ESLI

POLLET WATER GROUP

BUDGET SERIES REVERSE OSMOSIS SYSTEMS USER MANUAL

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These instructions for use should always be kept near the device and in an easily accessible place when necessary.

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1.INTRODUCTION

ESLİ Industrial Products Marketing Industry and Trade Limited Company has rights to change all information that exist in operating manuals without any prior notice. All informations can be changed in those operating manuals. ESLİ AQUALINE operating manuals are prepared for customers and contains important information for starting up the system in safe and maintenance the system. Operating manual must be near the system to reach easily when it is required.

1.1 ABOUT THE INSTRUCTION BOOK

There is important information for use and care of devices of the system inside the ESLİ AQUALINE BUDGET SERİES REVERSE OSMOSIS SYSTEMS operating manuals. Manual must be read attentively by all responsible people for the system. Thus, the system can be carried, stored and operated safely after purchasing the system. People who are responsible for the system must act according to advice and directions otherwise, the person who did the process will be in charge.

1.2 MODEL IDENTIFICATION

ESLI AQUALINE Reverse Osmosis System is called as a figüre that is below.

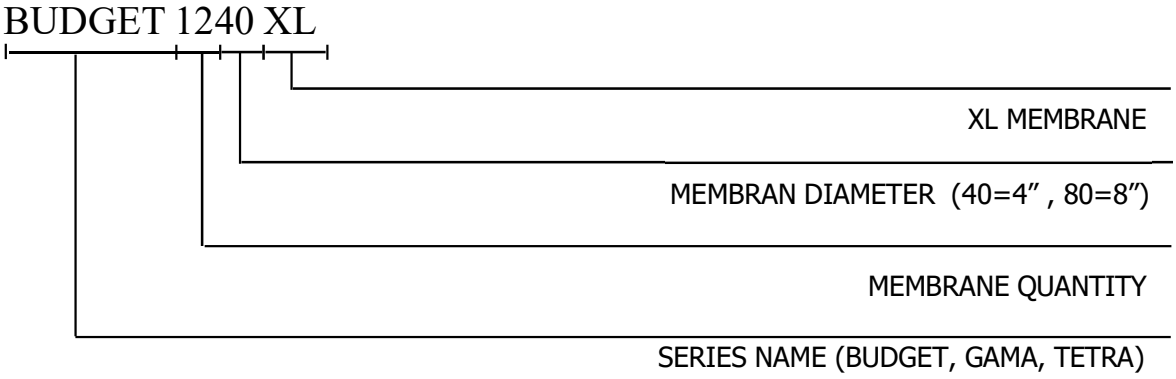

Figure 1-1: AQUALINE RO Systems Model Identification

1.3 DEFINITION OF BUDGET SERIES REVERSE OSMOSIS SYSTEM

1.3.1 Explanation of Reverse Osmosis System

Reverse Osmosis system is called the membrane filtration process to obtain pure water applied to the water and that is applied water that a classic water treatment system can not be enough. Also, the RO system suspends all undesired minerals from the water. Membranes on the system have an important role for working principle of reverse osmosis system. Water is forced to pass through the pores on the membranes under high pressure. During the process, water molecules and some organic molecules can be passed through those pores, most of the substances in the water can not be passed through those pores and product water is excreted as permeate water. Reverse osmosis devices are popular with improved technology and automatic RO devices are able to produce. High quality with desired permeate water flow is able to be obtained with an improved RO system.

