PREPARATION AND EXECUTION OF TRIAL BLAST ON THE BURLYKIYA RIVER

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The problem of the directed blast on the Burlykiya River (Fig. 1) was to form a rock pile which would model the Kambaraty Dam. The working design of the blast took into account the microrelief features of the gorge. Determination of the blast outline and construction of the pile profiles were carried out by the method of parallel sections. A linear charge arrangement was adopted. The lines of least resistance (LLR) for individual segments of the charges were determined graphically. Depending on the designed dam section, the LLR of the main charges for the left and right banks amounted to 7-40 m and 9-24 m, respectively. The values of LLR for auxiliary charges ranged from 8 to 22 m.

The charge per meter of the gallery was computed from

$$Q = \frac{Kw^2 (0.4 + 0.6n)e}{0.55(n + 1)}$$

where $K$ is the computed consumption of explosive, with an adopted value of 1.8 kg/m³, assuming granular granulite 79/21 was to be used; $w$ is the line of least resistance, m; $n$ is an index of the action of the blasts (for the main charges, $n$ was taken to be 1.1); and $e$ is the power coefficient. Where LLR exceeded 25 m, a correction $\sqrt{\frac{w_f}{25}}$ to the embedment depth was applied. For the explosive, granulite "M" (power coefficient $e=1.12$) was adopted; this was loaded into the galleries by pneumatic chargers. Having regard to the great mass of explosive supplied, the complex topography, the limited time available, and the stricter requirements for safe work, a separate design was prepared for the charging operation.

A short-delay detonation of the charges was proposed in the following pattern: on the right bank, the first- and second-stage blasts of charge 1 (Fig. 2) and, after a 25-msec delay, those of the charge in gallery No. 4; on the left bank, the third- and fourth-stage blasts 100 msec after the charge in gallery No. 1, and the charges in galleries Nos. 2 and 3 also after 100 msec.

In arranging the delays, allowance was made for an overhang over a considerable area of the left bank, and also having regard to the recommendation of the Institute of Physics of the Earth (IFZ) of the Academy of Sciences of the USSR, stemming from results of small-scale modeling. The design aimed at heaving 478,000 m³ of rock into the gorge, to form a pile some...
40 m high and up to 230 m long, with a volume of 188,000 m$^3$. The computations assumed a
loosening coefficient of 1.26 (residual).

The radius of the danger zone to people from rock scatter was fixed at 1600 m, and for
buildings and plant it was established at 800 m. It was planned to stop the driving of tun-
nel No. 2 at a distance of 40 m from the charge. The computed velocity of 78 cm/sec for the
lining of this tunnel was deemed safe.

Presented in Table 1 are data on the excavations driven in preparing for the blast. Al-
together 702 tons of explosives were placed in the galleries in 52 working shifts. The shift
output in loading charges amounted to 2.2 tons per man.

The detonators for the linear charges were installed at the faces and each point charge
had an individual detonator of two cartridges of APN-6ZhV, operated from a line of primer
cord (PC). The ends of the PC for the left-bank charges and blasting galleries Nos. 1 and
3 were led outside through the stemming. The electric detonators were connected to them be-
fore the blast. In charges 2 and 3 (Fig. 2), the detonators were placed on both sides of the
access excavation. Each pair was connected by four lines of primer cord, laid in air hoses.
The electric detonators were connected on the day of the blast, after the danger zone had
been blocked off, and stemming was therefore omitted.

All the excavations were, in the main, located in accordance with the design, excepting
blasting gallery No. 3 on the left bank, which intersected a talus slope and was shifted in-
to the abutment of the gorge.

Loading of charges was begun in December, with air temperature $-20^\circ$C. In order to re-
duce the static electricity potential and to improve dust suppression, hot water was poured
into the charge loader, amounting to 5-6% of the charge weight. The explosive was transport-
ed along a steel pipe (D= 50 mm), with a maximum length of 250 m and a level difference of
37 m.

Where the charge weight averaged less than 600 kg/m, point charges were placed at inter-
vals of multiples of the pipeline lengths (7.7 m). The remaining segments of the charges
were solid. The ratio of the volume of explosive to that of the excavation amounted to:
2 -- 0.16; 3 -- 0.63; 5 -- 0.21; the density of explosive in charge 1 was 1.1 kg/m$^3$. Data on
the charges are given in Table 2. A plan view of the rock pile is given in Fig. 3. As the

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**TABLE 1**

<table>
<thead>
<tr>
<th>Excavation</th>
<th>Sectional area, m$^2$</th>
<th>Length, m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outlet works</td>
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<td></td>
</tr>
<tr>
<td>Tunnel No. 1</td>
<td>3.6</td>
<td>278</td>
</tr>
<tr>
<td>Tunnel No. 2</td>
<td>5.8-7.8</td>
<td>63*</td>
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<tr>
<td>Excavations for charges</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left bank</td>
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</tr>
<tr>
<td>Blasting gallery No. 1</td>
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<tr>
<td>Blasting gallery No. 2</td>
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<td>Blasting gallery No. 3</td>
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<td>37</td>
</tr>
<tr>
<td>Access works</td>
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<tr>
<td>Right Bank</td>
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</tr>
<tr>
<td>Blasting gallery No. 4</td>
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<td>Blasting gallery No. 5</td>
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<td>15</td>
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<tr>
<td>Investigational excav.</td>
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</tr>
<tr>
<td>Investigation gallery with crosscut</td>
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<td>130</td>
</tr>
</tbody>
</table>

*Remaining 99 m were driven after blast.*