Formerly Ryan Pasteurization and Power)**

Description: Pasteurization disinfection process

References:

- Conditional acceptance letter dated July 25, 2007 from CDPH.

- Report entitled “RP&P Wastewater Pasteurization System Validation Report” by Carollo Engineers (July 2007).

Conditions of Acceptance:

- Pasteurization temperatures must  $\geq 180$  degrees F with temperature maintained continuously for a minimum of 10 seconds;
- Upon completion of construction and prior to operation, the minimum contact time and temperature must be demonstrated to the Department, spanning a range of flow from the low flow to the high flow, with two intermediate flow points;
- For new installations, a 6-point bioassay must be performed on the pasteurization unit using seeded MS2 coliphage;
- The accuracy and repeatability of the on-line temperature probes (thermocouples) must be demonstrated;
- On-line monitoring of flow and temperature must be implemented in a manner similar to that documented in the July 2007 report from Carollo Engineers. The temperature throughout the cross-section of the vessel should be uniform;
- All future proposals shall employ the operational and maintenance criteria outlined under Section 6.3 of the July 2007 report from Carollo Engineers;
- Ryan Pasteurization must be preceded by filters meeting the definition of “filtered wastewater” under CCR, Title 22, Section 60301.320 (a & b) or those demonstrating equivalency under Section 60320.5 (“Other Methods of Treatment”) outlined in the Water Recycling Criteria. Additionally, CDPH recommends that pilot testing of pasteurization prior to design be conducted to document any impacts from a water quality that is different from the water quality documented in the July 2007 report from Carollo Engineers.

Comments: Pilot studies were conducted at the City of Santa Rosa’s Laguna Wastewater Treatment Plant.

Installations: Graton CSD

---

#### **d. Ultraviolet Disinfection (UV)**

UV Disinfection Guidelines (UV Guidelines) were first published in 1993 by the National Water Research Institute (NWRI). Since that time, the field of UV disinfection has taken great strides forward. As a result of the progress made in understanding the UV disinfection process, DDW and NWRI agreed to revise and update the UV Guidelines. NWRI and the American Water Works Association Research Foundation (AWWARF) pooled their resources in order to revise the original UV Guidelines, which now covers water recycling and drinking water UV

disinfection applications. As a result of these efforts the "Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse" was published by NWRI/AWWARF in December 2000, revised as a Second Edition dated May 2003, and later revised again as a Third Edition dated August 2012. DDW endorses the latest August 2012 UV Guidelines and refers to them when evaluating UV disinfection proposals. One major recommendation of the UV Guidelines is that all UV equipment (including previously approved equipment) be tested and validated under the new guidelines before being conditionally accepted by DDW. For existing systems approved under earlier guidelines, documentation of compliance with the August 2012 UV Guidelines should be provided when permits issued by the RWQCB come up for renewal. It is believed that existing UV disinfection systems that were properly designed should comply with the elements of the revised guidelines. Re-validation of such existing systems is typically performed by on-site bioassays, however alternative methods are being considered by industry. DDW-approved testing protocols must be followed in all instances.

The implication of the recommendations contained in the 2012 UV Guidelines is that even the horizontal low-pressure low-intensity UV systems must be validated before they are conditionally accepted for a UV disinfection application. Previous conditionally accepted UV technologies that were considered to be nonconforming under the 1993 guidelines will also have to be retested using the latest recommended testing procedure. The UV technologies listed herein include a note indicating whether compliance with the most recent 2012 UV Guidelines has been demonstrated by the manufacturer.

Utilities that are in the planning or early design stages have the most flexibility and should be able to require completion of UV validation testing before they accept delivery of the UV equipment. Therefore, the utility can plan and begin the design work around a given UV system, but not allow delivery of equipment until validation testing is completed. This will allow comparison of the UV reactor design to the validation test results in order to ensure adequate sizing and performance of the UV system. This could be done as part of the design review process, i.e., while the design is not yet complete. If the design process has been completed and the contract for equipment has been signed, there will be less recourse for the utility. However, the utility can require a demonstration of performance or performance guarantee on the equipment for their protection.

It is important to note that the UV Guidelines are only 'guidelines' and are therefore not limiting with respect to alternative approaches a manufacturer or utility may propose for consideration on a case-by-case basis. It is possible, however, that future regulations may be based on the UV Guidelines.

Appendix B is an advisory memo dated November 1, 2004 that DDW sent to the RWQCBs in California concerning the importance of cleaning the UV quartz sleeve; the memo also outlines recommendations to help ensure effective UV disinfection.

## 1) AquaAzul – AZ-4000 UV System

Description: Open channel with four 155-W low-pressure high-output lamps.

References:

- Conditional acceptance letter dated June 18, 2019 from DDW.
- Report entitled "AquaAzul UV Validation Report" by Stantec Engineers (November 2018).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Seventeen conditions of acceptance are outlined in the 06-18-2019 acceptance letter.

Comments: There is no mechanical sleeve wiping system.