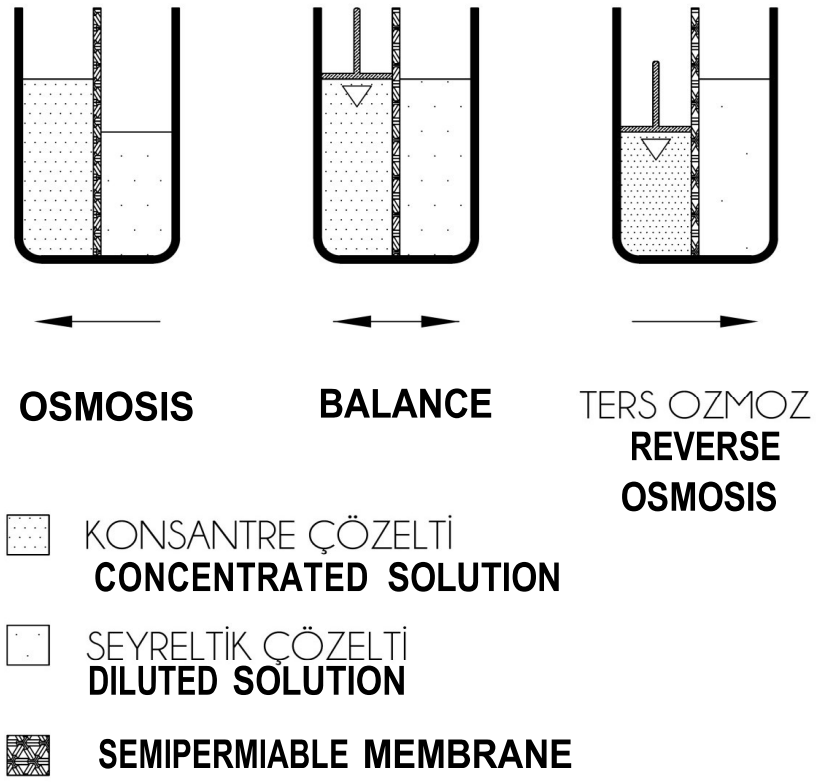

Figure 1-2: Osmosis & Reverse Osmosis Relation

1.3.2 Working Principle of Osmotic Pressure and Reverse Osmosis System

Osmotic pressure is a pressure created by water. There is an active value of any solution with a specific density to absorb the pure water that is in contact. That value is called the osmotic value of solution. The pressure that exists during the osmotic process is called osmotic pressure.

Osmosis has a significant role in the wild for the life of creatures. Understanding the principle of reverse osmosis is difficult without knowing the principle of osmosis. Osmosis is occured as vegetations sucks the water from the soil, receiving and giving water from the blood to feed the cells in the body, also works flawlessly in many places, such as separating blood from urine in the kidneys in nature. Water in the soil goes up to the plant water that is more salty with an open membrane on the plant root with osmosis despite the water pressure in the soil is less than the water pressure at the root of the tall tree. Thus, osmosis provides entrance of water from the soil to the root of tall trees. That natural phenomenon proves us there is pressure of less mineral water by comparing with the water having more minerals. Thanks to the osmotic pressure due to salty difference between water, water under the same atmospheric pressure can pass through easily the membrane that divides the creatures or cells. The law of compound vessels is not valid for this natural phenomenon that water is divided by membrane. For the RO systems, that principle uses inversely to get good quality water from bad and salty water.

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1.3.3. Reverse Osmosis Membrane Qualification

Reverse osmosis system based on membrane filtration feed by the pressurized flow is parallel to the surface of membrane. Part of this flow keens on and passes through the membrane. Particles that could not pass through the membrane make concentrated solutions. This solution flows as parallel to the surface of the membrane. Hence, collapsing of dissolved minerals and particles on the membrane prevents.

Reverse osmosis membrane makes its duty against as a barrier to all dissolved salts, inorganic molecules and organic molecules with a molecular weight greater than about 100. Water molecules in the other words, molecules pass easily through the membrane create purified production flow. The efficiency of reverse osmosis system for separating dissolved salts from water molecules is between % 95 - %99

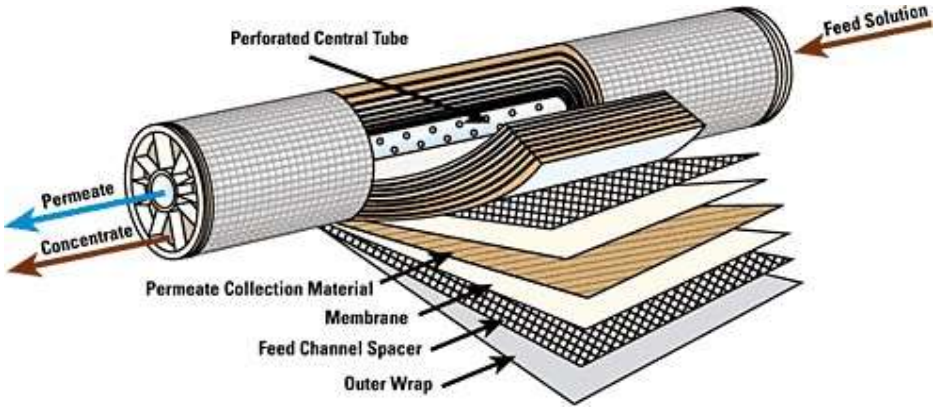

Figure 1.3: Membrane Section View

1.4 STANDARD DESIGN DATA

AQUALINE BUDGET SERIES Reverse Osmosis system is designed by expert engineers with OLTREMARE SIRIO software. After entering Feed water and permeate water values on the software, reverse osmosis system design is projected. Feed water values accepted by ESLI are given below for the standard system.

