



SIKA AT WORK

KÁRAHNJÚKAR HYDROELECTRIC
PROJECT, ICELAND

BUILDING TRUST



THE HEARTHBEAT OF CLEAN ENERGY

PROJECT DESCRIPTION

The development of the Kárahnjúkar Hydroelectric Power Station entails the harnessing of the glacial rivers Jökulsá á Dal and Jökulsá i Fljótsdal. These rivers both originate in the north-eastern region of the Vatnajökull ice cap and run in a north-easterly direction through the Jökuldalur and Fljótsdalur valleys to their common estuary in the Héradsflói bay. This is the heart of Iceland's largest-ever industrial development; a € 1.1 billion hydroelectric power plant that took 5 years to build and required the construction of 73 km of tunnels and five dams for three reservoirs – one of the dams being amongst the largest concrete-faced rock-fill dams in the world. The whole project was exposed to extreme climatic conditions and required concrete solutions that could deal with the harsh arctic environment over prolonged period of time.

The structures included:

The Háslón Reservoir and Dams: The Kárahnjúkar dam (concrete-faced rock fill dam) with a length of 730 m and a maximum dam height of 193 m, together with two saddle dams – the Desjarár dam with a length of 900 m and a maximum dam height of 60 m, and the Saudárdalur dam with a length of 1,100 m and a maximum dam height of 25 m, forms the Háslón storage reservoir. The full reservoir will cover an area of 57 km².

The Ufsarlón Reservoir and Dams: The Ufsarlón reservoir for the headrace tunnel covers an area of 1 km² and was formed by damming the River Jökulsá i Fljótsdal with the Ufsa dam that has a length of 675 m and a height of 32 m.

The Headrace Tunnel and Penstocks: Water is carried from the Háslón reservoir through the underground headrace tunnel (length 39.8 km and diameter approx. 7.2 m) eastwards to a junction with a tunnel (length 13.3 km and diameter approx. 5.5 m) from the Ufsarlón reservoir. From there, a single tunnel continues north-east to the Teigsbjarg escarpment.

The Underground Power Station: The Power Plant is also located underground and is approximately 115 m long, 14 m wide and a maximum height of 34 m.

PROJECT REQUIREMENTS

The fill material of the 5 dams has a total volume of approx. 13'600'000 m³, which had to be prepared on site, then placed and compacted to achieve a watertight construction.

The headrace tunnels were mostly excavated using a “full-face” tunnel boring system (TBM) with a diameter of 5.5 – 7.2 m; the others were built using the “drill and blast” method for cross sections of 5.8 × 5.8 m and 7.2 – 7.6 × 8 m.



SIKA SOLUTION

A minimum 250 mm thick layer of shotcrete using Sigunit® accelerator was applied throughout the drives with additional rockbolts, steel ribs and even thicker layers of shotcrete applied in zones of more difficult geological conditions. For all of the concrete on the project Sika admixtures were used to ensure consistent performance and quality. Under the prevailing harsh Icelandic environmental conditions the shotcrete admixtures Sigunit®-L53 AF (IS) and Sika® ViscoCrete®-SC 305 were also used to maintain the pumpability of the shotcrete. The sprayed concrete application equipment selected by the contractors included 8 Sika Putzmeister spraying systems, Sika PM®, plus 3 Aliva® shotcrete machines and pumps that were installed on the 3 Hardrock Robbins TBM's. For the mass concrete on the dams the water reducing plasticiser Sika® Plastiment® LA-100 was used.

The presence of Sika Concrete Technicians on site throughout the construction period provided all of the concrete technology and technical support required by the contractors. Due to the remote site location with complex logistics, for long winter periods materials could not be delivered regularly to the project. Therefore the shotcrete set accelerator selected was a highly soluble powder type which provided an extended storage life and could be dissolved in water and made ready to use on site, wherever and whenever the works were scheduled, thus preventing any unnecessary delays in supply or the programme.

SIKA PRODUCTS

- Sigunit®-L53 AF (IS)
- Sigunit®-P1 AF
- Sika® ViscoCrete®-SC 305
- Sika® Plastiment® LA-100
- SikaFiber® 65/35
- SikaPM®-400 – Sika-Putzmeister spraying systems
- Aliva®-278 shotcrete pumps
- Aliva®-403 accelerator dosing unit
- Aliva®-285 rotor machines



Front page Face slab paving and dam filling

- 1 Karahnjúkar project site during arctic winter days from the distance
- 2 Toe wall construction during early winter time
- 3 Concrete works under arctic conditions around diversion tunnel inlet portal





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- 1 Faceslab concreting during wintertime with dam filling in the background
- 2 Shotcreting underground using Sika Aliva spray equipment
- 3 Faceslab paving
- 4 Sika Aliva spray robot mounted on the TBM

PROJECT PARTICIPANTS

Owner: Landsvirkjun, The National Power Company of Iceland
Design: (excl. the Jökulsárveita diversion)
 Kárahnjúkar Engineering JV Káraborg
 Kárahnjúkar Supervision JV
Contractors: Impregilo (Italy), Suðurverk (Iceland)
 Hochtief (Germany), Pihl & Søn (Denmark)
 Ístak (Iceland), Íslenskir aðalverktakar (Iceland)
 Va-Tech Escher Wyss (Germany and Austria)
 DSD Stahlbau (Germany)

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SIKA SERVICES AG
 Tueffenwies 16
 CH-8048 Zurich
 Switzerland

Contact
 Phone +41 58 436 40 40
 www.sika.com

