PROJECT BENEFICIARY 2:

MUNICIPALITY OF DIMITROVGRAD

PROJECT:

APPLICATION OF INNOVATIVE TECHNIQUES FOR IMPROVING THE QUALITY OF DRINKING WATER IN URBAN AREAS - AQUA-LITY

DELIVERABLE 3.2.4:

PILOT OPERATION

LABORATORY ANALYSIS OF WATER SAMPLES FROM THE PILOT AREA

CONTRACTOR:

WATER ENVIRO PROJECT LTD

The Project is co-funded by the European Regional Development Fund (ERDF) and by national funds of the countries participating in the Cooperation Programme Interreg V-A "Greece-Bulgaria 2014-2020"

AUGUST 2019

CONTENT

1 DESCRIPTION OF THE SYSTEM

In order to ensure quality management of the risk of drinking water contamination at selected points in the water supply network, a set of sensors was assembled, the information from which is combined from telemetry stations and transmitted remotely to a central control point. Through the newly constructed water supply and sewerage system, the operator monitors in real time the basic chemical parameters of the water. In addition, the quality control points measure both main performance indicators - instantaneous flow and pressure. This facilitates the operation of the network by providing real-time information about its hydraulic performance..

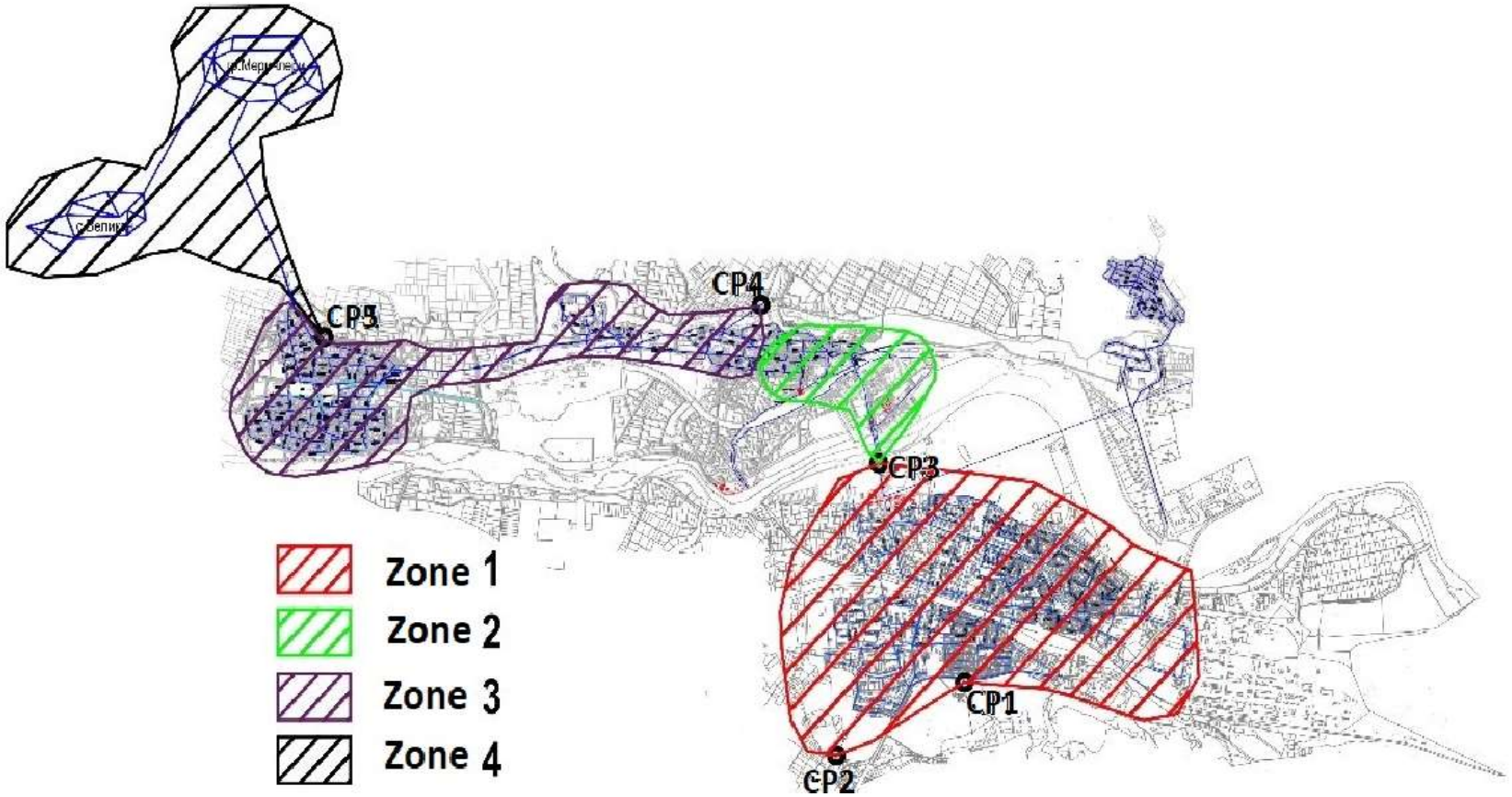
The following parameters shall be monitored at each of the control points, using the appropriate measuring equipment and sensors:

- pH – this is a measure of the amount of hydrogen in the liquid. It does not reflect the alkalizing or acidifying chemicals in the liquid, but the amount of hydrogen atoms. Water with a pH of less than 6.5 is corrosive, can contain metal ions such as iron, copper, zinc or manganese and is hazardous to both human health and water and sewage infrastructure..
  - measurement principle: potentiometric
  - mounting method: in a measuring cell with running water
  - ORP (oxidative reduction potential) – the oxidative reduction potential indicates potential pollution, especially with industrial waste water. Due to the fact that in the presence of a high concentration of metal salts, the value of the ORP is significant, it is very often the monitoring of this indicator that is carried out to control the contamination of ground and surface water by heavy metals.
  - measurement principle: potentiometric
  - mounting method: in a measuring cell with running water
- temperature

- - Input: Temperature sensor Pt100 or Pt1000
- Output:4-20mA
- Mounting method: Submersible threaded probe for water supply

- free (residual) chlorine - chlorine (or chlorine-containing substances) is used for the disinfection of drinking water due to the fact that it breaks down the molecules of organic compounds of plant and animal character and thus destroys all pathogens.
  - measurement principle: amperometric, 2 electrodes, coated diaphragm
  - mounting method: in a measuring cell with running water
- flow rate
- pressure

1.1 DIAGRAM WITH CONTROL POINTS AND SURVEILLANCE ZONES



Scheme 1 – *diagram of the zones with control points for observation*

1.2 CONTROL POINTS

CP 1 – Zone shaft „Aphrodite“

CP 2 – Zone shaft with regulators „Ring road"

CP 3 – Zone shaft „The bridge"

CP 4 – Zone shaft with regulator „Marijno"

CP 5 – Pumping station „Chernokonevo"

1.3 EQUIPMENT

In order to ensure effective monitoring of selected indicators and quality management of the risk of drinking water pollution, sensors and controllers have been installed as follows:

- To measure pH, ORP and temperature, a dedicated SC1000 separate controller is used.
- For the measurement of residual chlorine in water, we rely on a separate system with direct communication consisting of a sensor and a controller model CL17

Manufacturer of all components, part of the water quality measurement system - pH, ORP, temperature and residual chlorine, is the company Hach Lange, Germany. During the implementation of the project, the supplier's team has significantly succeeded in reducing the water consumption of the equipment by installing pressure regulators and flow regulators. The result of the change of the circuit boards is to limit the consumption of drinking water from the system from 1.3 m3/day to 0.5 m3/day.

2 DATA ACCESS

As part of the equipment and sensors for measuring the listed parameters in item 1 of this report, a logic controller for their integration was installed at each of the control points. As part of the telemetry stations is the upgrade with a modem with a SIM card for real-time data transmission. In practice, the W&S Operator has the ability to monitor the data through the built-in remote access system or locally through the displays for adjustment and visualization of each of the components of the equipment.

2.1 FUNCTIONALITY OF THE REMOTE ACCESS SYSTEM

The data from all measurements are integrated into a specialized SCADA system, where information on the reported values is available in graphical and tabular format. The communication between the telemetry stations and the SCADA system is two-way, using a specially designed VPN network. This makes it possible to manually recall data and remotely reset the controllers as needed.

The functionality of the system allows the creation of different levels of access, and administrators, in addition to the option of remote access to telemetry stations will be able to create alarms and different logics.

For the needs of the water supply and sewerage Dimitrovgrad, a working screen was created with the observed parameters of the five points.

