Non-contact UV disinfection systems

Dry · Simple · Intelligent · Energy Efficient

ENAQUA™

Designed and manufactured in USA

The right choice

UV is the most cost effective and environmental friendly disinfection solution for wastewater.

About UV Disinfection

Ultraviolet light irradiation is a proven disinfection process using short wave length 254nm Ultraviolet (UV) energy to inactivate harmful microorganisms. UV radiation disrupts the DNA of pathogenic organisms such as bacteria, viruses and molds, leaving them unable to reproduce. UV has been used to disinfect various types of effluent from low-quality combined sewer overflow (CSO) to high-quality tertiary effluent since early 1900's.

UV – The preferred disinfection method in municipal wastewater

To comply federal Clean Water Act, and other regulations for indicator organisms, municipal wastewater must be disinfected before discharging or reusing. There are multiple options for chemical disinfection, but only one non-chemical disinfection technology. UV is the preferred disinfection method for municipal wastewater discharge or water reuse applications various chemical disinfection technologies. Currently more than 20% of wastewater treatment plants in the United States use UV as their preferred disinfection technology and this percentage has been increasing year over year.

Enaqua – a history of innovation

1985	1990	1992	1993	1997	1999	2003	2007	2009
Enaqua founded								
First Non-Contact UV System Water Technology Consulting	Patented Non-Contact Opaque Fluid UV System	Chemical Recovery RO Systems Brackish Water RO Systems	Municipal UV Waste-water System	Distribution of Membrane Products	Large Municipal UV Waste-water Systems	Seawater De-salination RO Systems	UV Web-based Control System	UV / UF / RO Municipal Waste-water Systems

4010403_EWT_Enaqua_Bro_r12_DSH_ART1_XHI.indd 2 12/04/2018 09.57

2012	2013	2015	2017	2022
Acquisition by Grundfos				
Ensure Dosing System(EDS)* SMART Lamps*	$11 Million UV/ UF/ RO Chemical Recovery System	Validation test NWRI Title 22 and T1	Approval for CA Title 22 recycled water	Acquired by Management

**Patent pending*

Advantages & benefits

Compared to conventional chlorination

	Ultraviolet light	Sodium hypochlorite	Chlorine gas
Disinfection effectiveness	**High**	**High***	**High***
Disinfection by products	**No**	**Yes**	**Yes**
Safety risks	**Low**	**High**	**High**
De-chlorination required	**No**	**Yes**	**Yes**
Contact channel	**Small**	**Large**	**Large**
pH dependency, Corrosion	**No**	**Yes**	**Yes**
O&M Cost	**Low**	**High**	**Medium**
Capital Investment	**Medium**	**Low**	**High**

**Cryptosporidium and Giardia are resistant against chlorination*

Third party validated technology, approved for CA Title 22 Recycled Water.

Enaqua is the first non-contact UV system supplier to have applied and received Third Party Validation, as a result of continuous efforts improving the Non-Contact UV disinfection technology. The validation testing and reports were conducted in 2015 by Carollo Engineers in accordance with the following protocols:

1. UV - Disinfection Guidelines for Drinking Water and Water Reuse (National Water Research Institute [NWRI]), August 2012
   - 53% to 80.0 % UVT range validated*
2. Uniform Protocol for Wastewater UV Validation Applications (International Ultraviolet Association [IUVA], 2011) – 36.0% to 81.0% UVT validated range*
   - MS2 Bacteriophage
   - T1 Coliphage

Validation Test Certification

for the

Enaqua Enlight Non-Contact Ultraviolet Disinfection System

This Document certifies that validation testing was conducted on the Enaqua Enlight Non-Contact UV disinfection system manufactured by Enaqua.

The validation testing was conducted by Carollo Engineers in accordance with the Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse (National Water Research Institute [NWRI]/American Water Works Association Research Foundation [AwwaRF], August 2012). Bioassay testing was performed in August and September of 2015 in Ramona, California. Carollo Engineers conducted oversight on all validation testing, analyzed the test data, and developed the performance models. All microbiology services were conducted by GAP Laboratories, Canada.