Installations: Unknown

---

## 2) Aquaray - 3X HO

Description: Horizontal lamp/low Pressure/high intensity open channel reactor

References:

- Two conditional acceptance letters (one is a cover letter, the second is the actual acceptance letter) dated May 30, 2008.
- Report entitled "Aquaray 3X HO UV Disinfection System Bioassay Validation Report" by HydroQual, Inc. (December 2007).
- Acceptance granted under the outdated May 2003 NWRI Guidelines. Compliance with the latest NWRI Guidelines has been demonstrated via onsite bioassays at the City of Visalia.

Conditions of Acceptance:

- Twenty-four conditions of acceptance are outlined in the 05-30-2008 acceptance letter.

Comments: This system has dimensions of 0.74-m wide, 0.91-m long and 2.25 m in height, inclusive of top enclosure. There are thirty-six 160-W LPHO Amalgam lamps in a staggered six by six array oriented vertical to the flow in an open channel. An air scrub sleeve cleaning system is typically provided. This technology is applicable for flow rates ranging from 2 to 12 MGD at UVTs ranging from 55 to 75 percent, lamp current ranging from 2.8 to 4.5

amps, and Effective Output (EO) ranging from 0.42 to 1.00. Testing was performed using both granular media and membrane-filtered effluent. Two similar operating equations were developed with different constants for granular media filtration or membrane filtration.

Installations: City of Visalia

---

### 3) **Aquaray - 40 HO VLS**

Description: Vertical lamp/low pressure/high intensity open channel reactor

References:

- Conditional acceptance letter dated 10/24/2003 with subsequent correspondence dated 2/23/2004, 4/13/2004, 10/04/2006 and 1/12/2007.
- Acceptance granted under the outdated May 2003 NWRI Guidelines. Compliance with the latest NWRI Guidelines has not been demonstrated.
- Revised conditional acceptance letter from DDW dated March 14, 2017, based upon the 2016 report entitled “Enhanced Bioassay of the Ozonia Aquaray 40 HO HLS System”, by HDR Engineering (2016). This letter revises the previously accepted 2003 UV dose equation and replaces it with the UV dose equation which is contained in the 2016 report. These revisions may be utilized at the Irvine Ranch Water District, Michelson Water Recycling Plant (MWRF), and is applicable for 40 HO VLS systems at other locations as well.

Comments: Evaluation memo dated 4/30/1997 from CDPH concerning transmittance restriction be set at >55%.

Installations: El Dorado ID Deer Creek plant, El Dorado ID Hills plant, City of Petaluma, Russian River CSD, Irvine Ranch ID Michelson Water Recycling Plant

---

### 4) **Aquaray - 40 VLS**

Description: Vertical lamp/low pressure/low intensity open channel reactor

References:

- Conditional acceptance letter dated October 24, 1997 from CDPH.
- Acceptance granted under the outdated May 2003 NWRI Guidelines. Compliance with the latest NWRI Guidelines has not been demonstrated.

Comments: Evaluation memo dated 4/30/1997 from CDPH concerning transmittance restriction be set at >55%.

**5) Aquaray – AZ-4000 HiCAP UV Disinfection System**

Description: Open channel with 1000-W low-pressure high-output lamps. Created in three different module sizes.

References:

- Conditional acceptance letter dated January 10, 2019 from DDW.
- Report entitled "Aquaray HiCAP UV Disinfection System Validation Report" by HydroQual, Inc. (June 2016).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Seventeen conditions of acceptance are outlined in the 01-10-2019 acceptance letter.

Comments: The Aquaray HiCAP comprises three different module sizes, which have twelve, twenty-four, or thirty-six 1000-W low-pressure high-output amalgam lamps that are placed in a staggered array oriented vertical to the flow in an open channel.

Installations: Unknown

---

**6) Aquionics - 400+**

Description: Six-inch chamber, four medium-pressure high-output lamps. Perpendicular to flow with auto wiper system. Closed Vessel

References:

- Conditional acceptance letter dated February 19, 2015 from DDW revises the letter dated October 15, 2008 from CDPH.
- Report on-file entitled "Aquionics Inc. InLine+ UV Disinfection Validation Report" by Carollo Engineers (April 2008).
- Report entitled "Addendum – InLine+ UV Disinfection Systems Validation Report, 2012 NWRI Analysis of the InLine 400+ Reactor Validation Data" by Carollo Engineers (August 2014).
- Acceptance granted under the 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 2-19-2015 acceptance letter.

Comments: None

Installations: Tejon Ranch, Douglas Flat/Vallecito WTP Calaveras County WD,  
Google Bay View

---

**7) Aquionics - 16000+**

Description: Closed Vessel

References:

- Conditional acceptance letter dated December 15, 2008 from CDPH.
- Report entitled "Aquionics Inc. InLine+ UV Disinfection Validation Report" by Carollo Engineers (April 2008).
- Acceptance granted under the outdated May 2003 NWRI Guidelines. Compliance with the latest NWRI Guidelines has not been demonstrated.

Conditions of Acceptance:

- Twelve conditions of acceptance are outlined in the 12-15-2008 acceptance letter.

Comments: None

Installations: Unknown

---

**8) Aquionics - 18000+**

Description: Closed Vessel

References:

- Conditional acceptance letter dated February 5, 2009 from CDPH.
- Report entitled "Aquionics Inc. InLine+ UV Disinfection Systems Validation Report" by Carollo Engineers (April 2008).
- Acceptance granted under the outdated May 2003 NWRI Guidelines. Compliance with the latest NWRI Guidelines has not been demonstrated.