	CP 1
Pressure	1,38 Bar
Flow	12,84 l/s
Quantity	31736,7 m3
pH	7,35 pH
Temperature	22,0 °C
Residual chlorine	0,00
ORP	445 mV

CP 2
2,63 Bar
72,09 l/s
83603,9 m3
7,27 pH
19,1 °C
0,11
561 mV

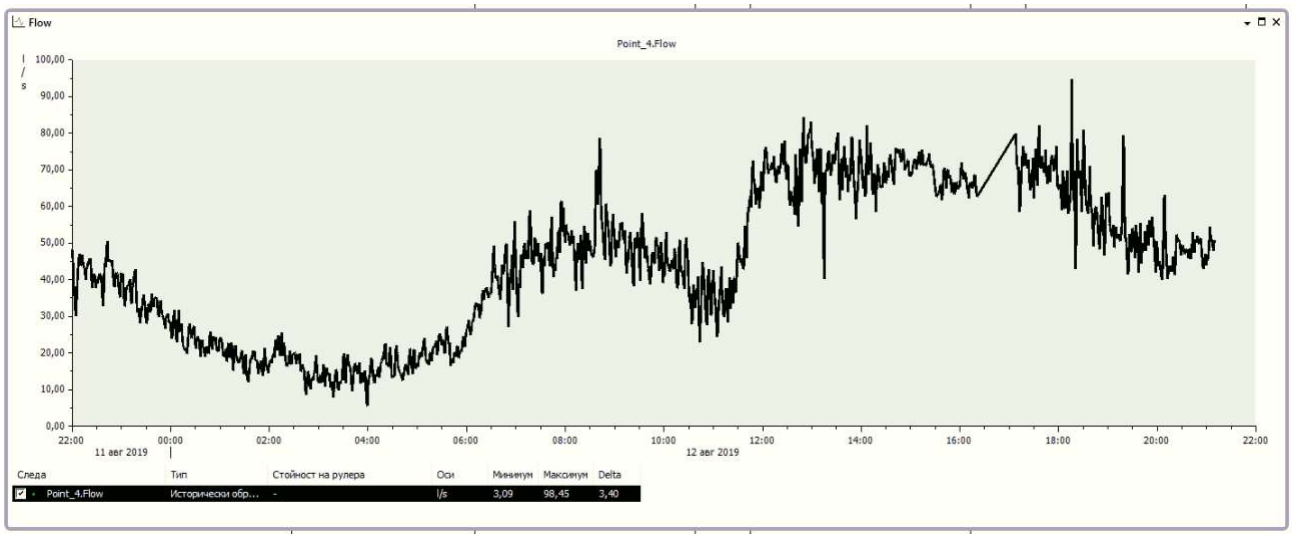
CP 3
3,52 Bar
29,12 l/s
66587,7 m3
7,37 pH
25,0 °C
0,10
57 mV

	CP 4
Pressure	1,60 Bar
Flow	26,03 l/s
Quantity	66203,6 m3
pH	7,44 pH
Temperature	21,7 °C
Residual chlorine	0,01
ORP	147 mV

CP 5
3,06 Bar
10,12 l/s
28158,3 m3
7,57 pH
25,8 °C
0,10
340 mV

Each value cell is active. When you point to the mouse and left-click, a pop-up menu appears with the option to select additional analytic features.

- History graphics – graphically display historical data. There is an option to set the period - hour, day, week, month. Data analysis for the selected period - minimum value, maximum value, average value, difference.



- Current graphics – when requesting such a graph, a graph of the current data begins to be drawn on the desktop;

- History list – when you select this menu, the table displays the values of the variable for the selected period.

- Show map - Locates the map point with exact geographical coordinates;

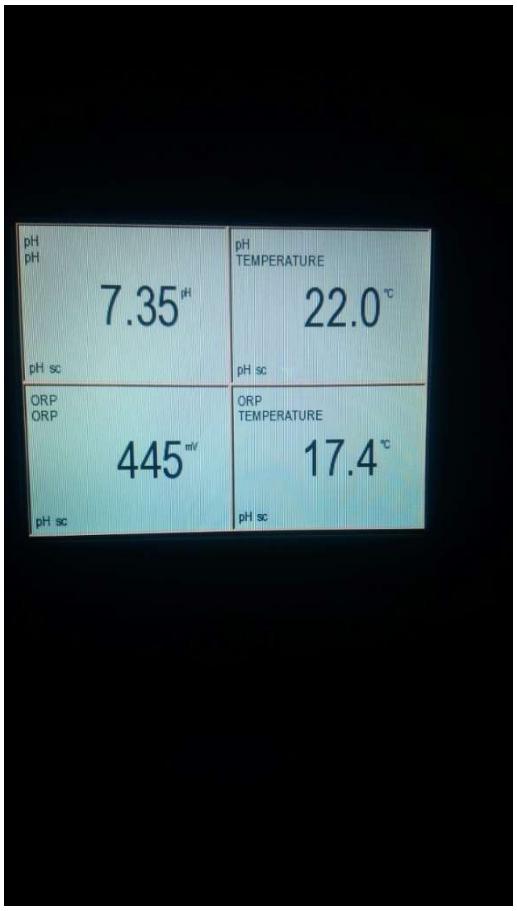
- Show Alarms - Displays a list of alarm events - lost connection, going out of range;

- Show events - displays a list of operator interventions - turn off alarms, turn off point tracking;

2.2 COMPARISON OF READINGS FROM MEASUREMENTS

When sampling for verification, the team took pictures of the equipment displays (locally) and screenshots of the remote sensing system.

The photos shown below show that there is no difference in the measured metrics in local and remote reading.

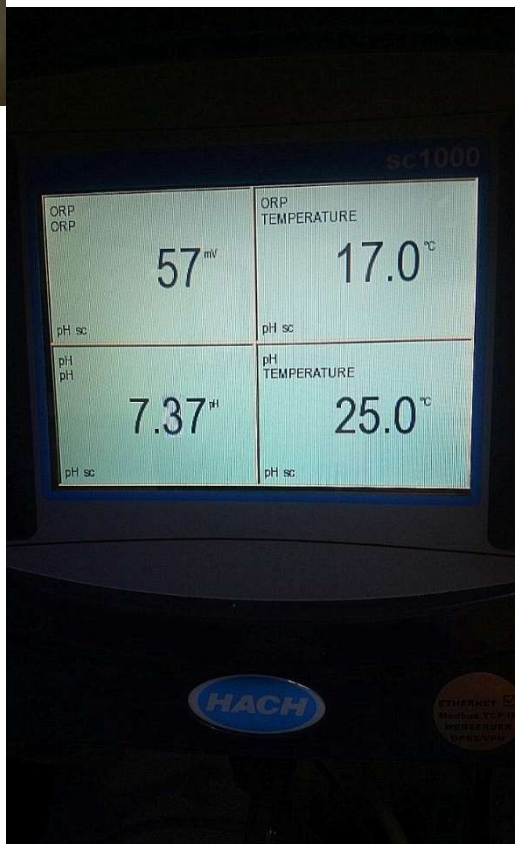


	CP 1
Pressure	1,38 Bar
Flow	12,84 l/s
Quantity	31736,7 m3
pH	7,35 pH
Temperature	22,0 °C
Residual chlorine	0,00
ORP	445 mV

Photo 1 – *results of visual and software reports for measurement CP 1*

CP 2
2,63 Bar
72,09 l/s
83603,9 m3
7,27 pH
19,1 °C
0,11
561 mV

Photo 2 – *results of measuring CP 2 visual and software reports for*



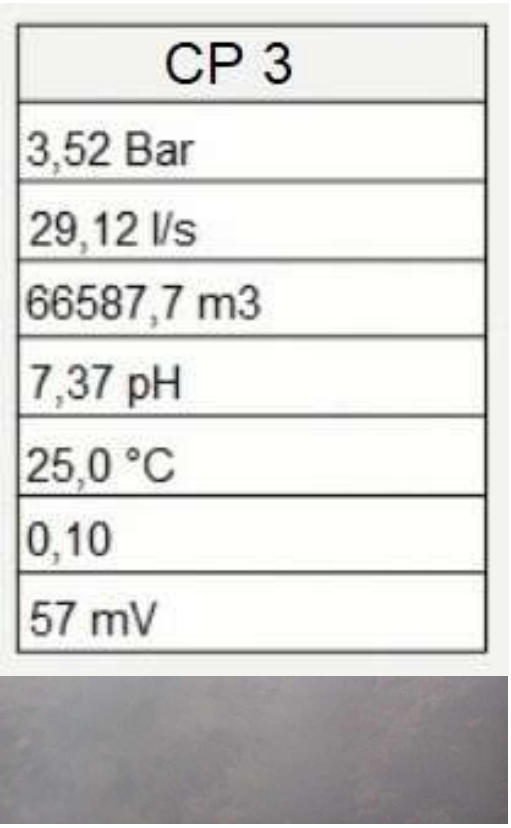
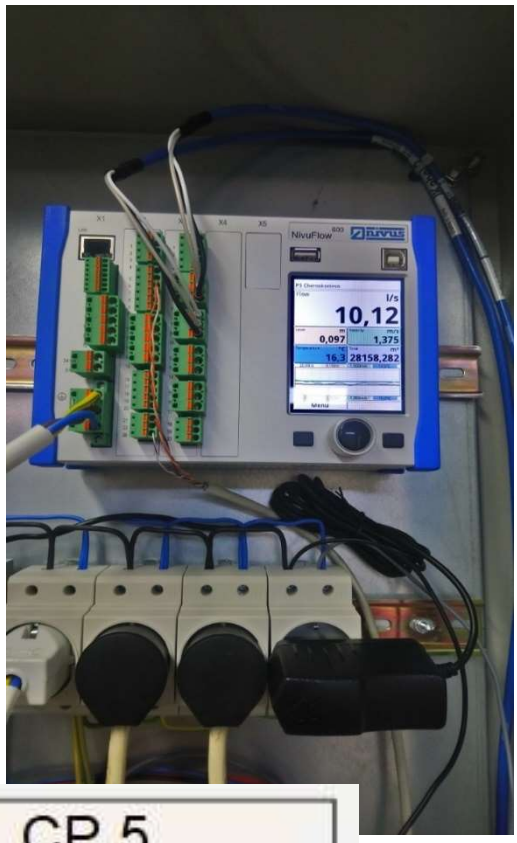


