The experience of carrying out grouting works during construction of high concrete dams attests to a substantial change in the stress state of adjacent columns under the effect of a comparatively small pressure on the surface of the joint between the columns [1]. In this connection the authors as early as the stage of working out the specifications for suppressing seepage through the stretched zone of concrete of the Sayano-Shushenskoe hydrostation dam gave special attention to possible consequences (positive and negative) of injecting grouts into seeping cracks at pressures considerably greater than those observed during grouting of the joints between columns and sections of the same Sayano-Shushenskoe dam during its construction. The firm approved to carry out the grouting works was supposed to inject comparatively viscous grouts of the "Rodur" type, as on other objects in past years, at a pressure exceeding 40 MPa at the pump outlet, which rapidly dropped on advancing along the injection path with a length of 15-20 m and at the mouth of the crack varied within 6-8 MPa with a 3 × 3-m arrangement of the holes and delivery of the polymer material through two holes. Only such a pressure made it possible to provide high-quality and continuous filling of the cracks with grout even with a small opening.

During approval of the specifications specialists of the firm asserted that the effect of the grout pressure was limited to a small zone near the hole and additional opening of the cracks would not exceed the compressive strains from the unique press plate, which in cross sections with through cracks usually did not exceed 1 mm.

Different regularities of additional opening of cracks that partially disturbed continuity of a cross section about 80 m high to a depth of 15-17 m ought to be expected in the particular case of grouting. The more so as grouting was to be done at upper pool levels (UPLs) close to the normal pool level (NPL), when the cracks without additional interference were in an equilibrium state.

In the first years of normal operation it was established during drilling of exploratory holes and inspecting the walls by means of TV cameras that cracks were prevalent in the mass in the form of numerous small disturbance of the solidity of the concrete in zones 1.5-5.6 m high. Exploratory drilling before the start of grouting in 1996 showed the presence in each section of one to three zones with several cracks with a comparatively small opening. According to the readings of long-base deformometers, the openings of the cracks immediately before the start of industrial grouting at an UPL close to elevation 540 m were from 0.33 to 0.98 mm. At the dead storage level all cracks were practically closed. A plan was drawn up for grouting 40 zones in 24 sections to fill the main and small, intensely seeping cracks with grout into the depths of the mass. During grouting one could not assume penetration of cracks into the depths of the mass of the dam in connection with the fact that calculations established a zone of tension along vertical longitudinal areas above the II and III joint approximately at the elevations of the spread of subhorizontal cracks from the upstream face.

It should be noted that the contract firm did not have the necessary experience of working within the framework of the requirements indicated above. Additional opening of the cracks being grouted up to 1.8 mm was noted already during experimental works. The specifications on conducting industrial grouting of cracks limited the additional opening from injecting the grout to 1.5 mm. Taking into account the possible consequences of grouting cracks at high pressures – the propagation of the cracks into the mass, the hydrostation operating service compiled a detailed program for monitoring the change in the stress-strain state (SSS) of elements of the dam in the grouting zone, on one hand, for the purpose of not allowing the propagation of cracks into the second column and, on the other, for the purpose of using the forces of filling the cracks with the hardening grout for improving the stress state of the concrete near the upstream face.

The monitoring program included observations:
Fig. 1. Displacements of contour of gallery (elevation 344 m) along the vertical axis and additional openings of cracks during grouting of section 26. Additional opening according to extensometers: -- --) section 26 at distance of 9.64 m from upstream face; - - - - - - section 27 at distance of 7 m from upstream face. Displacements: -A-) section 24; -) section 25; ---) section 26; - - - -) section 27; -O-) section 28; -) section 29.

of the change in seepage discharges of water through concrete of the upstream face and rock foundation;
of the dynamics of opening of cracks in the sections being grouted and adjacent ones with an increase of the frequency of readings from the remote gap gauges to 15 min;
from all remote monitoring transducers located in a radius up to 30 m from the grouting site;
of settlements by longitudinal hydrostatic leveling instruments at elevations 308 and 344 m and transverse ones at elevations 308, 344, and 359 m;
of deformations ahead of the front of the crack by measurements of the contour of the longitudinal gallery, located at the end of the first column at elevation 344 m, in the vertical direction (Fig. 1).

The change in seepage discharges through the upstream face during grouting was examined in detail in [2]. Extensometers (gap gauges) with a 2000-mm base, from two to five of them depending on the number of cracks and their location, were installed specially on the cracks being grouted for controlling the technological process. In sections 22, 33, and 46 gap gauges were installed at the start of the second column to monitor possible propagation of cracks and their passage across the column joint. The maximum additional opening of cracks at the very start of industrial grouting considerably exceed the 1.5 mm limited by the specifications and reached 2.7 mm. According to the results of inspecting cores drilled from the grouted zone, the thickness of the layer of injected material was from 1 to 8 mm. The maximum additional openings during grouting belonged to sections with several subhorizontal cracks and high zone of disturbance of the solidity of the concrete. Later, after a detailed study of the regularities of