Fact Sheet

UNLINED SNOW TUNNELS AT THE AMUNDSEN-SCOTT SOUTH POLE STATION

PROBLEM

Drifting snow, extreme low temperatures, and vehicular traffic at the U.S. Amundsen-Scott South Pole Station make placement of surface utility structures difficult. Subsurface placement of utilities and data links is problematic due to lack of maintenance access as well as relocating and recovery of the systems. Winter access and maintenance are especially difficult because of the complete darkness and temperatures in the –80°C range. A midwinter failure of a critical system could be disastrous at the Pole.

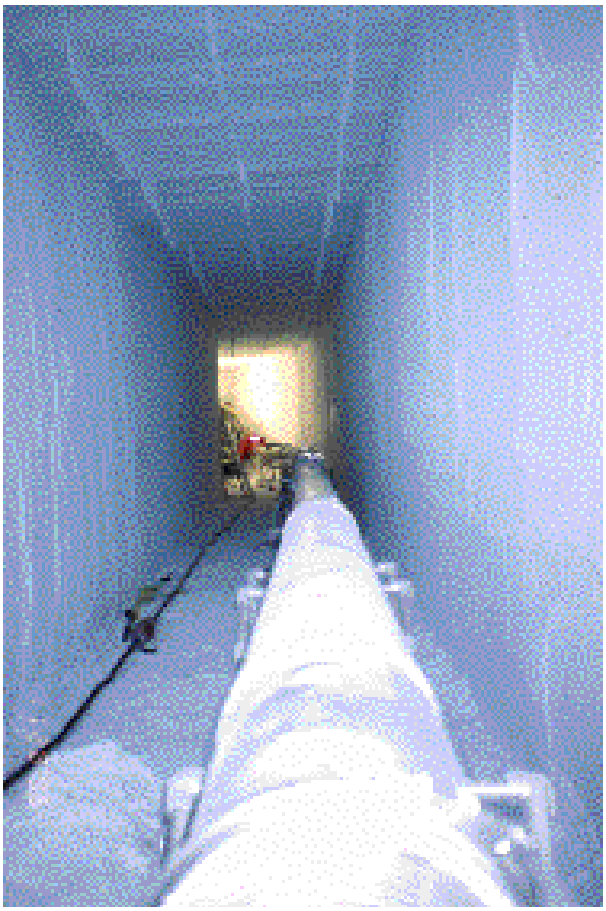
SOLUTION

Development of a tunneling system capable of machining an unlined 2- × 3-m tunnel into firn at depths of 5 to 14 m for placement of easily accessible utilities.

RESULTS

CRREL was tasked by the National Science Foundation to develop a concept incorporating an unlined tunnel for the installation of utilities and to provide safe passage for personnel during winter months. Modeling at CRREL and testing at the South Pole indicated that a 5-m depth to the tunnel roof would be sufficient for heavy equipment traffic in the snow conditions found at the Pole. A system, based on a modified Bobcat 231 tracked excavator and a 50-HP centrifugal fan chip ejector, was designed, built, and tested at CRREL for use at the station.

In November 1996, a team of four CRREL engineers and technicians deployed the tunneling system at the South Pole Station. A 120-m-long tunnel connecting to the central dome structure was machined at a maximum depth of 14 m for the installation of a wastewater outfall line. Production rates of up to 1.5 meters per hour were achieved over the 12-day process. More than 380 tons of 0.54 g/cc-density snow were removed from the tunnel during excavation. Two outfall structures will be incorporated into the tunnel this season for a projected system life of ten years. Further tunneling work is being planned for the South Pole Station in the near future.



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January 1997

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