Photo 3 – *results of visual and software reports for measuring CP 3*

CP 4
1,60 Bar
26,03 l/s
66203,6 m3
7,44 pH
21,7 °C
0,01
147 mV

Photo 4 – *results of visual and software reports for measuring CP 4*



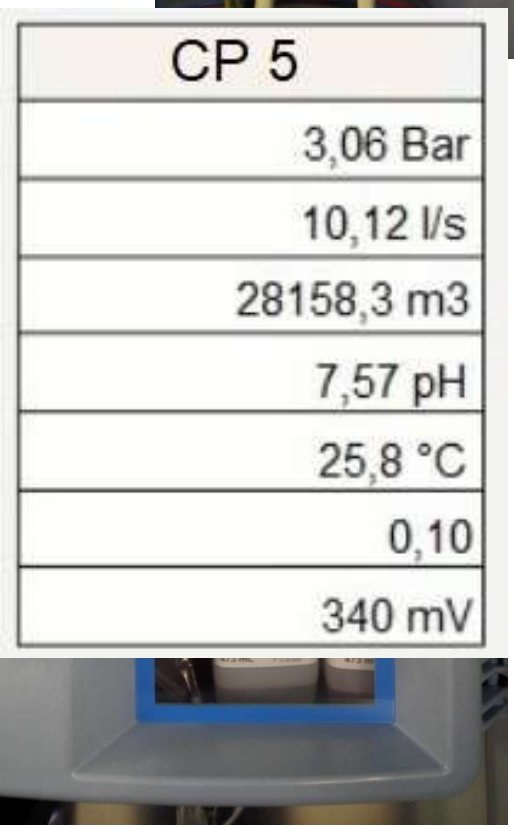


Photo 5 - *Results of visual and software reports for measurement CT 5*

3 SAMPLE RESULTS

3.1 SAMPLING

To ensure the accuracy of the equipment used, the team performed two types of sampling:

1) A point sample in which two samples, each with a volume of 0,5 liter, were taken directly from the water supply network. These types of samples are shipped to a accredited laboratory for pH, temperature and residual chlorine determination
2) Sampling of the installed equipment by means of a flow cell, adding reagent every 2.5 minutes in the continuously extracted water and making the necessary analyzes on different parameters of the respective sensors

Oxidation Reduction Potential (ORP) testing has not been performed in an accredited laboratory, because testing on this indicator is only done in the field conditions and an accredited result cannot be provided.

On July 16, 2019 manual sampling was performed - a point sample with the results of the RHI accredited laboratory below:

ТРАНСГРАНИЧЕН ИЗСЛЕДОВАТЕЛСКИ ЦЕНТЪР
„ОКОЛНА СРЕДА И ЗДРАВЕ"
при РЕГИОНАЛНА ЗДРАВНА ИНСПЕКЦИЯ
6600. - гр. Кърджали, ул. "Ген. Владимир Стойчев" № 2
тел:/факс: 0361/60287 , GSM: 0882 838 414
e-mail: rceh.eh@gmail.com

ПРОТОКОЛ ОТ ИЗПИТВАНЕ

№ ЛИП 325 - 150 / 16.07.2019г.

1. Наименование на продукта	*Питейна вода*
2. Заявител на изпитването	*„Уотър Енвайро Продженкт" ЕООД* *гр. София* *ул. „Михаил Тенев" №6*
3. Произход / Партида	***ЛИП 325 – 150 - 1 – контролна точка 1*** ***ЛИП 325 – 150 - 2 – контролна точка 2*** ***ЛИП 325 – 150 - 3 – контролна точка 3*** ***ЛИП 325 – 150 - 4 – контролна точка 4*** ***ЛИП 325 – 150 - 5 – контролна точка 5***
4. Предназначение на изпитването	*По Заявка № 325/15.07.2019 г.*
5. Метод за изпитване	*БДС 8451:1977*
6. Начин на вземане на пробата:	*Представена от заявителя*
7. Дата на получаване на пробата	*15.07.2019 г.*
8. Количество на изпитваните проби	*5 x 0,5dm³*
9. Дата / период на извършване на изпитването	*15.07.2019 г.- 16.07.2019г*

РЪКОВОДИТЕЛ НА
ТРАНСГРАНИЧЕН ИЗСЛЕДОВАТЕЛСКИ
ЦЕНТЪР „ОКОЛНА СРЕДА И ЗДРАВЕ": .....
/ инж. Рени Митева /

10. РЕЗУЛТАТИ ОТ ИЗПИТВАНЕТО

№ по ред	Наименование на показателя	Методи Стандартизирани/ валидирани вътрешно лабораторни	№ на пробата	Единица на величината	Резултати от изпитването / стойност, неопределеност	Стойност и допуск на показателя	Условия на изпитването
1	2	3	4	5	6	7	8
1	Температура	БДС 8451:1977	ЛИП 325-150-1	°C	22,0	-	21,8 °C RH 49,0 %
2	Температура	БДС 8451:1977	ЛИП 325-150-2	°C	19,1	-	21,8 °C RH 49,0 %
3	Температура	БДС 8451:1977	ЛИП 325-150-3	°C	25,0	-	21,8 °C RH 49,0 %
4	Температура	БДС 8451:1977	ЛИП 325-150-4	°C	21,7	-	21,8 °C RH 49,0 %
5	Температура	БДС 8451:1977	ЛИП 325-150-5	°C	25,8	-	21,8 °C RH 49,0 %

Забележки:

1.Резултатите от изпитванията се отнасят само за изпитваните образци. Извлечения от изпитвателния протокол не могат да се размножават без писмено съгласие на лабораторията за изпитване.

2. Изпитванията са проведени в работните помещения на лабораторията.

3. Лабораторията не отговаря за информацията, предоставена от клиента, при условие че тази информация може да повлияе на валидността на резултатите.

4. Лабораторията не е отговорна за етапа на вземане на проба/извадка, тъй като тя е предоставена от клиента в качеството на външен източник.

5. Докладване за обявяването на съответствие: Не се извършва.

6.Ако е необходимо, протоколът от изпитване може да включва мнения и тълкувания за определени резултати от изпитвания (заключения не се допускат) само в съответствие с изискванията на т.7.8 от БДС EN ISO/IEC 17025:2018.

7.Разширената неопределеност на резултата включва неопределеност от измерване и съответства на ниво достоверност приблизително 95%

Забележка*:*Обхватa на стойностите на показателя по нормативен документ Наредба №9 /2001г. от Министерството на здравеопазването, Министерството на регионалното развитие и благоустройството и Министерството на околната среда и водите, за качеството на водата предназначена за питейно-битови цели се посочва в колона №7 „Стойност и допуск на показателя"*

Провел изпитването: 1. .....
/ Румяна Кирекчиева /

КРАЙ

ТРАНСГРАНИЧЕН ИЗСЛЕДОВАТЕЛСКИ ЦЕНТЪР
„ОКОЛНА СРЕДА И ЗДРАВЕ"
при РЕГИОНАЛНА ЗДРАВНА ИНСПЕКЦИЯ
6600. - гр. Кърджали, ул. "Ген. Владимир Стойчев" № 2
тел:/факс: 0361/60287 , GSM: 0882 838 414
e-mail: rceh.eh@gmail.com
Сертификат за акредитация, рег.№ 216 ЛИ /01.10.2018 г. , валиден до 31.05.2021 г., издаден от ИА БСА, съгласно изискванията на БДС EN ISO/IEC 17025:2006

ПРОТОКОЛ ОТ ИЗПИТВАНЕ
№ ЛИП 325 / 16.07.2019г.

1. Наименование на продукта	*Питейна вода*
2. Заявител на изпитването	*„Кюбико" ЕООД* *гр. София* *ул. „Михаил Тенев" №6*
3. Произход / Партида	***ЛИП 325 – 1 – контролна точка 1*** ***ЛИП 325 – 2 – контролна точка 2*** ***ЛИП 325 – 3 – контролна точка 3*** ***ЛИП 325 – 4 – контролна точка 4*** ***ЛИП 325 – 5 – контролна точка 5***
4. Предназначение на изпитването	*По Заявка № 325/15.07.2019 г.*
5. Метод за изпитване	*БДС 3560:1981* *БДС EN ISO 10523:2012*
6. Начин на вземане на пробата:	*Представена от заявителя*
7. Дата на получаване на пробата	*15.07.2019 г.*
8. Количество на изпитваните проби	*5 x 0,5dm³*
9. Дата / период на извършване на изпитването	*15.07.2019 г.- 16.07.2019г*

