Intent Research Scientific Journal-(IRSJ)
ISSN (E): 2980-4612
Volume 4, Issue 3, March - 2025
Website: intentresearch.org/index.php/irsj/index

RELIABILITY INDICATORS OF PIPELINE WATER SUPPLY SYSTEMS FOR IRRIGATION CANALS

E. S. Nabiev*
Karshi Engineering and Economic Institute,
180100, Karshi, Uzbekistan elyor.nabiyev.@mail.ru

Abstract

Having determined and evaluated the reliability indicators of the pipe water transmission facilities under construction during the period of use, it can be said that in order to increase reliability, it is necessary to clarify the characteristics of the joint operation of the structure and the ground and to further improve the methods of design, construction and use based on it.

Keywords: Hydrotechnical structures, reliability indicators, elements, object, failure.

Introduction

It is known that in order to increase the reliability of any facility, including irrigation and drainage, its reliability is ensured in three stages, that is, during the periods of design, construction and operation. The irrigation system consists of a complex network of irrigation canals, hydraulic structures and auxiliary devices. This depends on the structure of such a system, the nature of its operation, the organization of maintenance during its use and the description of failures that may occur in its elements. Therefore, it is necessary to evaluate hydraulic structures from a reliability point of view, like other large systems. The reliability of hydraulic structures can be assessed by single and complex indicators. Single indicators reflect the technical condition of the object and include: failure rate λ *(t)*, probability of failure *P(t),* average time of continuous operation of an object T_{av} failure rate *a(t),* failure flow parameter $\boldsymbol{\omega}$ (t) includes the like. [1, 3]

Methods

Comprehensive indicators describe the technical condition of an object and the average time spent on recovery after failure, maintenance and time during storage. Examples of complex indicators are indicators such as availability factor $K_m(t)$, technical utilization factor $K_\phi(t)$, forced downtime factor $K_б(t)$. Let's consider some basic parameters used in assessing hydraulic structures. When assessing hydraulic structures and their elements, first of all, production and statistical data on the operation of its elements is collected and a mathematical law is determined that describes the change in technical indicators during operation If the statistics are accurate, then the failure rate is defined as:

$$\lambda(t) = \frac{\Delta N}{N_{av} \cdot \Delta t} = \frac{N_б - N_0}{N_{av} \cdot \Delta t} \quad (1)$$

in that ΔN – Δt the number of elements that have failed over time;

$\lambda(t) = \frac{N_б + N_0}{2}$ -number of work items; $N_б$ – starting, Δt – number of working elements in time;

N_0-Δt -number of work elements at the end of time;

The probability of being able to operate continuously for a long time:

$$\mathrm{P}(t) = e^{-\int_0^t \lambda(t)dt} \quad (2)$$

If λ(t) = const = λ be $\mathrm{P}(t) = e^{-\lambda t}$ (3)

where: λ – failure rate; e – base of natural logarithm.

The above expression (3) indicates an exponential distribution law, which means that the probability of being able to work continuously for a long time obeys the exponential law in cases where the number of failures does not change over time.

The probability of failure is found as follows:

$$Q(t) = 1 - \mathrm{P(t)} \quad (4)$$

The average time of continuous operation of an object:

$$T_{av} = \int_0^\infty e^{-\int_0^t \lambda(t)dt}\, dt \quad (5)$$

When λ(t) = const

$$T_{av} = \int_0^\infty e^{-\lambda t}\, dt = \frac{1}{\lambda} \quad (6)$$

Therefore, the average uptime is inversely proportional to the failure rate.

$$T_{av} = \frac{\sum_{i=1}^n ti}{n} \quad (7)$$

where: n - is the number of monitored object elements;

t_i - is the time interval before an i-item fails.

Taking into account that hydromelioration facilities are a technological system, a complex indicator - the readiness coefficient - is accepted as an indicator of its reliability.

$$К_T = \frac{\mathrm{T}_{av}}{\mathrm{T}_{av} + \mathrm{T}_\mathrm{T}} \quad (8)$$

ISSN (E): 2980-4612
Volume 4, Issue 3, March - 2025
Website: intentresearch.org/index.php/irsj/index

where: T_{av}- is the average time until failure, that is, the average time of continuous operation;

T_T- is the recovery time. The coefficient of forced idleness is determined as follows:

$$К_б = \frac{T_T}{T_{av}+T_T} \qquad (9)$$

the sum of these coefficients is

$$К_T + К_б = 1 \quad \text{is equal to} \qquad (10)$$

The reliability of hydromelioration facilities is determined by the reliability of its constituent elements. When analyzing any technical system, including hydrotechnical structures, it is necessary to distinguish between its main and secondary elements. The failure of the main elements leads to the failure of the entire system. In order to quantitatively evaluate the reliability of the system during the entire period of its operation, it is necessary to draw up a conditional structure-functional scheme. This scheme is both a physical and a mathematical model of the system at the same time. [1,2]

The resulting functional scheme of the system showed the serial connection of the elements of hydrotechnical structures. The probability that the system will be able to work for a long time in such connections is determined as follows:

$$P_T(t) = \prod_{n}^{i=1} P_i(t) \qquad (11)$$

where: $P_i(t)$ – during *t* - time *i* - the probability that the element can work for a long time; *n* - the total number of elements.