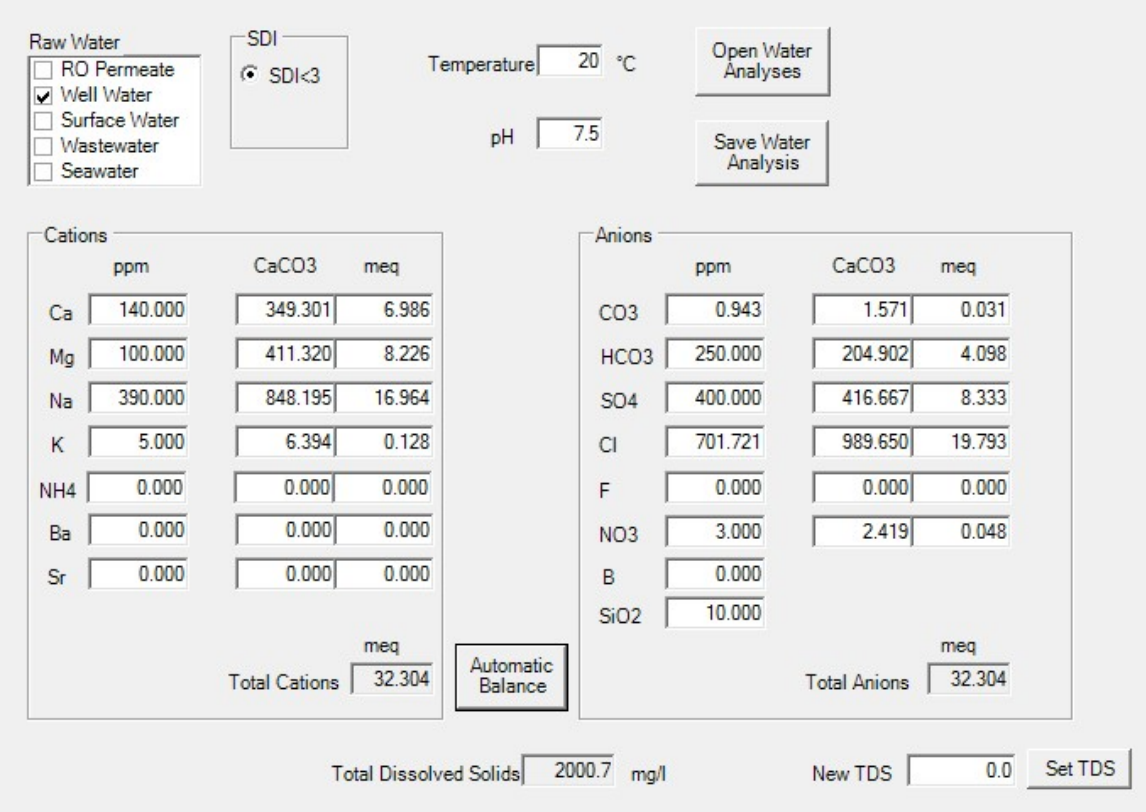

Figure 1-4: AQUALINE BUDGET Series RO Systems Standart Design Data

1.5 APPLIED AREAS

- Drinking Water Production: Drinking Water Production : Main purpose of using a reverse osmosis system is obtaining drinking water. RO system is used commonly to get drinking water from water containing high salt.

- Soft Drink Industry: Fruit juices are concentrated for making their shelf life longer, carrying and stored and reducing the cost. Then they are diluted and pasteurized before selling. After that they are packaged. During the concentration of juice, it is made by vacuum evaporation and volatile flavors disappear with steam during that time but if membrane technology is used during concentration time, more qualified products will be obtained because of no loss for flavors. Also, membrane technology is used commonly for preparing soft drinks. Operating a reverse osmosis system is easier than conventional methods and more qualified water is obtained with lower cost.