РЪКОВОДИТЕЛ НА
ТРАНСГРАНИЧЕН ИЗСЛЕДОВАТЕЛСКИ
ЦЕНТЪР „ОКОЛНА СРЕДА И ЗДРАВЕ": .....
/ инж. Реги Митева

РЗИ - КЪРДЖАЛИ ТИЦ "ОСЗ" РСЕН RI - KARDZHALI

10. РЕЗУЛТАТИ ОТ ИЗПИТВАНЕТО

№ по ред	Наименование на показателя	Методи Стандартизирани/ валидирани вътрешно лабораторни	№ на пробата	Единица на величината	Резултати от изпитването / стойност, неопределеност/	Стойност и допуск на показателя	Условия на изпитването
1	2	3	4	5	6	7	8
1	Остатъчен хлор	БДС 3560:1981	ЛИП 325-1	mg/dm^3	< 0,01	-	21,8 ^{0}C RH 49,0 %
2	Активна реакция	БДС EN ISO 10523:2012	ЛИП 325-1	pH единици	7,35 ± 0,04	-	22,8 ^{0}C RH 49,0 %
3	Остатъчен хлор	БДС 3560:1981	ЛИП 325-2	mg/dm^3	0,10 ± 0,01	-	21,8 ^{0}C RH 49,0 %
4	Активна реакция	БДС EN ISO 10523:2012	ЛИП 325-2	pH единици	7,28 ± 0,04	-	22,8 ^{0}C RH 49,0 %
5	Остатъчен хлор	БДС 3560:1981	ЛИП 325-3	mg/dm^3	0,10 ± 0,01	-	21,8 ^{0}C RH 49,0 %
6	Активна реакция	БДС EN ISO 10523:2012	ЛИП 325-3	pH единици	7,41 ± 0,04	-	22,8 ^{0}C RH 49,0 %
7	Остатъчен хлор	БДС 3560:1981	ЛИП 325-4	mg/dm^3	< 0,01	-	21,8 ^{0}C RH 49,0 %
8	Активна реакция	БДС EN ISO 10523:2012	ЛИП 325-4	pH единици	7,46 ± 0,04	-	22,8 ^{0}C RH 49,0 %
9	Остатъчен хлор	БДС 3560:1981	ЛИП 325-5	mg/dm^3	0,10 ± 0,01	-	21,8 ^{0}C RH 49,0 %
10	Активна реакция	БДС EN ISO 10523:2012	ЛИП 325-5	pH единици	7,54 ± 0,05	-	22,8 ^{0}C RH 49,0 %

Забележки:

1.Резултатите от изпитванията се отнасят само за изпитваните образци. Извлечения от изпитвателния протокол не могат да се размножават без писмено съгласие на лабораторията за изпитване.

2. Изпитванията са проведени в работните помещения на лабораторията.

3. Лабораторията не отговаря за информацията, предоставена от клиента, при условие че тази информация може да повлияе на валидността на резултатите.

4. Лабораторията не е отговорна за етапа на вземане на проба/извадка, тъй като тя е предоставена от клиента в качеството на външен източник.

5. Докладване за обявяването на съответствие: Не се извършва.

6.Ако е необходимо, протоколът от изпитване може да включва мнения и тълкувания за определени резултати от изпитвания (заключения не се допускат) само в съответствие с изискванията на т.7.8 от БДС EN ISO/IEC 17025:2018.

7.Разширената неопределеност на резултата включва неопределеност от измерване и съответства на ниво достоверност приблизително 95%

Забележка*:*Обхвата на стойностите на показателя по нормативен документ Наредба №9 /2001г. от Министерството на здравеопазването, Министерството на регионалното развитие и благоустройството и Министерството на околната среда и водите, за качеството на водата предназначена за питейно-битови цели се посочва в колона №7 „Стойност и допуск на показателя"*

Провел изпитването: 1. .....
/ Румяна Кирекчиева /

Провел изпитването: 2. .....
/ Цветана Костова /

КРАЙ

4 CONCLUSION

From the data provided in t. 3.1 and t.2.2 - controllers' photo material and references from the remote monitoring system, it can be read that the water quality data that the sensors and controllers register are correctly transferred and visualized in the remote monitoring system . In addition, analyzes performed by an independent laboratory show that the accuracy of the field measurement is close to that of the laboratory samples, making the system a reliable means of controlling drinking water quality.

PROJECT BENEFICIARY 2:

MUNICIPALITY OF DIMITROVGRAD

PROJECT:

APPLICATION OF INNOVATIVE TECHNIQUES TO IMPROVE THE QUALITY OF DRINKING WATER IN URBAN AREAS – AQUA-LITY

DELIVERABLE 3.2.4

PROTOCOL OF IDEAL USE OF THE TELEMETRY BASED SYSTEM FOR WATER QUALITY INSPECTION

CONTRACTOR:

WATER ENVIRO PROJECT LTD

The Project is co-funded by the European Regional Development Fund (ERDF) and by national funds of the countries participating in the Cooperation Programme Interreg V-A "Greece-Bulgaria 2014-2020"

SEPTEMBER 2019

Application of innovative techniques to improve the quality of drinking water in urban areas - AQUA-LITY

Content:

1 COMPONENTS OF THE DRINKING WATER QUALITY MONITORING SYSTEM

1.1 WATER QUALITY

In order to achieve simultaneous monitoring of all the parameters set in the project for drinking water quality, sensors and their controllers and components were selected, which in a practical and effective way will sample, analyze and drain the required volume of water, giving information about pH, ORP, temperature and free (residual) chlorine. Monitoring of selected indicators and quality management of the risk of drinking water pollution is done by mounting sensors and controllers as follows:

- Specialized controller with separate power supply is used to measure pH, redox potential and temperature SC1000

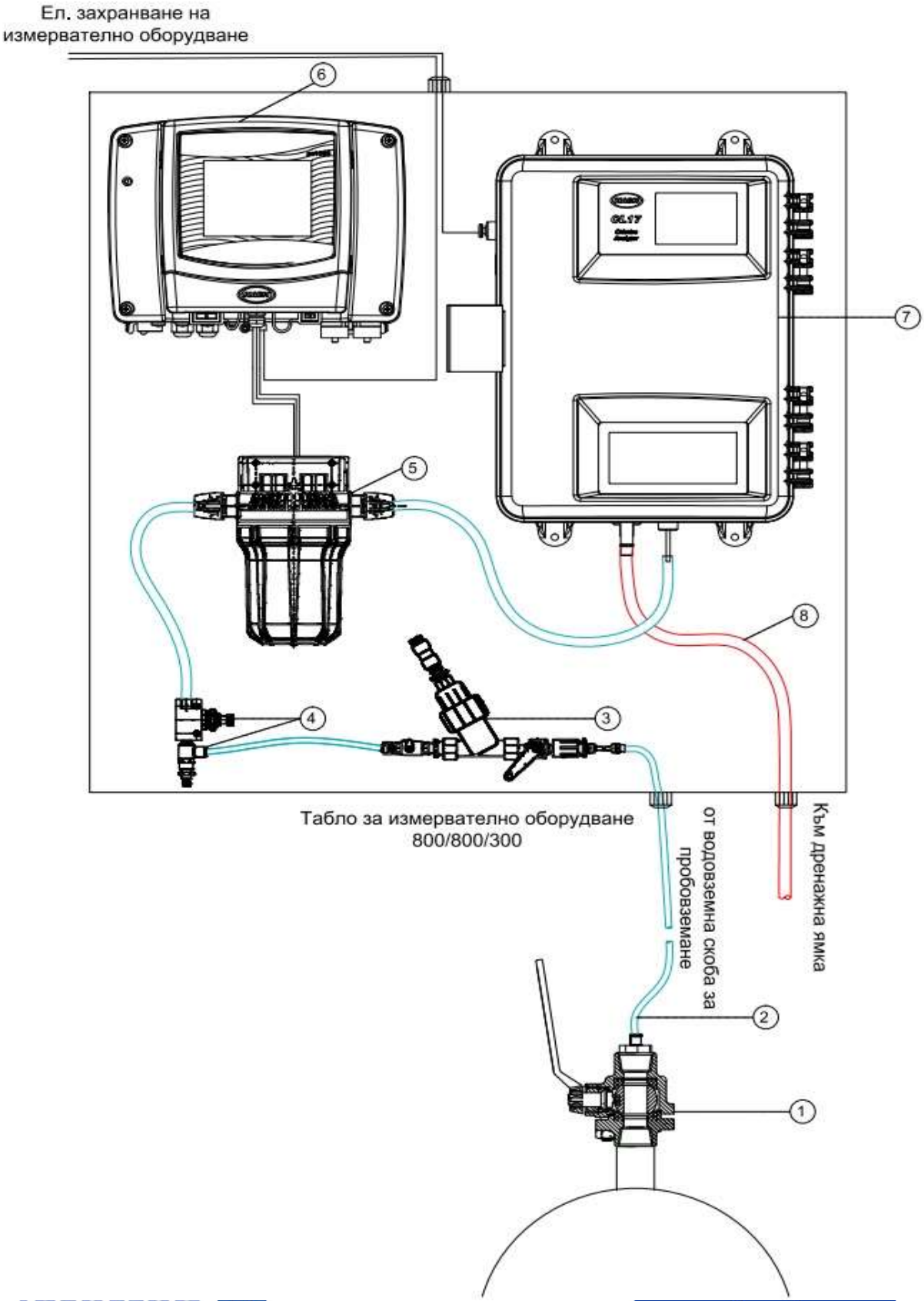
- For the measurement of residual chlorine in water, we rely on a separate system with direct communication consisting of a sensor and a controller model CL17

