Improvement of the pressurization station SPP 41 from the irrigation system of Ograda, Ialomita County, Romania

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Abstract. The water supply of the arrangement is made from the Danube through the I.M. Gheorghiu base station and is pumped into the CA Lunca Canal. The outlet of the floating station is on the Cremenea arm of the Danube River at 221 + 650 km. The flow required for the Ialomița Călmățui terrace is 110 mc/sec. The 6.7 km long Lunca CA channel runs water through the Călmățui-Gropeni meadow to the base of Mihai Bravu terrace to the north of Spiru Haret locality, from where through the SRPA1 Spiru Haret repacking station, it is raised on the terrace and directed on the AC adduction channel. This channel is dimensioned in 3 sections: the first section with a length of 12.445 km crosses the area from the discharge basin of the SRPA1 Spiru Haret refueling station to DN21 Slobozia-Brăila, which it intersects south of the town of Inssurața; the second section is between DN21 (km12 + 445) from the channel and the SRPA4 station at km30 + 835; the third section with a length of 2690 m is between km30 + 835 and km33 + 525. From the main channel of adduction CA Terasa derives in the following channels: CD1 at km2 + 285, CD3 at km10 + 750, CD7 near the SRPA3A station and CD9 fed from the downstream end of the channel CA Terasa. The total length of the channels of adduction and distribution in the perimeter of Ialomița Călmățui is 318,866 km, the net surface of 137291 ha arranged for irrigation and is composed of 512 plots generally rectangular in shape. From the CD3 channel, the CD5 channel is formed stage 1 in the length of 14.3 km from which SRPA4 Bucșa is fed. This refueling station supplies 13.1 km long CD5 channels and CD4B, CD4C. The latter channel feeds the SPP41 pressurizing station serving 1692 ha belonging to OUAI Ograda. The proposed works will be limited to the refurbishment and consolidation of the SPP41 pressure pumping station.

1. Introduction

The water supply of the arrangement is made from the Danube through the I.M. Gheorghiu base station and is pumped into the CA Lunca Canal. The outlet of the floating station is on the Cremenea arm of the Danube River at 221 + 650 km. The flow required for the Ialomița Călmățui terrace is 110 mc/sec. [1]

The 6.7 km long Lunca CA channel runs water through the Călmățui - Gropeni meadow to the base of Mihai Bravu terrace north of Spiru Haret locality, from where through the SRPA1 Spiru Haret repacking station it is lifted onto the terrace and directed to the AC adduction channel. This channel is dimensioned in 3 sections:
-the first section with a length of 12.445 km crosses the area from the discharge basin of the SRPA1 Spiru Haret refueling station to DN21 Slobozia-Brăila, which it intersects south of the town of Inssurața.

- the second section is between DN21 (km12 + 445) from the channel and the SRPA4 station at km30 + 835.

- the third section with a length of 2690 m is between km30 + 835 and km33 + 525.

From the main channel of adduction CA Terasa derives in the following channels: CD1 at km2 + 285, CD3 at km10 + 750, CD7 near the SRPA3A station and CD9 fed from the downstream end of the channel CA Terasa.

The total length of the channels of adduction and distribution in the perimeter of Ialomița Călmățui is 318,886 km, the net surface of 137291 ha arranged for irrigation and is composed of 512 plots generally rectangular in shape [2].

From the CD3 channel, the CD5 channel is formed stage 1 in the length of 14.3km from which SRPA4 Bucșa is fed. This refueling station supplies 13.1km long CD5 channels and CD4B, CD4C. The latter channel supplies the SPP41 pressurizing station serving 1692 ha belonging to OUAI Ograda [1, 2] (Figure 1).

Figure 1. Area layout plan
The proposed works will be limited to the refurbishment and consolidation of the SPP41 pressure pumping station.

The project proposes modern and energy efficient solutions for MV 253x3 pumping units and the related electrical installations, including by creating the possibility of varying the rates of the pressure pumping station, with variable speed, to increase the elasticity in the operation of the modernized system. The main pipes and the pipes of five antennas from the premo and azbo of the station owned by the organization will be replaced.