Conditions of Acceptance:

- Twelve conditions of acceptance are outlined in the 02-05-2009 acceptance letter.

Comments: None

Installations: Unknown



---

---

**9) De Nora Capital Controls (formerly Calgon) – C3 500D**

Description: 574-W low pressure/high output open channel reactor

References:

- Conditional acceptance letter dated February 13, 2012 from CDPH.
- Report entitled "Calgon Carbon C3 500 Wastewater UV Reactor Validation Report" by Carollo Engineers (January 2010).
- Acceptance granted under the outdated May 2003 NWRI Guidelines. Compliance with the latest NWRI Guidelines has not been demonstrated.

Conditions of Acceptance:

- Ten conditions of acceptance are outlined in the 2-13-2012 acceptance letter.

Comments: Reactor renamed from 500 to 500D. Horizontally mounted lamps spaced at 6-inches. Has calibrated germicidal sensor. Uses dose-pacing methodology relying on UV sensor readings.

Installations: Coast Guard TRACEN Petaluma base

---

---

**10) Enaqua - Enlight UV System 60 mm Tubes**

Description: closed vessel, low-pressure high-output lamps.

References:

- Conditional acceptance letter dated October 6, 2017 from DDW.
- Report entitled "Enaqua Enlight Non-Contact UV System NWRI Validation Report Final", by Carollo Engineers (November 2016).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Sixteen conditions of acceptance are outlined in the 10-6-2017 acceptance letter.

Comments: Non-contact UV system that consists of UV lamps, sensors, and electrical components outside of the water. A single reactor consists of one 60 mm plastic pipe (AFP840TM) surrounded by at least six low-pressure high-output lamps and four reflectors.

Installations: Unknown

---

---

**11) Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-6800-10**

Description: Six 800-W low pressure/high output lamps within a 10-inch diameter closed vessel reactor.

References:

- Conditional acceptance letter dated July 15, 2014 from DDW.
- Report entitled “Engineered Treatment Systems/ATG UV Technology UVLW-6800-10 Closed Vessel UV Reactors Validation Report” by Carollo Engineers, (April 2013).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Sixteen conditions of acceptance are outlined in the 10-6-2017 acceptance letter.

Comments: Lamps are mounted horizontally and parallel to the flow, within a 10-inch diameter closed vessel reactor. Has a calibrated germicidal sensor. The operating approach uses a “dose-pacing” methodology, relying on detailed and accurate UV sensor readings.

Installations: Descanso Gardens

---

**12) Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-6800-14**

Description: Six 800-W low pressure/high output lamps within a 14-inch diameter closed vessel reactor.

References:

- Conditional acceptance letter dated July 29, 2014 from DDW.
- Report entitled “Engineered Treatment Systems/ATG UV Technology UVLW-6800-14 Closed Vessel UV Reactors Validation Report” by Carollo Engineers, (April 2013)
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 07-29-2014 acceptance letter.

Comments: Lamps are mounted horizontally and parallel to the flow, within a 14-inch diameter closed vessel reactor. Has a calibrated germicidal sensor. The operating approach uses a “dose-pacing” methodology, relying on detailed and accurate UV sensor readings.

Installations: Unknown

---

**13) Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-8800-14**

Description: Eight 800-W low pressure/high output lamps within a 14-inch diameter closed vessel reactor.

References:

- Conditional acceptance letter dated September 16, 2014 from DDW.
- Report entitled “Engineered Treatment Systems/ATG UV Technology UVLW-8800-14 Closed Vessel UV Reactors Validation Report” by Carollo Engineers, (April 2013).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 09-16-2014 acceptance letter.

Comments: Lamps are mounted horizontally and parallel to the flow, within a 14-inch diameter closed vessel reactor. Has a calibrated germicidal sensor. The operating approach uses a “dose-pacing” methodology, relying on detailed and accurate UV sensor readings.

Installations: Unknown

---

**14) Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-16800-20**

Description: Sixteen 800-W low pressure/high output lamps within a 20-inch diameter closed vessel reactor.

References:

- Conditional acceptance letter dated May 24, 2016 from DDW.
- Report entitled “Engineered Treatment Systems/ATG UV Technology UVLW Series Closed Vessel UV Reactors Validation Report” by Carollo Engineers, (April 2013).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 05-24-2016 acceptance letter.

Comments: Lamps are mounted horizontally and parallel to the flow, within a 20-inch diameter closed vessel reactor. Has a calibrated germicidal sensor. The operating approach uses a “dose-pacing” methodology, relying on detailed and accurate UV sensor readings. Accepted up to 2.54 MGD per reactor.

Installations: Unknown

---

**15) Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-20800-20**

Description: Twenty 800-W low pressure/high output lamps within a 20-inch diameter closed vessel reactor.

References:

- Conditional acceptance letter dated October 27, 2014 from DDW.
- Report entitled “Engineered Treatment Systems/ATG UV Technology UVLW-20800-20 Closed Vessel UV Reactors Validation Report” by Carollo Engineers (April 2013).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 10-27-2014 acceptance letter.