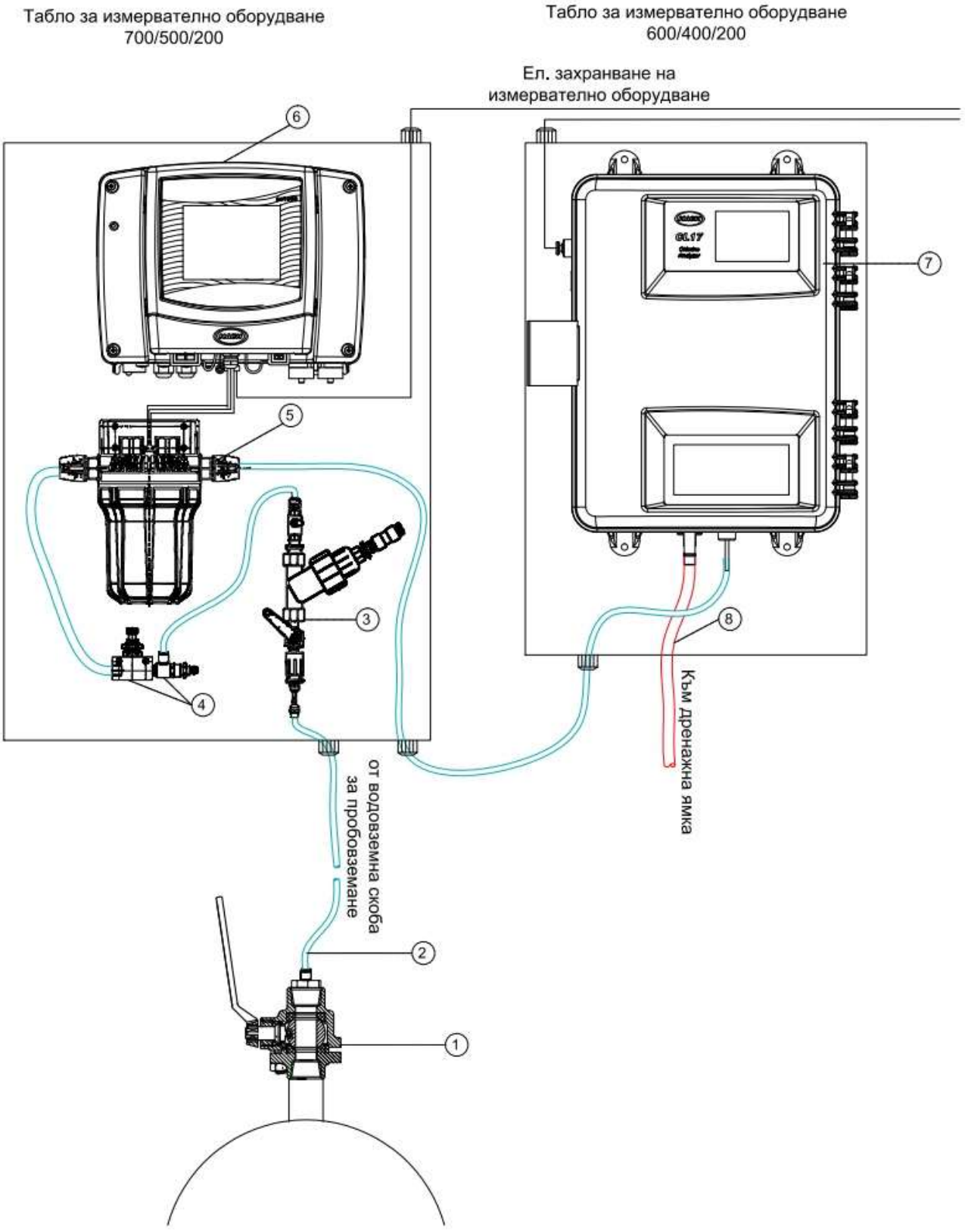
The manufacturer of all constituents, part of the water quality measurement system - pH, ORP, temperature and residual chlorine - is Hach, Germany. In order for the complete system to be fully completed and well-functioning, along the water path from the water intake to the drainage, the kit includes (the elements are shown in the two graphs below):

1) Nozzle with ball valve for water intake directly from the drinking water supply network for analysis;
2) Water supply hose from the intake point to the dashboard with the quality analysis equipment;
3) Particulate filter with secondary ball valve;
4) A combination of a flow regulator and a pressure regulator;
5) Flow cell with sensors for analysis, part of controller SC1000;
6) Controller SC1000 for analysis of pH, ORP and temperature;

7) Controller CL17 for analysis of free (residual chlorine);

8) Drainage hose to drainage shaft.


Ел. захранване на измервателно оборудване
6
7
5
8
4
3
Табло за измервателно оборудване 800/800/300
от водовземна скоба за пробовземане
Към дренажна ямка
2
1

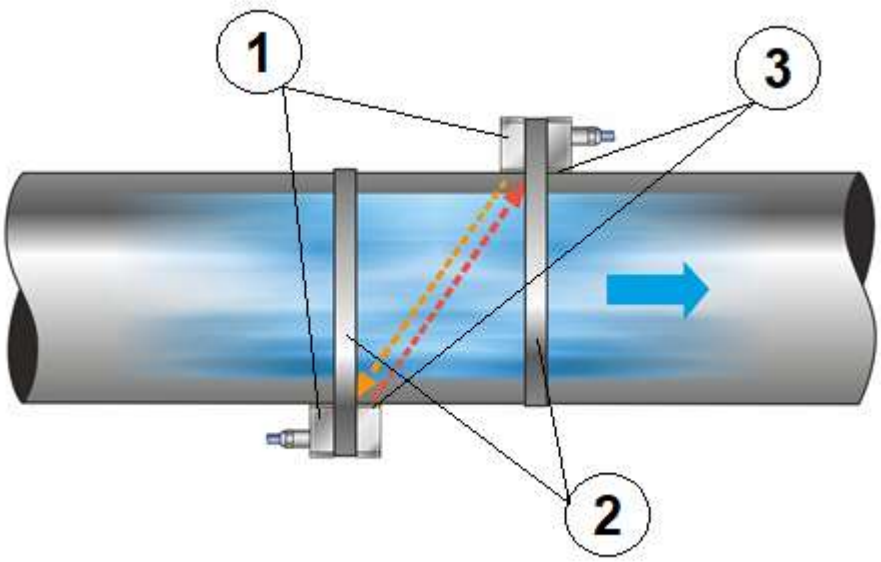

Табло за измервателно оборудване
700/500/200
Табло за измервателно оборудване
600/400/200
Ел. захранване на
измервателно оборудване
6
5
3
4
7
8
Към дренажна ямка
от водовземна скоба
за пробовземане
2
1

1.2 WATER QUANTITY AND PRESSURE

Ultrasonic flow meters with clamp on sensors for pressure pipelines were installed at the monitoring points to measure the water quantities. The Nivuflow 600 instruments are certified measuring instruments of an approved type by the Bulgarian Institute of Metrology and are manufactured by the German company NIVUS GmbH, a leader in the field of pressure and pressure measurements.

Based on the principle of the time of sending and receiving the ultrasonic signal from one sensor to another, the "transit time" measurement technology in filled pipelines depends to a large extent on the following factors, which contribute to the good and reliable measurement of the passing water quantity.:

- precise measurement of the outer diameter and thickness of the pipeline wall;
- cleaning of the pipeline sections where the sensors will be installed - removal of pipe insulation, rust, irregularities and accumulated dirt;
- providing insulating grease to improve contact between the sensors and the pipe;
- tightening the sensors to the tube with steel straps.



1) Clamp on sensors - sending and receiving;
2) Steel bands;
3) Insulation grease.

The good measurement indicator, which must be monitored during the installation and adjustment of the sensors, is checked from the Diagnostics -> v-Paths -> Alignment menu of the NivuFlow 600. The indicator must not be less than 50%.

Sensors with a maximum measurement range of 16 bars were installed for pressure measurement. To this end, nozzles or water intakes shall be secured directly to the water main, ending with ½ spherical taps. " The output current signal 4-20 mA is sent directly to the controller combining data from all devices.

1.3 COMMUNICATION MODULES

To integrate all the monitored parameters of each of the telemetry stations at each checkpoint, logic controllers were installed, upgraded with real-time SIM data modems. Merge and remotely send data remotely to monitor and respond when needed.

1.4 VISUALIZATION SOFTWARE

The provision of a constant electrical supply to each of the telemetry stations allows the W&S Operator to monitor in real time the measurement data in specially adapted visualization software. The auctioned computer systems have specially installed for this purpose data visualization software in both tabular and graphical format, with historical preview function for a selected period of time. Also, computers have remote access.

2 INSTRUCTIONS FOR PLANNED MAINTENANCE

Regular maintenance of the equipment is required after the commissioning and guaranteeing of an initial period of time during which the telemetry stations operate without the need for the intervention of the operating personnel. This will ensure the normal operation of all sensors and controllers and keep them in good working order, which in turn will ensure adequate and maximum accurate measurements of all quantities.