- Steam Boiler Feed Water: Especially in plants that use open steam, there is low condensate. Always new feed water is given to the steam boiler in that type of steam system. Thuse, the conductivity of boiler water increases rapidly and a lot of boiler bluffs are made to reduce conductivity. Boiling water is thrown during boiler blowdown and bluffing from the boiler also means heat loss but this is not economical. Steam boiler has to be cleaned by low conductivity water prepared with reverse osmosis system instead of high conductivity water because boiler bluffs decrease 97% and cost of owner decreases.

- Steam Generator Feed Water: Water comes to steam generators is converted to steam in short time and petrifies inside the pipes of every mineral generator except water molecule in water. There is no effect for softening process for water not to petrifies because softening removes calcium and magnesium but that gives sodium molecules and many minerals to water. Minerals cause petrification which decreases the heat efficiency of generators in a short time. However, steam generator can be fed by water these are produced with reverse osmosis and purified water and problems experienced can be decreased.

- Preparing Cooling Water: Cooling waters are prepared by using reverse osmosis devices in order to increase the formation of stones and scales, product quality and production speed in mold cooling waters For industrial establishments that make precise metal casting and precise plastic injection.

- Power Plant: In power plants, the quality of pure water under 0.1 µS/cm conductivity and the amount of Silicate (SiO2) in water should be under 0.05 mg/ t. This water purification process is usually done with reverse osmosis systems. Up to 99% of the unwanted minerals in the feed water are separated by reverse osmosis systems. After that, the water is purified by a mixed-bed demineralization system or Electro-Deionization (EDI) system.

- Textile Process Water: Softened water is often used in textile dye houses. Due to the change in the seasons for Well and Dam waters, it is impossible to obtain water as product quality in every period of the year because seasonal changes occur in the waters coming from the springs. Product waters obtained by using reverse osmosis systems are preferred in the product waters of textile dye houses, as they are minimally affected by seasonal changes.

- Chemical Industry: In some chemical industries, the low conductivity water required for the process and this water is obtained by reverse osmosis systems.

- Pharmaceutical Industry: Reverse osmosis systems are used as a pre-treatment device in the pharmaceutical industry, in the production of pure water used in the manufacture of medicines given to humans by syringe. Then, this water is used by purifying with distillation and micro-filtration methods. Dialysis machines in hospitals are fed with quality water produced with reverse osmosis devices.

2. HEALTH & SAFETY

ALL HEALTH AND SAFETY PRECAUTIONS DESCRIBED UNDER THIS SECTION MUST BE READ CAREFULLY AND ALL WARNINGS MUST BE FOLLOWED.

2.1 WARNINGS AND PRECAUTIONS ABOUT THE SYSTEM

- Δ Antiscalant dosage is so essential for membranes of RO units. Thus, If there is dosage of antiscalant for system design, won't work until finishing of dosage.
- Δ If different antiscalant from advised from ESLİ for the system, ESLİ is not responsible for damage that can be occured on the membranes.
- Δ The level and suction of antiscalant must be controlled usually.
- Δ Membranes must not be without water in the RO unit. The RO system has to be worked once and 2 hours per day for a shorter than 4 days stopping of the system. At the section of 7.2.2.1 Deactivation the System in Short-Term Stopsı more information exists. At the section of 7.2.2.2 Deactivation the System in Long-Term Stops the way has to be followed.
- Δ Check usually membrane entrance pressure of RO unit. If the pressure increases, will look for the reasons and will take precautions.
- Δ The conductivity of concentrated and permeate water of RO Unit has to be checked. If the conductivity increases, we will have to analyze precautions.
- Δ The flow rate of permeate water and drainage concentrated water has to be checked usually. If the flow rate increases or decreases, will have to analyze the causes and take precautions.
- Δ The shelf life of RO membranes is minimum 3 years in normal conditions. If the recovery of membranes or the efficiency cannot be increased despite chemical washes in case of clogging of membranes, membranes will have to be replaced .

- Δ It is important to work with water supply chlorine. If there is an ORP probe in the system, chlorine concentration has to be controlled when the rings of ORP alarms, and chlorine value must be under 0 ppm. If chlorine exists in the raw water, chlorine must be prevented from active carbon filtration and SBMS dosage
- Δ Inlet and outlet valves should not close when the system works.
- Δ System should be used just for treating brackish water and municipal water.
- Δ Sistem devrede iken sistem drenaj hattındaki iğne vana asla kapatılmamalıdır.
- Δ Needle valve at the drainage line must not be closed when the system works
- Δ Reverse Osmosis Device will be shipped to your business as a package system. Linkage of feed product and drainage line that are empty on the device will be done on site. Detailed information exists at the section of 5.2.2 Hydraulic Installation.