Disinfection Principal Technologist

Senior Technologist

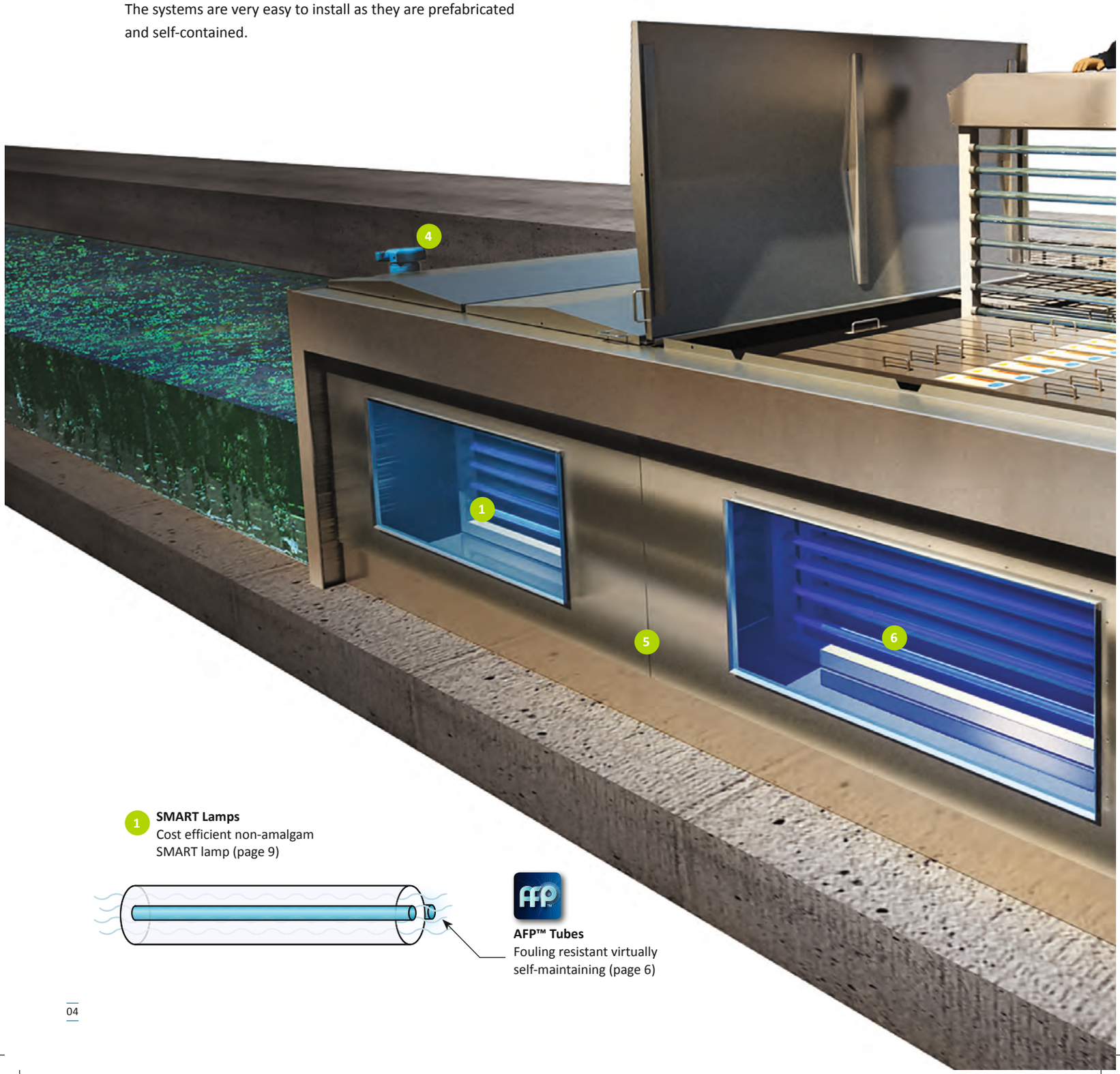
**Please contact Enaqua for validation range, parameters, and other technical details.*

4010403_EWT_Enaqua_Bro_r12_DSH_ART1_XHI.indd 3 12/04/2018 09.57

UV made simple – features at a glance

All of Enaqua's Non-Contact UV disinfection systems are built out of standard modules with high customization flexibility. The UV reactors are offered for both In-pipe or In-Channel configurations with variable plug & play inlets and outlets (page 10).