2.1 RESIDUAL CHLORINE MEASURING INSTRUMENT CL17

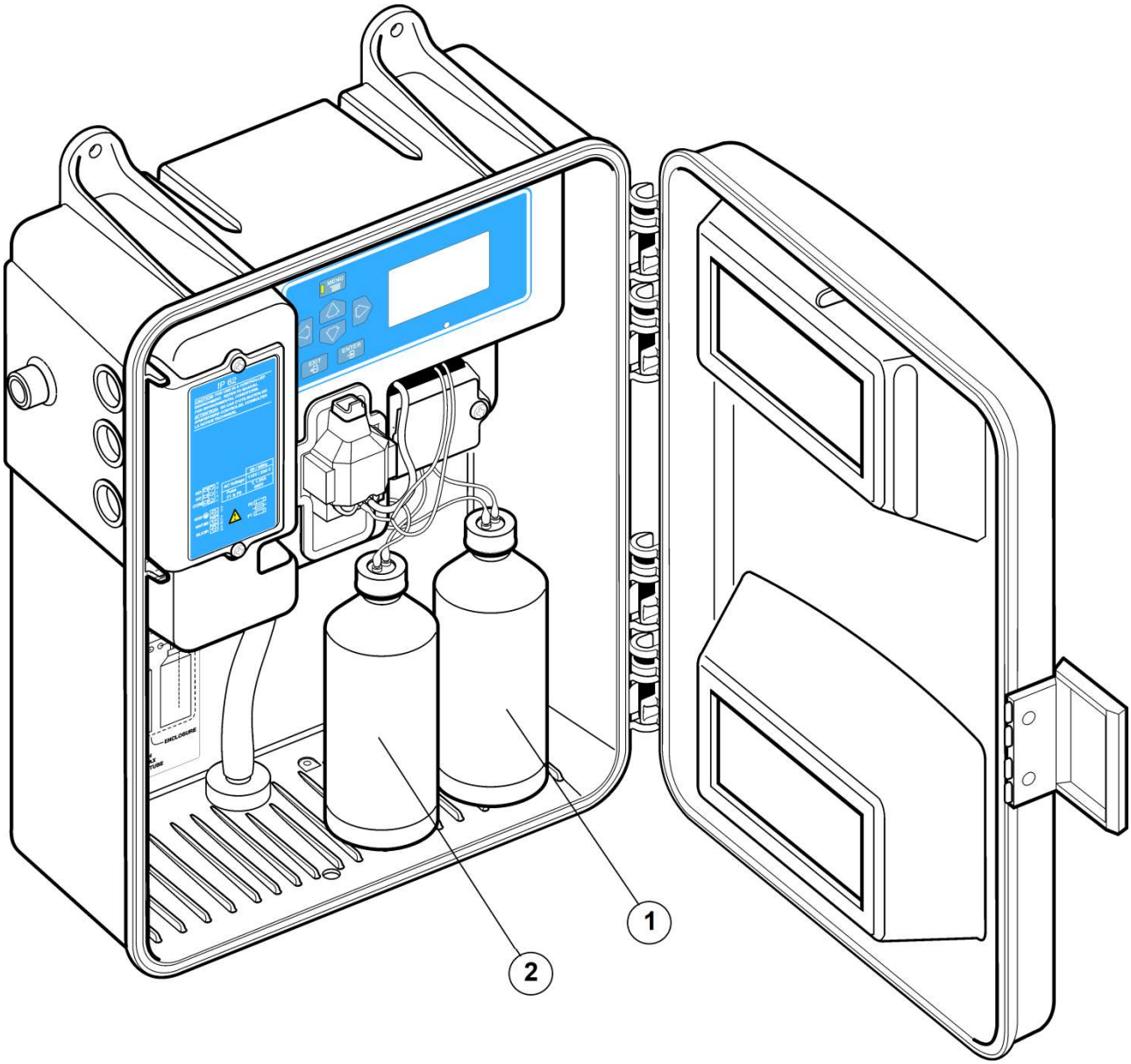
The residual chlorine analyzer requires two reagents, a buffer solution and an indicator. Space is provided in the housing of the 500 ml bottle instrument for each of the reagents. The two reagents used in the chlorine assay are placed in the hydraulic section of the assay device and refilled monthly. For any subsequent service, discard old unused containers and replace with new bottles.

One reagent is buffer solution, free chlorine buffer, cat. No. 2314100 used to determine free chlorine or total chlorine buffer, cat. No. 2263500 used for analysis for total chlorine. The buffer solutions are completely factory-formulated and ready for use. Remove the stopper and seal from the buffer solution bottle and fit the BUFFER label and pipeline to the buffer solution bottle.

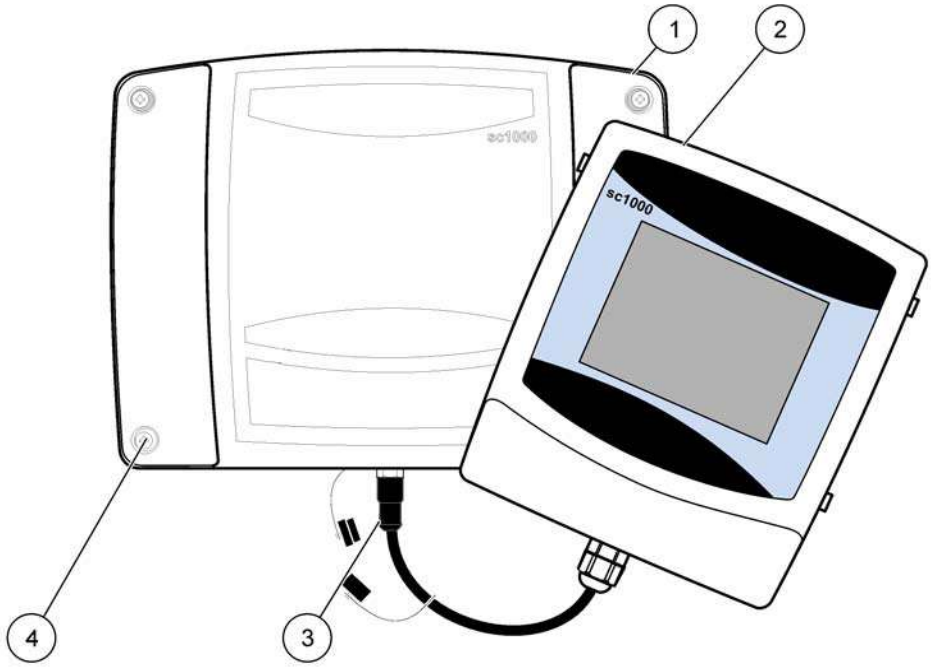
Note: It is normal after some time that the reagent pipeline becomes discolored.

The second reagent, the indicator solution, has to be prepared. The indicator solution and indicator powder should be mixed immediately before use to ensure the best operation of the instrument. Use the provided dust funnel in the support kit to add the contents of a high-capacity DPD powder bottle, Cat. No. 2297255, to bottle with indicator solution for total chlorine, cat. No. 2263400, or free chlorine indicator bottle, Cat. No. 2314000. Stir or shake until the powder is completely dissolved. Remove the cap from the reagent bottle and place it along with the pipeline labeled INDICATOR on the reagent bottle. The pipeline should be inserted into the bottom of the

bottles to prevent air from entering when the level in the bottles drops.



2.2 PH, ORP AND TEMPERATURE MEASURING DEVICE



1) Probe module cover;

2) Display module;

3) Clutch, display module;

4) Screw (4x).

- Check the probe module and the display module for mechanical damage regularly;
- Check all connections for leaks and corrosion regularly;
- Check all cables for mechanical damage regularly;
- Clean the probe module and the display module with a soft damp cloth. Use a mild detergent if necessary.

2.3 FLOW CELL PREVENTION

The normal functioning of the flow cell is based on it being clean, without any accumulation on its walls and on the probe module for measuring the pH, ORP and temperature parameters. Accumulations over time may change the measurement results of the respective values.

Prevention consists in stopping the water supply to the flow cell, separating it from the main board, and then rinsing all the elements inside with water using a soft cloth or sponge. If necessary, in the presence of water-insoluble accumulations, a dishwasher or alcohol-based detergent may also be used. In case of more severe accumulations, a 5% solution of hydrochloric acid may be cleaned as a last resort, subject to the necessary conditions for its operation.

2.4 CHECKING THE QUALITY OF WATER QUANTITY MEASUREMENT

The planned maintenance of the ultrasonic flow sensor sensors consists mainly in the verification of the Alignment indicator mentioned in item 1.2. In circumstances where the percentage value of the measurement quality does not deviate from the recommended, no additional intervention of the service personnel is required.

3 UNPLANNED / EMERGENCY / EQUIPMENT MAINTENANCE INSTRUCTIONS

3.1 RESIDUAL CHLORINE MEASURING INSTRUMENT CL17

3.1.1 *Replacing fuses*

The T, 2.5 A, 250 V fuse used in this tool is used for 115 V and 230 V operation.

Fuse replacement procedure:

- Make sure no power is supplied to the instrument. The instrument's power switch does not interrupt power from the fuses. It must be interrupted remotely to cut off the power to the fuses;
- Remove the user access cover;
- Locate the fuse holders (near the terminal block in the wiring compartment for the user);
- Remove the two fuses (F1 and F2) and replace them with new fuses of the same specifications (T, 2.5 A, 250 V);
- Place back the user access cover and resume the power supply.

3.1.2 *Cleaning the colorimeter*

A precipitate may accumulate in the colorimetric measuring chamber or a coating may form on the inner walls. It is recommended to clean it with an acid solution and a cotton swab on a monthly basis. Depending on the sample conditions, it may be necessary to clean the camera more frequently.

