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APPROVAL OF THE NEED FOR THE RECONSTRUCTION OF ARENI PUMPING STATION

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Abstract

The Areni-Khachik pumping station raises the waters of the Arpa river from the 976 m mark to the pressure basin located at the 2012 m mark of the upper mountain pass of the Khachik village, from which the water was given to the Khachik community with a maximum output of 415 l/s and to the Amaghu village with a maximum of 41 l/s. with output.

The pumping station has three stages, the engine rooms of which are located: First stage, on the right bank of the Arpa river at the mark of 975 m, with a geodetic pumping height of 318 m, pumping output of 582 l/s. Second stage: at the 1295 m mark of the site near the Areni-Khachik highway, with a geodetic elevation of 370 m, pumping output of 456 l/s . And the third stage: at the site of 1651 m near the Areni-Khachik highway, with a geodetic elevation of 361 m, pumping output of 456 l /v .

All three stages of the pumping station belong to the class of high-pressure pumping stations, with a relatively small discharge output and high pressure, the specific power

consumption of which is significantly higher. Analyzing the technical condition of the pumping station, a program is proposed to implement its reconstruction and reduce operating costs.

Keywords: river, pump, cavitation, hydraulic shock, pipeline.

Introduction

The Areni pumping station was operated in 1974 to irrigate the lands of Areni, Khachik, Amaghu and Rind border settlements of the Yeghegnadzor region with water from the Arpa river.The building of the pumping station is located on the right bank of the Arpa river. Formerly, 9 high-pressure pumping units and 2 low-pressure pumping units were installed in the engine room to create excess pressure at the inlet of the propulsion pumps.

The Areni pumping station supplied irrigation water in opposite directions: the left-hand branch for Areni, Amaghu, Khachik settlements, and the right-hand branch for irrigating the lands of Areni and Rind settlements through two separate pipelines.The hydraulic system of the left-hand branch of the pumping station is a three-stage pumping station, and the right-hand one is a single-stage one.

After operation of the Hermon-Yelpin gravity two-line water pipeline (2007), the lands of Areni and Rind settlements fell under the service of this (Hermon-Yelpin) water pipeline, which eliminated the need to mechanically pump water through the right-hand branch of the Areni pumping station.

At the same time, an opportunity was created and, without serious professional justification, it was implemented from the end of the high-pressure line of the Hermon-Elpin water pipeline, bypassing the pumping station and using the pumping pipelines on both sides of the pumping station, to raise water by gravity to the 2nd stage pumping station of the left branch. Irrigation of the land areas of the right-hand branches of the Areni pumping station in full, and the left-hand branch, partially replaced by gravity mode, led to the following: The Areni coastal pumping station was completely shut down , its maintenance costs were saved (mainly by reducing the installed capacity of several thousand kilowatts of electricity). About 1,000 l/s of the output from the Arpa river previously taken by the pumping station is currently flowing outside the borders of the Republic of Armenia.

Currently, the irrigation water supply of Khachik settlement lands is carried out by the 2nd and 3rd level pumping stations of the left side branch of the Areni pumping station. Many years of operation of high-pressure branch water pipelines built in mountainous terrain show that they do not produce their design output. The elevated land areas of Vernashen, Gladzor, Aghavnadzor, Rind and Yelpin settlements are under the service of the Hermon-Yelpin high-pressure highway complex pipeline. The water supply of Vernashen and Gladzor settlements is carried out by throttling the remote control valves to closing in order to ensure the necessary pressure. As a result, in the case of feeding the 2nd level of Areni from the end of the water pipe, the problem of pressure increase occurs again, which is accompanied by a decrease in the output given to other consumers. Therefore, the already overloaded line of the water pipeline, by adding another high consumer, leads to a violation of the stability of the water supply to the settlements of Arpi Aghavnadzor, Rind, Yelpin. The modified scheme of

the Areni pumping station hydronode is shown in Fig.