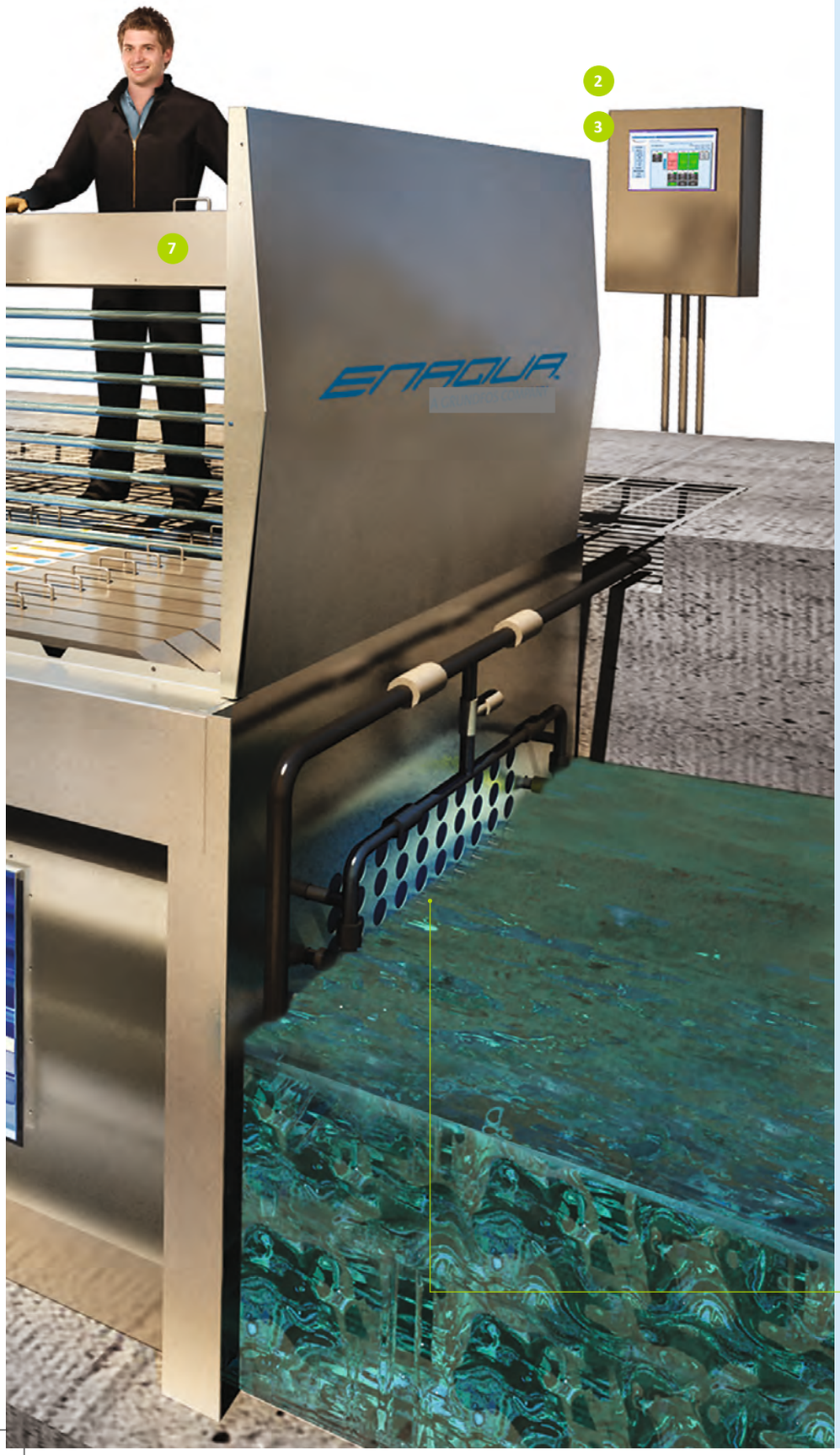
The systems are very easy to install as they are prefabricated and self-contained.



1 **SMART Lamps**
Cost efficient non-amalgam SMART lamp (page 9)

AFP™ Tubes
Fouling resistant virtually self-maintaining (page 6)

4010403_EWT_Enaqua_Bro_r12_DSH_ART1_XHI.indd 4 12/04/2018 09.57



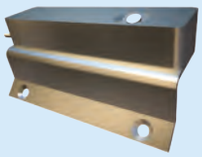
2 Ensure Dosing System (EDS)
Intelligent monitoring, control and FAIL SAFE ensures compliance at all times (page 8)

3 Electrical panel
Simple, compact and operator friendly HMI

4 Flow & Level pacing
Optimize energy consumption & life of consumables

5 Heat Exchange System
Controls reactor temperature for optimal UVC output using Effluent, plant W3 water, Potable, or Closed Loop system