By carrying out these modernization works the cost of water at the point of delivery of water SPP41 will decrease by over 17.75%, the cost of electricity will decrease by over 22%.

SPP 41 - Located on the CD4C channel, it has 6 aggregates, mounted on motherboards fixed to the floor of the tank, of which 3 MV 253x3 type aggregates with 160 kW electromotor at 1500 rpm with a supply voltage of 0.4 kV, 3 VTP units 1434-04 with 132 kW electric motor at 1500rot / min with the supply voltage of 0.4 kV upgraded by FEADR. It is supplied from PT PTS type 1600 KVA. It serves a net area of 1692 ha. The network of buried pipes consists of two CPs from which 12 antennas leave telescoping (Figure 2).

Figure 2. Master plan
2. **Proposed works**

The Irrigation Water Users Organization Ograda owns the irrigation infrastructure (pressure pumping stations and underground irrigation pipelines) on an area of 1692 ha related to the SPP41 plot which will be modernized, and which is within the commune's radius. Bucu, Ialomita County

The pumping station SPP41, subject to the expertise, is a pressure pumping station, which draws water from the CD4C irrigation channel and discharges it into the network of pressure pipes, main, secondary and antennas on the agricultural surface arranged.

The pressure pumping station SPP41, proposed for rehabilitation, was put into operation some 30 years ago, is an open ground construction [3].

Water for irrigation is taken from the Danube by the floating base station SPA I.M.Gheorghiu and pumped into the channel AC terrace, after which it is replenished by the station SRPA4 Bucşa, after which it reaches the derivative channel CD4C from which the pumping station SPP41. In order to bring the SPP41 pumping station to the higher operating parameters, operating with high efficiency and low energy consumption, rehabilitation works will be required which will consist of:

- dismantling the equipment related to the three MV 253x3 aggregates existing in the station (pumps, motors, valves, valves, mounting compensators, pipe sections, etc.);
- procurement of technological pumping equipment (pump and motor) with pumping height 60mCA and flow rates of 500 mc / h for new basic pumps;
- new electric pumps will be provided with frequency converters for taking overflow variations and for protecting the electric motors and their economic functioning;
- the valves and valves on the discharge pipes will be replaced with new ones;
- the electrical installations will be dismantled and replaced with new installations (general panel with USOL type switch, electrical panels for frequency converters);
- the main conduits and the pipes of the station's pre and azbo antennas will be replaced with other PEHD pressure pipes dimensioned in such a way as to meet the requirements of the watering facilities provided by the OUAI members.
- CP and line valves will be replaced with new ones;
- Apometers will be mounted on each antenna, following the line valve;
- the dismantling of old equipment and installations will be done by qualified personnel respecting the current norms of protection and hygiene of the work;
- the tools, equipment, pipes and fittings to be replaced will be removed from the station's location and stored in specially designed spaces for recovery;
- the rehabilitation works will not affect the environment and the health of the people.

3. **Results and discussions**

The proposed works will be limited to the refurbishment and consolidation of the SPP41 pressure pumping station.
The project will propose modern and energy efficient solutions for pumping units’ type MV 253x3 and the related electrical installations, including by creating the possibility of variation of the rates of the pumping station of pressure, with variable speed, to increase the elasticity in the operation of the modernized system. The main pipes and the pipes of five antennas from the Premo and Azbo of the station owned by the organization will be replaced.

By carrying out these modernization works the cost of water at the point of delivery of water SPP41 will decrease by over 17.75%, the cost of electricity will decrease by over 22%. Following the hydraulic calculations, the pressure distribution diagram for each main pipe was obtained [4, 5] (Figure 3).