Comments: Lamps are mounted horizontally and parallel to the flow, within a 20-inch diameter closed vessel reactor. Has a calibrated germicidal sensor. The operating approach uses a “dose-pacing” methodology, relying on detailed and accurate UV sensor readings. Accepted up to 4.63 MGD per reactor.

Installations: Unknown

---

**16) Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-22800-24**

Description: Twenty-two 800-W low pressure/high output lamps within a 24-inch diameter closed vessel reactor.

References:

- Conditional acceptance letter dated June 26, 2015 from DDW.

- Report entitled “Engineered Treatment Systems/ATG UV Technology UVLW Series Closed Vessel UV Reactors Validation Report” by Carollo Engineers (April 2013).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 06-26-2015 acceptance letter.

Comments: Lamps are mounted horizontally and parallel to the flow, within a 24-inch diameter closed vessel reactor. Has a calibrated germicidal sensor. The operating approach uses a “dose-pacing” methodology, relying on detailed and accurate UV sensor readings. Accepted up to 2.72 MGD per reactor.

Installations: Unknown

---

**17) Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-30800-24**

Description: Thirty 800-W low pressure/high output lamps within a 24-inch diameter closed vessel reactor.

References:

- Conditional acceptance letter dated October 24, 2014 from DDW.
- Report entitled “Engineered Treatment Systems/ATG UV Technology UVLW-30800-24 Closed Vessel UV Reactors Validation Report” by Carollo Engineers (April 2013).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 10-24-2014 acceptance letter.

Comments: Lamps are mounted horizontally and parallel to the flow, within a 24-inch diameter closed vessel reactor. Has a calibrated germicidal sensor. The operating approach uses a “dose-pacing” methodology, relying on detailed and accurate UV sensor readings. Accepted up to 9.67 MGD per reactor.

Installations: Unknown

---

**18) Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-30800-30**

Description: Thirty 800-W low pressure/high output lamps within a 30-inch diameter closed vessel reactor.

References:

- Conditional acceptance letter dated May 27, 2015 from DDW.
- Report entitled “Engineered Treatment Systems/ATG UV Technology UVLW Series Closed Vessel UV Reactors Validation Report” by Carollo Engineers, (April 2013).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 05-27-2015 acceptance letter.

Comments: Lamps are mounted horizontally and parallel to the flow, within a 30-inch diameter closed vessel reactor. Has a calibrated germicidal sensor. The operating approach uses a “dose-pacing” methodology, relying on detailed and accurate UV sensor readings. Accepted up to 8.22 MGD per reactor.

Installations: Unknown

---

**19) Evoqua (formerly Engineered Treatment Systems)/ATG UV Systems – UVLW-45800-30**

Description: Forty-five 800-W low pressure/high output lamps within a 30-inch diameter closed vessel reactor.

References:

- Conditional acceptance letter dated August 14, 2014 from DDW.
- Report entitled “Engineered Treatment Systems/ATG UV Technology UVLW-45800-30 Closed Vessel UV Reactors Validation Report” by Carollo Engineers (April 2013)
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 08-14-2014 acceptance letter.

Comments: Lamps are mounted horizontally and parallel to the flow, within a 30-inch diameter closed vessel reactor. Has a calibrated germicidal sensor. The operating approach uses a “dose-pacing” methodology, relying on detailed and accurate UV sensor readings. Accepted up to 10.77 MGD per reactor.

Installations: Unknown

---

## 20) NeoTec – Aqua D438™

Description: Single closed vessel reactor with two 111-W low pressure/high output bulbs.

References:

- Conditional acceptance letter dated December 30, 2013 from CDPH.
- Report entitled "NeoTech Aqua D438™ UV System: Validation Testing Final Report" by Trussell Technologies, Inc. and Carollo Engineers (August 2012)
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Eleven conditions of acceptance for non-potable reuse applications and thirteen conditions of acceptance for potable reuse applications are outlined in the 12-30-2013 acceptance letter.

Comments: The 2012 report was tested for reverse osmosis permeate and advanced oxidation process applications. DDW has recently reviewed a validation performed by NSF International Lab, dated September 30, 2019. While the 2019 report does not follow the 2012 NWRI UV guidelines, it provides limited information to accept the following conditions:

Based upon the recent NeoTech Aqua D438 validation by NSF, these are the following reactor configuration options:

1. Recycled water filtered by media at a minimum UVT of 55%. A dose of 40 mJ/cm<sup>2</sup> was measured at full power at a flow of 40 gallons per minute. The UV intensity was 0.8 mW/cm<sup>2</sup>. The log inactivation was two. To meet the minimum 100 mJ/cm<sup>2</sup> dose, three reactors must operate in series and operate at the UV intensity of 0.8 mW/cm<sup>2</sup> or greater. While this provides a dose of 120 mJ/cm<sup>2</sup>, the NSF validation does not provide any information at any other UV intensity or flow when the UVT is between 55% and 67%. Therefore, three reactors in series are required.
2. Recycled water filtered by membrane at a minimum UVT of 67%. A dose of 30 mJ/cm<sup>2</sup> was measured at a flow of up to 83 gallons per minute. The UV intensity was 1.9 mW/cm<sup>2</sup>. The average log inactivation was 1.7. To meet the minimum dose of 80 mJ/cm<sup>2</sup>, there are two reactor configuration options:

- a. Two reactors in series at a flow no more than 40 gpm and operate at the UV intensity of 0.8 mW/cm<sup>2</sup> or greater (see option 1 above in which two in series adds up to 80 mJ/cm<sup>2</sup>).
- b. Three reactors in series at a flow no more than 83 gpm and operate at the UV intensity of 1.9 mW/cm<sup>2</sup> or greater. While this provides a dose of 90 mJ/cm<sup>2</sup>, the NSF validation does not provide any information at any other UV intensity or flow when the UVT is 67%. Therefore, three reactors in series are required.

Installations: Unknown

---

## **21) NeoTec – Open Channel NOL-HM**

Description: 320-W low pressure/high output open channel reactor.

### References:

- Conditional acceptance letter dated September 30, 2013 from CDPH.
- Report entitled "Neotec Open Channel NOL-HM Wastewater UV Reactor Validation Report" by Carollo Engineers (December 2012).
- Acceptance granted under the August 2012 NWRI Guidelines.

### Conditions of Acceptance:

- Twelve conditions of acceptance are outlined in the 09-23-2013 acceptance letter.

Comments: Horizontally mounted lamps parallel to the flow spaced at 10-cm.  
Has calibrated germicidal sensor. Uses dose-pacing methodology relying on UV sensor readings.

Installations: Unknown

---

## **22) Quay Technologies - OCS 6000 Microwave**

Description: Electrodeless UV lamps

### References:

- Conditional acceptance letter dated June 8, 2007 from CDPH.
- Report entitled "Quay Technologies, Ltd. OCS 6000 Microwave UV Validation Report" by Carollo Engineers (September 2006).
- Acceptance granted under the outdated May 2003 NWRI Guidelines.  
Compliance with the latest NWRI Guidelines has not been demonstrated.



Conditions of Acceptance:

- Eight conditions of acceptance are outlined in the 06-08-2007 acceptance letter.

Comments: Piloted at City of Roseville. Instead of utilizing electrodes, microwave energy is generated by magnetrons and directed through wave guides into the quartz lamp sleeves containing the gas filling. The directed microwave energy excites the argon atoms, which in turn excite the mercury atoms to produce radiation.

Installations: Unknown

---

### **23) Trojan Technologies – TojanUVFit 04AL20**

Description: Closed vessel with four 0.25-kW low-pressure high-output lamps.

References:

- Conditional acceptance letter dated August 2, 2017 from DDW, based upon the 2016 Carollo report, presenting the results of the 2009 bioassays analyzed per the August 2012 NWRI Guidelines. This amends the UV dose equations in the 2010 Carollo validation report.
- Report entitled "Addendum – TrojanUVFit 04AL20 Validation report 2012 NWRI Analysis of the TrojanUVFit 04AL20 Reactor Validation Data" by Carollo Engineers (September 2016).

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 08-02-2017 acceptance letter.

Comments: Ballasts adjustable from 60 to 100 percent full power. Four lamps horizontally mounted and parallel to the flow in a 4-inch diameter closed vessel. Has calibrated germicidal sensor. Uses dose-pacing methodology relying on UV sensor readings.

Installations: Facebook Campus Water Reclamation Facility Menlo Park

---

### **24) Trojan Technologies – TojanUVFit 8AL20**

Description: Closed vessel with eight 0.25-kW low-pressure high-output lamps.

References:

- Conditional acceptance letter dated February 25, 2021 from DDW, based upon the 2016 Carollo report, presenting the results of the 2008 bioassays analyzed per the August 2012 NWRI Guidelines. This amends the UV dose equations in the 2010 Carollo validation report.
- Report entitled "Addendum – TrojanUVFit 8AL20 Validation report 2012 NWRI Analysis of the TrojanUVFit 8AL20 Reactor Validation Data" by Carollo Engineers (September 2016).

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 02-25-2021 acceptance letter.

Comments: Eight low-pressure high-output lamps horizontally mounted in an 8-inch diameter closed vessel. Ballasts adjustable from 60 to 100 percent full power. Has calibrated germicidal sensor. Uses dose-pacing methodology relying on UV sensor readings.

Installations: Unknown

## **25) Trojan Technologies – TojanUVFit 18AL40**

Description: Closed vessel with eighteen 250-W low pressure/high output bulbs.

References:

- Conditional acceptance letter dated August 19, 2014 from DDW.
- Report entitled " Addendum – TrojanUVFit™ 18AL40 Validation Report 2012 NWRI Analysis of the TrojanUVFit™ 18AL40 Reactor Validation Data" by Carollo Engineers (August 2014).
- This 2014 report replaces the old validation report of 2009. The 2014 report presents the results of the December 2009 bioassay analyzed per the 2012 NWRI Guidelines.
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 08-19-2014 acceptance letter.

Comments: Horizontally mounted lamps parallel to the flow spaced within a 16-inch diameter closed vessel. Has calibrated germicidal sensor. Uses dose-pacing methodology relying on UV sensor readings.