6 UV Intensity Monitor
UV Sensor placed outside of AFP™ tubes – Dry without fouling



7 Individually fused and switched lamp racks
No cranes required, simple maintenance (page 7)

Single lamp ballast
Non-prorated Warranty up to 24 on/off cycles per day

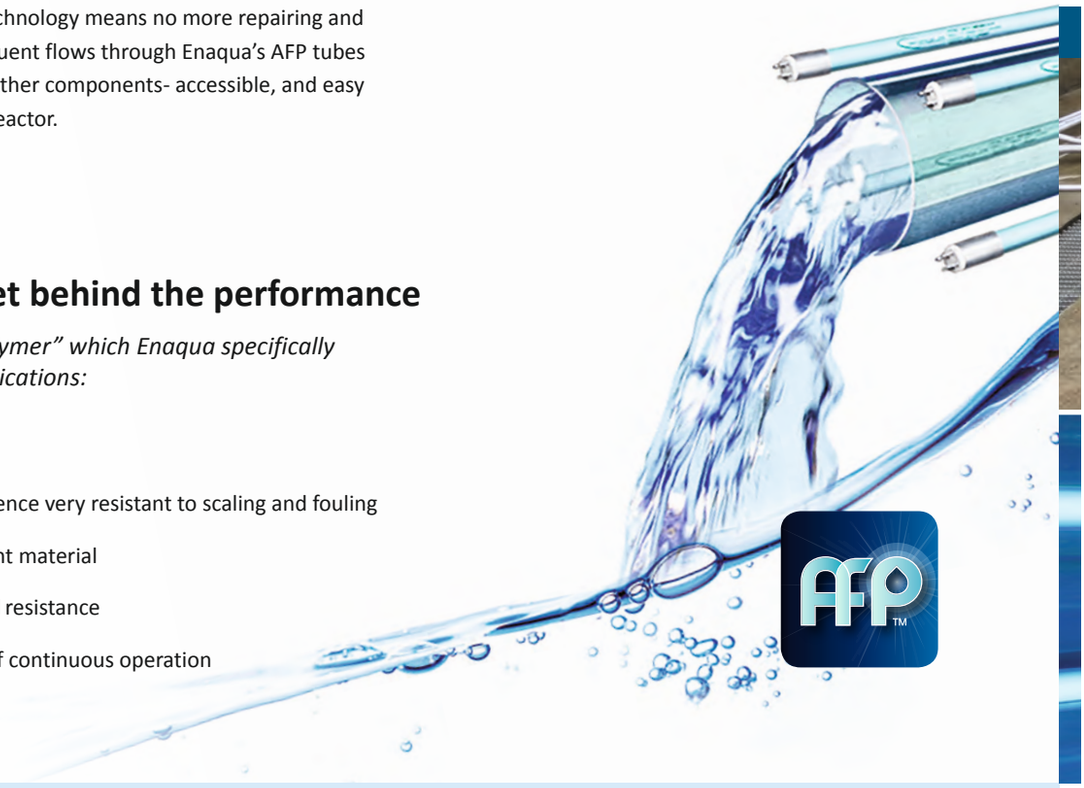
8 Controlled Water Level Downstream
No level control mechanism required – simple hydraulic design

4010403_EWT_Enaqua_Bro_r12_DSH_ART1_XHI.indd 5 12/04/2018 09.57

Always dry – AFP™ Non-Contact UV Technology

Enaqua – The Pioneer in cost effective Non-Contact UV design

Enaqua's innovative non-contact UV technology means no more repairing and replacing submerged components. Effluent flows through Enaqua's AFP tubes leaving the UV lamps, electronics and other components- accessible, and easy to maintain in the dry body of the UV reactor.



AFP™ tubes – The secret behind the performance

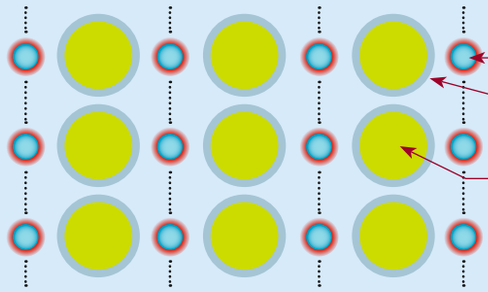
AFP stands for "Activated Fluoropolymer" which Enaqua specifically developed for Non-Contact UV applications:

- High transmissivity of UVC
- AFP Tubes have no micro-structure-hence very resistant to scaling and fouling
- Durable, flexible, and fracture resistant material
- Long term UVC stability and Chemical resistance
- Multiple plants with over 20+ years of continuous operation

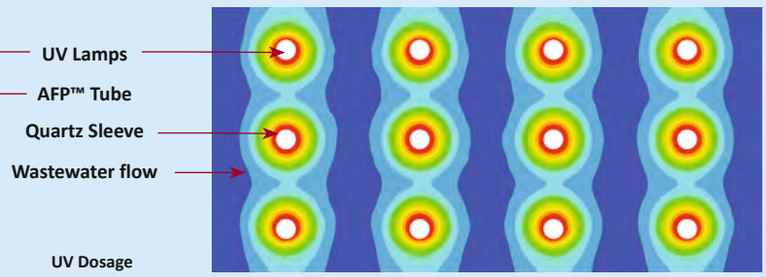
Technologies in comparison

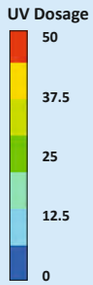
ENAQUA AFP™

Non-Contact Technology



Low cost high output lamps
No quartz sleeves
Fouling and Scaling Resistant AFP tube
Turbulent flow provides self-cleaning of AFP™ tube
No AFP tube replacement needed under normal operating conditions
Simple pipe hydraulics makes UV disinfection easy to predict
Level Control Devices typically not required