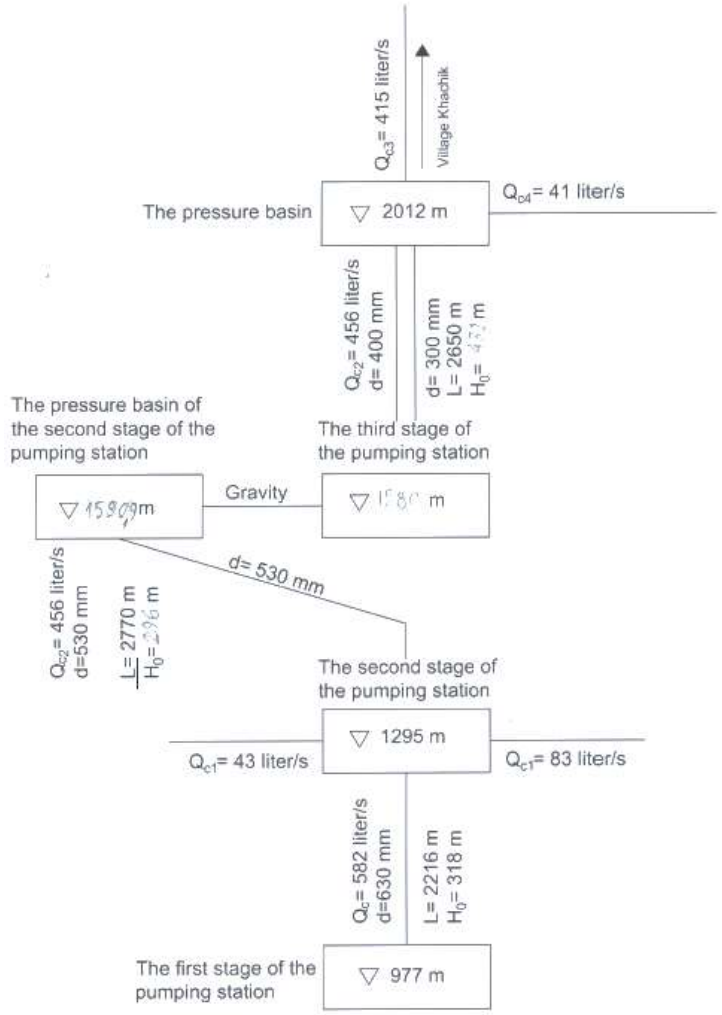

Fig. Scheme of Areni pumping station structures (geometric and hydraulic design parameters)

Since the system of the left side branch of the Areni pumping station is provided only for irrigation water supply of land areas of Khachik settlement, then the three-stage pumping station should be renamed three-stage pumping station of Khachik, or Khachik pumping station.

Conflict Setting

The task is to study technical condition of the Khachik three-stage pumping station and develop a plan for its reconstruction.

Research Results

1. Description of the condition of the 1st stage structures of the Khachik pumping station:

Approaching canal: The intake of the head of the approaching canal is located on the right bank of the embankment built on the Arpa river. The canal has a rectangular section, has a length of 460 m and a drop of 4 m, the average slope of the bottom is 0.0087. The channel at the lower end joins the receiving basin of the pumping station, from which the water is delivered by a buried pipe to the outside collector on the north wall of the engine room. The height of the wall of the approach channel is 1.1 m at the entrance section of the headland, the width of the floor is 1.4 m. The technical condition of the approach canal is satisfactory, it is necessary to carry out surface coating of the floor and walls in order to increase the degree of unevenness to n=0.014, and to plan the implementation of measures to establish a type a2 curve of the free surface of the water current along the length of the canal.

An automatic metal grid should be installed in the cut at the end of the approach canal for removing floating sediments. The technical condition of the receiving basin is very unsatisfactory. It should be completely reconstructed and adapted to the hydraulic regime above the approach canal and an appropriate damping measure should be implemented to maintain a constant water level in it.

Engine room: All the power equipment was dismantled: 11 hydro turbine units, suction and discharge pipes with their valves, reverse dampers and shaped parts, electrical equipment, control and protection cabinets, hoist. Briefly, the engine room is empty.