As can be seen from the given formula, the probability of uninterrupted operation of the scheme with relatively few elements in the structural schemes of systems consisting of elements with equal reliability is higher. One of the ways to increase reliability is to reserve individual, unreliable and highly responsible elements, i.e. reserve. In such cases, the elements are connected in parallel. In that case

$$P_T(t) = 1 - \prod_{n}^{i=1} [1 - P_i(t)] \quad \text{is equal to} \qquad (12)$$

The disadvantage of the above indicators is that they have a probability description. Therefore, it is impossible to say with complete confidence when system elements will fail. But it should also be recognized that these indicators serve as a basis for determining the time and standard of system maintenance, predicting the system's ability to work, and determining the amount of materials

Intent Research Scientific Journal-(IRSJ)
ISSN (E): 2980-4612
Volume 4, Issue 3, March - 2025
Website: intentresearch.org/index.php/irsj/index
needed for repair. In addition, information about the reliability of the systems in use allows for the further improvement of the newly designed systems.
In conclusion, in order for the objects under construction in our republic to have scientifically based reliability and durability, the following set of activities should be carried out: [1, 3]
-clarification of accounting schemes;
- taking into account the factors causing sudden malfunctions and injuries during the design period and the probability of their occurrence;
- calculation of the system with technical and economic justification;
- control over the quality of preparation of materials, as well as the reliability of construction and assembly works;
- to ensure that the system indicators do not deviate from the project, to operate the system according to the rules developed taking into account the theory of reliability.
A number of reasons can be mentioned that affect the reliability of irrigation canals and their hydrotechnical structures, including pipeline water transfer structures during their operation. Some researchers analyze these reasons affecting the reliability of irrigation canals and their structures and divide them into groups of objective and subjective reasons.
It is known that objective causes include natural and environmental factors, and subjective factors include factors related to human activity.
At this point, the analysis of the factors is worth noting, because it is not always possible to take into account all the factors directly. - based on the results of the reliability studies of buildings and structures, we will consider the factors that affect the reliability of the use of irrigation canals and hydrotechnical structures in them
We found it necessary to divide all the factors affecting the reliability of irrigation canals into two groups, that is, groups that reduce reliability and groups that increase reliability. [4, 5]
In our opinion, climate is one of the factors that reduce the reliability of hydrotechnical structures and piped water transmission structures on subsiding soils; wear, decay, corrosion geological; hydrological; hydrogeological; biological; socio-economic; constructive defect; non-compliance with the quality and rules of preparation work; violation of storage rules; non-compliance with transportation rules; deficiency in construction and assembly works;

Intent Research Scientific Journal-(IRSJ)
ISSN (E): 2980-4612
Volume 4, Issue 3, March - 2025
Website: intentresearch.org/index.php/irsj/index

violation of rules of use; failure and failure to eliminate injuries in time can be included.

The following should be added to the increasing factors: improvement of construction; use of durable materials and details; improvement of preparation technology; use of advanced and modern technology in repair works; timely control and improvement of the technical condition; repairability; determine and collect the necessary amount of reserve materials; measures to strengthen subsoil soils and improve their properties; determine the reliability indicators of the structure and its weak points; control and increase the quality of construction, assembly and repair works; production, regular training of personnel of construction-installation and user organizations; giving relevant conclusions and suggestions to production by users; strengthening the integration between scientific research, science and technology and educational institutions of production, construction-assembly and user organizations in the field; increasing the interest of the user service; pre-preparedness for adverse natural events (service level) and so on.

In general, the classification of the mentioned factors should not be considered as the only, complete and the last one, because all these factors themselves depend on numerous and unexpected circumstances over time, but also classification of the performed factors allows to take into account in further calculations, to solve to a certain extent the issues of increasing the reliability of irrigation canals and hydrotechnical structures in them.

Conclusions

In conclusion, by determining and evaluating the reliability indicators during the period of use of the irrigation canals established and under construction on the subsoil soil, to clarify the characteristics of the joint operation of the structure and the ground in order to increase reliability, and to design, build and use it based on it it can be said that it is necessary to further improve the methods.

References

1. Хужакулов Р.Повышение эксплуатационной надежности гидротехнических сооружений ирригационных систем на просадочных грунтах.Дисс.на соиск.уч.степ.докт. техн. наук (DSc). Ташкент, ТИИМСХ,2019.- 230 с.

Intent Research Scientific Journal
IRSJ

Intent Research Scientific Journal-(IRSJ)
ISSN (E): 2980-4612
Volume 4, Issue 3, March - 2025
Website: intentresearch.org/index.php/irsj/index

2. Мирцхулава Ц.Е.Надежность гидромелиоративных сооружений. –М. 1986, 279с.
3. Xujakulov R., Raxmatov M., Nabiev E., Zaripov M. Determination of calculating stresses on the depth of loess grounds of hydraulic structuresVII International Scientific Conference "Integration, Partnership and Innovation in Construction Science and Education" (IPICSE 2020) 11th-14th November 2020, Tashkent, Uzbekistan
4. Irgashev, D., Toshtemirov, S., Maiviatov, F. M., & Muqimov, B. (2023). Placement of working bodies on the frame of the tool plow-ripper. In E3S Web of Conferences (Vol. 390). EDP Sciences.
5. Mamatov F. et al. Justification of the bottom softening parameters of working organ with a sloping column //E3S Web of Conferences. – EDP Sciences, 2023. – T. 434. – C. 03010.