Quartz Sleeve UV

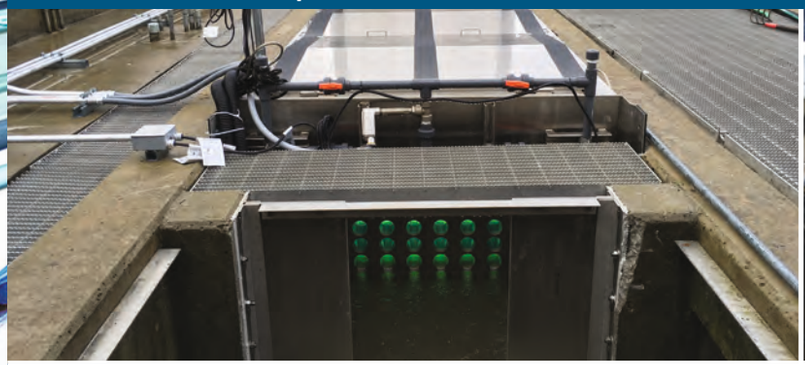
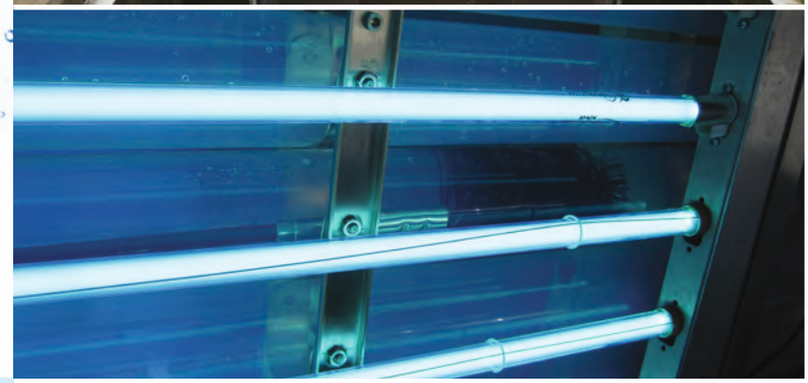
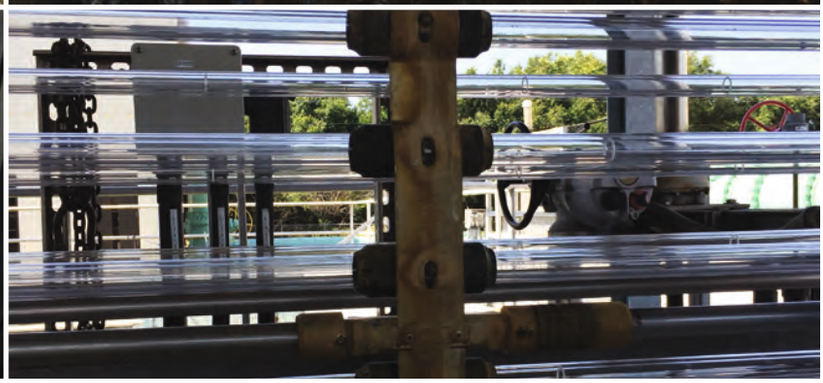
traditional Contact Technology

High cost amalgam lamps
Fragile quartz sleeves with risk of mercury and glass contamination
Fouling-prone quartz sleeves
Cleaning system required
Quartz sleeves need to be replaced over time
Channel hydraulics makes UV disinfection less predictable
Level control devices increase footprint

4010403_EWT_Enaqua_Bro_r12_DSH_ART1_XHI.indd 6 12/04/2018 09.57

Simple – maintenance made clean, fast and easy

Enaqua's Non-Contact UV technology system maintenance is simple:

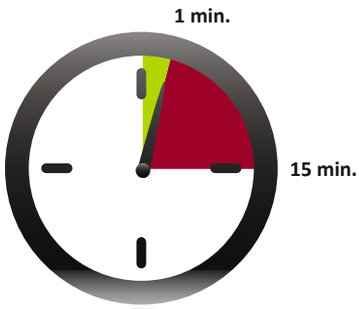
Enaqua's Non-Contact UV	Traditional Contact UV
	
	

No more:

- High cost amalgam lamps
- Dirty and fouled quartz sleeves
- Problems with quartz cleaning devices
- Need to interrupt or remove any hydraulic seals
- Heavy duty cranes required for system maintenance
- Minimize Civil and Structural construction costs
- Time consuming lamp replacements
- Algae growth on the lamp racks
- Quartz sleeves to break and replace*
- SCADA programming