Lifting pipeline: The pipeline is single-line, the length of which is 2215 m, the diameter is 630 mm. Around 450 m of the pipeline's origin is buried. Previously, the maximum output through the pipeline was 682 l/s. Currently, the pipeline is fed from the edge of the Hermon-Elpin gravity aqueduct. According to the operator's information, a pipe burst recently occurred in the buried section of the pipeline. The above-ground section of the pipeline is equipped with compensators. A professional survey is required to determine the technical condition of the pipeline.

Anchor and free supports The anchor and free supports (concrete, partly metal) of the pipeline were destroyed and some free supports were deprived of their function of creating countermeasures. All supports are rebuildable.

Pressure basin. The pressure basin has the necessary height in relation to the pump shaft, which ensures the requirement to create an excess pressure at the inlet of the latter. The basin has two departments. receiver and accumulator. The receiving section of the basin is damaged in the bottom part, the accumulating section is filled with heavy rubbish. The pool does not have a car ramp or a slope pad. The pressure tank needs repair.

2. Description of the condition of the structures of the 2nd stage of the Khachik pumping station:

Receiving Basin: The 2nd stage intake basin is the 1st stage pressure basin. The intake basin of the 2nd stage has the necessary height relative to the pump shaft, which ensures the requirement of creating an excess pressure at the inlet of the latter. The technical condition of the basin is mentioned above in the description of structures of the 1st degree.

Engine room and auxiliary buildings. The engine room and service building need renovation. There are two parallel-connected pumping units with a capacity of 630 and 500 kW, each of which is in a single operating mode.

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Lifting pipeline: The pipeline is single-line, the length to the intermediate pressure basin is 2770 m, with diameter 530 mm. The entire length of the pipeline is above ground. Water from the intermediate basin is supplied by gravity to the duke site passing through the deep gorge, at the end of which the receiving basin of the 3rd level pumping station is built.

A professional survey is required to determine the technical condition of the pipeline and duker pipe. As a separate issue, it is necessary to study the expediency of the presence of a large slope canal on the thrust tract.

Anchors and free supports: The anchor and free supports (concrete, partly metal) of the pipeline were destroyed and some of the free supports were deprived of the function of creating countermeasures. All supports are rebuildable.

Intermediate and edge pressure basins

Intermediate pressure basin and edge basin need repair. The pressure head basin, which is the receiving basin of the stage 3 pumping station, does not have a perfect drainage system to the nearby gorge. Short-term free discharge of water from a basin with a sloping slope needs to be studied.

3 Description of the state of structures of the 3rd level of the Khachik pumping station:

Receiving basin : The 3rd stage receiving basin has the necessary height relative to the pump shaft, which provides the requirement to create an excess pressure at the inlet of the latter. he technical condition is described above in the description of Tier 2 structures.

Engine room and auxiliary buildings . The engine room and utility building need repair. Two 1000 kW parallel-connected pumping units are installed in the hall, each of which is in single operation mode. There is a mismatch of the installed pumping unit (ЦХС-300-600) with the pressure front of the pumping station.

Lifting pipeline. The pipeline is two-line, 420 mm and 320 mm in diameter and has an equal length of 2650 m. Except for a short length of origin, the pipelines are buried up to the final pressure basin. The technical condition of the 2 pipeline lines is not sufficient for reliable and safe operation.

Anchor and free supports. The anchor and free supports (concrete, partly metal) of the short length of the pipeline were destroyed and some of the free supports were deprived of the function of creating countermeasures. All supports are rebuildable.

Last pressure basin (bomb station): The pressure tank needs repair. In case of an accident of the gravity aqueduct supplying water to the Khachik settlement, there is a drainage pipeline in the basin.

For the reconstruction of the 3-level engine rooms and auxiliary buildings of the Khachik pumping station, to obtain a conclusion on their seismic resistance.