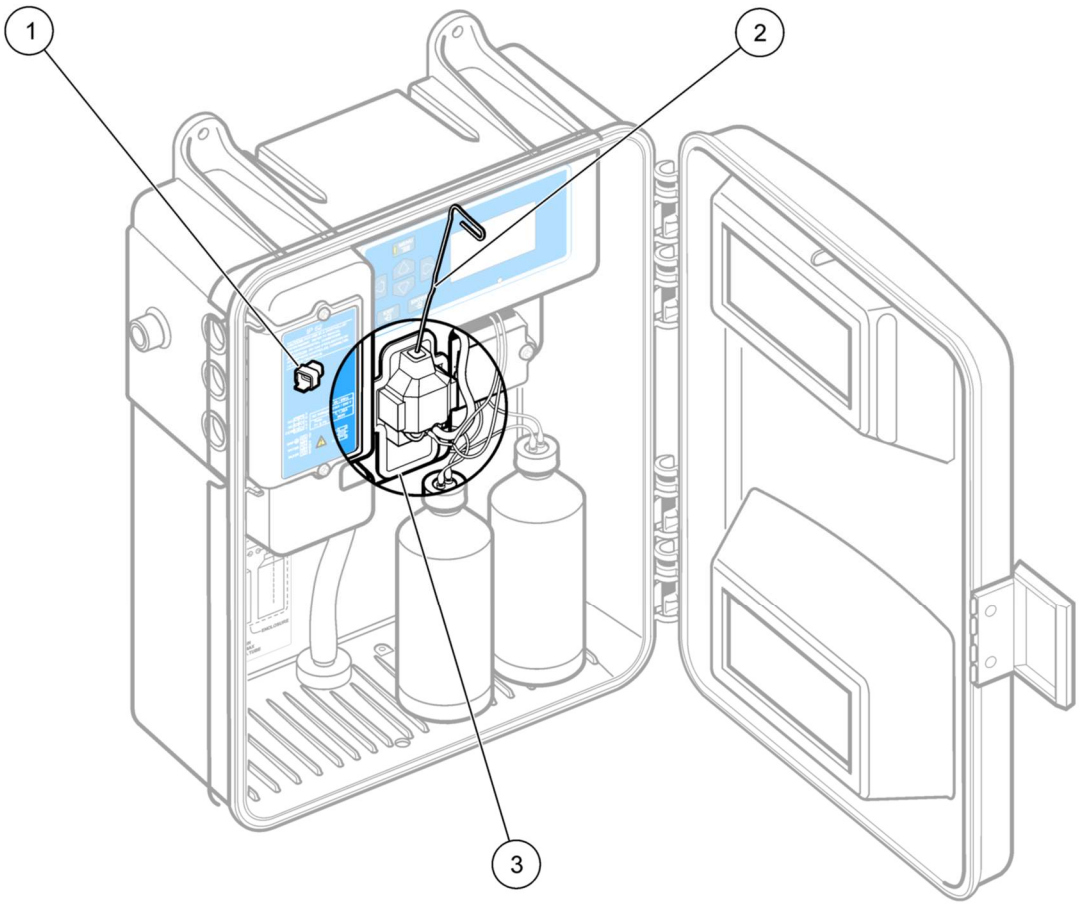
Procedure for cleaning the colorimetric chamber:

- Press the MENU button, then press the DOWN arrow until the MAINT menu appears. Press ENTER;
- Press the DOWN arrow to scroll to the CLEAN option. Press ENTER.

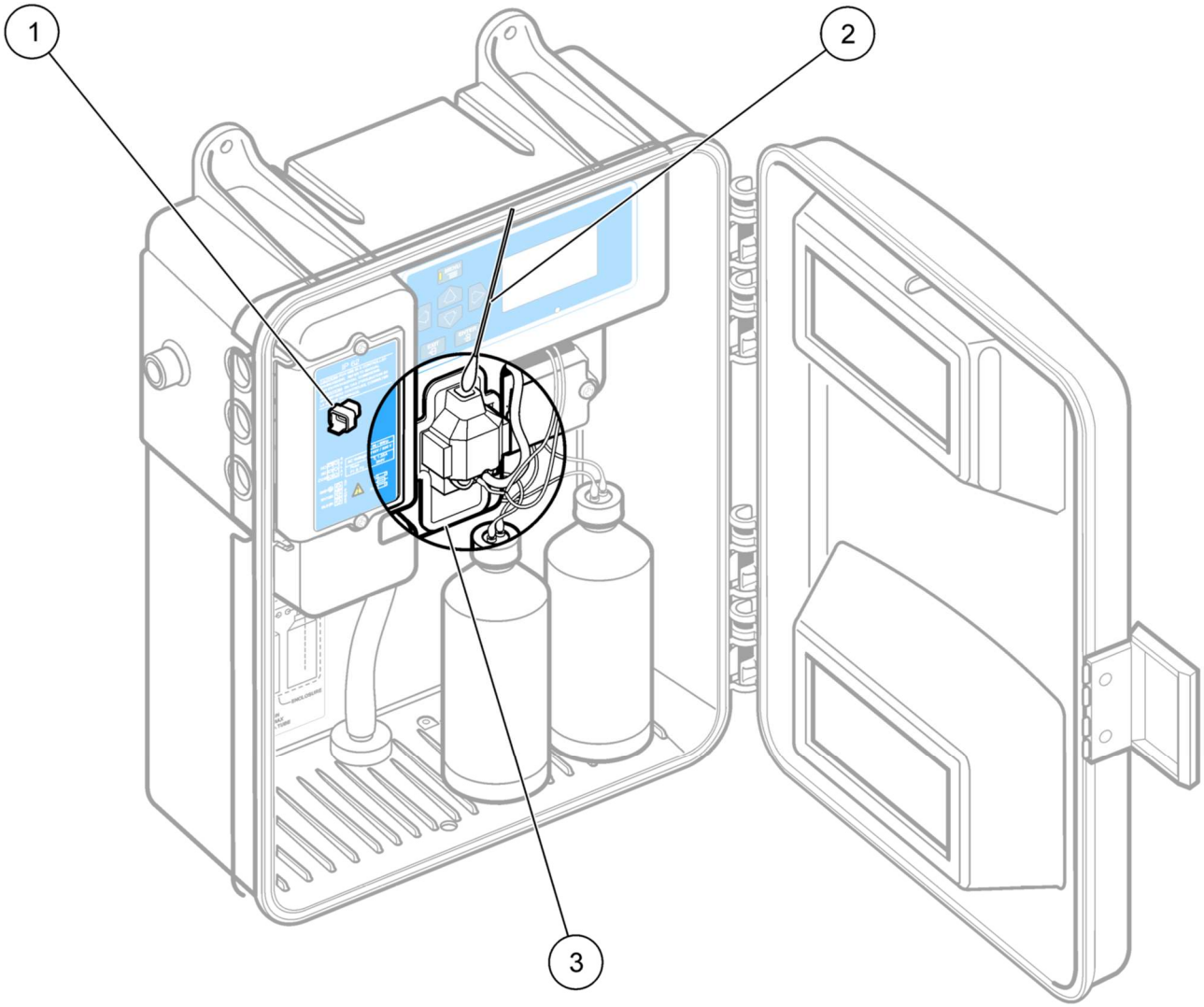
- Look at the figure below the current description and find the colorimeter;
- Remove the rubber stopper at the top of the colorimeter;
- Remove the magnetic stirrer using a curved metal clip. See the figure below the current description;
- Wait for CLEAN to flash in the display status bar, then fill the colorimeter with a standard solution of 19.2 N sulfuric acid (203832);

Note: Sulfuric acid with lower normality will NOT be sufficient for cleaning the colorimeter.

- Leave the sulfuric acid in the colorimeter for 15 minutes;
- Insert a wooden or paper swab with a cotton tip * into the hole and move it up and down, rubbing it gently to clean the inside surfaces of the colorimetric chamber. Clean the mixer with a cotton swab (the figure below the current description);
- Insert the stirrer;
- Replace the rubber stopper at the top of the colorimeter and make sure the lid is on the viewfinder of the colorimeter;
- Press the EXIT button to return to normal operation immediately.The tool will return to normal operation automatically after 60 minutes.



1) Remove the plug from the upper hole of the colorimeter;
2) Carefully insert a straightened paper clip into the hole at the top of the colorimeter and slowly pull the agitator out.;
3) Colorimeter.



1) Remove the plug from the upper hole of the colorimeter;

2) Gently rub the inside of the colorimeter with a cotton swab;

3) Colorimeter.