**No AFP™ tube replacement under normal conditions (20+ year history)*

Typical lamp replacement time



1 minute – Enaqua's Non-Contact UV

15 minutes – Traditional Contact UV

4010403_EWT_Enaqua_Bro_r12_DSH_ART1_XHI.indd 7 12/04/2018 09.57

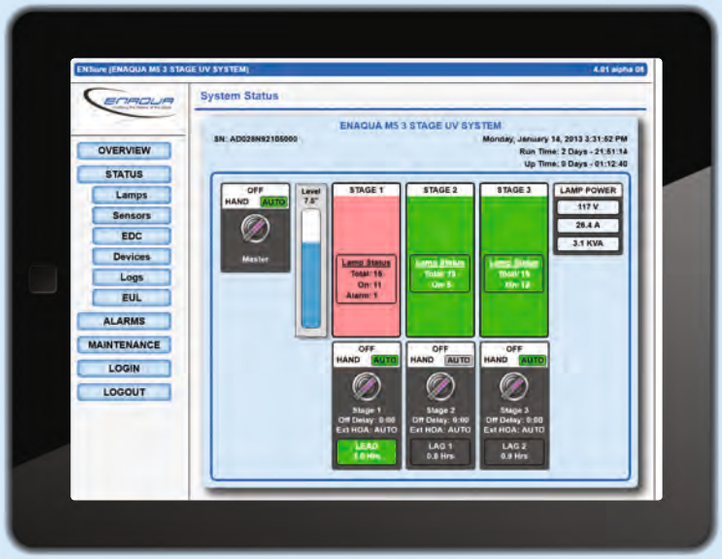
Intelligence – you don’t want to miss...

Where Energy Efficiency matters

The Ensure Dosing System (EDS) is the most comprehensive monitoring and control system in the industry.

SCADA built in – Full system control and performance monitoring wherever and whenever you want:

- No special hardware and software requirements
- Simple connection via web browser
- Multiple Levels of Access
- Remote monitoring and control via Internet
- Stand-alone WiFi control e.g. with iPad®
- SCADA integration with ModBUS TCP/IP
- Remote troubleshooting
- Email and text notification



Fail Safe – Intuitive protection

Enaqua’s FAIL SAFE intelligence ensures compliance at all times. In case a lamp in one stage fails, the system will command selected lamps in a redundant stage to power-on to compensate for any UV dosage reduction (see application example).

Stage 1

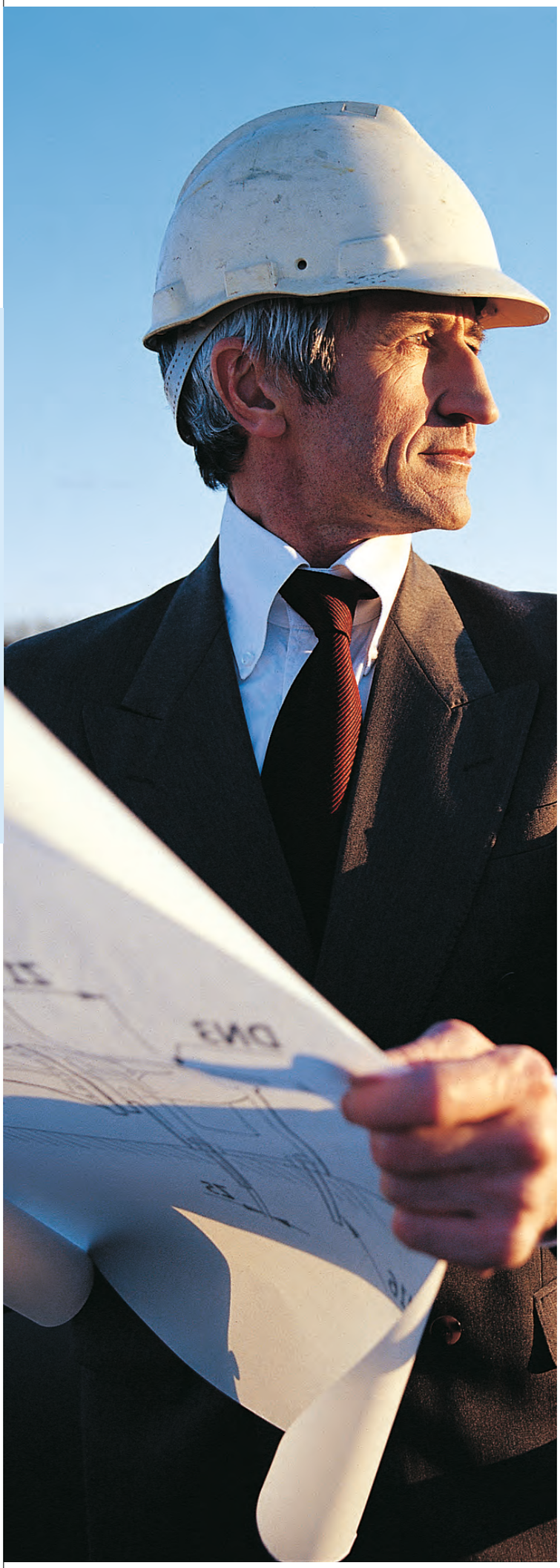
Lamp fault in stage 1: Alarm Alerts

Stage 2

Automatically energizes ONLY selective lamps in Stage 2 to ensure disinfection while optimizing use of energy and consumables