It is recommended:

1. To determine the amount of water supply necessary for irrigation of the lands of Khachik settlement, based on:

a. the possibilities of applying the latest irrigation technologies.

b. occupying the land with agricultural crops with high yield and relatively low water demand (provide justifications for the effectiveness of the proposed crops);

c. security reasons, to provide the border lands for the foundation of gardens instead of wheat;
d. construction of water basins requiring relatively small anti-filtration measures in the surrounding area of Khachik village, for the accumulation of water pumped by pumping stations at night.
3. for the 1st stage pumping station of Khachik, to develop and implement a self-priming method of pumps without the need for a charging pump system (two charging pumping units were planned in the previously operating pumping station).
4. to select the diameters and wall thickness of the pumping pipelines of all three stages of the Khachik pumping station according to the calculated output defined in point 1, taking into account the magnitude of the pressure increase that occurs in the event of an emergency power outage of the pumping station.
5. to maintain the current locations of pumping station engine halls and auxiliary buildings, pressure basins, suction tract pipes and the coordinates of the pumping pipelines.
6. make a topographic survey of the pipelines of pumping stations of the 1st and 2nd levels, 10 m wide on both sides, marking the number of the support and the distance from the starting point.
7. find out the geological, elemental, structural and operational reasons for the deterioration of anchor and intermediate supports and develop the use of protection measures and measures against them. To develop and implement structural arrangements for placing the pipe on the intermediate support to ensure easy longitudinal movement of the pipe due to thermal deformation. In areas with a large slope of the terrain, to reduce the distance between the anchor supports.
8. in order to avoid the occurrence of cavitation phenomena, establish the largest possible excess pressure in the suction tract of the pumps to obtain a cavitation reserve.
9. to provide comprehensive automatic protection measures against hydraulic shock and extreme air emissions for the pumping pipelines of a three-stage pumping station and to develop rules for their safe operation [1, 2, 3].
10.to increase the volume of the pressure basin of the 1st stage pumping station, so that in case of an emergency power outage caused by the local nature of the electric motors of the pumps, the possibility of short-term accumulation of water (provide the necessary justification) is created.
11. to develop a software alarm system and carry out installation, testing and verification of its devices in case of emergency power failure occurring due to local nature in any of the stages of the pumping station.
12. to provide all stages of the pumping station with a small power source to meet their own needs (especially at night). To find out the possibility of providing low voltage electric current from another substation as such source.

Conclusion

Analyzing the technical condition of Khachik three-stage pumping station, it is recommended to include in its reconstruction plan:

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1. To rebuild the former "Areni" 1st stage pumping station, renaming the "Areni" three-stage pumping station to "Khachik" pumping station.

2. The "Khachik" pumping station includes the first reconstructed stage and the second and third stages of the “Khachik” pumping station.

3. 180...200 l/s output should be set for the irrigation of land areas of Khachik settlement, instead of the previous output of 451 l/s.

4. All stages of the "Khachik" three-stage pumping station will receive water exclusively from the Arpa river through the existing approach canal.

5. To give 50 l/s output from the operating branch of the Hermon-Yelpi water pipeline in gravity mode for irrigation of the high lands of Areni settlement.

6. When determining the size of the water intake from the Arpa river, take into account the cooling water outputs necessary for the own needs of the 2nd and 3rd stages of the pumping station.

7. To provide the 1st level of the pumping station with the left compartment of the first level engine room of the former pumping station, in which to install 2 identical self-priming pumping units without a charging pump (as before) with parallel connection. One of these units is intended as a spare.

8. To carry out repair work in the 2nd and 3rd levels of the pumping station according to the new project.

9.To equip clearly defined siphon sites on the Hermon-Yelpin water pipelines with high-efficiency ventilation and automatic ventilation devices.

10. Development of pressure increase measures in the suction tract of the second stage of the pumping station, based on the results of its hydraulic modeling.

11. In the Khachik three-level system reconstruction project, to include the introduction of modern means of remote control in order to ensure safe management of the system in conditions of power outages of pumping stations.

12. In terms of improving the work of the Hermon-Elpin water pipeline, to include the issues of ensuring operational safety and increasing efficiency, including:

- ensuring the design capacity of the aqueduct;
- reduction of the maximum pressure of the aqueduct by 11 mtn;
- reconstruction of river crossings;
- development of measures for safe passage of water lines in Chiva village;
- furnishing of well-defined siphon sites of water lines with modern ventilation and ventilation devices [4];
- model studies of complex junctions (siphon, duker sites, river crossings).