Installations: North Fresno Wastewater Reclamation Facility, City of Pacific Grove

**26) Trojan Technologies – TojanUVFit 32AL50**

Description: closed vessel, low pressure/high output.

References:

- Conditional acceptance letter dated January 24, 2012 from CDPH.
- Report entitled "Trojan Technologies, TrojanUVFit 32AL50 Validation Report", by Carollo Engineers (September 2009).
- Acceptance granted under the outdated May 2003 NWRI Guidelines.
- Conditional acceptance letter dated August 20, 2018 from DDW, based upon the 2016 Carollo report, presenting the results of the November 2008 bioassays analyzed per the August 2012 NWRI Guidelines. This amends the UV dose equations in the 2009 Carollo validation report.
- Report entitled "Addendum - TrojanUVFit™ 32AL50 Validation Report, 2012 NWRI Analysis of the TrojanUVFit™ 32AL50 Reactor Validation Data" by Carollo Engineers (September 2016).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 08-20-2018 acceptance letter.

Comments: Ballasts adjustable from 60 to 100 percent full power. 32 lamps utilizing 0.25-kW LPHO lamps in a horizontally mounted in 20-inch closed vessel. Has a calibrated germicidal sensor. Uses dose-pacing methodology relying on UV sensor readings.

Installations: Sharon Heights Plant West Bay Sanitation District

---

**27) Trojan Technologies – TojanUVFit 72AL75**

Description: closed vessel, low pressure/high output.

References:

- Conditional acceptance letter dated August 24, 2012 from CDPH.
- Report entitled "Trojan Technologies, TrojanUVFit 72AL75 Validation Report", by Carollo Engineers (November 2009).
- Revised conditional acceptance letter dated December 5, 2017 from DDW, based upon the 2015 Carollo report, presenting the results of the 2008 bioassays analyzed per the August 2012 NWRI Guidelines. This amends the UV dose equations in the November 2009 Carollo validation report.
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 12-05-2017 acceptance letter.

Comments: Ballasts adjustable from 60 to 100 percent full power. 72 lamps horizontally mounted in 30-inch diameter closed vessel. Has a calibrated germicidal sensor. Uses dose-pacing methodology relying on UV sensor readings.

Installations: Las Galinas, Fresno Clovis Regional Wastewater Reclamation Facility Fresno

---

---

## **28) Trojan Technologies – TojanUVFit D72AL75**

Description: Dual configuration, closed vessel with seventy-two 0.25-kW low-pressure high-output lamps.

References:

- Conditional acceptance letter dated August 16, 2017 from DDW, based upon the 2015 Carollo report, presenting the results of the 2008 bioassays analyzed per the August 2012 NWRI Guidelines. This amends the UV dose equations in the 2009 Carollo validation report. Report entitled "Addendum – TrojanUVFit D72AL275 Validation report 2012 NWRI Analysis of the TrojanUVFit D72AL275 Reactor Validation Data" by Carollo Engineers (August 2015).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 08-16-2017 acceptance letter.

Comments: Dual configuration consisting of two reactors within one chamber in a vessel. Seventy-two low-pressure high-output lamps horizontally mounted in a 30-inch diameter closed vessel. Ballasts adjustable from 60 to 100 percent full power. Has calibrated germicidal sensor. Uses dose-pacing methodology relying on UV sensor readings.

Installations: Unknown

---

---

### **29) Trojan Technologies – UV 3000**

Description: low pressure/low intensity open channel reactor.

References:

- Acceptance granted under the outdated December 2000 NWRI Guidelines. Compliance with the latest NWRI Guidelines has not been demonstrated.
- "Equivalency of the Trojan System UV4000 and System UV3000 in Meeting California Wastewater Reclamation Criteria at Pacifica, California", June 1994

Comments: None

Installations: City of Escondido, Olivenhain WD (replaced with Wedeco Duron in 2020), UC Davis WTP

---

---

### **30) Trojan Technologies – UV 3000+**

Description: low pressure/high output open channel reactor.

References:

- Revised conditional acceptance letter from CDPH dated July 23, 2009 for UV 3000+ (including modified end-of-lamp-life factor of 0.98). Amended October 30, 2003, October 24, 2005 (concerning lamp spacing), October 5, 2006 (concerning sleeve fouling factor of 0.95).
- Report entitled "Addendum – UV 3000Plus (4" lamp spacing) Validation Report 2012 NWRI Analysis" by Carollo Engineers (April 2014) replaces the reactor validation performed in 2005.
- Revised conditional acceptance letter dated June 16, 2014 from CDPH, based upon the 2014 Carollo report, presenting the results of the 2005 bioassay analyzed per the August 2012 NWRI Guidelines.
- Compliance with the latest 2012 NWRI Guidelines with a new UV dose operational equation granted in a CDPH letter dated June 16, 2014.

Conditions of Acceptance:

- Fourteen conditions of acceptance are outlined in the 06-16-2014 acceptance letter.