2.2 HEALTH PRECAUTIONS

- Fire must not be used in areas where chemicals are stored and used.
- Using chemicals could be so dangerous. That's why staff should pay attention not to hurt anyone by taking precautions. Education of staff to use chemicals properly is the responsibility of the customer.
- The panel cover should not be closed while the panel is energized. It can be exposed to high voltage.
- Any different operation and maintenance from manual should not be done. System should be used just for water treatment.
- All pipings on the system must be controlled everyday. For detecting leaks and leaks the system should be stopped and necessary precautions should be taken. Any equipment on the system line should not be disassembled due to the unknown pressure or high pressure.
- Responsible staff should use protective equipment during the system maintenance. Protective clothing and equipment should be used at all times, especially the face, eyes, hands and neck should be protected. Staff should be careful not to be allowed to come into contact with the eyes, skin and clothing, and vapors should not be inhaled.
- Voltage changes should be checked periodically. Electrical lines that will feed the system must be grounded; Precautions should be taken against phase change or voltage drop.
- It should never be entered into a tank exposed to chemical steam or a closed area without a suitable ventilation system and accompanying personnel.

- In the water treatment system, water is conditioned with the help of chemicals. Chemicals are used pre or post treatment such as chlorine, sodium metabisulfite, acid, caustic. Among the chemicals, its effect is acid burning differently from sodium metabisulfite, caustic, antiscalant, and chlorine, you should pay attention to this feature.
- Energy should be cut off inside the panel before working and it should be controlled with a control pan or avometer not to bring energy to the panel. You should not intervene with any equipment or instrument that is fed with electrical energy before cutting off energy.
- System should be protected against the risk of freezing.
- Main energy must be cut off, dry powder fire extinguisher should be used and water should be thrown during the fire extinguishing process.
- System should be worked at the range of flow rate that is expressed in manual. Maximum work temperature is 50°C. System must not be worked over that temperature value.
- Electric current should be cut off from the switch or the contact of casualty with the bare cable should be cut with a non-conductive object. In the case of an accident, first aid should be applied immediately. If there is a loss of consciousness, a burn or a fracture due to a fall, the transplant should be provided without lifting.
- In every severe injury, a doctor or nurse should be called for every situation.
- If the chemical is swallowed and the consciousness of the patient is good, the mouth of the patient will clear with plenty of water. It is important that the tongue of the patient should be forward and the regularity of breathing should be checked. The patient should not be attempted to be used. If there is a loss of consciousness of the patient, anything should not be given by mouth.
- If there is contact with eyes, eyes should be cleared with plenty of water for 15 minutes. If there is a shock condition, tight clothes should be loosened and feet should be raised around 30 cm above (heart level) the ground.
- If a person breathes the chemical vapor, the patient should be taken to fresh air immediately. If the breathing of the patient stops, artificial respiration should be applied.
- Clothes that are contacted to chemicals should be taken off. Body areas that were affected by chemicals should be cleaned with plenty of water for 15 minutes.

- In the case of burning, any oil or ointment should not be applied to the burned areas. If there is a flame burn and synthetic clothes are adhered to the skin, they should not be removed. Clothes were exposed to age and heat should not be removed

3. TECHNICAL SPECIFICATION

3.1 GENERAL TECHNICAL SPECIFICATIONS

In this section, technic informations are given about BUDGET SERIES REVERSE OSMOSIS devices and panels on these devices

Standard general technical specifications of BUDGET Series RO devices are expressed below.

- **Membrane Vessel** **:** It is manufactured with FRP material in FRP standard, optionally in stainless steel.

- **Membrane** **:** Membranes that are 4 inch diameter and TFC spiral winding are used in the devices

- **High Pressure Pump :** Rotary types with the stainless steel SS304 body vertical centrifugal high pressure pumps are used in BUDGET 140, BUDGET 240 models, BUDGET 340 and BUDGET 1540. The outlet pressure ensured by pump is 4 bar for a ¾ pipe.

- **Chassis** **:** Chassis are made by SS304 stainless steel for BUDGET 140 – BUDGET 640, they are made by ST-37 carbon steel for. Also, they can be made by SS304 stainless steel for BUDGET 840 – BUDGET 1540 optianally.

- **Cartridge Filter** **:** There exists a 5 micron precision cartridge filter before the RO unit.