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ԱՐԵՆԻԻ ՊՈՄՊԱԿԱՅԱՆԻ ՎԵՐԱԿԱՌՈՒՑՄԱՆ ԱՆՀՐԱԺԵՇՏՈՒԹՅԱՆ ՀԻՄՆԱՎՈՐՈՒՄԸ

Ա.Յա. Մարգարյան, **Վ.Հ.Թոքմաջյան**, **Դ.Վ. Մադոյան**
Ակադեմիկոս Ի.Վ. եղիազարովի անվան ջրային հիմնահարցերի և հիդրոտեխնիկայի ինստիտուտ

Արենի-Խաչիկ պոմպային կայանը Արփա գետի ջրերը 976 մ նիշից բարձրացնում է Խաչիկ գյուղի վերնամասի լեռնանցքի 2012 մ նիշի վրա տեղակայված ճնշման ավազանը, որից ինքնահոս ճնշումային շարժումով ջուրը տրվել է Խաչիկ համայնքին՝ առավելագույն 415 լ/վ ելքով և Ամաղու գյուղին՝ առավելագույնը 41 լ/վ ելքով: Պոմպակայանն ունի երեք աստիճան, որոնց մեքենայական սրահները տեղադրված են՝ Առաջին աստիճան՝ Արփա գետի աջ ափին 975 մ նիշի վրա, 318 մ մղման գեոդե- զական բարձրությամբ, մղման 582 լ/վ ելք: Երկրորդ աստիճան՝ Արենի-Խաչիկ ավտոճանապարհի հարևանությամբ տեղանքի 1295 մ նիշի վրա, 370 մ մղման գեոդեզական բարձրությամբ, մղման 456 լ/վ ելք և Երրորդ աստիճան՝ Արենի-Խաչիկ ավտոճանապարհի հարևանությամբ տեղանքի 1651 մ նիշի վրա, 361 մ մղման գեոդեզական բարձրությամբ, մղման 456 լ/վ ելք: Պոմպակայանի երեք աստիճաններն էլ պատկանում են բարձր ճնշման պոմպակայանների դասին՝ համեմատաբար փոքր

թողարկման ելք և մեծ ճնշում, որոնց էլեկտրաէներգիայի տեսակարար ծախսը մղվող մեկ խորհանարդ մետր ջրի բարձրացման վրա ծախսվող էլեկտրաէներգիան զգալիորեն բարձր է: Վերլուծելով պոմպակայանի տեխնիկական տեխնիկական վիճակը, առաջարկվում է դրա վերակառուցումն իրականացնելու և շահագործման ծախսերը նվազեցնելու ծրագիր:

Բանալի բառեր. գետ, պոմպ, կավիտացիա, հիդրավլիկական հարված, խողովակաշար:

ОБОСНОВАНИЕ НЕОБХОДИМОСТИ РЕКОНСТРУКЦИИ НАСОСНОЙ СТАНЦИИ АРЕНИ

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Насосная станция Арени-Хачик поднимает воды реки Арпа с отметки 976 м над уровнем моря в напорный бассейн, расположенный на отметке 2012 м на перевале в верхней части села Хачик, из которого под действием силы тяжести вода подавалась в общину Хачик с максимальным расходом 415 л/с и в село Амагу с максимальным расходом 41 л/с. Насосная станция имеет три ступени, машинные цеха расположены: первая ступень на правом берегу реки Арпа на отметке 975 м, вторая ступень на отметке 1295 м, прилегающей к автодороге Арени-Хачик, с высотой подъема 370 м, выход тяги 456 л/с, и третья ступень на отметке 1651 м местности рядом с автодорогой Арени-Хачик, геодезическая высота тяги 361 м, выход тяги 456 л /с. Все три ступени насосной станции относятся к классу насосных станций высокого давления с относительно небольшой выходной мощностью и высоким давлением, при этом удельный расход электроэнергии, затрачиваемой на подъем одного кубометра перекачиваемой воды, значительно выше. Анализируя техническое состояние насосной станции, предлагается план ее реконструкции и снижения эксплуатационных расходов.

Ключевые слова: река, насос, кавитация, гидравлический удар, трубопровод.

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