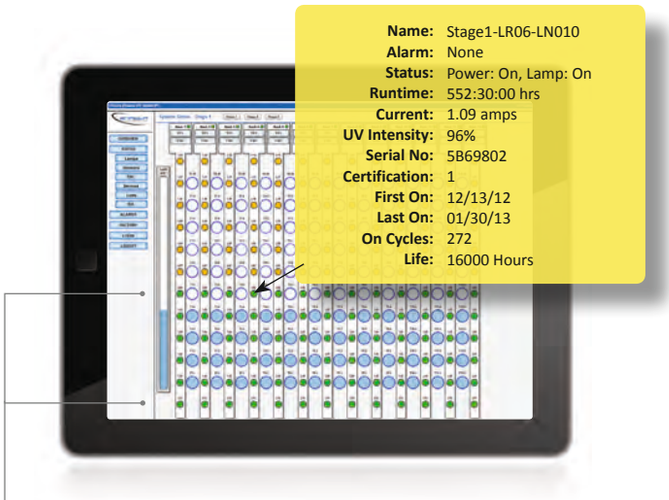
Ipad® is a registered trademark of Apple

4010403_EWT_Enaqua_Bro_r12_DSH_ART1_XHI.indd 8 12/04/2018 09.57



SMART Lamps – Advanced lamp control

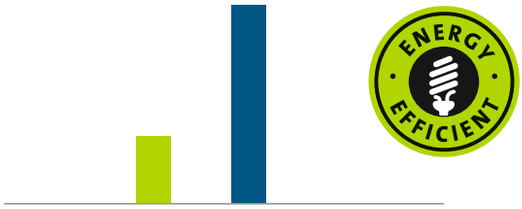
Enaqua's Low Pressure High Output (LPHO) lamps are equipped with a unique Smart Lamp Technology, a microchip integrated with the lamp connector identifies each UV lamp with a unique ID, monitors and logs lamp status, run time, lamp cycles, etc.



Flow & Level Pacing – Best energy efficiency

Enaqua's Flow & Level Pacing system automatically turns on only lamps which are required. This improves lamp and ballast life and reduces power consumption compared to systems that use "dimming".

Annual Energy Cost Comparison



$13,346
Enaqua EDS

$34,528
Traditional Dimming Systems

Actual comparison of bid guaranteed UV energy costs for Wastewater Plant, Peak 28MGD, Average 6MGD, $0.10/kWh.

4010403_EWT_Enaqua_Bro_r12_DSH_ART1_XHI.indd 9 12/04/2018 09.57

Features and functions

For specific selection and sizing please contact Enaqua

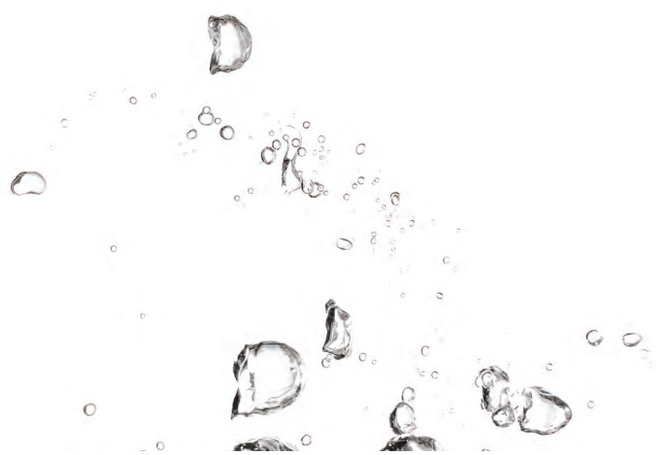
		M3	M4	M5	C-Series	D-Series	E-Series
Maximum F low and Pressure							
Flow Range*1	MGD	0.03 - 0.12	0.04 - 0.17	0.2 - 0.5	0.5 - 10	0.5 - 21	0.5 - 27
	gpm	20 - 80	30 - 120	140 - 350	350 - 6944	350 - 14600	380 - 18500
	m3/h	5 - 18	6.8 - 27	32 - 80	80 - 1600	80 - 3300	80 - 4200
Max. Operating Pressure	psi	40*2	40*2	40*2	20	15	10
	bar	2.8	2.8	2.8	1.4	1.0	0.7
Mechanical data							
Max. Number of AFP™ Tubes	pcs	2	2	6	180	160	140
Max. UV Lamps per Stage	pcs	8			228	204	180
Inlet and Outlet Configuration	inch	Flange 2	Flange 4, 6	Flange 8, 10	In-Channel or Flange Options		
Wetted Materials		AFP™, 304SS Option: 316SS, PVC, CPVC		AFP™, 304SS Option: 316SS			
Multistage Design		–	–	Option	Option	Option	
Electrical data							
Operating Voltage at 50/60 Hz	V, 1PH	120, 220			220		
	V, 3PH	–		220, 380, 415, 480*3			
Ballast Type		Auto Ranging 110-277 VAC 50/60 Hz with 5 Year Warranty					
Controls							
LCD Status Display		✓	✓	✓	Option	Option	Option
Hand-Off-Automatic Switch		✓*4	✓*4	✓	✓	✓	✓
Control Light: Alarm/Running		–	–	✓	Option	Option	Option
Individual Lamp Rack Fuse and Switch		✓	✓	✓	✓	✓	✓
UV Status LEDs in Lamp Racks		–	✓	✓	✓	✓	✓
Ensure Dosing System (EDS)		Option	Option	Option	✓	✓	✓
SMART Lamps		✓	✓	✓	✓	✓	✓
Flow & Level Pacing		–	–	–	Option	Option	Option
Fail Safe		Option	Option	Option	Option	Option	Option
UV Sensor		Option	Option	Option	✓	✓	✓
Heat Exchange System (Lamp Temperature Control)		Ambient Air Exchange			Air to Air. Air to Liquid using Effluent, plant W3 water, Potable, or Closed Loop system		