- **Piping** **:** Low and High Pressure installations are made of UPVC/Zonder pipes. Optionally, it can be made by stainless steel SS304.

- **Otomatik Vana** **:** Automatic valves with electric actuator are used as standard

- **Control Valves** **:** There exists flow control on the pump outlet and waste water lines.

- **Pressure Switches** **:** There exist low and high pressure switches.

- **Flowmeter** **:** Permeate water and concentrated water outlet flow meters exist in all models. Also, return scratch flow meter exists additionally for between BUDGET 340 – BUDGET 1540 models

- **Manometer** **:** There exist manometer glycerine manometers in all models.

- **Conductometer** **:** Permeate water conductometer exists as standard in all models

- **Autoflush** **:** There exists an autoflush system as standard in all models

- **Printed Circuit Card** **:** As a standard condition, electronic control cards have alarm and condition lambs are used.

- **Electricity Supply** **:** Single-phase feed is required for BUDGET 140 and BUDGET 240, Three-phase feed is required for between BUDGET 340 – BUDGET 1540. Operating power supply for the logical boards is 24 V DC and for the High Pressure Pump is 220V AC (50 Hz).

- **Design Limits** **:** İnlet water limits are shown below for BUDGET series reverse osmosis devices with standard design;

  - Inlet Water TDS : ≤ 2000 ppm
  - Inlet Water Pressure : 0,5-5 bar
  - Inlet Water pH : 6-8
  - Silica (SiO_2) Tolerance : Up to 25 ppm
  - Inlet Water Temperature : 3 – 50 ° C
  - Iron (Fe) Tolerance : 0,05 ppm (If ASC dosages, will be 0,2 ppm)
  - Hidrogen Sülfid Tolerance : 0 ppm (Zero)
  - Turbidity Tolerance : NTU < 1
  - Oil Grease Tolerance : 0 ppm (sıfır)
  - SDI : < 5
  - Microbiological Pollution : Must not exist.

Differences between BUDGET Series RO systems are shown on the next page that is Table 3-1: BUDGET Series RO Systems Technical Details Table

MODEL	FEED CAPACITY (m^3/day)	PRODUCT CAPACITY (m^3/day)	MEMBRANE SIZE (diameter x length)	MEMBRANE QUANTITY (pcs)	RECOVERY (%)	ENGINE POWER (kW)
BT125 – 1	1,8	0,72	2,5″ x 21″	1	40	0,37
BT125 – 1	3,75	1,5	2,5″ x 40″	1	40	0,37
BT125 – 1	5	2	4″ x 21″	1	40	0,37
BT 140	10	5	4″ x 40″	1	50	0,64
BT 240	20	10	4″ x 40″	2	50	0,64
BT 340	25	15	4″ x 40″	3	50	1,1
BT 440	33,5	20	4″ x 40″	4	50	1,5
BT 540	42	25	4″ x 40″	5	50	2,2
BT 640	50	30	4″ x 40″	6	50	2,2
BT 840	57,5	40	4″ x 40″	8	60	2,2
BT 940	64,5	45	4″ x 40″	9	60	2,2
BT 1040	71,5	50	4″ x 40″	10	60	2,2
BT 1240	86	60	4″ x 40″	12	60	3
BT 1540	107,5	75	4″ x 40″	15	60	3

Table 3-1: BUDGET Series RO Systems Technical Details Table

4. WORKING PRINCIPLE & CONTROL PANEL

4.1 WORKING PRINCIPLE

In this part, working principle of BUDGET Series Reverse Osmosis systems. It could be explained in the simplest language below.

The raw water passed through the pre-treatment supplied by ESLİ AQUALINE; İT İS treated with 5 micron by entering a cartridge filter. The raw water passed through the pretreatment cartridge filter is reached to design pressure by the help of a high pressure pump. Permeate water products from the system are stored, waste water thrown to the waste line.

4.1.1 System Operation

System starts to work when operatör or responsible person gives the start command to the system. When the system started to work;

Pre treatment Works, Permeate water tank is not full and there is no alarm in the system.