**Figure 3.** Pressure distribution diagram

The main features of the constructions [3]:
- Vertical pumps with discharge diameter 250 mm, pump efficiency 80%, pump flow 500 mc/h at pumping height of 60 mCA, driven by a three-phase asynchronous motor with vertical short-circuit rotor, power 110 kW, speed 1500 rot/min, voltage power supply 0.4 kV. Will be purchased - 3 pcs
- Cast iron valve oval PN10 DN = 250mm on pump discharge - 3 pcs
- Swing valves DN = 250 mm on the pump outlet - 3 pcs
- PEHD manifold pipes DN 500 PN10 - 48 m
- Pipe discharge pipes DN 250 PN10 - 60 m
- Power cable for electric motors P = 110 kW - 75 m
- Power cable general picture power supply - 20 m
- Control and signaling cable - 75 m
- General picture with general switch type USOL 1000A - 1 pcs
- Frequency converters for electric motors P = 110 kW mounted in the panel - 3 pcs
- Ultrasonic flowmeters on manifold DN = 500 mm - 2 pcs
- PLC automation panel - 1 pc
- Main pipe PEHD DN = 500mm PN10 - 612 m
- Main pipe PEHD DN = 450mm PN10 - 1224 m
- Main pipe PEHD DN = 400mm PN10 - 1224 m
- PEHD antenna pipes DN = 300mm PN10 - 1440 m
- PEHD antenna pipes DN = 250mm PN10 - 1440 m
- PEHD antenna ducts DN = 200mm PN10 - 8488 m
- High hydrant valve Dn = 100 mm PN10 - 161 pcs
- Reduction PEHD 300 / 100mm PN10 - 20 pcs
- Reduction PEHD 250 / 100mm PN10 - 20 pcs
- Reduction PEHD 200 / 100mm PN10 - 121 pcs
- Cast iron oval valve PN10 DN = 500mm on CP - 2 pcs
- Cast iron oval valve PN10 DN = 300mm line - 11 pcs
- Cast iron oval valve PN10 DN = 250mm line - 1 pcs
- PN10 water meter DN = 300mm line - 11 pcs
- PN10 water meter DN = 250mm line - 1 pc

4. Conclusions
Considering the degree of use of 85.00% of the surface of the SPP41 station we have 1438 ha with a crop structure for 2013 - an average year of the period 2010 - 2015 (according to Annex 2 to the multiannual contract): 400 ha corn, 530 ha wheat, 379 ha sunflower and 129 ha other crops; the
watering norms are 1000 mc / ha for maize and 800 mc / ha for wheat, sunflower and other crops, resulting in a volume of plant water of 1230.4 thousand mc; using 75% field watering efficiency, transport efficiency between SPP and 90% field, 70% SPP pumping efficiency, 70% channel transport efficiency and 60% aggregate filling stations efficiency - according to the Project for the Rehabilitation and Reform of Irrigation in Romania (page 17 table no. 1 DHV BV) - we will have a volume of water taken from the source (SRPA4 Bucșa) of 6200 thousand cubic meters. This volume is used for three months: May, June and July, so for a month, we will have 2067 thousand cubic meters of water taken from the source.

The cost of water delivery to the hydrant represents the cost of the electricity consumed with the pumping units of the station, the cost with the salaries of the station's service personnel, the cost of transporting the water from the SPP to the hydrant, filling the buried pipeline network. The costs of water delivery to the hydrant remained constant between 2010 and 2015 respectively at SPP41 - 200 lei / 1000mc.

In order to reduce the cost of water delivery to the hydrant and to reduce the cost of electricity, the MV 253x3 vertical pumps operated by electromotor with P = 160 kW and n = 1500 rpm with efficient vertical pumps operated by electromotor with P = 110 kW will be replaced. , n = 1500 rpm, flow rate 500 mc / h for SPP41 station. For the variation of the flow and slow starts without current shocks, the electric motors will be provided with frequency converters. Currently, the station has a specific consumption of 292 kWh / 1000 mc. By replacing the existing pumps with performance pumps, the specific consumption will be 242 kWh / 1000mc, the water saving (loss reduction) will be 27.10%, the cost of water delivery will be reduced by over 17.75%, the cost with energy electricity will be reduced by over 22.19%.

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