Comments: None

Installations: LACSD Whittier Narrows, City of Fillmore, City of Roseville, City of Watsonville, City of Soledad, City of Healdsburg, La Contenta Calaveras County WD, CA Correctional Institute Tehachapi, Rosemead Community Sanitary District, Susanville Sanitary District, California Men's Colony, City of Woodland, City of Colusa, City of Modesto, Yucaipa Valley WD Wochholz Regional WRF

---

---

**31) Trojan Technologies – UV 4000**

Description: medium pressure/low intensity open channel reactor.

References:

- Conditional acceptance letter from CDPH dated September 8, 1995 for UV4000.
- Report entitled "Trojan System UV4000 UV Disinfection Pilot Study. Riverside, California", by Trojan Technologies Inc. (May 1995).
- "Equivalency of the Trojan System UV4000 and System UV3000 in Meeting California Wastewater Reclamation Criteria at Pacifica, California", June 1994
- "Technical Review: Ultraviolet Disinfection of Wastewater to California Wastewater Reclamation Criteria (Title 22, Division 4, Chapter 3, of the California Code of Regulations) Using Trojan Technologies' System UV4000 (High Intensity UV Lamp Technology)", August 1995.
- Acceptance granted under the outdated 1993 NWRI Guidelines. Compliance with the latest NWRI Guidelines has not been demonstrated.

Conditions of Acceptance:

- Continuous monitoring/recording of filter effluent turbidity (pre UV);
- Daily coliform monitoring (disinfected effluent);
- Provide UV dose of at least 100 mW-sec/cm<sup>2</sup> under worst operating conditions at peak daily instantaneous flow with a minimum of three banks in operation and a UV dose of at least 140 mW-sec/cm<sup>2</sup> with a minimum of four banks in operation, subject to all of the conditions indicated in the NWRI Guidelines.

Comments: None

Installations: City of San Diego South Bay WRF (replaced with Trojan Signa in 2020), City of Pacifica, City of Santa Rosa

---

---

**32) Trojan Technologies – TrojanUVSignaTM**

Description: open channel system with 1000-W low-pressure high-output lamps.

References:

- Conditional acceptance letter dated March 17, 2017 from DDW.
- Report entitled "TrojanUVSignaTM (2-Row) CA NWRI 2012 Validation Report Revision 1 Final", by Carollo Engineers (January 2017).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 03-17-2017 acceptance letter.

Comments: Open channel system with 1,000-W low-pressure high-output amalgam lamps oriented at 45-degree angle to the direction of flow. Has a calibrated germicidal sensor. The operating approach uses a “dose-pacing” methodology, relying on detailed and accurate UV sensor readings.

Installations: City of San Diego South Bay WRF, City of Beaumont. City of Paso Robles, East Vally Water District (Sterling Natural Resource Center)

---

---

### **33) Xylem Water Solutions Wedeco – LBX 90**

Description: Low pressure/High Output/closed vessel

References:

- Conditional acceptance letter dated August 21, 2008 from CDPH.
- Report entitled “LBX UV Disinfection System Validation Report” by Carollo Engineers (July 2008).
- Acceptance granted under the outdated May 2003 NWRI Guidelines. Compliance with the latest NWRI Guidelines has not been demonstrated.

Conditions of Acceptance:

- Eleven conditions of acceptance are outlined in the 08-21-2008 acceptance letter.

Comments: Tested on potable water; therefore acceptance is limited to membrane filtered effluent per NWRI. This system has a 20.8-cm chamber and four 330-w LPHO lamps applicable for flow rates ranging from 0.037 to 0.432 MGD (26 to 300 GPM) at UTVs ranging from 55.6 to 77 percent, and sensor intensities ranging from 2.1 to 8.0 mW/cm<sup>2</sup>.

Installations: General Services Authority San Ysidro Point of Entry

---

---

### **34) Xylem Water Solutions Wedeco – LBX 400**

Description: Low pressure/High Output/closed vessel

References:

- Conditional acceptance letter dated August 14, 2008 from CDPH.

- Report entitled "LBX UV Disinfection System Validation Report" by Carollo Engineers (July 2008).
- Acceptance granted under the outdated May 2003 NWRI Guidelines. Compliance with the latest NWRI Guidelines has not been demonstrated.

Conditions of Acceptance:

- Eleven conditions of acceptance are outlined in the 08-14-2008 acceptance letter.

Comments: Tested on potable water; therefore acceptance is limited to membrane filtered effluent per NWRI. This system has a 38.1-cm chamber and sixteen 330-w LPHO lamps applicable for flow rates ranging from 0.25 to 1.37 MGD (174 to 951 GPM) at UTVs ranging from 46 to 75 percent, and sensor intensities ranging from 2.8 to 9.2 mW/cm<sup>2</sup>.

Installations: Unknown

---

### **35) Xylem Water Solutions Wedeco – LBX 850E**

Description: closed channel with 32 320-W low pressure/high output lamps

References:

- Conditional acceptance letter dated February 8, 2016 from DDW.
- Report entitled "Xylem Water Solutions WEDECO LBX 850E UV System NWRI 2012 Validation Report", by Carollo Engineers (October 2015).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 02-08-2016 acceptance letter.