I. If the feed pump Works related to osmosis, the pump will work with 3 seconds delay. If there is no connection of the feed pump to osmosis, again there will be a 3 minutes delay but there is no effect to the operation status of the feed pump.
II. Inlet valve is opened after operation of the feed pump or after 5 seconds of finishing 3 second Delay.
III. Enough amount is fed to the system after opening the ınlet valve and after a 15 seconds delay, high pressure pumps and dosage pumps work together.[1]

[1] If the feed water is not enough, the system will be stopped. During that stopping time the feed pump continues to work. After 6 seconds, the inlet valve is opened again. If pressure is reached enough level, high pressure pumps, dosage pumps, and auto-flush valves start to work. If there is not enough pressure, the inlet valve will be closed after 6 seconds. After that, the inlet valve is opened again 6 seconds later. If there is not enough pressure level again, the low pressure switch led flashes gives audible warnings and the alarm led on the control panel lights continuously and keeps the system in Alarm Mode 10 minutes. After 10 minutes later, the expressed procedure is followed with the same row and the inlet valve is opened and closed 3 times again and expects to get enough pressure. If the required pressure is not obtained again, System will enter Alarm Mode for 10 minutes. If this situation is repeated 20 times, the system will be stopped completely. Low pressure switch led flashes and bip, the alarm led on the control panel lights up continuously.

IV. At the end of 15 seconds delay, the auto-flush valve is opened and ıt remains open for 60 seconds. Permeate water starts to produce after closing auto-flush. Every start of hours, auto-flush is opened and and it remains open for 60 minutes. Duration of operation and waiting can be extended and shortened by the help of DIP Switch. Detailed information is explained at the section of 4.2.1.2 Setting. System goes on working until the system is stopped, receiving fault or for some problem related to the working principle.

4.1.2 Switching the System to Standby

1.1.1 System's standy, means that stop like when the stop command is given and when the factor causes this stop removes, ıt will be started again to work without operatör intervention The factors affect the system to wait;

I. Filling the permeate water tank as full.

II. Entering pre-treatment to backwash.

III. Being empty of raw water tanks.

IV. If there is a connection, cause to wait.

4.1.3 System Restart

System restart; means that the state of the system goes into standby is activated again when the holding factor ends. System will start to work again as explained at the section of 4.1.1 Sistemin Çalışması. The factors that make the system work again are as follows;

I. By decreasing permeate water level and not being full of permeate water tanks.

II. Finishing of pre-treatment backwash.

III. Refilling of raw water tank.

IV. Except for them, cutting of signal comes from external connection causes the stop

4.1.4 SYSTEM'S STOP

System just stops when operatör or responsible staff gives a stop command. When the system is stopped;

High pressure pump and dosage pump stops at the same time and the inlet valve will be closed after 3 seconds and the feed pump will be stopped. If the operatör does not give start command, the system will never work. If the system waits for a long time, the explanation at the section of 7.2.2 Decommissioning must be applied.

4.1.5 Stopping the System due to Malfunction

If there is a malfunction, system will stop[2]. This malfunction can be understood by both audible and visual warnings. The device should be worked again by solving the problem with operatör and resetting the device. The factors cause stop the system due to the malfunction;

I. After the signals come from low pressure and high pressure switch [3]
II. Giving low level of chemicals in chemical tank
III. When there exists electrical or mechanical faults except for the others.

4.1.6 Stopping the System with the Emergency Stop Button by

If the system must be stopped for the emergency situation, emergency stop buttons on the control panel have to be used to stop the system. When the system stops by the emergency stop button, the system will stop completely and will switch to the alarm mode. For restarting of the system. Emergency stop button has not to be pressed.

[2] Automatic rinsing does not start in the system with CIP.
[3] After the low pressure or high pressure alarm, the system will run automatically every 10 minutes to check whether the specified alarms are gone, if there is no alarm, it will continue to operate.

4.2 CONTROL PANEL

There are 4 different panels for BUDGET Series Reverse Osmosis System. Standart BUDGET Panel is used for standard systems.

