



DSI References

Owner Ontario Power Generation Inc., Toronto, Canada +++

General Contractor STRABAG, Vienna, Austria +++ **Engineers** Morrison Hershfield Consulting Engineers, Canada; ILF Consulting Engineers, Munich, Germany

DSI Units DSI Austria, Pasching/Linz, Austria; American Commercial Incorporated (ACI), Bristol, USA

DSI and ACI Scope Supply of approximately 40,800m of friction bolts in lengths between 2.4 and 6.0m, 1,000 pieces of AT-Power Set Self-Drilling Anchors in lengths of 4m and over 1,200 pieces of type R32 and R38 IBO-Self-Drilling Anchors; supply of steel beams type C150x16, W150x37 and W200x59

Photo courtesy of STRABAG, Cologne, Germany



New Tunnel underneath Niagara Falls Built with DSI and ACI: Natural Wonder and Energy Source

The impressive Niagara Falls on the border between the State of New York and the Canadian province of Ontario have always been one of the most popular destinations for tourists on the American continent.

What many people do not know is that a large part of the Falls' original water volume is diverted to a weir and used for power generation at night and during off-peak hours. The exact quantity of water that can be diverted and used for power generation is explicitly regulated in terms of seasonality and times of day by a treaty dating from 1950.

Electrical energy has been generated by the Falls since 1922. In 1954, two 9km long tunnels that feed water to a local power plant were built underneath the city of Niagara

Falls. Only a fraction of Niagara River's energy, approximately 1,800m³ per second, is currently used for generating power. As a result of Ontario's ever increasing demand for electricity, Ontario Power Generation Inc. decided to build a third tunnel underneath the city. The new tunnel has a planned service life of 90 years and will supply 160,000 additional households with energy.

The new tunnel will be 10.4km long and will run at a depth of up to 140m underneath the existing tunnels. With its diameter of 14.4m, the pressure gallery will be 1½ times as wide as the Channel Tunnels. The tunnel will divert 500m³ of water per second from the headwaters of Niagara River to the power plant underneath Niagara Falls. Tunnel driving is carried out using the world's largest diameter hard rock Tunnel Boring Machine (TBM). The machine has a diameter of 14.4m and weighs 2,000t. The TBM's starting shaft had a length of 400m. For this project, a TBM for the first time was not assembled in a factory, but on-site in 11 months.

The tunnel will have a lining consisting of non-reinforced concrete that will be up to 70cm thick. In addition, the lining will have to be tensioned by injection in order to resist operating water pressures of up to 15bar. Tunnel construction is made difficult by the fact that the prevailing mudstone is fractured to a great extent and that the work has to be carried out in difficult ground water conditions. Consequently, DSI and ACI as the specialists for tunneling in geologically unstable environments are also involved in the project.

Up to now, DSI has supplied more than 40,800 friction bolts in lengths between 2.4 and 6.0m as well as more than 1,000 AT-Power Set Self-Drilling Friction Bolts in lengths of 4m. AT-Power Set is a specialist product that is used for instant protection in cases of rock fall hazard. The anchor has immediate load-bearing capacity after installation, which is why it is especially suitable for the geologically unstable zones prevailing in this project. No special equipment is necessary for anchor installation. Another advantage is that neither injection nor grouting is necessary. AT-Power Set is non-sensitive to vibrations and blasting operations and features high shear resistance.

As of this writing, DSI has also supplied more than 1,200 type R32 and R38 IBO-Self-Drilling Anchors. These special anchors can be flexibly adjusted to different rock mass conditions by using different types of drill bits. By using couplers, IBO-Self-Drilling Anchors are flexible in terms of anchor length and can thus be adjusted to a variety of application requirements. The anchor rod's special profile ensures optimum bonding with grout.

ACI supplied steel beams for the stabilization of the new tunnel. In order to adapt to specific requirements on site, three types of steel ring beams were installed. The profiles used were steel beams type C150x16, W150x37 and W200x59.

DSI and ACI are proud to have been chosen as specialist supplier of Tunneling Systems for this major project.



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