*1 Design consideration 65% UVT, ~30 mJ/cm², Contact Enaqua for more details

*2 Max pressure for High Pressure Option: 80 psi (5.5 bar)

*3 Three-phase voltage requires neutral wire

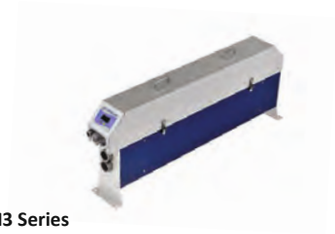
*4 On/Off switch only



4010403_EWT_Enaqua_Bro_r12_DSH_ART1_XHI.indd 10 12/04/2018 09.57

M Series UV reactors

– compact uv reactors ideal for small treatment plants for surface discharge, reuse, and industrial applications.



M3 Series
Flow rates up to 80 gpm (18.2 m^3/ h)

M4 Series
Flow rates up to 120 gpm (27.25 m^3/ h)

M5 Series
Flow rates up to 360 gpm (81.8 m^3/ h)

C1, C2, C3 & D1, D2, D3 UV series reactors

– medium size uv reactors for surface discharge, reuse, and industrial applications.

C1 & D1 Series
In pipe UV reactors , single or double banks- for Flow rates up to 2.0 MGD (315.4 m^3/ h).

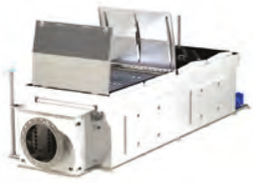
C2 & D2 Series
In pipe UV reactors, single or double banks- for Flow rates up to 4.2 MGD (662.5 m^3/ h).

C3 & D3 Series
In pipe UV reactors, single or double banks- for Flow rates up to 6.0 MGD (946.4 m^3/ h).

4 – 11 Series UV reactors

– large uv reactors offered "in-pipe" or " in-channel" configurations.

C Series "In pipe" or "In Channel"
Multi Bank UV reactors for Flow rates up to 24.0 + MGD . Applications– UV disinfection for surface discharge, Reuse, industrial appli-cation, Etc.



C Series "In Pipe " Reactor

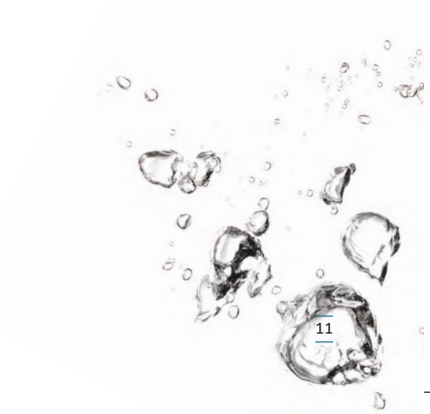
C Series "In Channel" Reactor

D Series "In pipe" or "In Channel"
Multi Bank UV reactors for Flow rates up to 36 + MGD . Applications– UV disinfec-tion for surface discharge, CSO, Industrial Applications, Etc.

D Series "In Pipe " Reactor

D Series "In Channel" Reactor

E Series "In Channel"
Multi Bank UV reactors for Flow rates up to 100 + MGD . Applications– UV disinfection for surface discharge, CSO, Etc.



Designed and manufactured in USA

Enaqua – UV made simple
Non-contact UV disinfection

- The **Engineer's Choice** for State-of-the-Art Technology
- The **City Manager's Choice** for Low Capital Cost
- The **Superintendent's Choice** for Low O&M Cost
- The **Operator's Choice** for Simple Operation
- The **Contractor's Choice** for Simple Installation
- The **Finance Director's Choice** for Lowest 20 Years Capital and Operations Cost Potential

The name Enaqua, the Enaqua logo, AFP, AFP840, AFP logo, Activated Fluoropolymer are registered trademarks owned by Enaqua, USA. All rights reserved worldwide. 0418/EWT/12728-BrandBox

ENAQUA
1350 Specialty Drive, Ste. D/F
Vista, CA 92081 USA
Tel: +1.760.599.2644
Fax: +1.760.599.2642
www.enaqua.com

ENAQUA INFO
info@enaqua.com

ENAQUA SERVICE
service@enaqua.com

ENAQUA SALES
sales@enaqua.com