4.2.1 Standard BUDGET Panel

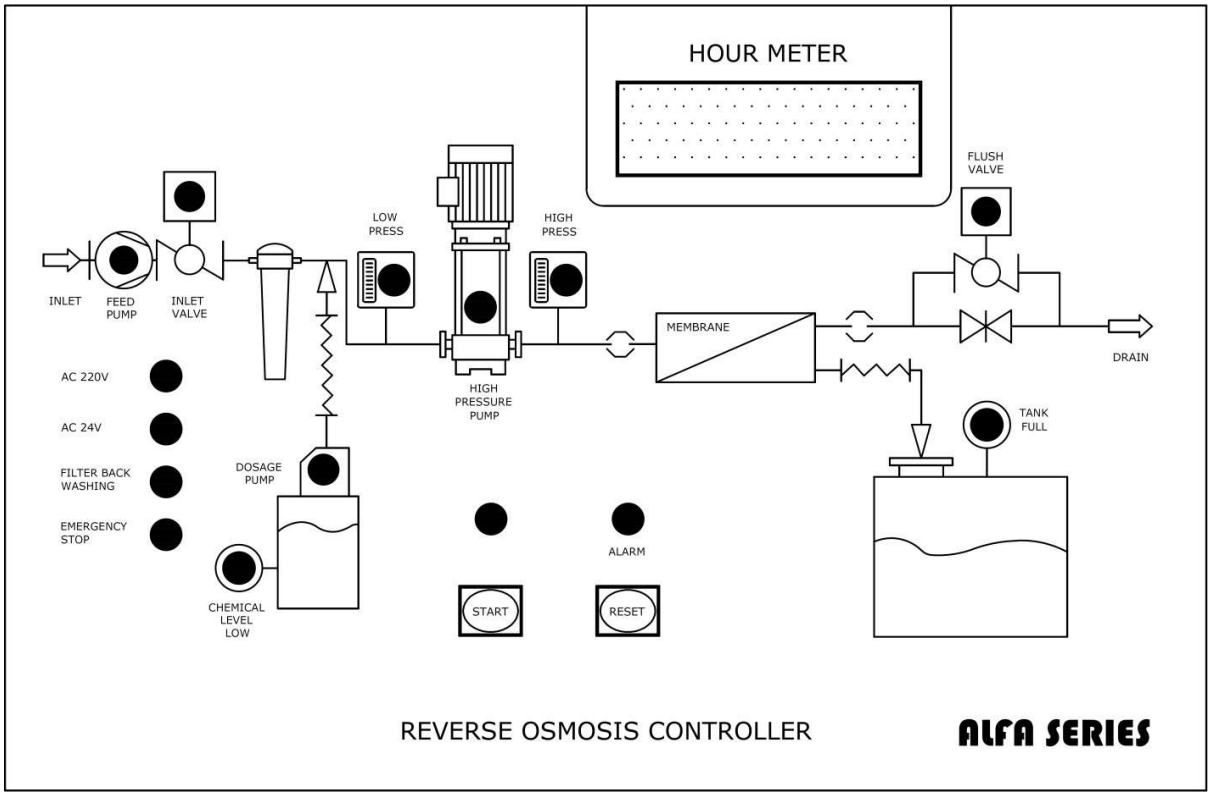

Figure 4-1: Standard BUDGET Control Panel Mimic Diagram

Operation of the system can be seen by the help of leds on the control panel. Continuous lighting of LED lights on the mimic diagram is considered normal operation. If any led of high pressure pump switch, chemical tank low level switch or any external switch is flashing, there will be a problem about the switch its led flashes. Also, for this situation, there are audible warnings and red led on led panel flashes continously. In this situation, after repairing the fault, the reset button is pressed for 3-4 seconds and it is reseted and the system continues to normal work.

4.2.1.1 Signs on the Control Panel and Their Meanings

The meaning of signs on the mimic diagram is explained at the below.

WRITTEN ON THE PANEL	EXPLANATION
START	It is the button used to start the system. If the START led on this button is lit, it indicates that the system is working, if it is not, the system is not working.
ALARM	The LED lights up when there is a malfunction caused by the equipment visible on the electronic card. After the fault has been checked and eliminated, the fault can be reset with the Reset button.
RESET	It is used to reset the incoming alarm.
INLET VALVE	If the led of this valve is on, it indicates that the valve is in open position.
LOW PRESS	It indicates that the pressure in the lines before the high pressure pump is below the set pressure value and the indicator led flashes.
HIGH PRESSURE PUMP	Indicates that the high pressure pump is running and the led will light as long as the pump is running.
TANK FULL	The led turns on when the product water tank is full. When the product water drops below the upper level, the led turns off.

Table 4-1: Standard BUDGET Control Panel Mimic Diagram Description Table 1

Components	EXPLANATION
A	3 Steps Prefiltration with PRV valve and manometer
B	Electronic Water Softener
C	BUDGET Series RO BT 140
D	Permeate Water Tank 500 L
E	Stainless Steel External High Pressure Pump
F	Stainless Steel External High Pressure Pump BYPASS connection

Table 4-2: Standard BUDGET Component