The effect of seepage processes on the stability and strength of hydraulic structures is well known from practice. The unconditional need for regular observations of the intensity of these processes in important hydraulic structures is specified in the technical operating regulations of power stations. By this is meant, naturally, that the system of observations at the object being monitored should provide information in a volume sufficient for timely detection of any unfavorable deviation of the seepage regime from the regime corresponding to the conditions of normal operation of this object.

For the most complete possible revelation of the essence of the processes being observed and organization of an effective system of regular observations, special seepage investigations are usually carried out preliminarily in the period of preparation for permanent seepage monitoring. Special investigations are conducted also in these cases when during operation the existing system of regular observations is found to be insufficient for some reason for solving the engineering problems arising. During special seepage investigations observations are performed according to an expanded program which provides for the possibility of obtaining additional information about the investigated object. After completing the special investigations the problem arises of reducing the volume of required observations to some reasonable minimum. With consideration of the wide ramification of the seepage monitoring systems at modern hydrostations, having a multitude of observation points, and the considerable labor intensity of the observations due to the lack of appropriate equipment for remote transmission of the measurement results, the posing of this problem is legitimate. However, at present no rigorous, scientifically founded regulations have been developed for determining the necessary volume of on-site observations of seepage, as a consequence of which notions about the said reasonable level have a somewhat subjective character. The absence of regulations with respect to the necessary volume of on-site observations promotes also the development of a trend, clearly manifested in recent years, toward a gradual reduction in the volume of on-site observations at hydrostations, which is regarded as a potential source for making a certain part of the personnel available for other duties.

Not being concerned here with particular exceptional cases where the possibility of reducing or eliminating individual types of on-site observations has been definitely proved during operation, we will examine the basic aspect of the matter of the permissibility of a gradual reduction in the total volume of observations of seepage established after performing special investigations.

The occurrence of a trend toward a gradual reduction in the volume of on-site observations of seepage is due to the wrong interpretation of the experience of operating hydraulic

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structures as a whole and the experience gained during operation of the investigated object in particular. We will dwell on this in greater detail. It is known from the literature [1] that as a result of statistical processing of data on accidents and emergency situations at hydraulic structures a relation can be obtained which characterizes the probability of disturbance of the normal operating conditions of the structure (failure) as a function of the time of its operation. According to this relation the greatest probability of the occurrence of an accident or emergency situation takes place during construction and the first years of operation of the structure. Then the probability of any malfunctions of the working conditions of the structure noticeably declines to a certain practically constant value which does not change during the more or less long period of "life" of the structure, after which "aging" processes of the structure begin to appear, and the probability of accidents and emergency situations again increases slightly. Taking into account that when organizing any monitoring in an explicit or implicit form we always proceed from an estimation of the probability of disruption of operational capability, some specialists take the proportionality between the volume of labor expenditures on monitoring and the probability of emergency situations as a characteristic. Hence, naturally, follows the conclusion of the possibility of reducing the volume of on-site observations after the first years of operation on the structure.

Yet it can be shown that in the particular case of seepage monitoring such a proportionality is practically absent. Thus, when measuring the many parameters of the seepage regime (rate of flow, head), which vary during the year in a rather wide range, precisely the general regularities of their variation are the most important object of monitoring; a decrease in the frequency of measurements can lead to a loss of this, sometimes basic, information for characterizing the object. In our opinion, the requirements imposed on invariability of the volume of observations from the standpoint of the total number of observation points at the object being monitored should be even more stringent. A decrease in the number of observation points, as a rule, leads to elimination from observations of parts of the structure on whose reliable state depends the reliability of the monitored object as a whole.

In other words, even a partial reduction of the volume of on-site observations for the most part reduces the quality of monitoring and sometimes makes it useless. Such reorganization of monitoring is possible only when we are certain that the probability of disruption of the normal operating conditions of the monitored object is close to zero. To judge, however, from the available literature data, there are no grounds for such assumptions, the more so as the aforementioned probabilistic relations obtained by statistical processing of the results of accidents at hydraulic structures are largely conditional and in no way can claim trustworthiness of the absolute values. Here we need recall that the data used in processing do not form a statistically uniform population; since the majority of examined structures are not characteristic for modern construction of hydraulic structures with respect to design characteristics and their operating conditions, factors complicating the operating conditions of large hydraulic structures near large industrial centers (roads with heavy traffic, dynamic effects from closely spaced industrial plants, etc.) have been practically ignored heretofore, and many other factors have not been taken into account.

By virtue of the aforesaid we can state that the indices obtained in statistical calculations cannot be used for quantitative estimates of the probability of disruption of the normal operating conditions for a particular object. As regards the essence of processes threatening the normal operation of hydraulic structures, the regularities of their development have been studied rather little so far. This circumstance is explained in part by the fact that when studying the operating conditions of comparatively small hydraulic structures investigators have not paid attention to certain factors whose role began to be revealed only during operation of large hydraulic structures.

We can include among these factors, for example, the seasonal variations of the stresses of the foundation of high concrete dams. These phenomena cannot be neglected when assessing the state of structures, since periodic variations in the stressed state of the permeable medium in which seepage occurs in the near-contact zone, which are intensified by corresponding changes in the seepage force, can promote expansion and fracture of the dam foundation. Seasonal variations of the stressed state of the foundation of high concrete dams were first discovered at the Bratsk hydrostation [2]. A tendency toward progressive opening of the contact joint in the foundation of the concrete dam and toward seasonal rises of the piezometric head, which at individual points reached 30-50 m, was revealed from the data of on-site observations. To illustrate the aforesaid, Fig. 1 gives the results of on-site observations for one of the monitoring sites of the Bratsk concrete dam. Subsequently, seasonal variations