Comments: The system is a closed channel reactor with a horizontally aligned, stainless steel cylinder, 1966 mm in length and a 560-mm internal diameter. There are 32 amalgam low pressure gas discharge 320-W lamps that are configured parallel to the flow, arranged in three concentric circles with 5, 10, and 17 lamps progressively in each circle. Uses a flow conditioner, consisting of three concentric stainless steel rings mounted inside the inlet portion of the reactor flush with the inlet flange. Has calibrated germicidal sensor. Uses dose-pacing methodology relying on UV sensor readings.

Installations: Victor Valley WRA Hesperia plant, Victor Valley WRA Apple Valley plant

---



### **36) Xylem Water Solutions Wedeco – LBX 1000**

Description: Low pressure/High Output/closed vessel

References:

- Conditional acceptance letter dated December 14, 2007 from CDPH.
- Report entitled “LBX 1000 UV Disinfection System Validation Report” by Carollo Engineers (December 2007).
- Acceptance granted under the outdated May 2003 NWRI Guidelines. Compliance with the latest NWRI Guidelines has not been demonstrated.

Conditions of Acceptance:

- Ten conditions of acceptance are outlined in the 12-14-2007 acceptance letter.

Comments: Tested on potable water; therefore acceptance is limited to membrane filtered effluent per NWRI. This system has a 65.5-cm chamber and forty 330-w LPHO lamps applicable for flow rates ranging from 0.58 to 3.51 MGD (403 to 2,438 GPM) at UTVs ranging from 54 to 77 percent, and sensor intensities ranging from 1.9 to 7.5 mW/cm<sup>2</sup>.

Installations: City of Clovis, Santa Clara Valley WD, City of Modesto

---

### **37) Xylem Water Solutions Wedeco – LBX 1500E**

Description: closed channel with 60 320-W low pressure/high output lamps

References:

- Conditional acceptance letter dated July 6, 2016 from DDW.
- Report entitled “Xylem Water Solutions WEDECO LBX 1500E UV System NWRI 2012 Validation Report”, by Carollo Engineers (September 2015).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 06-28-2016 acceptance letter.

Comments: This system has a stainless steel cylinder (1515 mm in length and a 32-mm internal diameter) and 60 amalgam low pressure gas discharge 320-W lamps applicable for flow rates ranging from 0.5 – 13.5 MGD, at UVTs from 19.9 – 98.04 percent, and sensor intensities ranging from 7.37 – 310.7 W/m<sup>2</sup>. Has calibrated germicidal sensor. Uses dose-pacing methodology relying on UV sensor readings.

Installations: Cayucos Sanitary District, Hi-Desert Water District

---

**38) Xylem Water Solutions Wedeco – TAK-55 320W**

Description: Low pressure/High Output/open channel

References:

- Conditional acceptance letter dated September 24, 2012 from CDPH.
- Report entitled “Wedeco Open Channel TAK-55 Wastewater UV Reactor 320W Validation Report” by Carollo Engineers (January 2010).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Ten conditions of acceptance are outlined in the 09-24-2012 acceptance letter.

Comments: The system utilizes 320-Watt low-pressure high-output (LPHO) lamps that are mounted horizontally and parallel to the flow, with a spacing 110 mm. Has calibrated germicidal sensor. Limited to 8.2-92.1 gpm/lamp, UVT $\geq$  54%, and UV sensor intensities ranging from 1.42 to 4.68 mW/cm<sup>2</sup>.

Installations: Victor Valley WRA Westside plant, South County Regional Wastewater Authority Gilroy

---

**39) Xylem Water Solutions Wedeco – TAK-55HP**

Description: Low pressure/High Output/open channel

References:

- Conditional acceptance letter dated November 24, 2003 from CDPH.
- Report entitled “Wedeco Ultraviolet Technologies TAK 55HP Validation Report” by Carollo Engineers (October 2003).
- Acceptance granted under the outdated May 2003 NWRI Guidelines. Compliance with the latest NWRI Guidelines has not been demonstrated.
- Revised end-of-lamp age factor for SLR 32143 HP lamp modified from 0.91 to 0.88 at 10,074 hours per letter from CDPH dated May 19, 2005.

Comments: None

Installations: LACSD Lancaster, City of Lincoln, Dublin San Ramon Services District

---

#### **40) Xylem Water Solutions – Wedeco Duron UV System**

Description: Open channel with twelve 600-W low-pressure high-output lamps.

References:

- Conditional acceptance letter dated July 30, 2015 from DDW.
- Report entitled "Xylem Water Solutions Duron UV System 2012 NWRI Validation Report " by Carollo Engineers (February 2015).
- Acceptance granted under the August 2012 NWRI Guidelines.

Conditions of Acceptance:

- Twenty conditions of acceptance are outlined in the 07-30-2015 acceptance letter.

Comments: The tested Duron UV system consisted of one channel of four UV modules. Each module contained two staggered rows of six 600-W low-pressure high-output lamps in each row that are mounted perpendicular to the flow at a 45-degree angle within an open channel reactor. Has a calibrated germicidal sensor. Uses dose-pacing methodology relying on UV sensor readings.

Installations: City of Shasta Lake, Olivenhain Municipal Water District, City of Santa Clarita Vista Canyon plant, Tesoro Viejo City of Madera

---