3.1.3 *Replacing the sample conditioning filter*

To put the filter in the housing:

1) Isolate the filter with the valves on each side;

2) Unscrew the top of the filter housing;

3) Insert the filter element and press it in place;

4) Replace the top of the filter housing;

3.1.4 *Reagent spill cleaning*

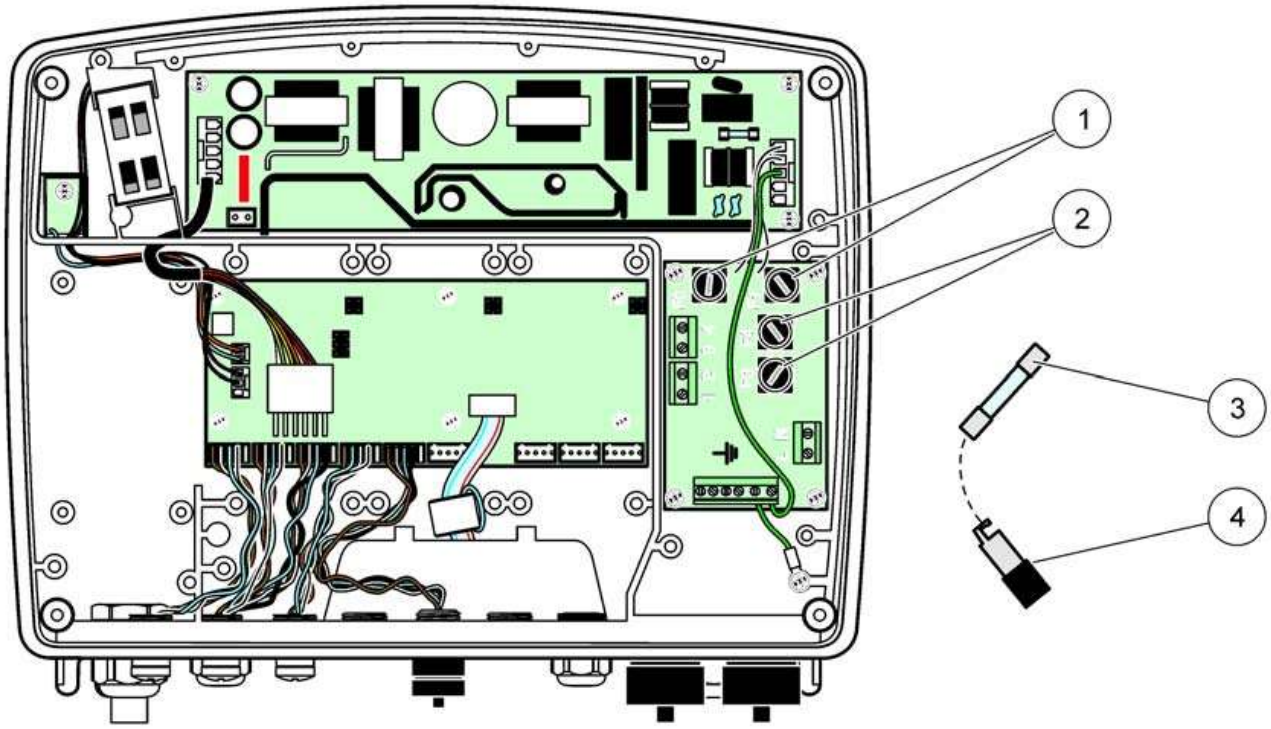
Wipe off spills with a clean disposable cloth and dispose of it in accordance with applicable federal, state, and local regulations.

3.2 INSTRUMENT FOR MEASURING PH, ORP AND TEMPERATURE

Information about the internal fuses can be found on the inside of the housing. Refer to the label fuse characteristics and the following instructions for proper fuse replacement..

- Turn off all power to the equipment before removing the covers and attempting to check the fuses.;
- Remove the display module from the probe module;
- Remove the four screws that secure the probe module front cover. Open the probe module and disconnect the body ground from the cover ground pin;
- Remove the six high-voltage barrier screws and take it off;
- Press the screwdriver slot;
- Turn the screwdriver at an angle of 45 ° to the left;
- The upper part has a spring and will now open;
- Remove the upper part with the fuse and replace it;
- Insert the new fuse, placing the top of it in the holder;
- Press the top of the slot with a screwdriver and carefully push the top down;

- With the screwdriver turn the top right side until the cover is firmly secured.



1) Fuses (2), F1 and F2: M 3.5 A medium slow burn;
2) Fuses (2), F3 and F4: T 8 A H; 250 V.;
3) Remove the guard from the holder as shown;
4) Fuse holder.

3.3 CHECKING THE QUALITY OF WATER QUANTITY MEASUREMENT

If a deviation is found in the Good Alignment indicator in the direction of deterioration of the ultrasonic signal quality between the sensors, it is advisable to take the following measures:

- Make a good note of the current locations where the sensors are placed;
- Loosen the bolts of the sensor straps to the tube so that they are released.;
- Peel the sensors from the tube and clean them thoroughly with paper / cloth;

- Apply sufficient insulating grease to the pipe-contacting side of the sensors;
- Clean the pipeline where the sensors come in contact with the pipe. If necessary, use a wire brush to roughly clean up any rust and deposits, and then finally clean with paper / cloth.;
- Return the sensors to the locations previously noted;
- Fit and tighten the sensor straps to the tube.

4 SERVER AND DATA VISUALIZATION SOFTWARE SUPPORT

4.1 PERIODIC DATA BACK UP

In normal use of the computer systems for access and visualization of the data, it is planned to carry out periodic storage of the data, the so-called back up. The activity is necessary in order to provide a common archive of data for the whole period of operation of the telemetry stations, as well as their use for various types of references and comparisons of the monitored parameters. It is recommended that data backups be performed once every 6 months.

DATA ACCESS

As part of the equipment and sensors for measuring the required parameters, a logic controller for their integration was installed at each of the control points. As part of the telemetry stations is the upgrade with a modem with a SIM card for real-time data transmission. In practice, the W&S Operator has the ability to monitor the data through the built-in remote access system or locally through the displays for adjustment and visualization of each of the components of the equipment.

FUNCTIONALITY OF THE REMOTE ACCESS SYSTEM

The data from all measurements are integrated into a specialized SCADA system, where information on the reported values is available in graphical and tabular format. The communication between the telemetry stations and the SCADA system is two-way, using a specially designed VPN network. This makes it possible to manually recall data and remotely reset the controllers as needed.

The functionality of the system allows the creation of different levels of access, and administrators, in addition to the option of remote access to telemetry stations will be able to create alarms and different logics.

For the needs of the water supply and sewerage Dimitrovgrad, a working screen was created with the observed parameters of the five points.

	CP 1
Pressure	1,38 Bar
Flow	12,84 l/s
Quantity	31736,7 m3
pH	7,35 pH
Temperature	22,0 °C
Residual chlorine	0,00
ORP	445 mV

CP 2
2,63 Bar
72,09 l/s
83603,9 m3
7,27 pH
19,1 °C
0,11
561 mV

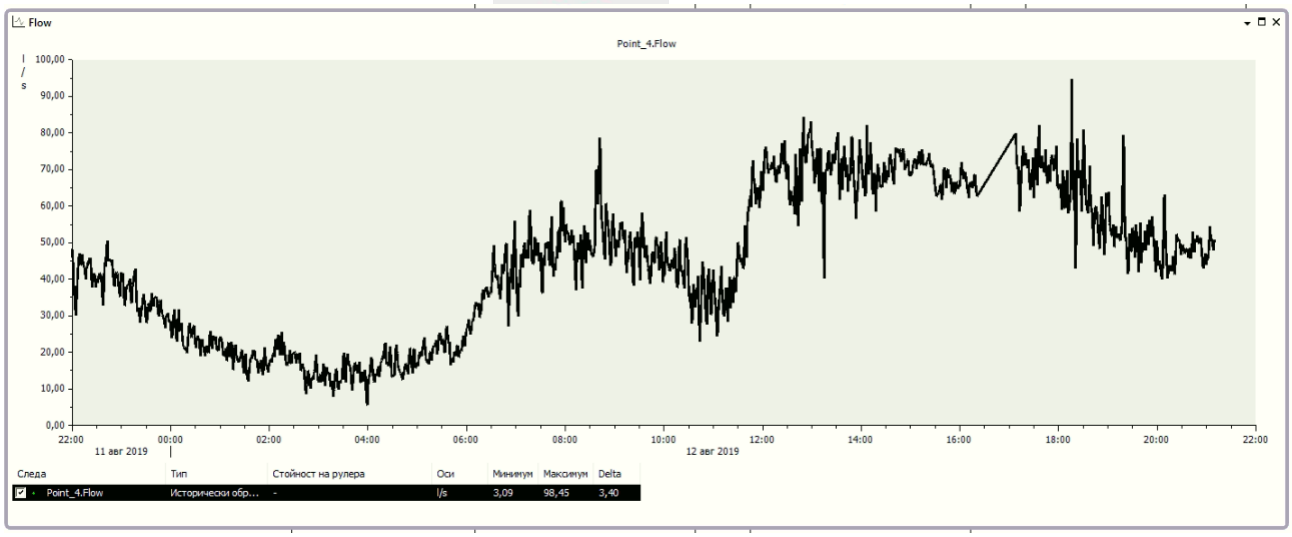
CP 3
3,52 Bar
29,12 l/s
66587,7 m3
7,37 pH
25,0 °C
0,10
57 mV

	CP 4
Pressure	1,60 Bar
Flow	26,03 l/s
Quantity	66203,6 m3
pH	7,44 pH
Temperature	21,7 °C
Residual chlorine	0,01
ORP	147 mV

CP 5
3,06 Bar
10,12 l/s
28158,3 m3
7,57 pH
25,8 °C
0,10
340 mV

Each value cell is active. When you point to the mouse and left-click, a pop-up menu appears with the option to select additional analytic features.

- History graphics – graphically display historical data. There is an option to set the period - hour, day, week, month. Data analysis for the selected period - minimum value, maximum value, average value, difference.



- Current graphics – when requesting such a graph, a graph of the current data begins to be drawn on the desktop;

- History list – when you select this menu, the table displays the values of the variable for the selected period.

- Show map - Locates the map point with exact geographical coordinates;

- Show Alarms - Displays a list of alarm events - lost connection, going out of range;

- Show events - displays a list of operator interventions - turn off alarms, turn off point tracking;

COMPARISON OF READINGS FROM MEASUREMENTS

When sampling for verification, the team took pictures of the equipment displays (locally) and screenshots of the remote sensing system.

Related photos and a comparison of readings from measurements are shown in Item 2 of Deliverable 3.2.4a.

Application of innovative techniques to improve the quality of drinking water in urban areas - AQUA-LITY